

A Computerized Inventory of Water Resources in the Ethiopian Somali National Regional State

*Summary Report of a Pilot Survey in the Weredas of
Jigjiga, Teferiber and Dembel*

Mulugeta Zewdie, Consultant Database/GIS Expert
Anteneh Tesfaye, Consultant Water/Environmental Engineer

1. General Conditions of the SNRS

The Somali National Regional State, SNRS, is found in the eastern part of Ethiopia and lies between 3.40° - 11.12°N and 38.74° - 48.00°E. The Region constitutes nearly one third of the total area of the country.

The average annual rainfall of SNRS ranges from 300mm to 700mm moving from south to north and has a climate classified as semi-arid. The low annual rainfall and its uneven distribution together with the frequent recurrence of drought have made water the single most important element that determines the living style of the population. People together with their herds of camels, goats, sheep and cattle move from place to place, continuously, in search of water and grazing.

The normalised difference of vegetation index is between 0.05 - 0.1 which is low to moderate and typical of vegetation cover in a semi-arid environment.

Refer to the annexes for maps detailing the Geology (Fig. 1), Hydrogeology (Fig. 2), Vegetation cover (Fig. 3) and Rainfall distribution (Fig. 4) of the Somali National Regional State respectively.

The total population of SNRS is 3.3 million, according to the government census conducted in 1998.

The constantly mobile nature of the population, which is mainly due to lack of dependable year-round water sources, is the major constraint to the development of basic infrastructure.

2. Agencies involved in the water sector

The leading agency in the sector is the Bureau of Water Resources Development, BWRD. It is the regional governmental agency responsible for the planning and implementation of water resources projects. It is also the authority in charge of coordinating and evaluating projects implemented by NGO's and other actors.

There are various agencies and NGO's involved in the development of water projects. NGO's are either international or local. Save the Children Fund – UK, Oxfam–UK, Ogaden Welfare Society, Alnejah Welfare Society, Medecine Sans Frontiers Belgium, Hope For The Horn, and the Lutheran World Federation are among the better known organizations in the region. Also very active in the area is the United Nations High Commissioner for Refugees

(UNHCR) which is providing care and maintenance to around 170,000 Somali refugees in the region and the United Nations Development Programme which is providing support to the water sector through its fifth country programme. A new governmental organization financed largely by the World Bank, the Ethiopian Social Rehabilitation & Development Fund, is expected to play an important catalytic role in the future through the funding of community-based water development schemes.

UNHCR is widely involved in the development of water schemes in and around refugee camps as well as returnee re-integration areas. UNHCR has been active in the area since 1988 when the first major influx of Somali refugees took place. In addition to developing/rehabilitation of water schemes by its own, UNHCR has also worked with the BWRD as a partner since 1994. UNHCR and BWRD's partnership is mainly in the areas of borehole rehabilitation, equipment maintenance, maintenance/upgrading of schemes, etc. As BWRD will ultimately manage the schemes when refugees repatriate, UNHCR involves BWRD in the maintenance of most schemes and helps it building its capacity in terms of the provision of office equipment and training of staff.

Oxfam-UK, initially involved in the tankering and water point rehabilitation in refugee camps, became involved in the rehabilitation of shallow wells, *birkas* (cement-lined cisterns) and ponds near refugee camps and returnee areas between 1993-1996. In its 1997-2000 integrated development programme in the Shinile and Jigjiga zones Oxfam works in water point rehabilitation, environmental protection (reforestation), fuel saving, training of traditional birth attendant, and capacity building of the Bureau of Disaster Prevention and Preparedness.

Along with its food security programme, SCF-UK has been involved in the development of water schemes in Teferiber and Jigjiga weredas since 1994. The main types of schemes developed by SCF are shallow wells, *birkas*, ponds and *haffir* dams (earthen dams).

3. Objectives of the pilot project

The Pilot Project for the establishment of a regional Water Resources Inventory focused on the collection of all relevant information on the hydrology, hydrogeology, rainfall characteristics of the target weredas as well as technical details of various water schemes such as boreholes, shallow wells, *birkas*, and earth dams. Following the inventory, the project focused on incorporating the information collated into a computerised database, training of BWRD staff in GIS software and on the use of GPS instrumentation.

The initial concept of establishing a regional water resources database arose during the last major drought that hit the region in 1997. The need for emergency support to the water sector was recognized with the operation and rehabilitation of existing water points having the priority but lacking sufficient technical information on the status of water sources is proved impossible to mount an effective response. As part of the overall strategy for disaster preparedness in the SNRS, through UNDP (Trac 1.1.3 funds) a project was proposed for the development of a computerised database through the auspices of the Disaster Prevention and Preparedness Commission and in conjunction with the federal Ministry of Natural Resources Development. Unfortunately the project stalled and after nine months the funds were returned.

Under a cooperative venture between the United Nations Emergencies Unit for Ethiopia (UN-EUE), Swiss Disaster Relief (SDR) and the United Nations High Commissioner for Refugees (UNHCR) in collaboration with the Bureau of Water Resources and Development of the Somali National Regional State, the initiative was later reformulated as a pilot project

intended to explore the utility of a computerised inventory through the compilation of information based on a limited number of selected weredas. Though not intended to substitute for a full-fledged programme, the pilot project was designed so that staff of the regional BWRD would have the opportunity to give feedback on the design and use of a suitable database and could receive basic training in the use of GIS software and GPS equipment. The project was intended to help identify sources of available information and explore constraints to the field collection of data.

In the long term it is envisaged that a computerised inventory and GIS database will serve as a baseline source of information for water resources data in the region. Moreover, the GIS database could be used for:

- Keeping/updating the inventory by type/number in a given area;
- Planning purposes in the BWRD's development exercise;
- Managing periodic maintenance requirements of equipment through automation of work schedules, ordering supplies, prioritizing work;
- Source of information for identification of potential water sources in drought prone and/or affected localities;
- Establishment of a systematic roster of NGO's operating in the region vis-à-vis the type, number and location of the different water schemes developed by the respective NGO's;
- Generation of maps and reports.

Based on time constraints, accessibility on the ground and availability of existing data, the weredas selected for the Pilot Project were Jigjiga, Teferiber and Dembel. Aisha was also considered but later removed from the list for reasons given below.

On the basis of the pilot project and subject to the recommendations of the BWRD it is envisaged that a proposal will be developed for a wider initiative to expand the water resources inventory and GIS database to cover the whole of SNRS.

The duration of the pilot project was one and half months, between mid-December 1999 to end of January 2000.

4. Funding and related inputs

Swiss Disaster Relief covered the consultancy fees for the Water Engineer and the GIS expert.

UNDP-EUE covered the transportation expenses, consultant subsistence allowances and provided ground transportation for the Water Engineer and BWRD staff during their field visits in the pilot areas and in Jigjiga. UNDP-EUE also paid the transportation and allowances for two of the BWRD staff during their computer training in Addis Ababa. Costs for digitising various maps were likewise covered by UNDP-EUE.

UNHCR-Branch Office Ethiopia provided office space and equipment including computers for the Water Engineer and GIS Expert during the project period. The one week training of the two BWRD staff in the GIS software was conducted in the UNHCR-Branch Office.

The computer and printer used at the BWRD's offices during the one week of staff training in Jigjiga of the water resources database was procured by UNHCR in 1999 as a capacity building exercise for Bureau. The same equipment was used for the installation of the

computerized inventory for the three weredas and associated database and GIS applications.

5. Methodology and activities

A design for the proposed computerized inventory and database was prepared based on formats already in use by UNHCR. Implementation of the design was completed in Microsoft Access and after testing in the field with real data further refined and elaborated.

Data entry formats for various schemes such as boreholes, shallow wells, *birkas*, ponds as well as related water equipment (pumps, generators, etc.) were developed and field tested.

Collection of relevant office level water resources data from pertinent governmental and non-governmental offices and field level data (co-ordinates & other pertinent information) of various water schemes was undertaken and used to create a multi-layer map (see sample maps in attached annex).

Training of BWRD staff on GIS software as well as use of GPS instrumentation was conducted in the field and in the offices of the BWRD and UNHCR.

The collation of existing data involved visits to various Governmental and non-Governmental Offices at Addis Ababa, Jigjiga and Dire Dawa. The search focussed on water resources-related data/information in SNRS and the Borena Zone of Oromiya in general and the pilot weredas in particular. The collection of field data included technical data as well as other relevant information such as geographical co-ordinates of the individual schemes using a GPS instrument.

Activities

i. Office data collection

One of the first steps in the pilot project was to identify the scope and type of information that would constitute the database, including profiles of the geology, hydrogeology and rainfall of the region as well as specific technical and geographical information on specific water resources and schemes in the target weredas. Linked to this was an exercise to identify the documentary resources that already existed with the relevant government departments, technical agencies and NGO's in Addis Ababa, Dire Dawa and Jigjiga.

During the first week of the project governmental offices in Addis Ababa were contacted. Among those contacted were the National Meteorological Agency, the Geological Survey Institute and the Ministry of Water Resources.

The National Meteorological Agency is the governmental agency at federal level dealing with all aspects of meteorological information. Based on a network of several hundred meteorological stations in the different parts of the country, it records, analyzes and compiles information on a wide range of all meteorological indicators. It also compiles and analyses raw data for a cross section of users upon demand in return for a service charge.

The Geological Survey Institute is the governmental agency within the Ministry of Energy and Mines that deals with various elements of geological survey and exploration. It maintains an archive of relevant documentary, maps and other data obtainable for official purposes or commercial on a chargeable basis.

The Ministry of Water Resources is the federal government body that regulates various aspects of water resources development in the country, coordinates bilateral aid in the water resources sector and provides a regulatory framework at the federal level.

Following the official channels within the National Meteorological Agency and the Geological Survey Institute, the process of acquiring data was halted after it was determined that the products/information available was excessively expensive in relation to the limited scope and objectives of the pilot project. As an alternative it was decided to use information already available with UNHCR-BO Ethiopia for the purpose of the pilot project.

In Jigjiga, together with a representative of BWRD, the project consultant visited Oxfam-UK, Save the Children Fund-UK, MSF-Belgium, Ogaden Welfare Society, the District Development Office, the Regional Agricultural Bureau, the Jigjiga Zonal Agricultural Office, Water Supply and Sewerage Office of Jigjiga, the Ethiopian Social Rehabilitation and Development Fund for SNRS, Hope for the Horn, and the UNHCR Sub-Office in Jigjiga. From all the offices, SCF-UK, UNHCR-SOJ and Oxfam-UK were the entities best able to supply information on their respective involvement in the water sector.

Consequently, available data on water schemes were collected from BWRD, UNHCR-SOJ, Save the Children-UK and Oxfam-UK. Save the Children-UK is very active in the development of *birkas*, ponds and few shallow wells in the rural areas around Jigjiga and Teferiber weredas. SCF was also extremely helpful in showing the schemes it developed in the various localities.

In Dire Dawa, various Governmental and Non-Governmental Offices were visited for the same purpose. The offices visited included: ESRDF -Dire Dawa, Lutheran World Federation, Catholic Relief Services, the Water, Energy and Mines Office of Dire Dawa, Agricultural Office of Dire Dawa. The response was generally disappointing and of all the institutions visited only the Lutheran World Federation was able to provide useful information - on two small-scale irrigation projects, one completed and one under construction, in Dembel Wereda.

ii. Field data collection

The limited duration of the pilot project and other aspects such as relatively better accessibility and availability of information were among the points considered in the selection of the pilot weredas. Initially, Jigjiga, Teferiber, Dembel and Aisha weredas were selected as the target areas for the collection of specific data.

The collection of data in the field was successfully undertaken in most parts of Jigjiga and Teferiber weredas with some areas of Dembel. Aisha Wereda was later excluded due to limitations on time and access.

The collection of data in the field was the most challenging exercise of all the activities envisaged in the pilot project with the relatively flat nature of the terrain making navigation and the identification of specific localities very tricky even for someone who is familiar with an area. The virtual absence of proper roads between villages, and hence the need to drive on extremely rough tracks and at times leaving the tracks to travel cross-country, made the collection of data even more difficult. It was recognized early on that working with someone who is familiar with the area to be surveyed and the local people was essential.

Despite the initial assumption that such people would be relatively easy to identify, finding a counterpart (engineer) from the BWRD familiar with the pilot weredas, and the water schemes developed by BWRD and NGO's in those weredas proved difficult.

However, a relatively comprehensive set of data, including co-ordinates of schemes developed by the BWRD and various other NGO's and other relevant field data was successfully collected and recorded on the formats designed for the purpose. Training of BWRD staff on the use of a GPS instrument was also conducted.

During the course of the field survey work, staff from SCF-UK were very helpful in locating some of its water schemes implemented in the rural areas around Jigjiga and Teferiber weredas. Getting to some of the other water sources developed by SCF and Oxfam-UK proved extremely difficult. Individuals co-opted from nearby villages were used to locate some of the ponds developed by SCF -UK around Jigjiga as well as some BWRD developed schemes in Dembel Wereda. Given that the pilot weredas are considered to be among the more accessible in the region, the need for careful planning and organization will be required for the efficient conduct to any proposed expansion of the inventory to other parts of the SNRS.

A summary table of the technical and other details obtained on water schemes whose field co-ordinates were collected is given in the attached annexes.

iii. Database design, development and data entry

Development of data entry formats for various types of schemes such as boreholes, shallow wells, *birkas*, ponds as well as related water equipment (pumps, generators, etc.) was undertaken in consultation with experts from the BWRD and used as its basis formats already in use with UNHCR. This allowed the easy incorporation of information held on the existing databank built up by UNHCR in recent years.

A user friendly and flexible database on Microsoft Access was designed and implemented again using the basic dataset and database framework already established and in use with UNHCR. The prototype database was given to the BWRD during the first week of staff training. After the training exercise, the trainees were able to maintain the database and generate useful outputs.

Data collected on the pilot weredas, both from field and various offices, were included in the database along with the information from the existing databank of UNHCR.

The final version of the database will be sent to the BWRD in Jigjiga as soon as the digitisation exercise is completed and all information incorporated into the database.

iv. Training of BWRD staff

Staff members of the BWRD who will be in most contact with the computerized inventory/databank were selected for the initial training and familiarization exercises. Efforts were also made to select/include professionals for the training that were from the area. However, due to engagements of most of the Geologists from the region on other training courses and activities this was not possible for the pilot project.

It is to be noted that the BWRD has been subject to a constant outflow of professional staff, each looking for better opportunities offered outside government service. It is apparent that the Bureau needs to find ways of retaining its professionals if it is to effectively discharge its responsibilities in the future. The issue of staff turnover is also one that would need to be considered in any future expansion of the inventory bearing in mind that additional training would have to be part of such a programme. One possible strategy would be to target the training not just at the level of head of department but to a much broader base of users

across all departments and levels, thus creating a pool of expertise able to ensure the required continuity.

The initial training of staff in GIS software was conducted both in Jigjiga and Addis Ababa. In Jigjiga, an introduction to MapInfo and MS Access software was given to four of the BWRD staff members. A further one week in-depth training on MapInfo and Access was given to two of the key staff, one from the Planning Department and one from the Engineering Section of BWRD, in Addis Ababa at UNHCR. A briefing on the use of GPS instrumentation for navigation, registering co-ordinates of locations and aiding surveying for flat terrain was given for most of the engineers in the BWRD.

6. Common water source types

i. Jigjiga Wereda

Major water sources in the Jigjiga area are, boreholes, shallow wells, *birkas* and ponds. In areas where hard formation is experienced *birkas* are favoured and where there is a clayey formation ponds or earth dams are used.

ii. Teferiber Wereda

The majority of water sources in this area are more or less similar to the sources in Jigjiga Wereda.

iii. Dembel Wereda

This is a different area in terms of the general water sources. The large majority of the people depend on shallow wells under the numerous dry river beds. Due to the rugged nature of the topography there are relatively many seasonal rivers, most of which have water under their bed.

7. Other related activities in the BWRD

The BWRD is working on a two and half year capacity building project in the design and implementation of small scale irrigation and water supply and sanitation schemes with funding provided through the Fifth Country Programme of the United Nations Development Programme, UNDP. In the joint project there is a component for computerisation of inventory of schemes in the region which are managed by the Bureau itself. However, the inventory format was in hard copies and the pilot project was viewed as very useful in establishing soft copies of the formats where the field data could be inputted.

8. Conclusion

Given the lack of organised baseline data in the water resources sector as well as the need to coordinate and monitor overall water related activities in the region, the initiative was viewed by the BWRD as very useful.

There remains an obvious need for better co-ordination and networking between the various actors involved in the water development sector in the SNRS. In the light of common objectives to provide wholesome water in sufficient quantity, NGO's and other concerned agencies in the sector need to work hand in hand to create better understanding, establish common standards and practices and improve the sharing of information/experiences.

Great enthusiasm and satisfaction was observed on the part of BWRD staff who were exposed to the work of the pilot project and those who were briefed on the project.

Problems encountered

Obtaining useful information and technical data from most of the NGO's and Governmental offices proved to be an unexpectedly difficult task. The most obvious problem, especially in the case of governmental offices, was the varying degrees of lack of information due to the relatively recent regionalization process, which has resulted in changes of location, organisational structures and personnel as well as mislaying of information in the process.

Another problem was a lack of willingness on the part of some NGO's to provide information on their respective water related activities. And even where organizations were interested in the work of the pilot project, there was often a problem in finding proper data due to a general poor filing/archiving of information.

The major problem, as far as the interest of the region is concerned, is the apparent lack of any central coordination of the various NGO implemented water projects and water sector programmes. The BWRD's responsibility in co-ordination and evaluation of NGO water projects has not been materialized for various reasons mainly capacity in terms of staffing.

UNDP/BWRD Capacity Building project

There seems to be room for complementarity between the UNDP/BWRD capacity building project and an expansion of this pilot project. In principle, the concepts and the inputs (the GIS Software and trained BWRD staffs) of the pilot project could be readily incorporated into the UNDP/BWRD capacity building exercise.

Ultimately, it is believed that the BWRD would benefit from an expansion of the Pilot Project as an efficient means to systematising its own data collection and handling capacity and, linked to this, its effectiveness in facilitating the co-ordination of NGO and other donor activities in the sector.

9. Recommendations

- i. As a follow-up to the Pilot Project, it is recommended that a workshop be organised at Jigjiga level under the auspices of the BWRD to create an awareness amongst the different actors in the water sector and create a forum for discussions fostering the importance of co-ordination and networking. The partners to this Pilot Project, perhaps led by UNHCR, could assist in developing the contents of the workshop and modalities for conducting it.
- ii. It is recommended that the BWRD, with other concerned Governmental Offices such as DPPB and the Regional Planning Office, draft clear guidelines that will enable it to better coordinate and evaluate water resources projects that are implemented through external actors.
- iii. In order to equip the Bureau with the necessary tools to expand and develop the computerized inventory and database it is recommended that funds be identified for the purchase of five handheld GPS instruments for the BWRD.

iv. An in-house consultation between UNDP, UN-EUE and UNHCR is needed to determine whether there is flexibility in the UNDP/BWRD capacity building project to incorporate the concepts developed in the pilot project and allow an expansion of the inventory to include all areas of the SNRS.

v. It is recommended that an informal evaluation of the impact of the Pilot Project be conducted in three months time. In addition to determining the degree to which the approach and tools promoted by the pilot project have been adopted by the BWRD, the evaluation exercise may look into the strengths, weaknesses to be corrected, and additional support needed to further strengthen the inventory/GIS database. The evaluation exercise might also come-up with a recommendation, based on progress in the continuing use of the pilot GIS database, for the support required to enable an expansion of the project to cover the entire of SNRS should this not be possible within the scope of the UNDP/BWRD capacity building project.

10. Annexes

i. List of schemes surveyed

Wereda	Location	Type of Source	Latitude(N)	Longitude(E)	Implemented by and date	Capacity in Cu. M	No. of Pop. in H/H	Remarks
Jijiga	Dhuhulaley	Pond	N09° 33.452'	E042° 47.608'	SCF – UK	927 (empty)	150	2 ponds & 15 private Birkas available
Jijiga	S/koraley	“	N09° 35.847'	E042° 46.412'	SCF – UK	935 (empty)	100	10 private Birkas available
Jijiga	Agajin-marodi	“	N09° 34.983'	E042° 44.426'	SCF – UK	965 (empty)	250	3 other communal ponds available
Jijiga	Agajin-libah	“	N09° 33.683'	E042° 43.681'	SCF – UK	593 (empty)	220	
Jijiga	Gella	“	N09° 36.464'	E042° 42.4651'	SCF – UK	535 (empty)	300	3 other communal ponds available, 2.5 hrs journey if no water is available
Jijiga	Tur-anod	Birka	N09° 36.809'	E042° 46.342'	SCF – UK	448 (empty)	170	2 communal ponds available & both are empty
Jijiga	Tur-wa'ad	Birka	N09° 26.568'	E042° 58.5931'	SCF – UK	648	400	10 local Birkas of sizes b/n 7x5 to 5 x5 & depth 3 m
Teferiber	Qabri-nune	Birka	N09° 38.076'	E043° 05.280'	SCF – UK	648 (empty)	150	Size 10x15x4 with 4x4 x3 trap, 12 local Birkas available
Teferiber	Go-hadaw	Birka	N09° 34.721'	E043° 03.6941'	SCF – UK			Size 10x15x4 with 4 x4 x3 trap, 10 local Birkas available
Jijiga	Feda-ad	Birka	N09° 31.499'	E042° 48.051'	SCF – UK	448 (1/2 full)	220 (1/2 full)	15 private Birkas available
Jijiga	Walgo	Birka	N09° 30.0231'	E042° 57.7351'	SCF – UK	703 (1/2 full)	110	Size 8 x20x4 with 4x4 x3 trap, 7 local Birkas available
Jijiga	Kudle	Birka	N09° 27.484'	E043° 04.6201'	SCF – UK	703 (1/2 full)	85	Size 20 x8 x4m with 4x4x3 trap, 5 local Birkas available
Jijiga	Guri-qayro	Birka	N09° 38.183'	E042° 41.671'	SCF – UK	703 (1/2 full)	110	Size 20 x8 x4 with 4x4 x3 trap, no local Birka
Teferiber	Surad	Birka	N09° 39.054'	E043° 07.9161'	SCF – UK	703 (no water)	300	Size 8 x20 x4 with 4 x4x3 trap, 3 local Birkas available
Teferiber	A/ladhig	Birka	N09° 37.916'	E043° 03.832'	SCF – UK			Size 8 x20 x4 with 4 x4 x3 trap. There are about 40 underground rain water storage units
Teferiber	Bodhely	Shallow well	N09° 56.041'	E042° 55.615'	SCF – UK	Functional	220	Located at the bank of Harewa river and its depth is 19m.
Teferiber	Subul-nirig	Birka	N09° 31.635'	E043° 05.3731'	SCF – UK	703	150 (1/2 full)	Size 8 x20x4 with 4x4 x3 trap, 6 local Birkas available
Teferiber	Dhagahya-ad	Birka	09° 39.31'	042° 47.004'	SCF – UK	703 (empty)	150	Size 20x8 x4 with 4 x4 x3 trap, 4 private Birkas available
Jijiga	Jijiga	Borehole	N09° 22.892'	E042° 47.236'	BWRD, 1999			New, not fitted with pumps and no pipeline is laid
Jijiga	Burko	Shallow wells	N09° 25.137'	E042° 47.047'	By the locals			It is extensively used for feeding cattle during droughts & at normal circumstances
Jijiga	Malawle	Borehole	N09° 24.538'	E 42° 46.045'				the B.H is operated and used by a single individual for irrigating sorghum and chat farms
Jijiga	Shikaligure	Borehole	N09° 18.992'	E 42° 47.640'				Fitted with Mono pump-MK3, Engine - Lister Petter, TS2, 4m ³ concrete tank, a cattle trough & a tap stand all on site

Wereda	Location	Type of Source	Latitude(N)	Longitude(E)	Implemented by and date	Capacity in Cu. M	No. of Pop. in H/H	Remarks
Jijiga	Elbayeh	Borehole	N09° 23.317'	E042 ° 49.951'				Engine Lister Petter TS2, Pump Mono - BKM2 *There is a loading station from which CARE trucks water to UNHCR and other occupancies in Jijiga. It is located just downstream of Elbayeh dam
Jijiga	Musley	Birka	N09° 27.008'	E042° 48.316'	Privately owned			3 in number
Jijiga	Kordere	B.H (3)	N09° 22.817'	E042 °47.301'	BWRD, 1995			Connected to the town supply, Engine Same Generators - Marellimotori, 53 KUA, Type - M*B 200 MA 4, Code - M8B 2032 LAO10M0 Pump - Plugar., good gen. House
Teferiber	Jara	Borehole	N09° 42.02'	E042 °46.71'				Generator house under construction, Borehole not fitted with pump & Gen. set, 3 Birkas in the village, Pipeline system under construction
Jijiga	Turanod	Borehole	N09° 36.680'	E042 °47.225'				No pump, Generator - James DRING/MECAALTE, 22KUA, Engine- Deutz - Mod - F3L912, Poor condition generator house. System not operational for the last 2 years. <u>Distribution system:</u> 7 ×7 ×1.5m concrete reservoir, 30m long cattle trough One public tap all located near the Borehole
Jijiga	Jijiga	Borehole (J8)	N09° 21.740'	E042° 48.400'	BWRD,1998			Serves the Teachers training Institute & the town systems. Generator - Marellimotori, 30KVA Engine - SAME, Model - 1053p, No. 47319 Pump - GRUNDFOS, SP16-20, 9.2 kW
Jijiga	Jijiga	Borehole (J7)	N09° 21.656'	E042 °48.501'	BWRD, 1995			Generators - Marellimotori, 30KVA, Engine – SAME Pump?, Supplies both the Hospital & the town system
Jijiga	Jijiga	Borehole	N09° 22.664'	E042 °47.49'	EWWCA			Sheep Farm (ELFORA), Details of equipment not obtained because it is private & moreover was locked
Jijiga	Kurula	Earth dam (Pond)	N09° 39.349'	E042° 45.002'				Empty
Dembel	Waji	Earth dam	N09° 43.934'	E042° 44.635'				empty, big size - 6 km from Jara on the way to Dembel. bushy land
Dembel	Jiri (1)	River bed (dry)	N09° 46.254'	E042 40. 781 '				On the way b/n Jara to Dembel, water collected from the river bed through shallow digging
Dembel	Dembel	Dembel river	N09° 48.811'	E042° 36.95'				Big river bed, so many cattle were feeding on the water collected from the river bed. (dry bed) - Natural (dry)
Dembel	Dembel							Wereda town & collected water from the Dembel river bed, currently dry
Dembel	Dembel	Borehole	N09° 48.909'	E042 °36.107'	EWWCA, 1988			Was not operational, capped/sealed. Has an on point distribution with 4m ³ elevated steel tank & one tap stand
Dembel	Worabes	Dry river bed	N09° 52.357'	E042° 39.857'	Natural			On the road b/n Dembel & Arabi

Wereda	Location	Type of Source	Latitude(N)	Longitude(E)	Implemented by and date	Capacity in Cu. M	No. of Pop. in H/H	Remarks
Dembel	Kenshebl	Dry river bed	N09° 52.357'	E042°41.046'	Natural river			Between Dembel & Arabi, sources water for humans & cattle
Dembel	Hrikobo	''	N09° 54.1631'	E042 °41.046'	''			''
Dembel	Arabi	''	N09° 55.664'	E042° 43.067'	''			Arabi river joins Harewa & flows together
Bembel	Arabi	Borehole	N09° 55.713'	E042 °43.330'	BWRD, 1995			Lister Petter engine - TR3A008, Gen. set SOLIMEX AB, 17.25 KVA, Good condition Gen. house, depth of Borehole 60m Water sale EB. 0.20/Jerrycan, Storage 6m ³ , Three tapstands, one each for public, mosque & school
Dembel	Arabi	Hot spring	N09° 57.456'	E042° 41.749'	Natural			Along the ARABI River bank, Extremely hot
T/Ber	Jara	Earth dam	N09° 41.804'	E042° 45.750'				On the way to Dembel (1.8 km from Jara) empty
Jijiga	Hadew	Birka			95, OXFAM-UK			
T/Ber	Hasadin	Birka			94, ''			
Jijiga	Kocharaha 'A'	Birka			95, ''			
Jijiga	Kocharaha 'B'	Birka			95, ''			
Jijiga	Sh. Faroawsa	Birka			95, ''			
T/Ber	Hajjin	Birka			99, OXFAM-UK			
T/ Ber	Guguyti	''			98, ''			
Jijiga	Gumburka	''			99, OXFAM-UK			
T/Ber	D/Biyale	''			99, ''			
T/Ber	Darwenaji	Shallow Well			96, ''			
T/Ber	Darwenaji	Shallow Well			96, ''			
T/Ber	Gogti	Shallow Well	N10° 04.52'	E042° 52.042'	95, ''			There are two shallow wells, 1 Italian & 1 OXFAM, water is collected by bucket and rope
T/Ber	Agjogsi	Shallow Well			95, ''			
T/Ber	T/Ber	Shallow well			97, ''			
Jijiga	Haroresa	Borehole	N09° 26.082'	043° 05.883'				Wells abandoned, one new well under construction
Jijiga	Bundo	Earth dam	N09° 26.54'	043° 01.572'	JERP, 1994			100 ×100 wide. 3/4 ^h full
Jijiga	Elbahay	Shallow Well	N09° 24.876'	042° 31.759'	Private, 1977			9 wells, Water sale is at EB. 25/Jerrycan, collection is through bucket & rope pulled by donkeys & drained to cattle trough, depths maximum 10m with 4m diameter

Wereda	Location	Type of Source	Latitude(N)	Longitude(E)	Implemented by and date	Capacity in Cu. M	No. of Pop. in H/H	Remarks
T/Ber	Lasanod (2)	River bed	09° 59.911'	042° 55.913'	Natural River (3rd)			Dry river bed b/n Darwanaji & Gogti
T/Ber	Walaldon	River bed	10° 01.328'	042° 55.509'	Natural river (4th)			“
T/Ber	Aubube	River bed	10° 03.46'	042° 53.225'	Natural river (5th)			“
T/Ber	Gogti River	River bed	10° 04.512'	042° 52.023'	Natural river (6th)			
Jijiga	Biyo Dam	Irrigation Dam	09° 27.001'	042° 42.346'				A huge number of cattle is fed on the dam, No dam info??
Jijiga	Biyo Village	Borehole	09° 28.275'	042° 43.48'				2.5km pipeline , 25m ³ reservoir is constructed by BWRD. Installation of submersible pump is being awaited.
Jijiga	Chinaksen	Irrigation Dam	09° 30.737'	042° 37.411'				Dam constructed by Russians, Canals constructed by BWRD. Earthfill dam, 13m high, 380m long, 13km ² catchment, 12ha reservoir area & 420.000m ³ live storage
Jijiga	Dibowga	Earth Dam	09° 30.213'	042° 48.500'	Constructed by the community			Empty dam (2), 3 private Bikas available
Jijiga	Shek Abdu Selam (PA)	J1 – Borehole	09° 19.78'	042° 47.61'	German Water Engineering			Fitted with Submersible pump and run by EELPA power, Inter-connected with Borehole J4 for stand by power supply, The water system is run by the water supply and sewerage office, Sale of water is EB. 1/m ³ , Operational
Jijiga	Jijiga Town	J2-Borhole	09° 22.65'	042° 47.35'	EWUCA			Interconnected with J3, Standby generator serves for both J3 & J2
Jijiga		J3-Borhole	09° 22.82'	042° 47.24'	EWUCA			Interconnected with borehole J2, Fitted with submersible pump, Stand by generator is at J2, Control panels is at J2,
Jijiga	Shek Abdu Selam (PA)	J4 – Borehole	09° 19.53'	042° 47.67'	German Water Engineering			Fitted with submersible pump and run by EELPA power, Inter-connected with Borehole J1, Operational
Jijiga	Shek Abdu Selam (PA)	J5-Borhole	09° 19.4'	042° 47.75'	EWUCA			Borehole fitted with submersible pump and run by EELPA power, With a standby Generating set, Operational
Jijiga	Shek Abdu Selam (PA)	J6-Borehole	09° 19.26'	042° 47.83'	EWUCA			Submersible pump run by EELPA power, Has a stand by generating set, Two cattle troughs are there for dry season, Operational
Jijiga	Jijiga town	J7 – Borehole	09° 21.63'	042° 48.42'	EWUCA			The Borehole is fitted with submersible pump and powered by a generator & supplies the Hospital & the town, Not connected to the EELPA power
Jijiga		J9	09° 24.76'	042° 46.97'	BWRD, 1997			The borehole is recently connected to the town supply system, operational
Chinaksen	Jijiga	Borehole-Chinaksen	09° 30.96'	042° 36.86'				Borehole fitted with submersible pump and powered by a generator, there are seven tap stands and 20 private connections, there is a hand dug shallow well for stand by
Jijiga		J10	09° 25.07'	042° 47.05'	BWRD, 1997			It is fitted with submersible pump & powered by a generating set, the borehole is connected to the Jijiga town system very recently.

Wereda	Location	Type of Source	Latitude (N)	Longitude (E)	Implemented by and date	Capacity in Cu. M	No. of Pop. in H/H	Remarks
Jijiga	Gelbob	Gelbob Village	09 °32.2'	042° 56.25'				Non-functional water loading system exists, elevated cylindrical reservoir, 3 tap stands & one cattle trough all onsite
Teferiber	Lafaisa Town	Lafaisa Town Borehole	09 °37.01'	042 °58.94'				Two masonry reservoirs, Seven water points, distribution pipeline, is available, the system is upgraded by UNHCR
Teferiber	Togochale	Togochale Borehole #(1)	09 °35.94'	043° 20.04'				
Teferiber	Togochale	Togochale Borehole #(2)	09 °35.89'	043° 20.10'				The system is administered by the village water committee, the system has one 4m ³ steel reservoir and one tapstand of 4 taps
Teferiber	Darwanaji Refugee Camp	Shallow Well No.1	09°50.24'	043° 01.60'	UNHCR, 1996			Fitted with submersible pump & powered by a generating set
Teferiber	Darwanaji Refugee Camp	Shallow Well No. 2	09° 50.18'	043° 01.60'	SERP, 1993			Fitted with Afridev hand pump
Teferiber	Darwanaji Refugee Camp	Shallow Well No.3	09 °50.08'	043° 01.60'	Oxfam, 1996			Fitted with Afridev hand pump
Teferiber	Darwanaji Refugee Camp	Shallow Well No.4	09° 49.93'	043° 01.53'	UNHCR, 1996			Fitted with Afridev hand pump
Teferiber	Darwanaji Refugee Camp	Shallow Well No. 5	09° 49.94'	043° 01.49'	UNHCR, 1997			Fitted with Afridev hand pump
Teferiber	Darwanako Refugee Camp	Shallow Well No. 6	09° 49.87'	043° 01.49'	UNHCR, 1996			Fitted with Afridev hand pump
Teferiber	Darwanaji Refugee Camp	Shallow Well No.7	09° 49.89'	043° 01.48'	UNHCR, 1996			Fitted with Afridev hand pump
Teferiber	Darwanaji Refugee Camp	Shallow Well No. 8	09° 49.23'	043° 01.08'	Oxfam, 1996			Fitted with Afridev hand pump
Teferiber	Darwanaji Refugee Camp	Shallow Well No. 9	09° 49.13'	043° 01.08'	UNHCR, 1997			Fitted with Afridev hand pump
Teferiber	Teferiber Refugee Camp	Shallow Well No. 1	09° 47.13'	043° 13.75'	?, 1945			It is called Italian well to imply that it was dug by the Italians, water lifting through bucket & rope
Teferiber	Teferiber Refugee Camp	Shallow Well No. 2	09° 47.10'	043° 13.73'	UNHCR, 1996			Fitted with Afridev hand pump
Teferiber	Teferiber Refugee Camp	Shallow Well No. 3	09° 47.11'	043° 13.76'	UNHCR, 1997			Fitted with submersible pump & powered by a generating set
Teferiber	Teferiber Refugee Camp	Shallow Well No.4	09° 46.83'	043° 13.52'	UNHCR, 1997			Fitted with Afridev hand pump
Teferiber	Teferiber Refugee Camp	Shallow Well No. 5	09° 46.88'	043° 13.56'	UNHCR, 1997			Fitted with Afridev hand pump
Teferiber	Teferiber Refugee Camp	Shallow Well No.6	09° 46.63'	043° 13.53'	UNHCR, 1997			Water lifting through bucket & rope
Teferiber	Teferiber Refugee Camp	Shallow Well No. 7	09° 47.03'	043° 13.73'	Oxfam, 1997			water lifting through bucket & rope
Dembel	Semekab	Approach Channel	1995/98		Lutheran World Federation		180HF	Q=110l/s, Irrigable area=95ha, canal length=6.5km
Jijiga	Chefe Temam	Spring (for irrigation)	1999		Lutheran World Federation		120HF	Q=50l/s, Irrigable area=55ha, canal length=4km, purpose of development for irrigation.

ii. Sample maps

The following maps are available as GIF graphics or MapInfo tables on request from the UN Emergencies Unit for Ethiopia:

- Figure 1: Geological Map of SNRS
- Figure 2: Hydrogeological Map of SNRS
- Figure 3: Season Vegetation Cover (NDVI)
- Figure 4: Average Annual Rainfal for Ethiopia