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BARI WATER REHABILITATION STUDY

Volume I

FINAL REPORT

On request of:
European Union
Somalian Unit
Nairobi

by:
SAWA
SPDS
Ede, September 1995

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BARI WATER REHABILITATION STUDY

Volume I

FINAL REPORT

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GLOSSARY

berkad	small ground tank for surface water collection and storage; mostly lined
togga	stream bed of a wadi (sometimes valley)
waro	larger dug-out for surface water collection and storage; mostly unlined

1. INTRODUCTION

the study

The study to the rehabilitation of water supply in the Bari Region was held by 2 consultants of SAWA (Netherlands) and 4 consultants, contracted by SPDS (Somalia). The study was on request of the European Union/Somalia Unit.

The main purpose of the study was to come to the formulation of two feasible urban and one rural water rehabilitation programme in the region, which can be financed through the EU NGO rehabilitation programme.

The report gives a draft of the methodology used (Chapter 1), the context of Bari Region (Chapter 2), the available water resources (Chapter 3) and the economic feasibility (Chapter 4). Based on this information it comes to a philosophy and a plan for further water development (Chapter 5), and a selection of short term and long term projects. For these projects a general outline of the approach (Chapter 6) and the institutional aspects (Chapter 7) are given.

Site reports and sketches of the villages and towns visited by the team are collected in a separate report, vol II.

background

The water supply system of Bari Region (North East Somalia) has deteriorated drastically during the last 5 years, because of destruction and looting of existing systems, and lack of adequate maintenance after the Collapse of the former government in 1990, after which the till then active regional Water Development Agency (WDA) disappeared.

The Regional Development Committee of the Bari Region with the assistance of international and local NGOs now intends to rehabilitate the water supply in the region. A global framework for planning is lacking. Preliminary investigations by SPDS, SAWA and NOVIB have resulted in a project proposal for Qandala Town, submitted through the Dutch NGO to the European Union. Other interventions were done by GTZ (southern districts), Africare, UNICEF and Technische Hilf Werke (THW). In March 1995, the German Ministry of Economic Cooperation cancelled its programme in the North East of Somalia, just before GTZ could start the implementation of W&S rehabilitation projects. Hence, the mission had to include the 3 southern districts in its study. UNICEF had made a rehabilitation survey in the north eastern Alula District, which, for that reason, has been left out of the study.

methodology

The mission has followed the following steps:

1. concerting its activities with other agencies and administration, acting in the region, and representatives of elders
2. field visits to the 6 Districts
3. definition of a short term water development plan
4. definition of specific rehabilitation projects
5. concerting the plans with the other agencies and administration

Although local administration and elders were consulted during the study the report cannot be considered as a plan developed by the local authorities, and is mainly developed by the study team.

future elaboration

This report is a reflection of the study, only. A number of rehabilitation programmes have to be worked out in separate project proposals. Other projects need further elaboration as well.

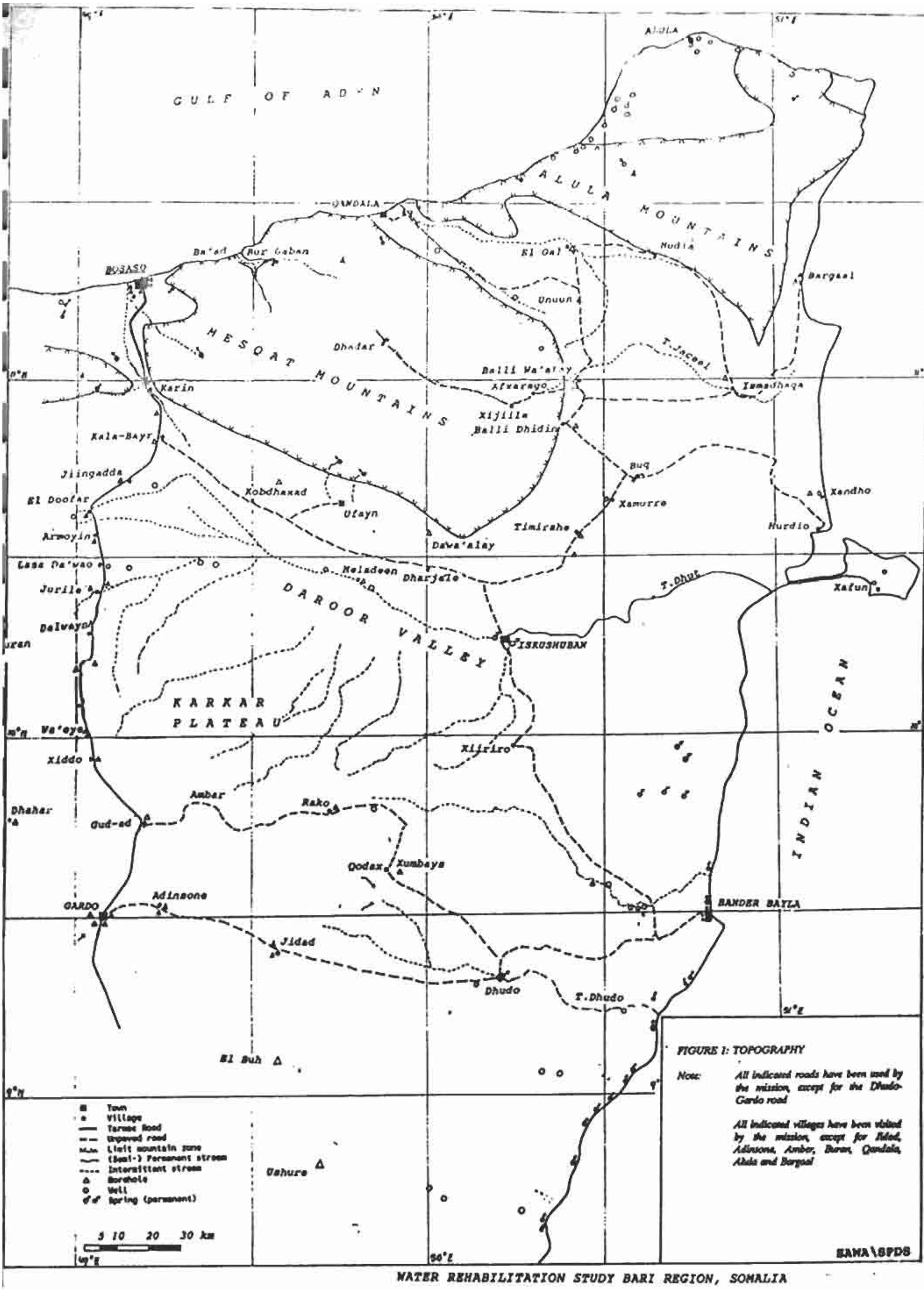

FIGURE 1: TOPOGRAPHY

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2. BARI REGION

2.1 Physiography

Bari Region is located in the Horn of Africa and is the outmost North Eastern Region of Somalia. Figure 1 gives the topographical map on which the passed roads and visited villages are indicated.

geology

The lithology of the rocks, underlying Bari Region, is relatively simple, and dominated by calcareous formations. Both the valleys and the plateaus are underlain by a sequence of horizontally bedded Tertiary sedimentary rocks. The sequence consists of thin and massive white limestones, marls and evaporites with well developed gypsiferous layers. The rocks have been intensely fractured and faulted, but only gently folded. Fault lines determine the present morphology.

The fractures have been widened by solution weathering ("karst"), especially in the limestones and to a lesser extend in the marlstones and gypsum layers. Karst weathering has created a network of well developed cavities. The fact that most of the important springs are found around the 300 meter level may indicate that karstification has reached till the 300 m level in the inland area. Table 1 gives the litho-stratigraphical sequence and the groundwater characteristics of the different formations. Figure 2 gives the geological map.

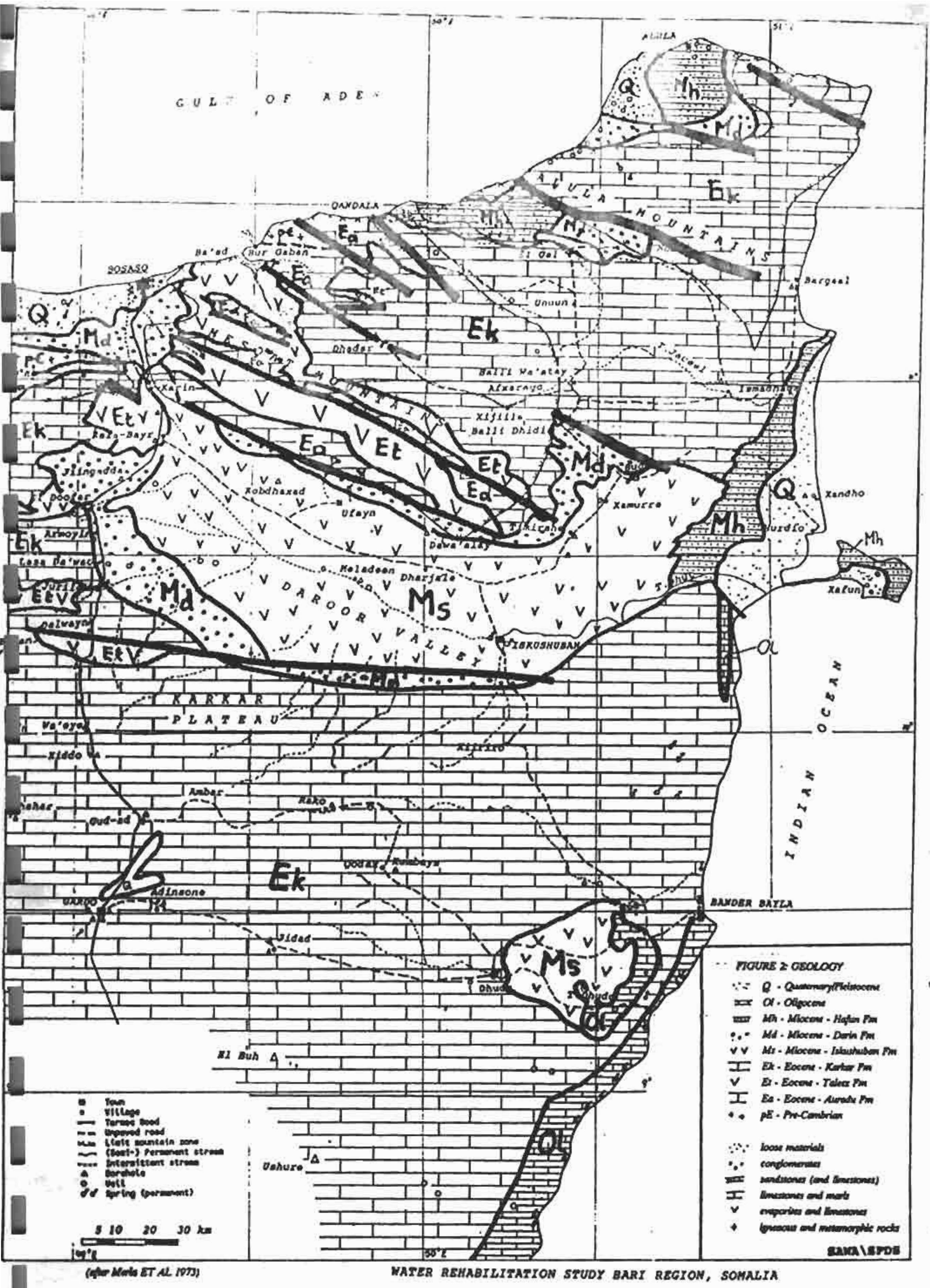
Outcrops of the Pre-cambrian are only found in a small area in the Coastal mountains between Bosaso and Qandala.

The most dominant formation in Bari Region was formed during Eocene: the Karkar Formation. This formation covers more than 75% of the area and consists of interbedded limestones and marls, with some gypsum beds. It is underlain by the Eocene Taleex Formation, mainly consisting of evaporites (gypsum). The older Eocene Auradu Formation (limestones) is only found in some outcrops in the coastal mountains.

Two structural valleys have been formed during Miocene: the Daroor Valley and the valley at the northern part of the foot slope of the Alula Mountains. Continental formations (conglomerates) have been deposited at the fringe of the depressions, whereas the central parts are filled with evaporitic rocks, like gypsum. Also east of Dhudo and along the eastern coastline, these Miocene sediments can be found.

Quaternary deposits have been little developed. Alluvial deposits are found along the toggas, but rarely thickly developed. The footslopes of the mountains are covered by whitish boulders, rarely thickly developed.
Where rivers enter the coastal plain alluvial fans are formed. The best developed one is around Bosaso, in which a ground water body is developed.

Local calcretes are found in the togga courses. Laterite remnants can be found very locally, being remnants of a more humid tropical climate. Recent gypsiferous soils are found in the centre of the



(after Merla ET AL. 1973)

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Daroor Valley.
Travertine deposits have been found in the spring zones of Iskushuban.

Low sand dunes are formed along the coast. Along the Indian Ocean, eolian activity has been more pronounced. Sands have accumulated in large isolated sand dunes and cover even the steep slopes of the plateau cliffs.

Thin beds of quaternary basalts are found in a narrow coastal strip east of Bosaso.

Table 1: Hydrogeological characteristics of geological formations in Bari Region (data mainly from Faillace (1986))

EPISODE	FORMATION		LITHOLOGY AND DISTR	HYDROGEOLOGY
QUARTERNARY	Qa	recent alluvium	Mainly in toggas; 3-4 m thick	Mainly fresh water. In coastal area: sandy to gravelly; infiltration; underground flow. Inland; togga's clayish to sandy/ gravelly; seasonal flow; exception in T.Dhot (Dorror Valley), but brackish.
	Qd1	coastal dunes	Little developed	Rare; Very shallow aquifer; EC 1000 - >4000
	Qd2	inland dunes	Little developed	Mostly dry. Sand covers in river valleys may contain seasonal water; sensitive for erosion
	Qc1	coral reef	Along coastline few metres	Brackish aquifer; most wells in Bosaso dug till top of reef; EC 2000->10,000; high yield
	Qc2	valley calcrete	In toggas and on plateaus; few metres	May contain water; sulfate rich water; springs at Buq, Iskushuban and Dhudo originate from calcretes/travertine;
QUARTERNARY/ PLEISTOCENE	QPa	old alluvium	Especially in coastal alluvial fans; some marine terraces; up to tens of metres	In coastal fringe: very good aquifers; water deep at mountain and shallow at foot
	QPp	Piedmont colluvium	At foot of mountain slopes; to tens of metres	Aquifers if recharge is good; deep In Darror valley: dry
	QPl	Laterite	At plateaus	No records
	QPc	Plateau calcrete	At plateaus	Few records, Haud plateau: wells 4-12 m; EC700-1800; Nugal EC 1700-6600
	QPr	Red clay	At plateaus	Little recharge, low permeability; in karst depressions: seasonal to permanent water (Qodah; Dhahar)
	QPb	Basalt	At coast; west of Bosaso, beds < 10 m	Top of table mountains; no water

TERTIARY Oligocene/ Miocene	Mafun Formation & Iskushuban Fm: U: Darin conglo-merate; M: biogenetic limestones and gypsum; L: marly lime-stones.	Darror Valley and Indian coast Thick graben deposit in Darror; 40-560 m; >220 m at Meladeen	Along northern margins and in west Darror valley continental deposits: recharge, groundwater flow, local good aquifer; EC 1000-3000 In central, eastern and southern part Darror and along Indian coast: gypse-ferous acquifer with variable permea-bility, variable but mostly deep groundwater tables and springs; EC 1200 - 5000; in coastal zone even higher; sulphate/Chloride type (Fp37); springs in Togga beds (Iskushuban)
Upper Eocene	Kakar Fm: U: limestones; M: shales L: limestones Mostly marls with limestone beds.	Most of Bari Region except Darror Valley, coastal fringe and small part mountain zone 80 - > 350 m thick	Deep groundwater under karstic pla-teau; bedding causes local variation in depth and yield (2 - 50 m3/h in Gardo); shales and evaporaites cause higher salinities; boreholes may enter into Taleex (Rako); EC 1100 - 6000 (also seasonal variation); Chloride to sulphate type.
Middle Eocene	Taleex Fm Evaporites, con-sisting of marls, gypsefe-rous limestone and anhydrites	Nugal Valley and Ta-leex Plateau, small outcrops in Mountain zone. Underlying Kakar Fm; (350 m)	Gypseferous aquifer with variable depths and yields, but poor quality. Yields may be good (0.5 - 10 m3/h/m); EC 2400 - 12,500 (springs EC 1000-6650); sulphate type; Carin Wells penetrating to Auradu Fm may be good (N.margin; Dawa'alley)
Lower Eocene	Auradu Fm (incl Allohkajid beds): U: chalky bedded limestone L: massive lime-stones	Haud Plateau (and N.edge Sol-Haud); Some outcrops in Coastal Mountain zone NE (200-400 m)	On Haud Plateau almost no data avail-able: deep In mountain zone karstified and bedded, faulted aquifer with many springs (Ufayn, Galgayo etc); power-full SE of Bosaso; EC < 1000 uS; Bi-carbonate type
CRETACEOUS	Marine in NE: fossilerous neritic limesto-nes;	Marine limestones in Coastal Mountain Zone	Springs at contact zone; no data
	Continental in NW Somalia: "Nu-bian Sand-stones"; Yasso-man Fm	Nubian Sandstone not in Bari	Bad acquifer, most wells are dry; some salty beds
JURASSIC	Sandy Limestones	Only preserved in down faulted blocks in Coastal Mountains; no outcrops in Bari	No data
	Basal basalts	No data	No data
PRE-CAMBRIAN	Metamorphic and igneous rocks	At base of coastal mountains; only small outcrop W of Qandala	Outside Bari: springs till 7 l/s; some thermal; EC 500-2800; drilled wells have higher salinities

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morphology
Bari Region can be divided in 6 geomorphological units (figure 3):

1. *Coastal Mountain Range* in the North with a maximum altitude of 2266 m; the most pronounced mountain zone can be found between Bosaso and Qandala. A less pronounced, but outstanding unit can be found in Alula District, with a maximum elevation of almost 1500 m. Most of the mountains are underlain by the Karkar Formation (limestones and marls), with little outcrops of the older Taleex Formation (evaporites) and Auradu Formation (limestones) and Pre-cambrian (metamorphic rocks).

2. *Dissected hills* in the Qandala District. The former mountains and plateaus in the east and south of Qandala district are highly dissected. Highest watersheds are found in between 400 and 750 m. The hills are underlain by limestones and marls of the Karkar Formation. Remnants of laterites are found on the tops.

3. *Daroor Valley* in the centre, having west-east orientation. The Daroor valley has a gentle slope across the area, falling from about 760 m in the West to sea level over a distance of 220 km. It is a tectonic depression, filled with gypsiferous and continental formations of Miocene/Oligocene age. A smaller tectonic depression is found in the west of Qandala district.

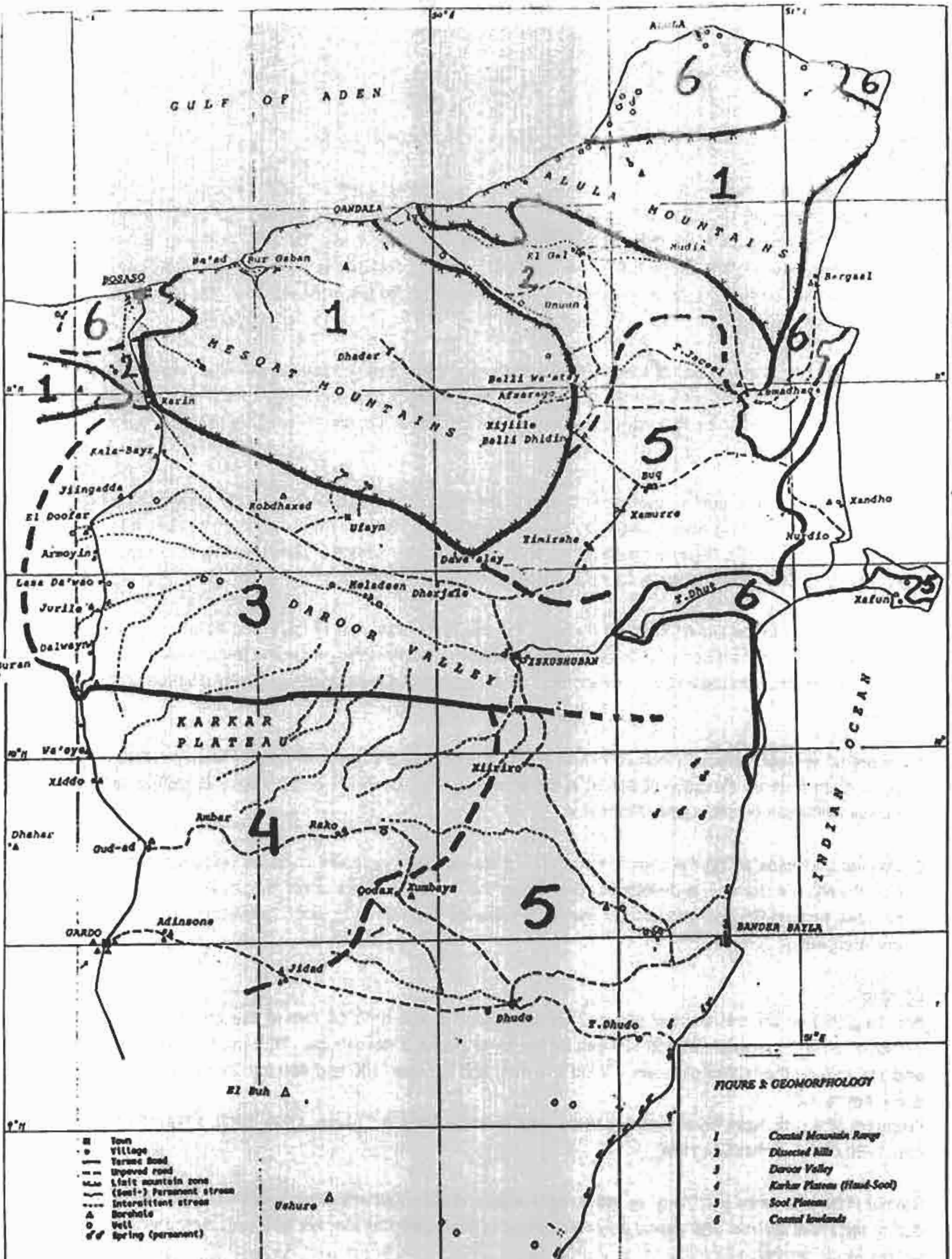
4. *Karkar Plateau* in the South West. The Karkar Plateau is an extension of the Haud Plateau in the west, and can be classified as a "karst plateau" underlain by limestone and marly formations of the Karkar Formation, underlain by the evaporitic Taleex Formation. Elevation is found between 600 and 1050 m.

5. *Descending Sool Plateau* in the centre and south. The plateau descends in a series of steps of 30-50 m each from an elevation of 600 m in the west to 240 m along the coast. Also this plateau is mainly underlain by the Karkar Formation.

6. *Coastal Lowlands* along the coastal fringe. The plateaus and mountains continue up to the coast line. Rarely, a wider strip is developed. Exceptions can be found where major toggas enter into the sea, like around Bosaso and around Hurdio. A separate depression is found between Ismadhaqa and Bargaal.

Climate
Bari Region has an arid tropical climate. Annual rainfall is less than 50 mm in the coastal fringe (Bosaso 15 mm), between 50 and 100 mm on the lower plateaus (Iskushuban 70 mm), between 100 and 150 mm on the higher plateaus (Gardo 110 mm) and between 100 and 400 mm in the mountain zone (figure 4a).
Frequent droughts have been reported in the past to occur once in 7 years: 1954, 1968, 1974, 1983, and 1989 (Clark University 1994).

Rainfall is concentrated in 2 "rainy" seasons: April-June and October-December. Rainfall occurs mainly during torrential storms. The period July-September is considered as the "hot season", during which strong winds prevail.



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Drainage

The mountainous area is deeply incised by numerous valleys. Those draining to the Gulf of Aden have a predominantly SE-NW orientation. Few major toggas drain towards the Gulf of Aden and are all seasonal.

Most of the Bari Region is drained towards the Indian Ocean. The most pronounced toggas are Togga Jaceel, draining towards Bargaal, Togga Dhut/Jaceyl, draining the Daroor Valley and Togga Dhudo, flowing along Dhudo. Only the last ones are permanent in some parts of their lower courses.

Density of the drainage is highly variable, and depending on the permeability of the soil. On the karst plateau, local depressions are found. The best known is the one at Dhahar (Sanaag Region), which is regularly flooded.

Torrential storms result in severe spate floods and flash floods. As a result, most of the ancient soils have been removed and rocks and stones are at the surface in most of the area.

2.2 Socio-economic aspects

Socio-economic data, collected through interviews in the villages are summarized in Annex 3.

population

The population of the Bari Region is estimated to be 220,000 people, but figures are highly unreliable. The population increased after the civil war by both the displaced and refugee population from other parts of Somalia and adjacent countries. The survey team estimated 40,000 people in Bosaso (before the hot season). Gardo is believed to have 20,000 people. The other part of the population is spread over the Region. Most of them still live a (semi-)nomadic life.

Settlement is quiet recent. Till the end of the 50-ties there were hardly any permanent houses, except along the coast and around traditional water sources. With the introduction of boreholes and the improvement of the roads, people started to settle. A second impulse was given by the introduction of berkads, the construction of which is mostly the start of a new village.

The study team visited about 40 villages and towns, of which primarily the largest ones. Of the visited villages and towns, about 10% had more than 300 houses, 17% had between 200 and 300 houses, 31% had between 100 and 200 houses, and 41% had between 25 and 100 houses. Many of the houses are temporary, mostly occupied by displaced people and nomads. In general 2 to 3 families live in 1 house, being 20 members per counted house on the average. In some rural areas, even all brothers of a family may share a 1 room house, 2 being in the village, 4 on the fields and 2 in town.

Seasonal migration is a common phenomena, not only for the nomadic people, but also for the people along the coast. During the hot season, most people along the coast move to the cooler highlands, where they have second houses or live with the family. In many cases, women and children stay on the highlands during the whole year, whereas the adult men go to Bosaso for work. Few male adults were found during the survey in many villages.

Many people leave places with poor water resources during the dry season. They cannot afford to pay for the water, which is brought by tanker at a price of 10 to 25 US$/m3.

Nomads return to permanent water sources during the dry season.

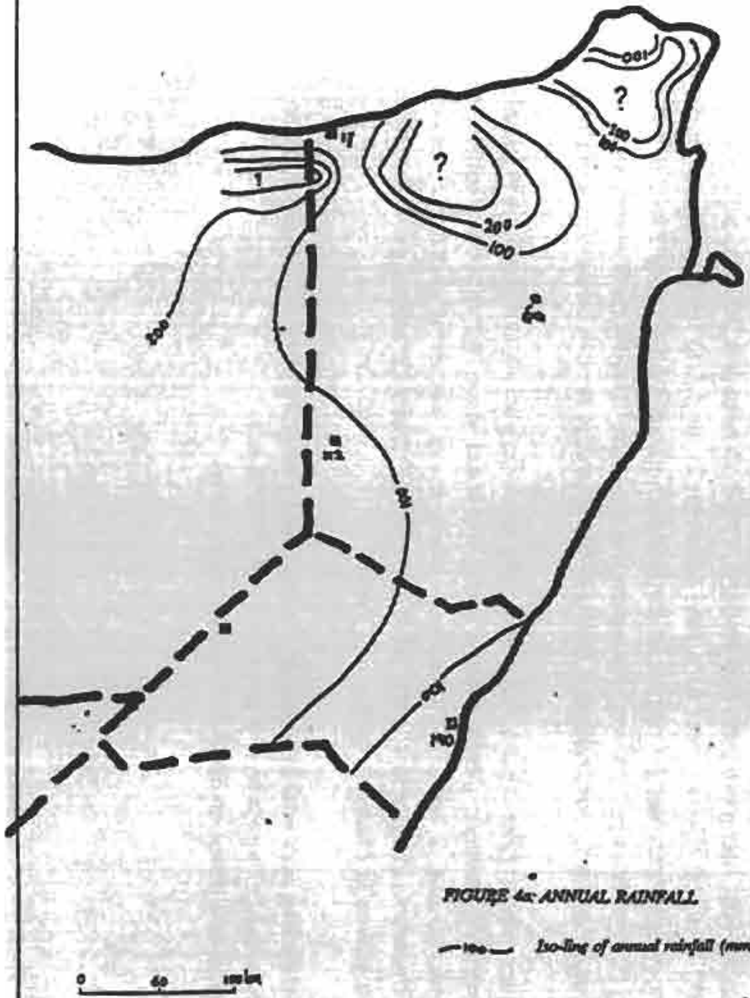


FIGURE 4a: ANNUAL RAINFALL

(After Fallace et al 1986)

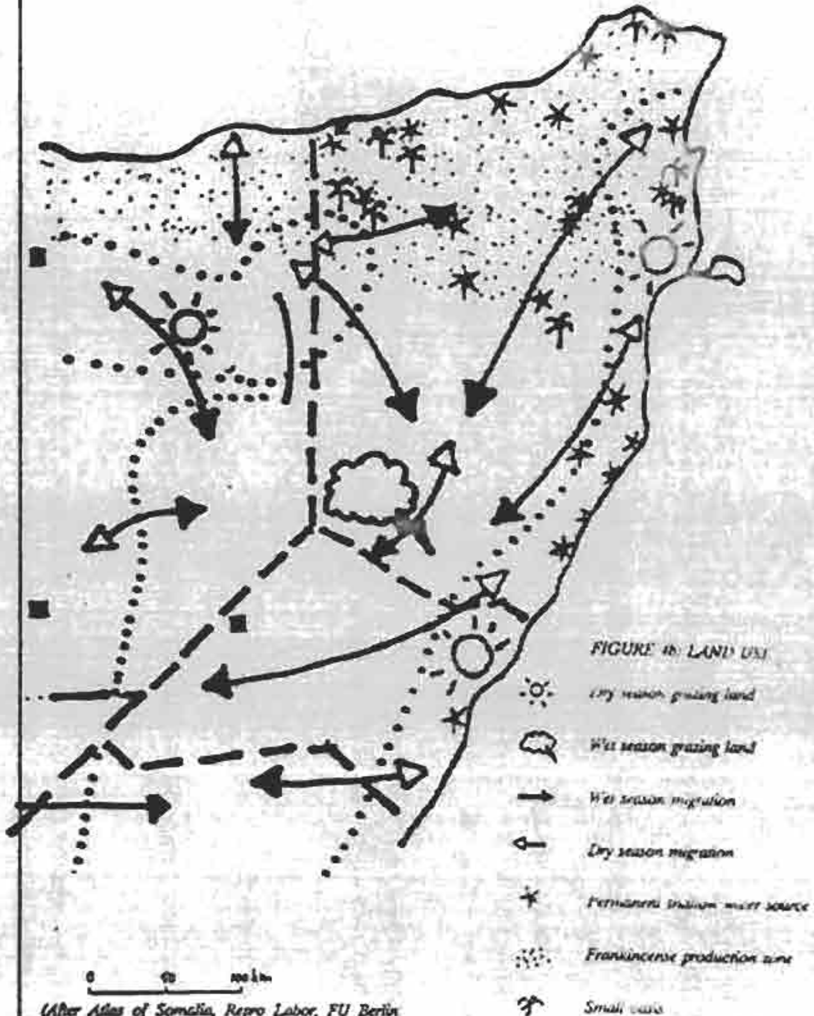


FIGURE 4b: LAND USE

(After Atlas of Somalia, Repro Labor, FU Berlin 1993)

<u>administration</u>

Bari Region has 6 districts: Bosaso, Qandala and Alula in the North, Iskushuban in the centre and Gardo and Bander Bayla in the South. No exact figure is known on the number of villages in each district. For example; Qandala District alone has 35 villages. Major towns are the 6 district centres and Ufayn, which counts more than 300 houses. Bosaso is the Regional Capital.
Just before the Collapse, the national government prepared the creation of more districts. These unfinished plans still create some instability in the Region.
After the implosion of the former Government, the total administration system collapsed. During the last 4 years a tradition based administration is slowly developing, in which Councils and Development Committees have been formed at Regional and District levels. The development committees function as a kind of backing group of intellectuals and are meant to develop to become technical advisory groups to the councils.
No portfolios have been divided, yet, and formal operational groups do not exist.

<u>traditional structure</u>

Somalian social structure is immersed in the clan lineage system. Every Somalian lineage confers to rights and obligations which are legally based on specific contacts (Xeer), controlled by the authority of the Council of Elders.
In Somalian society, descent is organized through the male line and defines membership. Each male citizen can trace his relationship to the founding father. Clanship is part and parcel of daily life operations and lineage segmentation determines socio-political structures. The different levels are clan family (1), primary lineage group (2), clan which determines political action (3), dija paying group (4) and household (5).
Each Dija paying group has its own territory ("deegaan"). Therefore it is convenient to deal with them separately in relation to the matters concerning their specific areas, apart from more formal structures. When pasture and water are in short supply, conflicts occur, but, formerly, the elders used to make immediate interventions to settle any disputes or disagreements. Islamic law is generally applied, then.

<u>local groups</u>

Apart of these structures, women groups/organizations are quiet active in many villages. In the example of Timirshe, they support the displaced people and prepare themselves on community meetings, where they are represented.

Remnants of production cooperatives (salt, fishing) can still be found, but lack of resources make them very weak. A collective investment was found in Timirshe, where men tried to develop agricultural plots, 14 km from the village. Other collective action is found in the mountains near Bosaso on irrigated farming, e.g. Galgalo). At Shademi, north west of Gardo, a cooperative livestock farm already exists for more than 10 years, and is run by 150 families.

<u>pastoral society</u>

Socio-cultural aspects of the pastoral society are well described in the GTZ-report on a participative Rural Appraisal workshop, held in Jiddad, mid 1994 (Clark University, 1994). A seasonal calendar (table 2) and a gender and age group division of tasks (table 3) are taken from this report.

<u>Land use</u>

Land use in Bari Region is mainly determined by the major economic activities: livestock grazing and frankincense collection. Next to this, some date palm oasis are found near permanent water sources

Table 2: *Jeded seasonal calendar (source: Clark University 1994)*

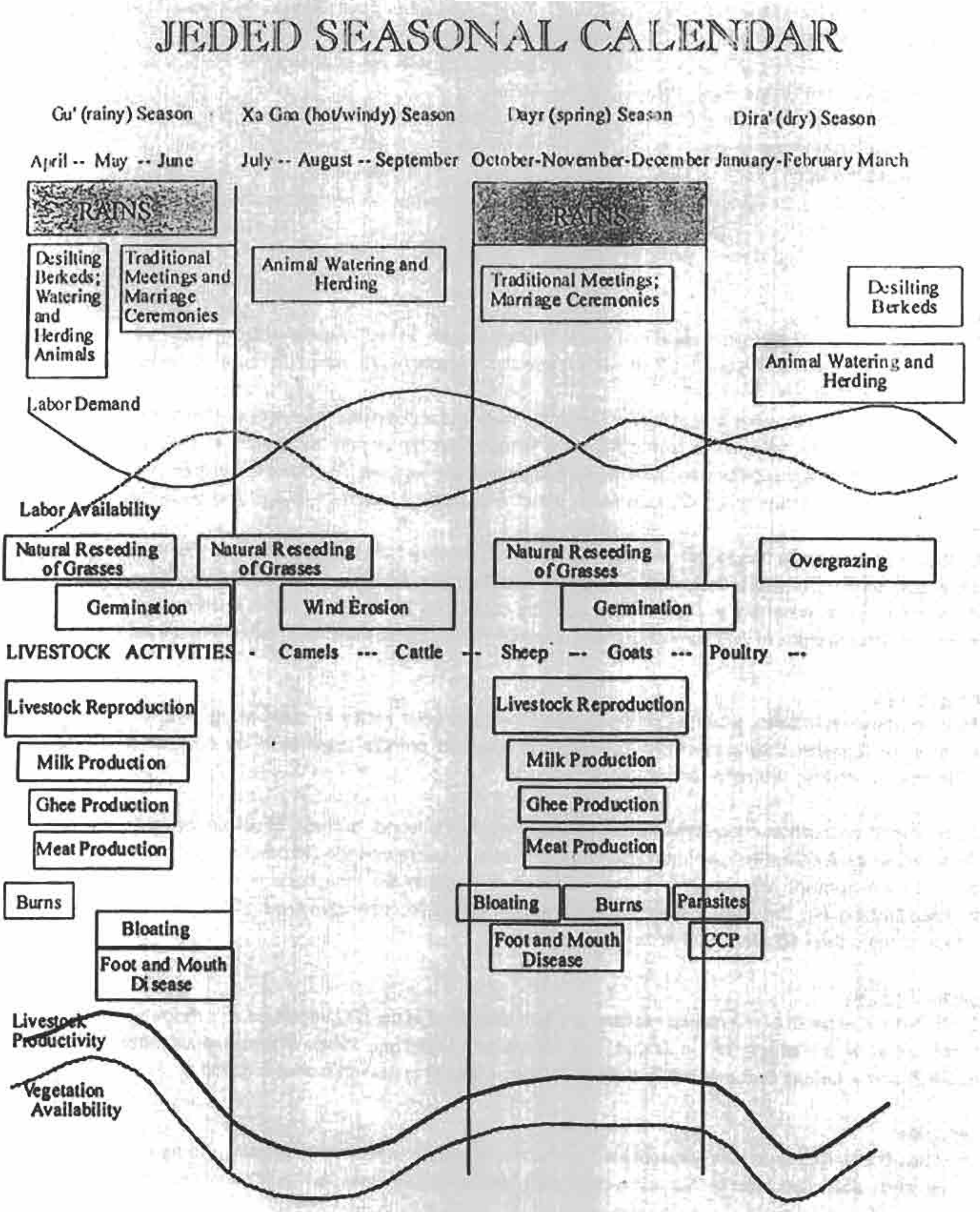


Table 3: Jeded village gender calendar (source: Clark University 1994)

Jeded Village Gender Calendar

Gender	Daily	Weekly	Seasonal
Women *	... food preparation ... child care ... small business ... handicrafts ... building huts ... house cleaning	... laundry ... garbage collection & burning ... ceremonial meetings ... removal of animal wastes (manure)	... looking after livestock in dry season ... animal health care ... extraction of ghee in rainy season
Girls	... house cleaning and washing utensils ... fetching water ... fetching fuelwood ... learning the Koran ... selling Berked water ... baby sitting		... looking after livestock in the rainy season
Men	... head of family ... watering camels and other animals ... milking camels ... fetching water ... searching for lost animals ... teaching the Koran ... burying the dead ... traditional healing		... solving problems & participating in meetings ... desilting berkeds and rehabilitating canals ... purchasing food ... surveying new grazing areas
Boys	... fetching water ... fetching fuelwood ... learning the Koran ... sports ... selling Berked water ... rearing birds (pigeons)		... looking after animals in the rainy season
Common Activities	... milking animals ... building and dismantling huts ... slaughtering animals		... looking after animals in the dry season ... cutting field grass

*: '... fetching water' should be added to womens calendar according to mission

and salt-fields are found along the coast.
Figure 4b gives a review of the land use patterns, e.g. the seasonal migration of herds. During the wet season, herds look for good grazing lands in the inland regions. Water supply isn't a determining factor as grass provides most of the water, required.
During the dry season, herds move to places with permanent water sources, being the coastal area, springs and functioning boreholes.
Land tenure for frankincense is determined by ancient rights, established in the 18th century.

Many records indicate that the density of vegetation decreased drastically during the last decennia. In former days, the Karkar Plateau was forested, whereas few trees can be found, nowadays. Apart from the high density of livestock, charcoal burning and domestic needs for fire wood have had a negative impact.
Most of the land was found to be covered for 10-20% only, and top-soil has been removed in almost all the area, leaving barren hard rocks or pebble covers at the surface. Rarely a vegetation coverage of over 50% was found at the end of the dry season.

economic resources

The main activities in the Region are livestock raising, frankinsence (gum) collection, fishing and commerce. Of minor importance are agriculture and salt production. Although many of these activities are based in a traditional society, they provide rich economic resources for the region. Bosaso Town is the main harbour for the North East of Somalia. Presently, due to war activities in Somaliland the port of Berbera is closed, it even serves the whole North of Somalia.

Livestock

Animal production is the basis of life for most of the people in Bari Region. Camels, sheep and goats are the most important species. Selling and export of live sheep and goats are the main stay of the economy. The second main product of pastoral economy is milk from goats and camels, but it hardly enters the main economy. Skins and hides are also produced, but the activity has been developed in recent years, only.
The number of livestock pastured in the Bari Region can only be estimated. VetAid (1992) estimated 950,000 sheep and goats and 50,000 camels. Other sources give much higher estimates: 3,000,000 of sheep and goats, 1 million of camels and 100,000 cattle (Clark University 1994). The same source mentions an export of 20,000 camels and 150,000 sheep and goats through Bosaso; other sources say 10,000 and 300,000 respectively.

Good prices are considered to be:

sheep or goat	US$ 50
camel	US$ 600

Marketing of livestock has a long tradition. Bosaso port is exporting livestock from most of Somalia and some parts of Ethiopia. The instability of prices, lack of veterinary services, risks of losses (and even rejection) and lack of access to credits are recent problems.
One poultry farm has recently set up in Jingidda.

Water supply is of paramount importance for human and animal consumption in the pastoral society. It is of major determining influence on pastoral movements and utilization of pasture. Big individual investments are made in the construction of berkads.

In frankinsence, one man can earn 2*200 kg * US$ 37,5 = US$ 15,000 per year, from which the cost for renting and transport should be subtracted, yet.

In the PRA study in Jiddad (Clark University 1994), people were categorizing poor, medium and rich families. From this list an estimate can be made of the capital assets and annual income limits between poor, medium and rich people.

Table 4: Income classification according to 10 villagers in Jiddad (Clark University 1994)

		Poor	Rich
Camels	$ 600	< 20	>200
Sheep	$ 50	< 60	>600
Goats	$ 50	< 60	>600
Cows	$ 400	0	>100
Berkads	$ 10,000	-	+
Stone House	$ 15,000	-	+
TOTAL CAPITAL		< 18,000 US$	> 245,000 US$
ANNUAL FAMILY INCOME*		< 4,000 US$	> 47,000 US$

* life cycle of goat and sheep 3 years; camels 5 years; losses 10% per year

According to the same study, people do not yet consider livestock breeding as a productive money earning activity. Many pastoralist keep their herds for bad years to come. Hence it is difficult to make a purely economical calculation, based on above figures. In a money oriented society, life cycle of animals would be less, and herds could stay smaller.

Furthermore, it should be stated that under the present conditions, each family is supporting an additional family of displaced people and, due to unemployment, few household members are able to earn money.

<u>Infra-structure</u>

Apart from the tarmac road running from Bosaso through Gardo to the South, roads are unpaved and seasonal. The access to many parts is difficult and most of the Alula District is even land-locked (and during the windy season even sea-locked).
The privately owned transport vehicles are regularly serving the community. Small ships and boats are used for coastal transport and even for export to the Arabic countries.

The port of Bosaso, built in 1988 with Italian assistance is the only modern harbour in the Region. As the works were not yet completed, it needs improvement and provision of equipment, necessary for the smooth running of port related services.

<u>services</u>

With the collapse of the government, the level of services has reduced to almost zero. In many villages, teachers, nurses, well operators and veterinary attendants staid, but they have no access to *frankinsence collection*

Another major and traditional foreign exchange earner is frankinsence production, a readily available natural resource. A large number of collectors are in the transition phase to a market oriented commercial system. Collectors get concessions of mountain areas for 1 season and can collect 200 kg per season, which can be sold for 25-50 US$/kg, depending the quality. Land titles date back to the early 19th century, but are shared now by hundreds of members of the same dija paying sub-clan.

fishery

Fishing is also important and applied along the entire coast-line. At present most of the fishing is oriented on the local economy by absence of good conservation and cooling infra-structure. Only lobster and sharks are exported. No export figures are available, but the price of 1 kg lobster at the port is 20 US$. Many people fear that the presence of foreign trailers within the 200 miles zone will have a negative impact on the fish population on the long term, but by absence of a formal government, nothing can be done. Capturing of foreign trailers has become one of the major sources of income of one of the visited villages.

Agriculture

Agriculture is hardly developed in Bari Region, due to lack of water, poor soils and lack of tradition. Some date palm cultivation is found near springs (Buq, Iskushuban and Dhudho), vegetable and food production is found in some mountain zones. Small plots of vegetables can be found near some houses and in local depressions. "Flood recession" farming was recently introduced in a depression near Timirshe.

Salt production

Salt production was a large source of income, during Colonial Rule. After independence, salt production was still organized in a cooperative way along the Indian Ocean and salt was exported. At present, salt production is almost paralysed.

Income level

Due to the above mentioned resources, income level of many Somalian people in Bari is not very low. In many villages, almost 30% of the villagers could afford a berkad, meaning an investment of US$ 10,000 per family. Additional money is spent on the water supply by tankers during the dry season, for which 18 US$ per m3 is paid. With 20 l/c/d and 8 family members and 100 needy days, this is about 300 US$ per year, extra. With a life time of 10 years for a berkad, these people spend 1,300 US$ per family on their water supply annually.

According to the people, about 70% of the villagers cannot afford the tanker water, and migrate seasonally.

Another important expense is made for the drug "khat". Each day an aircraft arrives with 6000 bundles of cat of 4 dollars each. Together with other social expense, when people enjoy their cat, this costs about US$ 10 per day. Most men using khat need to use it every day, spending about US$ 3,600 on entertainment, each year.

Income is about 4 US$/day for unskilled and 10 US$ for skilled labour, or 1,200 and 3,000 US$/year, respectively. However, many people are unemployed, due to the inflow of displaced people, seeking for jobs.

materials and goods. Foreign donors have reached these groups only partly.

Most of the visited villages had one or more mosques, one or more Koranic Schools (90%), one formal school (60%) and one health post (50%). In Gardo, Iskushuban, Bosaso and Ufayn, intermediate education was continued. In some villages, the communities have rented a room for education or health facilities.

health

Due to lack of services and lack of medicines, the health status in many communities is very poor. Diseases or accidents, which could be cured easily in the past, now may lead to death. On our survey we arrived in 2 villages where women had died during delivery, that night. In Meladeen 3 men had died from snake bites the last month. Cholera cropped up in the mountains, but no quick communication could be given to Bosaso.
The 13 doctors on 100 beds in the hospital in Bosaso form a big contrast with the needs in the rural areas.

The most common diseases, mentioned by the community elder during the interviews are malaria (always mentioned, first), Lung diseases and TB (mostly second) and anaemia (mostly third). Malaria is quiet artificial, as it is mainly associated to the berkads and permanent water sources. However, people from Jiddad recorded already an outbreak of malaria after the good rains of 1962. Jiddad had a borehole at that time.
Hepatitis comes on the fourth place. Diarrhoea is mentioned less frequently. People said that it is seasonal, and specially for children. On the other hand, people believe that berkad water leads to constipation.
In areas with salty water, kidney stones and high blood pressure were mentioned as common diseases. Among children, skin problems prevail in water deprived areas. Malnutrition (lack of vitamins) is mainly affecting children and women.

3. WATER RESOURCES

3.1 History of water development

studies
Little information is available on the water resources in Bari Region, with the exception of the profound water quality study of Faillace of 1986. This is mainly due to the looting and destroying of many files and documents after the Government Collapse.
Under the centralized government, a lot of attention had been given to the water sector. The Hydrogeological Map of Somalia was produced by the UN Mineral and Groundwater Survey Project by Popov et al (1972). In the eighties, GTZ was assisting the study on water resources in the North East. GTZ contracted E.Faillace to make a comprehensive study on the water resources of the northern part of Somalia, including Bari Region. Unfortunately, the joining Plates have not been found by the study team, so far. A draft hydrogeological map of unknown author with data until 1989 was found at the wall of the GTZ office in Gardo (annex 6). The Faillace study and the anonymous map were of great value for the present study.

The files of Aquater still have to be consulted in Italy, as they will contain lithological borehole descriptions and information on geo-electrical soundings.

source development
Traditionally, the local people in the region used water from natural resources like springs, pools, dug pits in togga beds and even some shallow wells. In the 50-ties, the Italian drilled several boreholes in the grazing areas on the plateaus.
In the early sixties, rainwater collection by berkads (lined sub-surface tanks) was introduced and found a wide response in the society. It has become the most common water source in the rural areas during the rainy season and the first dry month afterwards. During the survey, villages without other water sources had large numbers of berkads, in number about 30% of the houses. Each small berkad represents US$ 10,000 on investment. Larger dug-outs ("waros") are less common and mostly constructed with the assistance of outside agencies. Roof catching is rarely applied, and efficiency is very low.
Few hand dug wells have been made. Some springs have been captured: Iskushuban, Ufayn and Bander Bayla.

Most of the government attention was given to the development of a borehole network. In the 70-ties a network was planned for one water source in each 60 km, which was planned to be reduced to 20 km in later years.
In the past, some 34 boreholes were drilled by the Government, Chinese Borehole Programme, Aquater, GTZ and Western Geophysics. Other boreholes were made by companies for oil exploration or road construction, but were abandoned after the end of the works.

Apart from the boreholes, Aquater made some togga wells and constructed 3 schemes, based on springs (Ufayn, Iskushuban, Bander Bayla), replacing the existing ones. Most of the boreholes are not functioning, being demolished after the collapse and sometimes filled with stones by passers-by; mostly kids.

Especially the Aquater boreholes were target of looting and destruction. They were seen as government property, having an economic value. The fact that the project had neglected people's opinions during implementation has also contributed to the lack of care to maintain and protect the systems. Apart from that, pipes were of a very poor quality. Even with the good quality water of Ufayn (EC= 800 μS/cm) and alkaline water type (pH = 7.5-8.0) the pipes are completely rusted and worn out in a 5 years period.

The programmes, which started after 1990 had a local character and were focused on installing pumping devices on existing water points and on the construction of dug outs.
GTZ planned to do a 10-years development programme in the region, but its activities were cancelled after a decision of the German Ministry of Economic Cooperation in March 1995, before it could become operational for the water supply.

The study team found only 9 wells where water was running from the connected taps and 2 boreholes with hand pumps. Only 1 gravity scheme was working. With the exception of Bosaso, no other wells with hand pumps were found.

Table 5: *Boreholes in Bari Region for public water supply* (excluding 3 operational boreholes in Bosaso)

AGENCY	PERIOD	Nr. Drilled	Nr. Operational*	Names operational*
Government	1955-1978	7	1	Rako**
AGIP	1955-1960	1	0	
Chinese	1980-1985	5	4	Gardo/Xingole, Dhahar**, Jiddad, Adinsone
GTZ	1980-1988	3	1	Gardo/Kawane**
Aquater	1987-1989	19 bh + 5 tog + 3 spring	4+ 1+ 0	El Dofar; Kobdhehad; Bargaal; Jurille**; Jingidda**
Western Geophysics	1989	2	2	Timirshe***, Meladeen***

* potentially operational; most of the pumps and generators show defects
** not functioning, because of problems with pumping device
*** only hand pump installed

With the deterioration of the water supply network, the main water supply in the Region is dependent on berkads and the provision of water by tankers, not only for the nomads, but for almost every village.

evaluation of present sources

Berkads and tanker water must be considered as unreliable, as contamination can easily occur and cannot be controlled. Especially where tankers are filled from surface water resources and fill contaminated basins, like berkads, quality is highly unreliable.

Table 6: Access to water supply in Bari Region

People having access to reliable permanent uncontaminated water source within 2 km:	
	people
Pumped supply:	
Bargaal: pumping to tank and 1 standpost	3,000
El Dolar: borehole	4,000
Functioning well system with hand pump and water of good quality:	
Timirshe: rods and pipes wear out once a year	3,000
Functioning gravity scheme	
Ufayn: pipes worn out but still flowing	7,000
Total	19,000
	8%
People having access to water source of less quality:	
People having access to permanent source with poor quality	
Well system functioning, but too salty:	
Kobdhehad: almost worn out; EC 2600	1,200
Jiddad: borehole	1,000
Adinsone: borehole	1,000
Well system with too few and too far standposts:	
Gardo (one quarter, other part tanker)	7,500
Qandala (unreliable supply)	12,000
Reasonable, but easily contaminated water sources	
Bosaso: hand pumps; half (other half tankers)	20,000
Bander Bayla: spring	5,600
Iskushuban: spring	8,000
Dhudo; spring	3,200
El Gal: open lined well	2,400
Buq: spring	1,200
Xamure: dug pit	1,200
Total	64,300
	29%
People relying on fully unreliable water sources and tanker supply e.g. berkads	63%

Table 6 gives an estimate of the number of people having access to different levels of water supply. In this rough estimate, some unvisited villages with good sources may be excluded. Another factor is the mobility of people and the non-reliability of demographic figures.

Conclusion is, that according to modern standards, less than 8% of the population has good access to water.

Berkads

Although berkads are widely adopted and give people the chance to settle in water deprived grazing areas and frankinsence areas, they bring also disadvantages, like diseases (malaria, diarrhoea, hepatitis, cholera). Furthermore, people are made dependent on expensive tanker supplies.

Berkads are dug at a selected site, where run off water from slopes can be catched, or in a depression. The site should be underlain by 4 meters of easily removable materials. Preferably, people dig until they find a good foundation, like hard rock. Most small berkads are 3 to 4 m deep, 4 m wide and 12 m long, having an effective storage of 150 m3. Due to the quick use, evaporation is a less important factor. Most berkads are covered with local materials (grass on wire mesh). Water is guided by small ditches to the berkad. People deviate the first rain water, which is heavily contaminated, and collect what comes afterwards. A small wall is dug for flood protection. The berkads are encircled by an earth wall and a hedge.

Walls and floor are made of masonry, often loosely laid, sometimes with mud or cement mortar in between. Walls and floor are plastered with cement against leaking. Walls are 60 - 90 cm thick.

Many berkads suffer from cracks, which drain the berkad within a few days. During the survey, about 15% of the lined berkads was in disrepair, having cracks in the wall, in the floor or on the wall/floor connection. Water and soil pressure is much too high for this type of walls. Repairs are mostly made by rebuilding the wall.

Hardly any improvements have been made in the design of the berkads since its introduction, 35 years ago. Mentioned investment prices are quiet uniform throughout the area and vary from US$ 9,000 for a small, to US$ 36,000 for a large one. The investment cost of US$ 60 per stored m3 is far above the figures, mentioned in literature (IRC 1993).

Often, water from berkads is sold to outsiders. Sometimes, people want to safe water and don't sell the water, especially in the north eastern part. Selling price varies from 0.9 US$/m3 to 9.2 US$/m3, with a mean value of 4 US$/m3.

Price of tanker water varied from 9-18 US$/m3 along the tarmac road to 14 - 27 US$/m3 in the remote areas.

waros/dug outs

Only a few waros/dug outs are found in the region, and were all excavated by Africare in the early nineties. Waros are unlined dug-outs with a surface area of hundreds to thousands square meters and a depth of 2 to 3 m. They are dug by an excavator, which drops the loose materials on a wall, encircling the downstream parts of the dug-out. Water is led by ditches to the waro.

In Meladeen, people were positive about the waro, as it kept surface water for 1 month longer than the natural depressions. However, siltation and leakage are a problem. The water was found to be rather clear, whereas the waro was visited only 1 week after heavy rains.

In Xiiriro, people were less content with the waro. It couldn't compete with the numerous berkads, which keep the water for a longer period. The water was very turbid.

The team evaluates waros as unsustainable water sources, because of siltation and maintenance problems, and the difficulty in organizing maintenance at community level for a dug-out, made by outsiders.

Shallow wells

Few shallow wells were found in the Bari Region. Concentrations of wells are found in Bosaso, and along some inland streams. In Bosaso, wells were lined with loose masonry and a superstructure facilitating the access. More than 20 wells have been covered in the early nineties and handpumps were installed.

Except for ancient colonial wells (El Gal) and some private wells (Lasa Dawaco), well technology is of a poor and rudimentary quality. There is hardly any traditional knowledge on well construction, and Ethiopian refugees are contracted from Bosaso to dig the wells. Local people are difficult to motivate to dig. People seem to be reluctant to dig holes, because of their pastoral background.

Another negative factor is the presence of hard calcrete layers in the togga beds, which cannot be dug by traditional methods. Moreover, many wells may be destroyed by the violent floods in the toggas.

Development of new well sinking techniques may be a solution for the water supply along several toggas.

Boreholes

Boreholes were introduced in the fifties by the Italian and are considered as the best technology by most of the local people. However, the operation and maintenance of boreholes can hardly be organized at community level, and requires strong and efficient supporting Institutes.

Moreover, it can be observed that borehole technology is very poor. In the past, boreholes were drilled with the idea of: "the deeper the better". The Chinese installed screens from above the water table to the bottom of the borehole. No analysis was made of poor and good water bearing formations in the vertical section. Aquater drilled many deep boreholes in the salty Taleex formation, whereas more shallow boreholes would have given much sweeter water. Applied materials are of a very poor quality for the corroding environment.

Drilling boreholes in karstic formations is a specialized job, as losses of drilling mud can be enormous, for which wells have to be abandoned, unfinished. New borehole drilling projects require good supervision and strict contracts with drilling companies.

In the present context, a borehole project is not recommendable.

Springs

Springs are the traditional sources in the area. The major springs were recorded by Faillace (1986) (see annex 6).

Only in a few cases, springs have been captured:

* Ufayn (gravity scheme 1959, 1979 and 1989)
* Bander Bayla (pumped supply 1958, 60-ties and 1988)
* Iskushuban (pumped supply 60-ties, 1988 and solar pump 1992)
* Galgayo (gravity fed to irrigation fields, 1994)

The old gravity line of Ufayn and the Galgayo scheme are the only working ones.

People are attracted by the presence of fresh permanent water and made requests to the survey team for the springs of:

* Gaah (large spring; far from settlement)
* Ba'ad (medium spring; 10 km from settlement)
* Ufayn II (small spring; far from settlement)
* Buq (medium spring; in settlement)
* Dhudo (medium spring; near settlement)
* Tooh/Qandala (small spring; 12 km from settlement)

No further request was made for the valley springs near Karin.

Seen the importance of permanent water sources, a long term water development plan should include the improvement of the use of spring water. At this moment, spring water is easily contaminated and disappears rapidly in the permeable togga beds.

Tanker distribution
At present, water supply by tankers is the major source of water in Gardo and Bosaso during the whole year, and in most of the rural towns and villages during the dry season. Tankers fill at permanent water sources and supply to empty berkads and small ground tanks like drums or masonry tanks. It is estimated that Bosaso has 15 and Gardo has 10 tankers. During the dry season, elders in Bosaso arrange a tanker for their village and negotiate the price. For a mountain village of Dhadar, the tanker is filled at the spring in Buq and drives with 7 m3 over 85 km along the 'togga' road to Dhadar. The tanker will be stationed in Buq during the driest part of the year, as each village needs a regular supply.

Hence, tankers are a backbone for the water economy in Bari Region. With the outfall of borehole supplies, they become the last resort before people have to migrate to the towns.
In this way, the tanker supply has proved its importance, whereas owners have not shown an attitude of mis-use of the situation in raising the water price to unrealistic levels (see chapter 4).

Disadvantages of the tanker supply are:
* The poor status of the tankers: most of the float has to be replaced within a few years. Owners will not have the capital costs for investment, whereas including the depreciation of a new car in the water price will be unacceptable.
* High risks of contamination at the source and in the storage tanks
* High price of water

In developing a regional plan for water development, the tanker network should receive sufficient attention as it has proved to be vital during periods of emergency.

3.2 Water resources

general
The arid conditions of Bari Region result in a low potential for water resources development. Permanent surface water is almost absent, with the exception of some parts of the main river courses below the 300 m level.
Torrential rainfall, especially in the mountainous areas result in rapid run off through the toggas to the Indian Ocean and the Gulf of Aden. Most of the water, absorbed by the soil, is evaporated in the early days after the storm.
Little water will reach the deeper ground water levels. Only under special conditions, ground water recharge might be more substantial:
* in the togga beds
* in local depressions on the karst plateaus
* at the footslopes of the mountain zone
* on flat to slightly sloping terrains with sandy or gravelly top-soils

As these conditions can be found, locally, and most of the area is underlain by calcareous rocks,

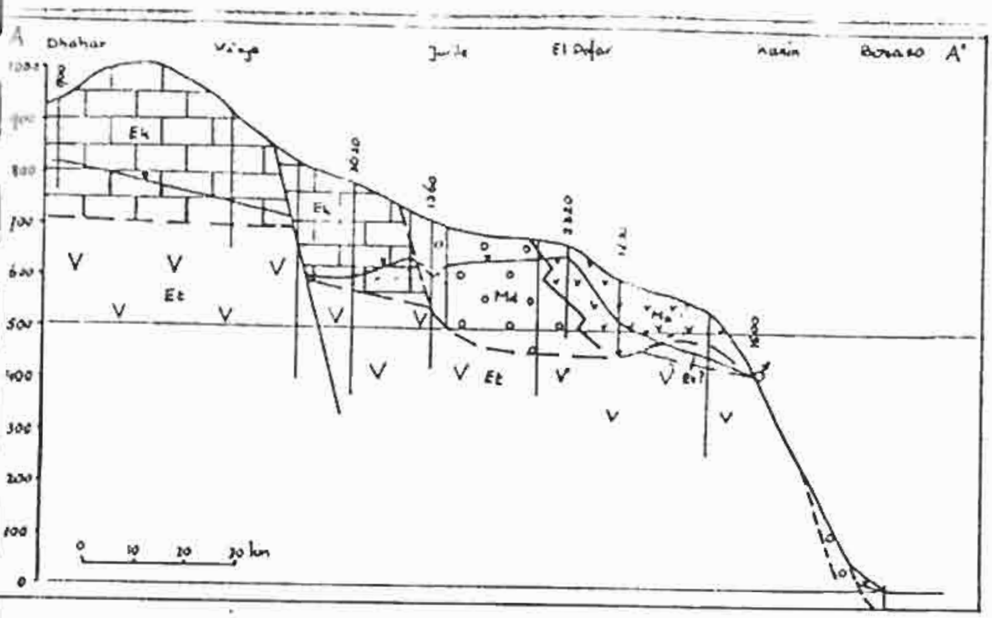


FIGURE 3: HYDROGEOLOGICAL CROSS-SECTIONS

Limestone

V V Evaporites (gypsum)

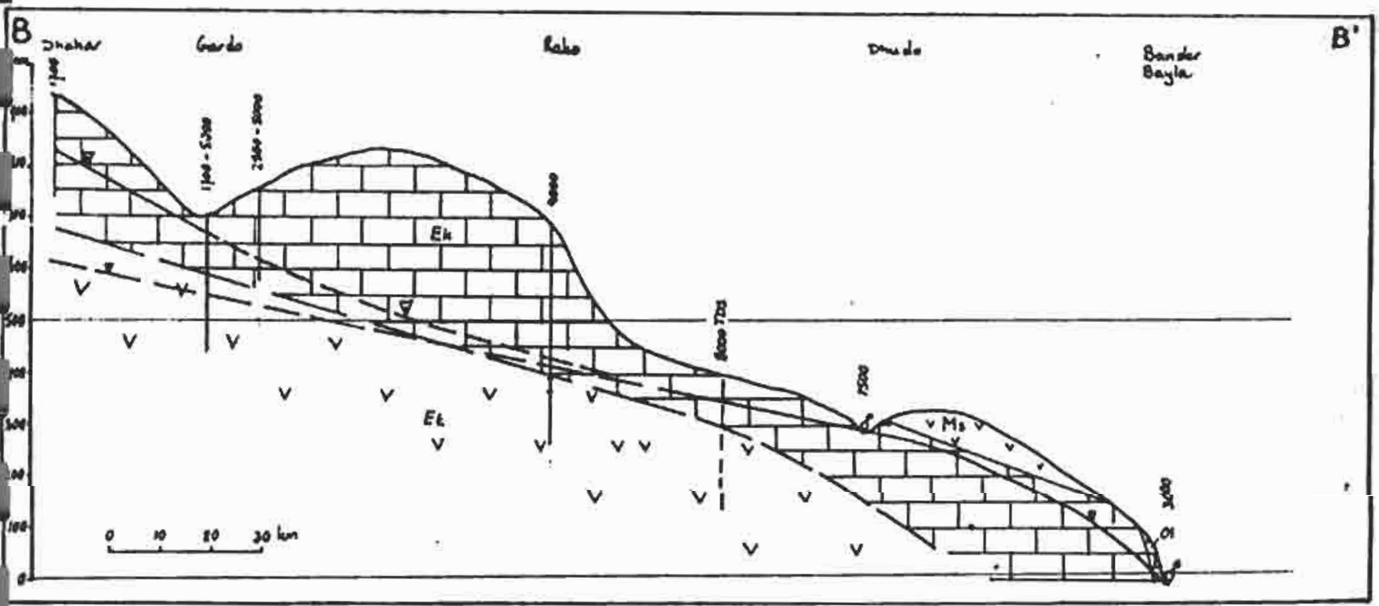
o o Conglomerates

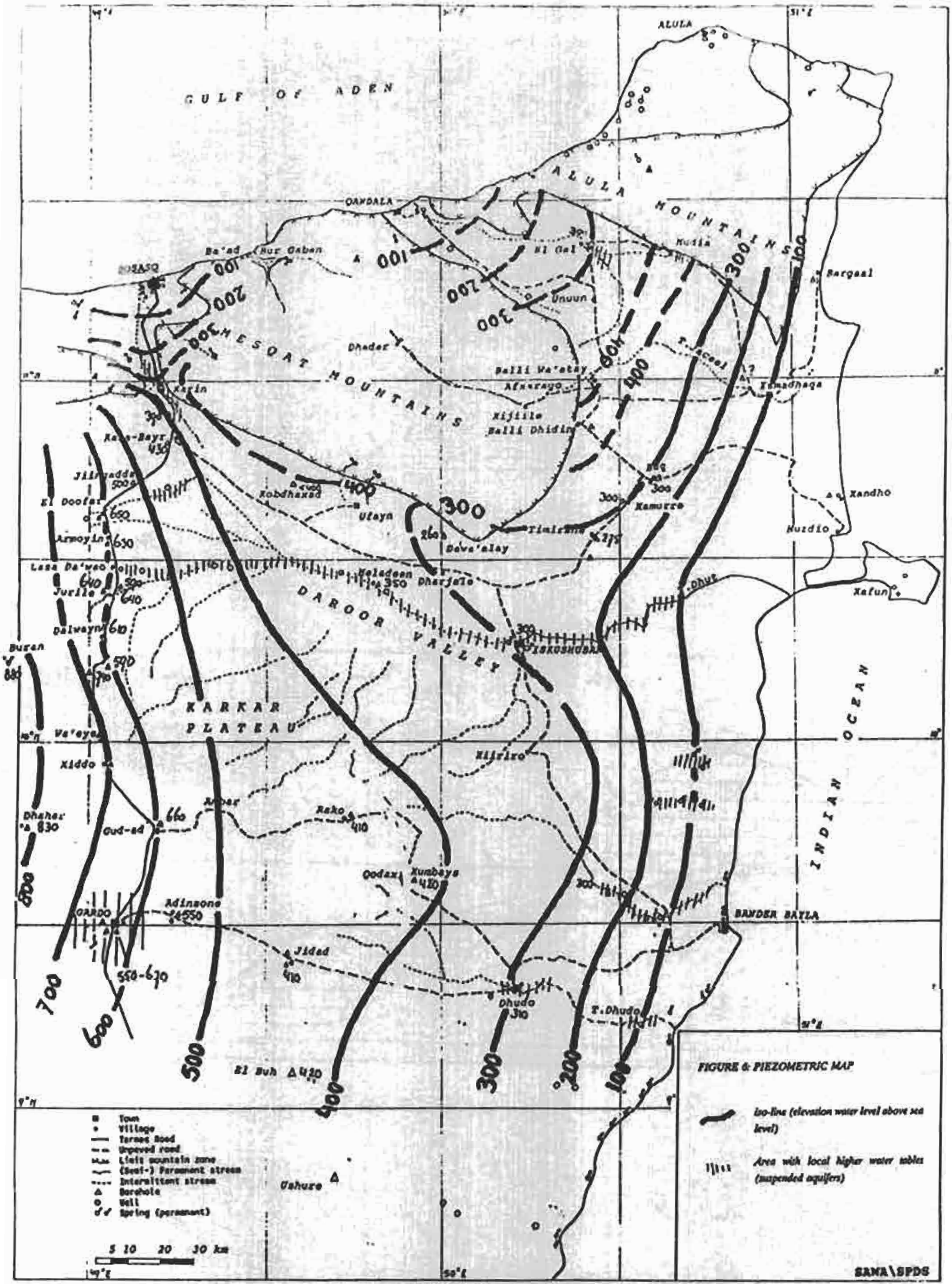
Et Taleex Formation (Eocene)
Ek Karkar Formation (Eocene)
Md Darin Formation (Micoene)
Ms Iskushuban/Hafun Formation (Miocene)
Ol Oligocene

Regional water table

Local water table (suspended aquifer Karkar Fm)

Borehole with salinity (EC in uS/cm)





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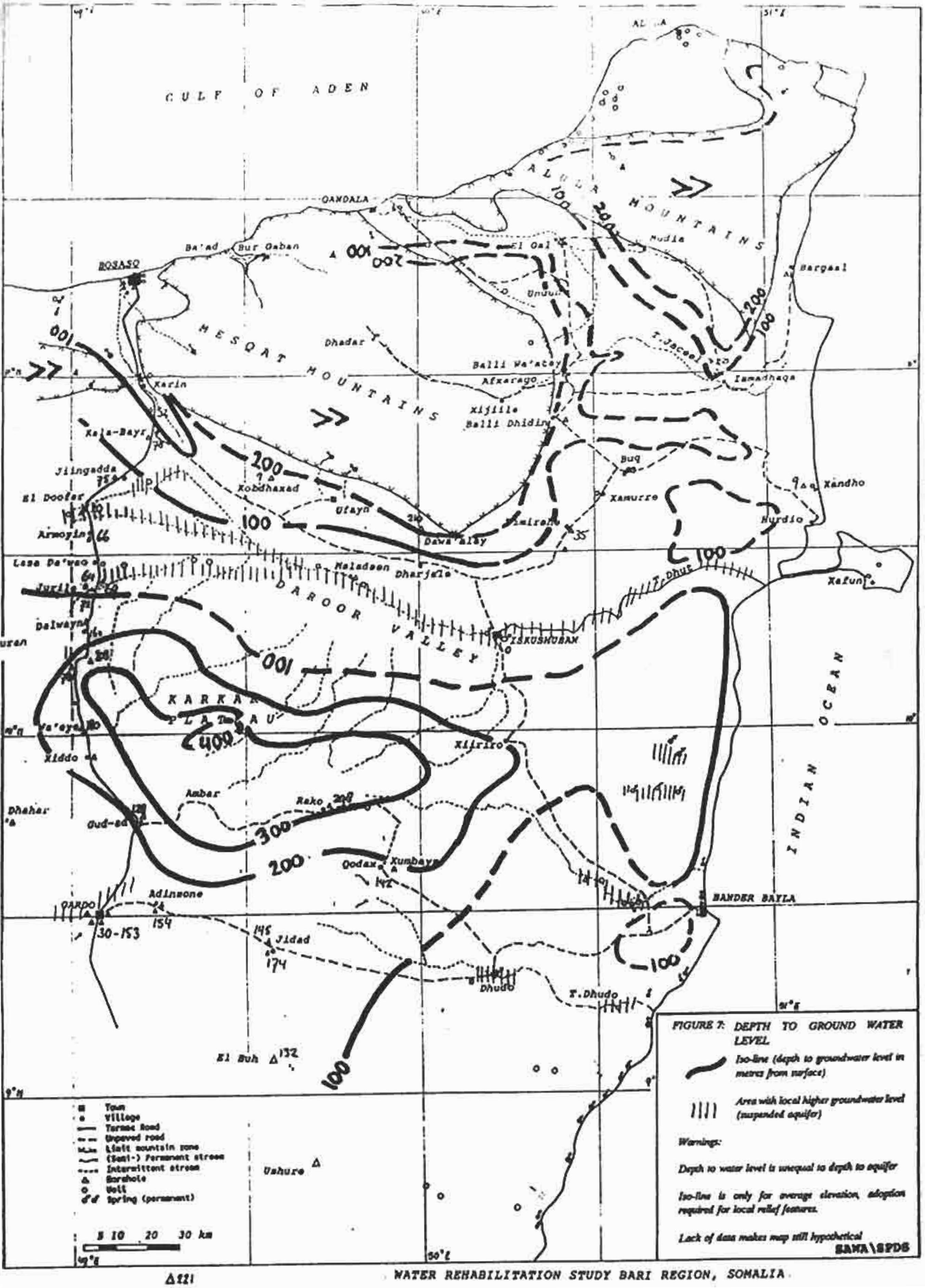

FIGURE 7: DEPTH TO GROUND WATER LEVEL

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ground water is available in most of the area.
However, high permeability of often kartsified limestones beds, together with the raised topography, results in deep ground water tables. Most of the boreholes are drilled in areas where ground water levels are deeper than 100 meter. Average borehole depth is over 200 m. The deepest borehole was made in Rako with 420 m.

Furthermore, quality is negatively influenced by the gypsiferous layers in the Taleex and Hafun/Iskushuban Formations. Also the dominant Karkar Formation contains gypsiferous layers. Hence, WHO established water quality criteria cannot be met in most of the area in respect to Total Dissolved Solids, sulphate content and hardness. In one more detailed analysis in Gardo, GTZ found also a too high fluoride content (Faillace 1986). Most of the water is only suitable for livestock watering.

Table 1 gives a summary of the hydrogeological characteristics of the different formations, figure 2 gives the geological map and figure 5 give sketches of 2 hydrogeological cross-sections: one South-North from Dhahar to Bosaso and one West-East from Dhahar to Bander Bayla. The last cross-section is more or less in parallel to the direction of groundwater flow, whereas the first one is partly perpendicular to it. By absence of borehole descriptions of the Aquater boreholes, depth of lithological boundaries is highly hypothetical.

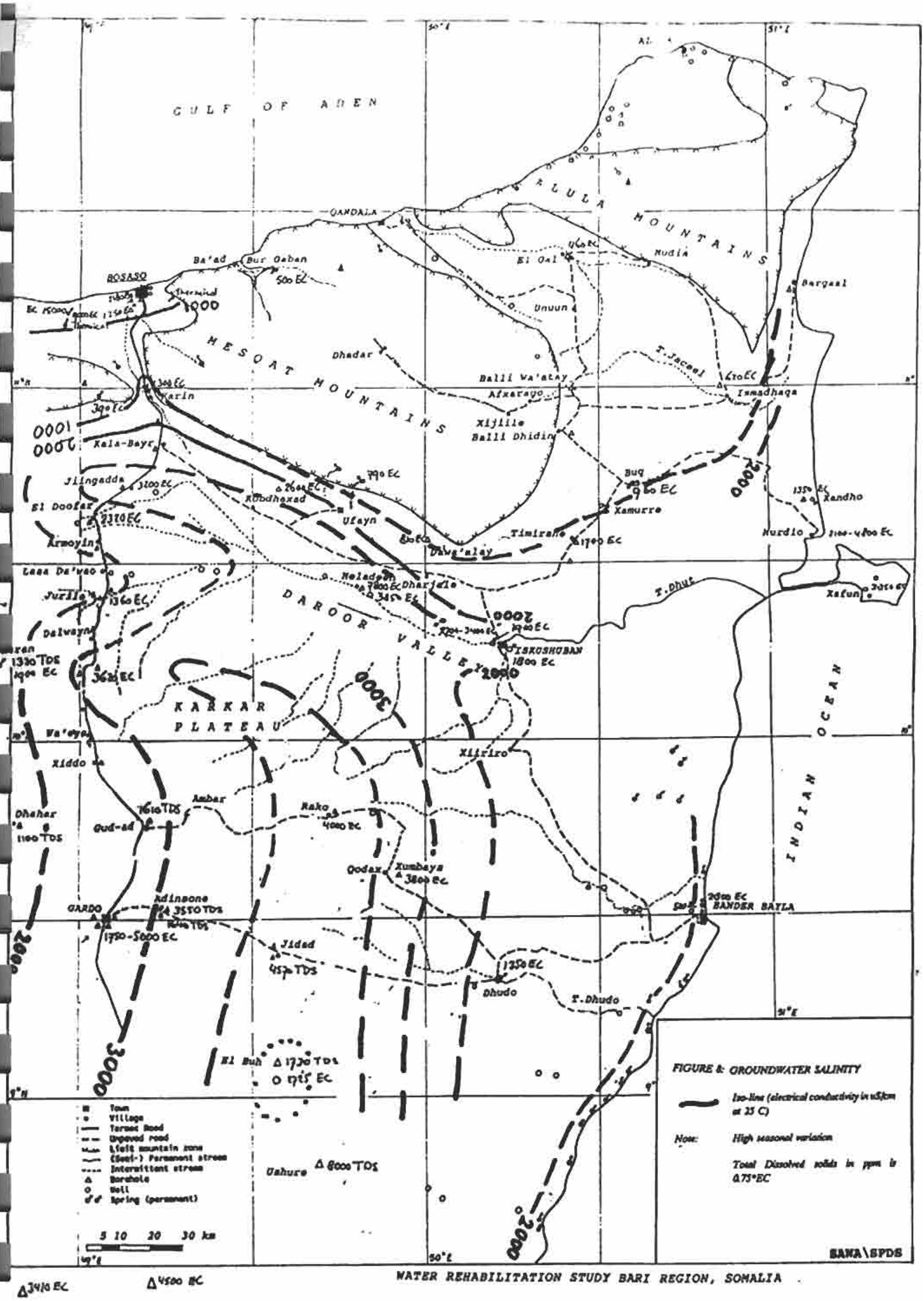
<u>groundwater levels</u>

Figure 6 gives the piezometric level of the aquifer. Lines for the southern part are based on borehole data. In the central part and northern part, almost no data were available, and levels have to be assumed. The karstification of the aquifer and the bedded marls and limestones result in local aquifers. The borehole data in Gardo show a very variable water level in the 9 boreholes. Shallow old boreholes have quiet shallow water, deeper recent boreholes have lower levels. It is believed that the shallow groundwater is found in karstified limestones of the Karkar formation which are supplied from local depressions, like the one in Dhahar. The deeper boreholes with brackish water tap water from the deeper evaporitic Taleex Formation. The water quality data confirm this hypothesis. It is believed that more eastward, the shallow karst aquifers have drained completely into the Taleex formation, and no fresh groundwater is found any more in Rako, Jiddad and Ushure.
Another problem in drawing the piezometric map is the question whether the spring outcrops at Dhudo, Iskushuban and Buq, which all lay between 290 and 300 m above sea level, are outcrops of the regional groundwater level, or that they are draining suspended aquifers, associated to the toggas. The latter is assumed, because all springs have reasonable water quality, whereas the deeper aquifer should have brackish water, and because river water disappears again after some kilometres.

It is believed that west of the spring line, karstification is only developed above the 290 m level. East of the spring line, water table drops quickly, again.

Another problem is the major drainage direction. Due to absence of data, deep drainage of the Daroor Valley towards the Gulf of Aden cannot be excluded. South of Bosaso, ground water seems to flow northward into the valley of the Karin springs. However it is believed that the major east west faults block the south-north flow of the water and channel the water in parallel to these faults.

Figure 7 gives the depth to groundwater map, derived from the piezometric map and the topographical map. Figures should not be taken as rough estimates. Firstly, local topographical



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features could not be included in the map. Secondly, the topographic base maps and the piezometric base map have a low accuracy.
The map gives an estimate of the water level in the borehole, but doesn't represent the aquifer level, which may be much deeper.

Rarely, the depth of groundwater level is less than 20 metres, except for togga beds and in the coastal lowlands. Mostly, groundwater is deep, especially in the mountainous zones and under the inland plateaus. But also in the coastal zone, the highly up-rising plateaus result in deep groundwater levels. Attention should be given to the high variation in levels, related to vertically separated water bearing layers.

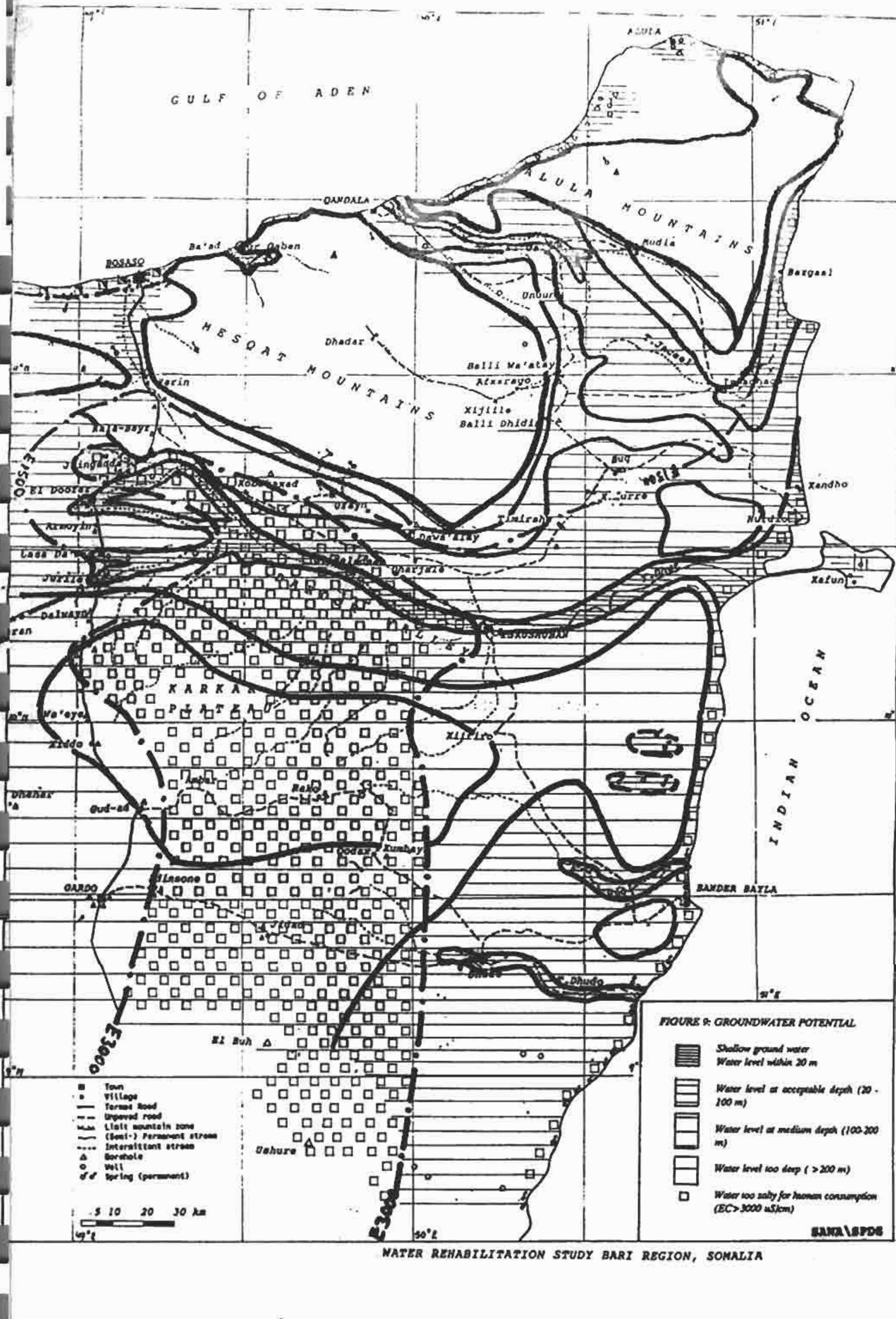
The shallow groundwater may be reached by shallow wells, and hand pumps can easily be applied. The water levels to 100 m can be reached by boreholes, using ordinary techniques. Sometimes, hand pumps and solar pumps can be used, but shall not be applied for depths over 50 m.
For depths above 100 m special drilling techniques and highly sophisticated pumping devices are required, which can only be maintained with a good service network. Boreholes with water levels of more than 200 m are not recommended under the present conditions, especially not with corrosive waters.

groundwater quality
Figure 8 gives an indication of the salt content of the water, represented by the Electrical Conductivity (μS/cm).
Most of the water is brackish and above the by the WHO established standards. As with the piezometric level, quality measurements are highly variable in Gardo boreholes, even in 1 borehole during a short period of time. It supports the idea that different aquifers are captured, which water intermixes in some boreholes.

Water of the Karkar Formation itself is of reasonable quality with TDS of 800 to 2000 μS/cm. Low conductivities are found in the pure limestones; higher conductivities in the marls. Boreholes which touch the Taleex Formation, with brackish water with EC levels between 2000 μS/cm and 8000 μS/cm. The same holds for springs.
Auradu limestones in the Mountains give good quality water, like in Ufayn spring (EC = 800 μS/cm). Water in the more recent evaporitic series of the Hafun/Iskushuban Formations are brackish again. Boreholes in Meladeen and shallow wells near the coast confirm this, just like the information people in Ismadhaqa got from Aquater, which did geo-electrical surveys.

All waters are of the sulphate>carbonate type and have Ca and Mg as dominant cations. pH is between 7.5 and 8.0. Most water is very hard (TH over 370 ppm $CaCO_3$ equivalents). Despite of its alkalinity and hardness, sulphate water is considered to be corrosive, which is illustrated by the rapid corrosion of the plain iron pipes in Ufayn. As the Ufayn water has a low salt content, the aggressiveness in most ground waters is even much higher, and installed screens, casings and pumping rods in boreholes must be considered as worn out.

Water quality in the toggas is different from the deep formation water as it is diluted with rain water. However, evaporation of stagnant water may result in highly saline waters, as well.



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productivity

Permeability of aquifers is another important parameter. Most of the wells have reasonable yields. Yields in the southern part of the Karkar Formation vary from 0.8 m3/h (in 2 old boreholes) to over 20 m3/h in Dhahar and Rako. Known specific yields vary from 0.09 m3/h/m in Adinsone to 1.8 m3/h/m in Gardo Kawane. GTZ did one pumping test in Gardo GTZ-1, which gave a KD of 4.8-5.2 m/d (estimated units).
In the NE, the Karkar Formation is more marly developed, and yields will be relatively low. The Balli Dhidin borehole had a too low yield and inhabitants were informed that prospects for other boreholes were worse.

It is not clear whether boreholes at the northern side of the Daroor valley along the tarmac road capture the continental series of the Hafun formation, or that they enter into the Karkar formation: borehole descriptions are absent. These boreholes have reasonably high yields of 8 to 21 m3/h.

Alluvium in toggas and coastal alluvial fans is believed to be permeable. This was confirmed in the Aquater wells in Bosaso and in a number of wells in togga beds elsewhere. In El Gal and Xamure, however, people indicated that during peak hours, they were able to drain the shallow wells completely.

3.3 Groundwater development potential

Ground water development potential is determined by 3 major factors:
1. Permeability of the aquifer
2. Depth to aquifer (and water level)
3. Water quality (e.g. conductivity)

Permeability is an uncertain factor, as one is uncertain whether deeper layers are marly developed, or not. Geo-electrical measurements can give some information on the clay content of the rocks and hence about permeability.
For the purpose of rural water supply, permeability it is mostly not taken as a limiting factor. For classification and mapping purposes, permeability could not be used for reasons of lack of data. However, it is generally believed that the Karkar Formation south of the Daroor valley is more permeable than the one north of the valley.

Depth to groundwater is an important factor. Deep boreholes are very expensive, are difficult to maintain and require high operation costs. For the purpose of this survey the following classification is made:
1. shallow groundwater level (within 20 m)
2. water levels between 20 and 100 m (normal boreholes)
3. water levels between 100 and 200 m (medium deep boreholes)
4. water levels over 200 m (highly demanding boreholes)

Water quality is classified according to the possible purpose:
1. less than 1500 μS/cm for domestic use and irrigation on sandy soils
2. between 1500 and 3000 μS/cm for domestic use (within former Somalian limits)

3. more than 3000 $\mu S/cm$ for small livestock (to 10,000 for camels)

Figure 8 gives the groundwater development potential, according to the above established classes.

In conclusion, the south western part of Bari has low potential, because of high salt contents and partly because of deep groundwater levels.
The Daroor Valley has highly saline deep water bearing formations, but in togga beds, water quality can be better under certain conditions.
The northern part of Bari Region and the eastern part have better groundwater prospects, with the exception of the coastal strip and the mountain zones. However, low permeabilities of marly aquifers may reduce the prospects.

Some areas have shallow ground water which may be reached by shallow wells. However, hard layers (calcrete), salty water (gypsum layers) or seasonality of aquifers may have a negative impact on the potential. On the other hand, sites for shallow wells can be found in suspended aquifers outside of the indicated areas. Some examples were found in the Togga Jaceel mountain valley. Karst depressions may have some potential for shallow wells as well, like the Qodha/Xumbals plains.

3.4 Water development technology

In developing water resources in Bari Regions, water development technology should be improved. Below follow a few recommendations, which should be considered when a certain technology is chosen. They have a technical character. In Chapter 6, other important aspects regarding approach, organization, financing, community involvement and operation and maintenance are given.

<u>boreholes</u>
Under the present conditions, no new boreholes should be constructed for reasons of:
* poor security: a drilling machine is target for looting
* cost efficiency: a borehole programme is only efficient when a series of boreholes can be made
* lack of hydrogeological information: more investigations are required before a borehole programme can start
* high risk of unsustainability with newly installed deep pumping systems

When conditions have improved, a borehole programme should include:
* effective prospecting techniques, including geo-physics
* consultation of people on preferred sites
* efficient drilling techniques, applicable for karstic aquifers and marly beds
* good borehole description, including geophysical borehole logging
* correct finishing of wells, including right positioning of screens, well calculated filter screens, use of plastic casing and screens if possible, good grouting of upper layers.
* use of corrosion resistant materials (sulphate water) and take other anti-corrosion measures
* good and permanent supervision
* training of drilling team on installation, Operation and Maintenance, servicing, client centred attitudes

* standardization of equipment
* easy manuals for operation, maintenance and monitoring

On the short term, existing boreholes may be rehabilitated, including:
* removal of debris (stones, fallen pipes and pumps) with a bailer
* inspection of screens and casing
* possible replacement of casings and screens
* possible chemical treatment against encrustation of screens and filter pack
* re-development of well
* pumping test (step draw down) with regular water sampling for chemical analysis
* selection of best pumping technology: specification of materials
* standardization of equipment
* take corrosion preventive measures
* installation of gen/pump sets and rehabilitation of distribution
* good supervision
* training of villagers and crew
* set-up of maintenance service

Because of the good ability to pay in most of the villages, it is recommended that communities at least pay for the equipment and materials, required for the pumping and distribution. Development programmes may provide credits for the purchasing and may facilitate the creation of an import and service agency for selected generators and pumps. However, in rehabilitation projects, community financing and credits may be less desirable and all investment costs should be covered by the donor. A project may cover the investment costs for cleaning and development of existing boreholes.

In long term projects, more attention should be given to the eastern part of Bari Region.

Recommended literature: Driscoll (1987) Groundwater and wells, Johnson Division,
ISBN 0-9616456-0-1

<u>shallow wells</u>
Shallow well technology is not yet developed in the region. Expertise of Ethiopian refugees is used, but no lining techniques are applied and no safety measures are taken during construction.
Factors which hamper the applicability of shallow wells are:
* hard calcrete and gypsum layers
* salty water in gypsum layers
* variable groundwater depths and fluctuations
* loose packing of boulders in togga-beds, endangering the safety of well sinkers

Furthermore, people are rapidly disappointed when, after weeks of digging, the pit stays dry.

A shallow wells programme should start with the development of appropriate well sinking and prospecting techniques and training of well sinkers. Hence a shallow wells programme should include:
* appropriate exploration methods (geo-electrical soundings, or seismic soundings)
* appropriate techniques and equipment to penetrate hard layers (dynamite, compressors)
* appropriate digging techniques and tools (including safety measures against falling stones)
* improved lining techniques

* a good superstructure
* flood protection (double wells)
* selection criteria for pumping devices and standardization
* training of well sinkers
* mapping of shallow well potential

A long term shallow wells programme should be based on privately operating well sinker teams. No financial input is required for materials, construction and water lifting devices. External input from local agencies is required for facilitation, logistics, health education, Operation and Maintenance training, monitoring and quality control of works. A certain type of construction standards should be developed to serve as a guide for supervision on behalf of the communities.

Four areas are identified to start a shallow wells pilot project:
1. Daroor Valley (Meladeen)
2. Qodha Plains (after survey)
3. Ismadhaqa
4. Jaceel-Dhadar Valley

Literature: Watt S.B. and Wood W.E. (1977) Hand dug wells and their construction, IT - ISBN 0 903031 96 5

<u>Infiltration galleries</u>
Infiltration galleries are permeable collectors for groundwater. They may be laid horizontally in a river bed and bring the water to a central collector or well. A downward impermeable body can be constructed to raise the groundwater level (see "sub-surface dams"). Or an infiltration gallery is made at the foot of a spring zone.
In central Somalia, infiltration trenches are made by the Water for Life project in the mid-eighties (Water for Life, 1987). In this project, trenches have been dug in aquifers with shallow fresh water and deeper salty water. The trenches are filled back with coarse materials in the lower part, functioning as infiltration galleries.
In Bari Region, infiltration galleries might be applied in:
* togga beds, associated to sub-surface dams
* shallow dune aquifers along the coast (like Hurdio)

Because of the unknown technology, infiltration galleries should be tried out in a pilot project.

Literature:
Water for Life; Farax I.M. et al (1987) Researches and low technology tests on shallow and surface water in central and southern Somalia; unknown source

<u>small dams</u>
Dam technology is hardly known in Bari Region. However, dams may provide a good alternative to waros and berkads to keep the water for a longer period.
During the survey few sites were identified which could have a potential for dam construction. But in most cases, the sub-surface and adjacent rocks were very permeable and reservoirs would become empty in a few weeks time. Even in less permeable soils, one may calculate with considerable water losses through leakage.

Furthermore, evaporation is 3,000 mm per year. With 2 rainy seasons per year, at least 1.5 m water depth is required to compensate for the evaporation. To compensate for leakage and evaporation, a water depth of 2.5 metre is the minimum to have water the whole year round during normal years.

Problems with dams are:
* high evaporation
* high leakage through permeable soils
* health risks, especially when animals and people can enter the water freely
* instability of soils
* poor compaction techniques
* high floods

Hence, a dam construction programme should include:
* good siting techniques, including permeability tests of soils
* high dam bodies, to compensate for evaporation and leakage
* good health education and preventive measures to avoid direct water contact
* proper design of spill ways and emergency spill ways

As there is little tradition in manual labour, sites should be selected which require minimum earth moving.
Dams are more economic than berkads or wars in financial terms. A combination of dug-out/dam may be considered.
An alternative designs for flood protection is to make dug-outs next to a togga, but not in the togga bed itself. Dug outs are filled during floods with relatively clean water.
Because of the unknown technology, dams should be tried out in a pilot programme.

Areas were identified to try a pilot with dams, but they should be evaluated before start:
* Dhadar and Dhadar/Jaceel Valley
* Ismadhaqa

Literature:
UNDP/ILO (1988) Small Earth dams; SPWP series vol 5; ISBN 92-2-105944-8
Nelson K.D. (1985) Design and construction of small earth dams, Inkata Press, ISBN 909605 34 5

<u>sub-surface dams</u>
Apart from surface water dams, one may consider an alternative dam technology: sub-surface dams. Sub-surface dams interrupt the underflow in permeable togga beds. Advantages above surface dams are:
1. Limited evaporation losses
2. Reduced flood risks
3. Improved water quality
However, permeability of soil stays a problem.

There are 2 types of sub-surface dams.
1. a clay or masonry wall, made in a trench in existing material
2. a masonry wall on top of an impermeable valley bottom, being raised in several steps after each flood (raised groundwater dam)

In the latter case, the river bed is raised and an artificial valley fill is created. Only coarse materials settle, when the dam is raised step-wise in time.

Water can be collected from wells in the river bed, or by a filter tube near the dam-wall (infiltration gallery) and lead to a downstream site.

The survey team did identify only a few potential sites. Most togga beds and margins were too permeable. In other cases, toggas were too wide. On the limestone plateaus, materials are often very clayish.

Because of the many uncertainties about the potential of this alternative technology, a pilot is recommended.

Some areas were identified for pilot projects, but suitability should be checked in more detail:
* Dhadar/Jaceel Valley
* Ismadhaqa
* Qodha

Literature:
Nilsson Ake (1988) Groundwater dams for small scale water supply, IT ISBN 1 85339 050X

<u>springs</u>
Spring captation is not an unknown technology in Bari Region, but rarely applied in a sustainable way. Till now, the following problems have been observed with springs:
1. **Spring water is seen as a free gift. It will be difficult to charge users for the water, supplied by spring fed gravity schemes.**
2. **Most spring water is already contaminated before it enters into a spring box or intake; improvements should include multi-purpose use like domestic use, bathing, livestock watering (at the source), irrigation and tanker supply; bathing for women should receive special attention. Intakes should be well protected against contamination.**
3. **Some springs lay below the dwellings and require water lifting devices to raise the water. In that case, maintenance and fund raising will be problematic issues as people can return to their original source**
4. **springs in togga bottoms are quickly suspect to flooding. Intake structures should be well protected against destruction.**
5. **Many springs lay in mountainous zones, far from settlements. Maintenance is a problem, then, and costs for piping will be high.**

It is recommended, that spring captation is started by the rehabilitation of the 3 intakes at Iskushuban, Ufayn and Bander Bayla and in the easily accessible spring of Dhudo. Sustainability should be evaluated before starting new captations in other places, like Buq.

<u>berkads</u>
Berkads show the following problems:
* **high percentage of failures**
* **malaria breeding and hepatitis**
* **high costs**

Technology might be improved, but applicability in the local context should be evaluated in a pilot programme.

1. Making the berkads less deep in cases water is required in a few month, only (most of the berkads have only for 2 months water; then evaporation loss is less than 50 cm.
2. Making berkads circular (stronger construction)
3. Improving masonry construction and application of types of re enforcement
4. Improvement of roofing (malaria mosquitos don't breed in dark places and algae need sun-light as well).
5. Introduction of flexible joints
6. Better foundation technology

Other improvements, like the introduction of fish to reduce malaria, or the protection of surface catchments against contamination or chlorination may be considered, but applicability is doubtful.

· Literature: IRC, Water harvesting

<u>tanker distribution</u>

In the whole area trucks are used to distribute water. Both in towns as Bosaso and Gardo, as well as in the rural areas where the water is transported over huge distances. Even if the proposed water programmes are carried out the use of these trucks will still be necessary.

The tankers are privately owned and most of them are in a bad condition. As many people will continue to depend of these trucks for their water supply, the programme should investigate how a future authority could guarantee this type of distribution, without taking over this buisness from the enterpreneurs. Next to this education on how to keep the water free of contamination during filling, transport and distribution should be given to the transporters.

<u>desalination</u>

Desalination offers in principle a good technical solution for drinking water supply in the coastal areas of the Bari-region. Main disadvantages are the high investment and O&M costs and the level of technology involved.

Therefore it is not advisable as a solution on the short term, because it will not be a sustainable solution.

5. WATER DEVELOPMENT PLAN

5.1 Needs and philosophy

The lack of readily available water provides a limit to the human population, their stock and economic development.
Starting from the point, that only 8% of the population of Bari has access to a reasonable source of permanent water of reasonable quality within a distance of 2 km, there is an urgent need for improvement of the water supply situation in the area.
Not only the villages and towns in the region are deprived from good water. The absence of a good water supply network for livestock during the dry season results in a rapid degradation of lands around the few, still existing water sources.
Due to the consequences of the war many people from the South have migrated to the towns and villages of the North East of Somalia. Absence of permanent water supply and the high price of water, delivered by tankers, is a limiting factor for the growth of villages. As a consequence, there is a large seasonal migration to the major towns like Gardo and Bosaso. At present, this migration tends to become more permanent, as people are attracted by the services, which can be found in these towns. As a consequence, the town of Bosaso is booming. Demand for improved water supply in the urban centres is high. But should go hand in hand with an improvement of living in the rural areas.

Especially in the rural areas, priorities need to be given to water projects, which stimulate economic development, like the installation of a good water supply network for livestock and fresh water in coastal areas with potential for fishing and salt production.

The poor hygienic and sanitary conditions in most of the villages and towns, require a project approach which includes hygiene education and sanitary components.
Although sanitation is of great importance for the improvement of health, priority is given to the improvement of the water supply, but hygiene eduction is added as a first attempt to raise awareness.

Absence of any formal operational groups in the Region asks for water schemes, which can be community managed and for demand driven service organizations. Although the set up of a certain coordinating body is required on the long term at regional level, it should only develop as a management unit, and not become a system in itself. The present situation has made the people conscious about their own potential for development. This gives a good challenge for a community managed and demand driven approach, which otherwise would have taken many years to develop. Rapid decline of water facilities, installed by Aquater, THW and other agencies, show, that water supply development should be done from the community and should get some time. This approach is further elaborated in the following chapters.

In the period of the former Governments, water was free and seen as a social right. Since the collapse in Somalia, water has become an economic good, for which high prices are paid. Hence there is a challenge to organize revenues on water schemes in such a way, that they can cover operational costs as well as new investments in the sector. For some categories of people, however, costs for water will become too high to afford. The communities have already a kind of system that supports these poorer people. Based on this 'system' special mechanisms should be worked out, to divide the

burden of the costs in a well balanced way.
Also not all the types of system will give sufficient revenue, especially when there are alternative (cheaper) sources available.

5.2 Objectives

over-all objective (aim)
Short, medium and long term activities should aim at an improved water supply and sanitation to improve health, release people from the continuous task of seeking for water, and induce economic development.

Indicators have to be defined, which are related to these intended impacts, but in the present situation, there are hardly any statistics available to serve as a base line. The only way for verification is interviews, in which people (subjectively) refer to an improvement of the situation.

Examples of indicators can be:

* improved health:
  xx% of people say there is a reduction of cases of hepatitis
  xx% reduction of mortality due to cholera over a 3 years period (hospital statistics)
  xx% reduction of new cases of kidney disease (hospital statistics)

* release of people, seeking for water:
  xx% indicate that they changed migration pattern after improved water supply (interview)
  xx% of women say that they spend less time on water collection than before (interview)

* improved economics
  xx% of interviewed nomads indicate that water has become more accessible (interview)
  xx% of interviewed fishers indicate that water has become more accessible

specific objectives / purpose
The specific objective of a water development programme is:

Acceptable part of population in Bari Region has access to a reliable water source with good quality water at an acceptable distance.

By setting the objectives, it should be taken into account that the majority of the population of Bari is semi-nomadic/nomadic. For this part of the population the water supply is combined for domestic use and for watering the livestock. Even most of the urban centres fulfil an important role as water points for the nomadic with their livestock.

Table 8 gives a quantification for the short, medium and long term in comparison to the present situation. The quantification can be used as indicators for monitoring. The targets in the lower part reflect specifically to the situation of the nomadic part of the population.

Table 8: Quantification of targets for short, medium and long term water development

	Now	short term	medium term	long term
Part pop. in villages (>500 people) + towns	8%	25%	50%	90%
Reliability (perm. = >340 d operational)	permanent	permanent	permanent	permanent
Water quality: EC (µS/cm)	<3000	<3000	<3000	<3000
Water quality: Faecal Coliform	<10 c/100 ml	<10	<10	<10
Water quality: Risk contamination	No risk	No risk	No risk	No risk
Max Distance towns Max Distance rural	1,000 m 2,000 m	500 m 1,000 m	200 m 500 m	200 m 500 m
Max people per tap towns rural villages	 400 800	 200 500	 100 400	 100 400
Max. interval permanent water points nomadic area	200 km	100 km	50 km	50 km
Tanker supply remote areas	25 tankers	to be defined		

<u>Boundary conditions</u>

Project development should fulfil the following boundary conditions:

* have full support of local institutions
* investment dependent on risk for looting
* fulfil donor requirements for proposals/budget lines
* adapted to limited institutional capacity
* technology appropriate to community managed systems
* environmental impact positive or neutral on regional scale
* Operation and Maintenance must be affordable for the community

<u>General assumptions</u>

Assumptions are boundary conditions which, when not fulfilled, may have a negative impact on the project results, whereas the project is unable to influence it.

Security
Security is the major risk in development projects in Somalia.
Outbreak of war can not be influenced by whatever project, but security risks for staff and project goods can partly be avoided.

Not only the looting of project materials, but also the looting of installed projects, offense to project staff all becoming part of political conflicts are serious risks, which are difficult to avoid. Staff recruitment has been a destabilizing factor in the past.

The project strategy can influence the risks, by:
* continuous co-operation with the elder
* working from the interest of the communities
* being transparent in decisions
* avoid too much emphasis on one part of the region, only
* be prudent with recruitment
* be accountable to local authorities

It is assumed that the risks of looting of installed schemes will be limited. All village committees of elders repeated that they can guarantee security and have learned from the past.
Risks of looting of project materials and especially cars and heavy equipment is still serious. Therefore, it is recommended, that in the first period, the most expensive equipment will be second hand or hired with a good risk assurance.

The recent past has learned that a project in Bosaso town is specifically subject to security risks, as an improved water supply will affect the families which own the tankers and wells and are at present the suppliers of water for the town. Working through the council and giving opportunities for alternative earnings should be part of the project strategy.

In general it has to be emphasised that the relative stable situation in the North East is for all a merit of the efforts of the elders. Their efforts can be strengthened by working close together with them and by supporting them in developing new government structures.

Other risks
No other general risks can be formulated, which cannot be influenced by the project.

5.3 Water development strategy

Water programmes
To reach the objectives of the water development philosophy, the following programmes are needed:
* short term urban programme (5.4)
* short term rural programme (5.5)
* long term programme

The urban programme includes projects for the towns Bosaso, Gardo and Ufayn. The rural programme is divided into two projects:

1. rural water development project, which includes all water supplies which are based on other technologies than deep boreholes;
2. borehole rehabilitation project.

The long term plan will only be shortly discussed in this report.

The main arguments to come to this division of projects are based in the kind of technology and management involved. The technology needed for the urban projects is of a higher complexity and asks for different external inputs during implementation and for a higher level of management during operation.
For the rehabilitation of boreholes a different type of investment in equipment and external input is requested as for the none-borehole projects. The same is true for the O&M requirements during the operational phase.

Setting priorities
For setting priorities between the different projects and sub-projects (see par. 5.4 and 5.5) a list of criteria has been used, which is presented in the table 'criteria for prioritising projects'.
For the urban plan these criteria have been used strictly.
For the rural plan we used these criteria in a more tentative way. The technology involved was the leading factor in defining the rural projects. The need for a good water supply network for the nomadic people and their livestock as well as the need for fresh water in the coastal area have been leading criteria for setting priorities in the rural projects, without excluding the other criteria.

Project Integration
The different projects and sub-projects presented in 5.4 and 5.5 have several overlaps regarding technology inputs and geographical location. For efficiency and budget reasons a combination and time-phasing of projects is highly recommended. Mentioned here are the main overlaps:

* Gardo needs for its water supply a complete rehabilitation of some of the boreholes. The necessary equipment is the same as for the borehole rehabilitation programme

* the proposed schemes for the towns Iskushuban and Bander Bayla (initially part of the urban programme) are comparable with the schemes of Dhudho and Xafun. The same is true for the proposed scheme of Timirshe (initially belonging to the borehole programme). Therefore these schemes will be carried out under the rural programme 'non-borehole schemes'.

* Both the Ufayn scheme and the none-borehole rural scheme should start after the Qandala scheme has been finished, because mainly the same team of staff will be needed.

Activities of other agencies
UNICEF has intentions to rehabilitate Bander Bayla. This has to be confirmed before final decisions on project proposals are made. Recommended will be to UNICEF if they decide to do, to include Dhudho as well for logistical reasons.

The German Ministry of Economic Coorporation cancelled its programme in the north east of Somalia. This means that GTZ will not return to the region and take up their intended programme.

Table 9a: HARD CRITERIA FOR PRIORITISING PROJECT LOCATIONS

Shortage good drinking water:
* distance from source — urban > 500 m.; rural > 1.000 m.
* water quality
  - bacteriological polluted source /distribution
  - salinity > 3.000 µS/cm (*1)
* water quantity — urban < 25 lpcpd; rural < 15 lpcpd

economic feasibility:
* investment materials < 35 US$/c, livestock < 5 US$/p
* minimum 25 families

technical feasibility:
* technology involved:
sources: wells, spring capture, infiltration galleries and boreholes.
treatment: sedimentation, slow sand filtration, desalination
* availability of data

manageability
refers to district/regional level where administration, planning and/or supervising is needed.

contribution of the stakeholders:
* willingness
* ability: 25% community investment, 100% cost recovery for sustainability

activity is request of community/authorities of town:
the stakeholders of the activity have requested for the project through SPDS, RDC-Bari or other (inter)national organisations

economic importance for the region:
has the development of the domestic water supply an impact on the economic development for the region

involvement other agencies:
does the activity compete with the activity or plans from another agency

SOFT CRITERIA FOR PRIORITISING PROJECT LOCATIONS

regional importance of location:
importance of the location for the region other than economic (resettlement of displaced people, schools, hospital)

existence of water committee:
does the community show a history of organised water management?

relation with other project locations:
(type of project (technical, institutional), geographical location (logistics))

ISSUES WHICH NEED ATTENTION BY DECISION OF PROJECT LOCATION

livestock:
the need for water of livestock and possible facilities

conflict in use:
is the source already in use for other purposes (e.g. irrigation)

environmental impact:
(e.g. overgrazing, resettlement, over abstraction,..)

*1: The WHO-guidelines give for maximum acceptable TDS = 2.000 mg/l, which equivalents to 3.000 µS/cm for the $Ca/SO_4/CO_3$ - waters .

5.4 Urban programme

Priority setting

For the urban programme we first defined which place should be regarded as a town and which as a village. We used two criteria for this. A town should count more than 300 houses or should be a district capital. The two district capitals of Qandala and Alula were not included in this study, because of the following reasons. For Qandala already a project proposal has been submitted to the European Union by NOVIB/SPDS, and when approved will form a part of the urban programme. Alula has recently been rehabilitated by UNICEF and is in no urgent need, according to the RDC of Bari and UNICEF.

The remaining five towns: Bosaso, Gardo, Bander Bayla, Iskushuban and Ufayn are listed in the table 9b 'prioritising table'. The criterium 'relation with other project locations' was not used specifically but is related to the observations made under 'project integration' in par. 5.3.

The outcome of this priority setting exercise has been the following:

1. Bosaso/Gardo
2. Iskushuban
3. Bander Bayla
4. Ufayn

For Bosaso, Gardo and Ufayn the projects are presented in the table 10. Iskushuban and Bander Bayla are covered in the rural programme for reasons mentioned before. This table shows an overview of the activities and the main necessary inputs.

Below the main necessary equipment, logistics and office needs are listed. Depending on the combination of projects these means can be (partly) shared with other projects.

Equipment

- 3-ton truck/each town
- small 2" motorpump
- welding equipment
- small compressor for pipe testing
- pipe cutters, threaders and other pipefitting tools
- tripod with tackle
- tire force
- 5 kVa mobile generator
- engine driven concrete mixer
- general workshop tools

Logistics

- guarded workshop and store
- one 4WD pick-up
- two motorbikes

Table 9b: Prioritising table

		TOWNS (defined as being a district centre or or having more than 300 houses)				
		Bosaso	Gardo	B. Beila	Iskushub	Ufayn
HARD CRITERIA						
Shortage good drinking water	Dist. *1		+	+	+	-
	W.Qual *2	+	o	-	-	-
	W.Quan *3		+	-	-	-
Economical feasibility	*4	+	+	+	+	-
	USD/c	9.3	12.1	9	5	36
Technical feasibility		+	o	+	+	+
Managability		o	+	o	+	+
Contribution Community	Willign.	+	+	+	+	+
	Ability	+	+	+	+	+
Request of community		+	+	+	+	+
Economic relevance for region		+	+	+	+	+
Other agencies involved	*5	+	+	-	+	+
SOFT CRITERIA						
Other relevance for region		+	+	+	+	+
water committee/ history of org.		-	+	o	o	+
relation with other project loc.						

*1: Dist. from source urban > 500 m.
*2: Water quality: 1. bacteriological polluted source/distribution. 2. EC > 3.000.
*3: Water quantity urban < 25 lpcpd.
*4: investment costs materials < 35 USD/cap.
*5: Gardo, Bander Bayla and Iskushuban were included in the GTZ-programme. UNICEF intents to rehabilitate Bander Bayla.

OBSERVATIONS

Gardo: the proposed activity should be regarded as a emergency activity, as the capacity of the available sources is too low.

Bander Bayla: the lifetime of a solarsystem in salty conditions has to be evaluated. A training component should be included. The village will not contribute in cash.

Iskushuban: attention has to be paid to flood protection of the pipe when passing the togga.

Ufayn: the present system is worn out and can break any moment, therefore the 'shortage of drinking water' can also be regarded as (+). Training on Operation and Management is important.

(+) means high priority
(-) means low priority

Office
- radio communication
- office/guesthouse with basic facilities (electricity, air conditioning, shower)
- drawing facilities
- copy + blueprint facilities

5.5 Rural programme

The main purpose of the rural programme is to re-install a water supply network for human consumption and livestock. This programme consists of two separate projects:
* rural water development project
* borehole rehabilitation project

Both projects are presented in table 11.

Rural rehabilitation project

Solutions of water supply in rural areas are very much depending on the local situation and availability of water. During the rehabilitation study, 3 areas for intervention were identified, resulting in sub-projects:
1. Works on small schemes:
   Iskushuban, Hurdio, Xafun, Bander Bayla and Dhudho
2. Improvement of Berkad construction techniques
3. Development of water resources in toggas

For the improvement of the berkad technology and the development of water resources in the toggas pilot projects are required. To increase the efficiency these 3 sub-projects will be done in parallel to each other in one project.

Below the main necessary equipment, logistics and office needs are listed. Depending on the combination of projects these means can be (partly) shared with other projects.

Equipment
- For geo-electrical survey, equipment will be hired for a survey mission.
- Concrete mixer and other equipment
- Survey equipment (auger set, etc)
- Well digging equipment
- Compressor and pneumatic hammer
- small compressor for pipe testing
- pipe cutters, threaders and other pipefitting tools
- tripod with tackle
- concrete mixer
- digging tools
- light duty 4" portable drilling rig
- motor mud pump
- dynamite

Logistics
- 2 4WD pick-ups
- trucks will be hired
- radio communication
- 2 motorbikes

Office
- Office/workshop, located in Iskushuban

Borehole rehabilitation project

Taking into account the scarcity of rains and periodic droughts, boreholes are an indispensable source of water. Therefore the rehabilitation of at least the boreholes situated in the areas far away from the permanent natural sources are urgently needed. Especially women and grown-up children, being herds(wo)men of the extensive herds of goats and sheep are victim to the lack of a water network as they have to move far from their dwellings, seeking for water.

The mission identified 28 boreholes outside Bosaso, which had been used for water supply and were located on suitable places. Table 12 gives a summery of the works to be done.
All the boreholes need repair, well cleaning operations and replacement of pumps, pipes and generators. The saline/sulphate water corrodes the pipe work very quickly. This makes the O&M requirements high and demanding. At present each 6-8 months an O&M routine is necessary. This period can probably be extended by an electrical protection of the pipes and pumps against corrosion. The fact that still many of the WDA staff is in the area makes it feasible to set up such an O&M system in a relative short time.

Below the main necessary equipment, logistics and office needs are listed. Depending on the combination of projects these means can be (partly) shared with other projects.

Equipment
- Maintenance rig with bailer
- Compressor for well flushing
- Well testing set (pump, mobile generator, level sounding device)
- mobile water tank
- fishing tools
- tripod heavy duty, with tackles
- welding equipment
- pipefitting tools

Logistics
- 2 4WD pick-ups
- 1 truck
- radio communication
- 2 motorbikes

Office
- Office/workshop

<u>Table 10: PROJECT SUMMARY URBAN REHABILITATION PROJECTS BARI REGION</u>

	BOSASO	GARDO	UFAYN
Target Population	40,000	20,000	7,000
Objective	Install sustainable main water supply and stand-post based distribution	Install sustainable main water supply and stand-post based distribution	Replace gravity fed water supply and distribution
Targets	* 15 l/c/d within 500 m * more than 200 taps * community managed system * hygiene improved	* 15 l/c/d within 500 m * more than 150 taps * community managed system * hygiene improved	* 15 l/c/d within 500 m * more than 35 taps * community managed system * hygiene improved
Design considerations	* design period 15 years * phased increase population; use per capita and house connections	* design period 15 years * phased increase population; use per capita and house connections	* design period 15 years * phased increase population; use per capita and house connections
Main works to be done	* rehabilitation 1 (or 2) airport wells and inst. gen/pump sets 30m-\75 m3/h * 1.2 km 10" DI-main line * 1 elevated reservoir 15m\200 m3 * chlorination; optional * 20 km distr. pipes * 60 standpost of 4 taps * materials for house connections (10%) * reh. office & store	* rehabilitation 4 boreholes and inst gen/pump sets * 3 elevated reservoirs 10m\50m3 each * chlorination; optional * 10 km distr pipes * 45 standposts\4 taps * materials for 10% house connections * Reh. office & store	* 8.2 km GS-3" main * 3 km HDPE-90mm main * 1 new elevated reservoir 10m\60m3 * 2.5 km distribution * 12 stansposts\4 taps * materials for 10% house connections * reh. office & store
Other activities	* Installation and training central and neighbourhood based water c'tees * Revenue collection system * awareness raising and hygiene education * revolving fund * training at all levels	* Installation and training central and neighbourhood based water c'tees * Revenue collection system * awareness raising and hygiene education * revolving fund * training at all levels	* Installation and training water c'tee * Revenue collection system * awareness raising and hygiene education * revolving fund * training at all levels
Estimated cost for materials (excl. chlorination)	US$ 370,000 9.3 US$/cap	US$ 242,000 12.1 US$/cap	US$ 253,000 36 US$/cap
O&M considerations	Medium running costs Safety protection	High running costs Borehole management	Low running costs Simple system
Period:	Phase 1: 1 year Phase 2: 1 year	Phase 1: 1 year Phase 2: ½ year	1 year
Expatriate staff input (man-months if shared with other projects)	12 mm engineer; 6 mm comm.dev/hygiene 9 wks missions	9 mm engineer 3 mm comm.dev/hygiene 9 wks missions	6 mm engineer 3 mm comm.dev/hygiene 5 wks missions
Local senior staff (if shared with other projects)	72 mm + contractors	48 mm + contractors	36 mm + mainly local labour

Table 11: PROJECT SUMMARY RURAL REHABILITATION PROJECTS BARI REGION

Project/	BOREHOLE REHABILITATION PROJECT	RURAL REHABILITATION	PROJECT	
Sub-project		SMALL TOWNS PROJECT	TOGGA WATER PILOT PROJECT	BERKAD PILOT PROJECT
Target population	25,000 + 50% nomads	14,000 + 50% nomads	5,000 + future	future
Objectives	Re-install former rural borehole network for people and livestock and make it sustainable	Improve sustainable water supply in small towns Iskushuban, Timirshe, Hurdio and Xafun	Make available water around toggas more accessible for people and livestock	Improve technology and use of widespread berkad system
Targets	* 21 more boreholes operational * community managed * hygiene improved * maintenance unit	Each town/village: * 15 l/c/d within 500m * community managed * hygiene improved	Phase 1: * water made accessible on 10 sites * 4 alternative technologies tested * water development plan developed	Phase 1: * new technologies and use tested in 5 pilots * dissimination plan * revolving fund used
Works	* removal stones (5) * well rehabilitation (21) * pump/gen & raising mains (12) * tank (3) * distr. system (5)	Timirshe: solar panels and system Iskushuban: spring box; solar panels, reh distribution Hordio and Xafun: evaluate altern. & impl	* Install workshop * 8 wells, * 1 dam; * 1 sub-surface	* 5 berkads in 2 villages
Other activities	* create Water Ctees * revenue system * Train Operators * Train Cty members * Hygiene education * Train teams * Spare part bank	* create and train Village Water Ctees * revenue system * Train Operators * Train Ctee members * Hygiene education * Train equipe	* evaluate prospection and construction alt. * create water ctees * revenue system * train Ctee members * hygiene education * train equipe * develop plan	* evaluate improvements for construction and hygienic yse * revolving fund * develop plan
Year 1: Year 2:	10 boreholes 12 boreholes	Timirshe & Iskushuban Hurdio & Xafun	See above Implement plan	See above Extend rev. fund, implement plan
Special equipment	Bailer rig (2nd h) Tri-foot + winch Chemicals etc		Survey set, compressor, pneum. hammer, office & workshop	Cement mixer
Material & equipm cost (rough est.; 2 phases)	US$ 500,000 <20 US$/cap	US$ 180,000 13 US$/cap	US$ 150,000 <30 US$/cap	US$ 40,000 (+ US$ 50,000 fund)
Expatriate staff input (if shared with other projects)	24 mm hydrogeologist 6 mm comm.dev/hygiene 12 wk missions (electro-techn; training)	>>>>>>>>>>>>>>>	18 mm engineer 9 mm comm.dev/hygiene 1½ mm geo-physics 1½ mm monitoring	<<<<<<<<<<<<<
Local senior staff	96 mm	>>>>>>>>>>>>>>>>>> Contractor	60 mm	<<<<<<<<<<<<<

Table 12: Summery of works in borehole rehabilitation

Village	Inh.	WL	D	Observations	Stones	Rehab. casing	gen/-pump/-rising ps	Tank	Main and Distrib
Kale Bayr	500	88	283	Caces; never installed	X	X	X	X	X
Jingidda	1080	75	125	Gen/pump problems EC3200		X	X		
El Dofar	4000	20	180	Operating		X			
Armoyin	500	66	320	Caces; never installed	X	X	X	X	X
Jurile	800	109	281	Pump fell down (Afr70)		X	X		
Dalweyn	1600	164	270	Change bh; Caces; EC3620	X	X	X		X
Wa'iye	3000	180	251	Stones in togga well	X	X	X		X
Xiddo	2400		>	Old bh; little capacity	X	X	X	X	X
Dhadar	3600	102	165	Gen/pump problems		X	X		(X)
Rako	3200	298	420	Leaking pipes; rods stuck EC4000		X	X		(X)
Jiddad	1400?	174	320	Operating; TDS4570		X	X		
Adinsone	1000?	139	220	Operating; TDS>>		X	X		
Gd-Xingood		139	200	Operating; Q20m3/h;-EC2900		X*		U	U
Gd-Kawane	Urban Proj	80	200	Operating;Q15m3/h;EC5600?		X*		U	U
Gd-College		139	223	Abandoned; Q2m3-/h;EC1630		X	U	U	U
Gd-Xingoole		153	193	Abandoned; Q7m3-/h;EC>		X	U	U	U
Kob Dhehad	1200	? .	188	Operating; pipes worn out		X	(X)		(R)
Daw'Aley	(40)	209	470	Gen/pump problems		X	X		?
Timirshe	(-3000)	35	75	Handpump>solar in Rural Project		X	RP		
2*Bosaso-It	Urban	9	19	Test 2 bh		XX	U	U	U
Ismadeqa El Gal Hurdio B.Dhiddin Qoton Timirshe II				Not selected: unfeasible, or no priority					
TOTAL	± 25000		± 4700		5	21	12	3	5

U = In urban projects

6. APPROACH

Some of the elements of the approach mentioned in this chapter are not entirely applicable in rehabilitation programmes. In the Somalian context where there is no government at all or any other sustainable organisation it is too much to expect the development of sustainable institutes/agencies in just one or two years. However rehabilitation projects should gave the ground for more sustainable development and not introduce approaches which counter act future approaches.

Analysis

Apart from the factors related to the collapse of the farmers Government, many of the existing water supplies have failed because of:

1. absence of involvement of the population and local authorities in selection of technology, in the implementation of works, and in operation and maintenance
2. too centralized maintenance and operation structures
3. absence of financing mechanisms for improvements on community level
4. too sophisticated technology
5. difficult physical conditions: deep boreholes and salty water
6. lack of hygiene education

Future projects should try to solve these problems to build-up a sustainable water supply.

Community focused approach

Projects should start from a request formulated by the communities themselves.

Thereafter, communities should be made aware, that projects and donors cannot be seen as agencies solving all their problems, but the communities themselves keep the responsibility for the activities. Only communities which are prepared to take this role should be selected for interventions. Hence, a phase of awareness raising is required.

Communities become clients, contracting an agency for certain services. In a contract, joint responsibilities should be defined. In this concept, the own contribution of the community should be determined. An intermediate agency may be contracted to act on behalf of the community, like in the case of borehole programmes, where external expertise is required to supervise the borehole drilling.

In preparation, all community groups should be involved, including women groups, representations of nomads etc. Solutions should be acceptable to all.

Technologies should be selected, that can be operated at community level. The community should be able to manage the maintenance: or do it themselves, or being able to contract local skilled people to do it.

The community should be represented in the steering committee during implementation. Elected community members should be trained in management activities in the Community Water Committee.

Selected community members should be involved in the implementation and be trained on operation and maintenance.

In the present context in Bari Region, there are 4 particularities, which need to be mentioned:

1. Government structures have collapsed and the context is highly favourable to start community based projects. However, people still look to external agents more as providers than as facilitators. New projects should try to change this mentality.

2. As long as donors are seen as external financial sources, they are vulnerable for means of influence. At present, armed force is used to influence project selection by donors. Lack of implementing capacity of existing agencies have contributed to this attitude, as more money is spend to operate the organizations rather than implementing projects.
   In this context, asking for a high own contribution is interpreted as unfair by many villagers. Projects and community elder should find an answer to these mechanisms. May be, that the 'demand driven' approach is not the right concept in this context, as it also demands for manipulation. May be, that the 'donor' concept is not very appropriate in the Somalian context, and that a more 'commercial' approach with credits in more applicable.

3. In general, people are prepared to invest in their own water supply, privately. However, there is mistrust regarding investments on community level. Most of the community owned berkads and wars are unfinished and lack maintenance. Projects and elder should try to find an answer to this attitude.

4. Pastoralists are faced with a dilemma of a desire for accessible water at the one hand and fear for power and control on the other. The VetAid report is very specific in this issue (page 43-44). In the present report, however, we face the problem from the point of domestic water supply and do not come across this dilemma

<u>Institutional setting</u>

In the approach, one can distinguish two stages for institutional arrangements:
1. during project implementation
2. after implementation

Institutional development should be focused on the latter stage, in which the following levels can be distinguished:
1. community level: responsible for operation and for management of maintenance
2. regional level: acting as facilitator and monitor; providing sophisticated services of maintenance
3. regional level: regional water authority

Institutional aspects are worked out in chapter 7.

<u>Financing</u>

For sustainable projects it is a prerequisite that the community takes financial responsibility. The costs can be divided into capital costs, operational costs and maintenance costs.
Regarding the investments people make for their water supply at present (chapter 4) it is recommended that people pay for all these costs except for the external technical assistance and project equipment. For covering the capital costs this would mean that some kind of revolving fund on the local level has to be created.

In rehabilitation programmes this is not realistic. In that case it is proposed that the following costs will be covered by the community:

- depreciation costs of the investments on materials to save for re-investment (pumps, generator, pipes)
- operating costs (salaries, fuel, administration)
- maintenance costs (spare parts, maintenance contract)

<u>Environment</u>

The impact of the programmes on the environment has to be assessed. Especially the impact of concentration versus spreading of water sources on overgrazing and the general balance between the amount of livestock and the potential of recovering of the vegetation needs attention. The balance in pastoral water supply has been analysed in the VetAid report. As more research will be necessary to answer this it is recommended that only existing sources will be rehabilitated or improved and no new sources developed.

<u>Health extension</u>

The field visits revealed a low level of knowledge on the relations between health and water and sanitation practices among the people. There is hardly any skilled health extension staff. UNICEF just started a hygiene training course for staff in Bosaso. A water supply programme gives good opportunities for a health and sanitation programme running in parallel with the implementation of the project facilities. The water committees in the neighbourhoods/villages could play a central role in such a programme.

Literature:

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7. IMPLEMENTING CAPACITY

For successful and sustainable water supply projects a sufficient implementing capacity on both the technical and the management level is of great importance. In this chapter a first analysis of these capacities and an assessment of needs on the institutional level will be presented.

7.1 Local capacity

Until the end of 1989, when the war broke out in Somalia, the responsibility for the water resources was in the hands of the Water Development Agency (WDA). This national institute was mainly focused on Mogadishu and surroundings and remote areas as the Bari-region got less attention, apart from borehole drilling programmes. During the seventies and eighties WDA developed a water resources development plan, which intended to guarantee minimum water supply for both the nomadic people and their livestock.

In the early eighties, the existing borehole network in North Somalia was revitalised by the Chinese Borehole Programme. In the late eighties, the network of pumped supplied schemes was made denser by the 'Aquater' water supply programme.

The only non-borehole supplied water points in the region were already developed during colonial rule: e.g. Ufayn, Bander Bayla, Iskushuban, Qandala. Some of them got partly rehabilitated by WDA and foreign agencies.

The policy for operation and maintenance for deep well water supply systems was strongly centralised. WDA employed operators mostly from outside the villages and region. Maintenance teams passed by regularly. The local people did hardly contribute in O&M, nor in labour, nor in cash.

At present, there is no regional water authority, but mostly each village which has an operational water supply has established some kind of water committee. In general they employ a caretaker/water seller and in any cases people have to pay for the water. In general the function of these committees is to keep the system running, in which they succeed with variable success. There is little capacity for action in case of major breakdowns, except to apply for support to foreign agencies. Some attempts although were made: Rako, Daw'aley, Dhahar.

Local initiatives seeking for alternatives can be found in several places. The present mainly water tanker supply-based network is driven by a mix of private enterprise and diffuse institutional arrangements between sub-clan elders in Bosaso and the enterprises.

A number of local NGO's are or have been active in the field of water supply. EDGS has already more than 10 years experience in the region but mainly worked south of Bari, and is specialised in small solar energy pump systems.

SPDS and Sorso worked in the past together with THW from Germany in an attempt to quickly rehabilitate the water supply for Bosaso which mainly failed as a result of unrealistic targets. SPDS is the initiator for the rehabilitation of the water supply of Qandala and partner in the present study.

During our visit at Dhadar we were reported by the villagers that they recently received a new generator from SEDRA, based in Buran, Somaliland/Somalia.

The development of the Galgalo irrigation scheme, supported by Africa'70, is implemented by Dandor.

Resuming it can be stated that there is the willingness for a community-based management structure for water supply systems in both villages and towns. Also there are still a great number of unemployed skilled people on both technical and management level: former employees of WDA in the region and skilled staff migrated from other regions.

What is lacking is any institution or service-agency which can support the communities in their efforts to develop and sustain their water supply systems. During all our talks with both communities and 'authorities' it became clear that there is no want for a return to centralised government based institutions. The preference seems to be community-based management with privatised service-agencies for support.

In general the deficits in technical capacities can be summarised as follows:
- no design capacity;
- the only water quality control capacity is within UNICEF and EDGS;
- no distribution network capacity;
- no water treatment capacity, except some experience of EDGS with Slow Sand Filters in the past;
- little construction capacity;

There is a differentiation between borehole and non - borehole schemes.

For the borehole schemes the capacities are:
- experienced former employees of WDA in maintaining deep wells;
- EDGS has experience with the installation of solar - and engine driven pumped systems;
- no operational drilling rig, maintenance rig, compressor, well test equipments available in Bari. The only equipment available is a 10 ton crane.

For the none-borehole schemes the capacities are:
- some employees have little experience with gravity-fed spring systems.
- no tools like pipe cutters, pipe threaders, etc..

On the level of health and sanitation related to water there is very little capacity for training. UNICEF did some activities in Bosaso town.

The following is a list of former WDA personnel still available in the region:

* 3 hydrogeologists (BSc)
* 4 master drillers
* 12 assistant drillers
* 3 electricians
* 4 welders
* 12 maintenance crew boreholes
* 8 drivers
* 6 mechanics (vehicles section)
* 14 pump and generator operators
* 8 administrators

7.2 Foreign agencies

Until March '95 GTZ was the leading foreign agency with a long history and commitment on water supply activities in the Bari-region. They were well ahead in the preparation of programmes in the three southern districts: Gardo, Iskushuban and Bander Bayla. Unfortunately they suspended all their activities and have withdrawn from the Bari-region.

The second important agency is UNICEF, who has planned to implement several shallow well and spring-capture systems in the district Alula, and also plan to support Bander Bayla town. Next to this they intend to continue with the improvement of shallow water wells in Bosaso town. UNICEF will have the capacity to execute water analysis and are working on a standardisation of pumps, generators, etc. Also they have started a training programme for staff working in water supply activities. UNICEF will not develop any activities which include deep wells and is mainly focused on domestic water use.

The third agency is the only foreign NGO present in Bosaso: Africa '70. Their water activities are more related to agriculture in the direct surroundings of Bosaso town. Some shallow wells and berkads have been developed in their project area.

7.3 Institutional framework

As most project failures are the result of institutional rather than technical inadequacies, a clear identification of institutions and their responsibilities is of great importance. As stated before there is a clear preference in Bari for community-managed water supply systems at the moment. This means that the approach has to start with the question "Can the tasks be done by the community?". When the answer is "no", the necessary support from outside agencies has to be defined.

For the longer term three levels of institutions can be determined. The first level is that of the water committees, directly appointed by the communities. The second level is that of the support-agencies and the third is a regional water authority. For the rehabilitation activities on the short term the only feasible ones are the first and the second levels of institutions. When properly established they can guarantee sustainable water supply systems.

The tasks of the water committees can be:
- to take the initiative for improvements of community water supply;
- to organise contributes by the communities, in cash or in kind, towards construction, and towards operation and maintenance;
- to organise proper operation and maintenance, including supervision of caretakers;
- to keep accurate records of all payments and expenditures
- to promote hygienic and effective use of the new facilities;
- to hold regular committee meetings to discuss and decide on issues, procedures and problems;
- to inform the community regularly about decisions and to report on revenues and expenditures.

In many of the existing village committees women play already a role. The establishment of the recent Regional Development Council in Bari has been initiated under the pressure of women. The involvement of women in the management of water supply systems seems certainly possible, and was found already in Ufayn and Timirshe.

The role of the support-agencies can be defined at different stages during the project:
- in the development phase, the agent plays a catalytic role, helping the community to reach appropriate decisions on technical and financial issues;
- in the implementing phase, the agency plays a supporting role, ensuring that supplies and back-up services are available when needed;.
- the agency needs to monitor operational projects, evaluate approaches and modify the type of support provided as necessary.

At the long term a regional water authority has to be established. The main functions of such an authority can be:
- to develop and promote regional programmes and projects and evaluate and select communities which fulfil the conditions set for receiving funds and other help for an improved water supply;
- to supervise the design and construction of local community water supply systems;
- facilitate technical and logistical support (major maintenance and repair jobs, spare parts supply, fuels supplies, etc.) through regional warehouses and workshops and mobile staff, if this can not be accomplished through private agents. This to be done in a financially sound way;
- provide regional training programmes and continued education programmes in technical, administrative and management skills for regional and local staff.

7.4 Needs for institution building

In the rehabilitation programme there is a need for training of the water committees in technical, administrative and hygiene education skills. SPDS and EDGS are the two potential local support-agencies active in the region at present for conducting this level of training. At the level of the agency staff, the exact training- and staff needs for these two support-agencies still have to be identified at the start of the rehabilitation activity, followed by the necessary training and/or staff recruitment.
EDGS has technical capacities in the field of installing small pumped water supply systems, with a specialisation in solar systems. They need some upgrading of the quality of their work, regarding finishing of works, design capacities and work on distribution nets.
SPDS has until now little experience in water supply projects. During implementation of the projects capacities of staff can be built. It is recommandes,.that the staff trained in the urban - and borehole projects will not stay within SPDS-structures after the project. They could carry on as a private service-agency.
The staff trained in the non-borehole rural projects and small 'urban' schemes could form the SPDS water sector in the future.

LITERATURE

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(found at wall of GTZ/Gardo office)

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Nugal Technical Mission
Mission Report

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Water for Life (1987?) Farax I.M. et al,
Researches and low technology tests on shallow and surface water in central and southern Somalia

SOMALIA WATER REHABILITATION PROJECT

NOVIB/SPDS WATER SUPPLY PROJECTS (BARI REGION)

APPRAISAL MISSION

Terms of Reference

Background

1. The water supply system of the Bari Region (North Eastern Somalia) has deteriorated drastically during the recent years because of the lack of adequate maintenance after the collapse of the former government and the disappearance of the Regional Water Agency. Many water points also suffered of deliberate destruction during the military operations of the civil war and from looting of pumping equipment.

2. The Regional Development Committee of the Bari Region with the assistance of international and local NGOs now intends to rehabilitate the water supply system of the region. Since the security situation in North Eastern Somalia is acceptable, several donor agencies are now supporting various development programmes in the North East. A proposal for the rehabilitation of the water supply system of the town of Kandala has been submitted recently to the European Commission for funding by NOVIB, a Dutch NGO, in association with SPDS, a local NGO. However, urgent needs exist also in other towns and rural areas of the region. A preliminary investigation has been made by a SAWA Water/Sanitation Engineer, Mr. Van Doorn in May/June 1994 to identify sites which need to be rehabilitated in priority but the full appraisal of these projects still needs to be done.

Project Scope

3. Placed under the authority of the EC Special Envoy, the Consultants will be acting as advisers to the EC Somalia Unit and NOVIB for preparing high priority rehabilitation projects and associated institutional building actions in the water supply sector of the Bari region.

Based on the preliminary survey of May/June 1994 mentioned above, two types of rehabilitation works have been identified:

i) the rehabilitation of the water supply system of the towns of Bargaal, Dhuddo and Hurdyo.

ii) high priority rehabilitation works of villages and grazing areas of Dharia and Khalos Bayer areas.

The final list of rural sites to be included in the EC programme will be defined in coordination with the actions of other donors.

Output of the Mission

4. The mission will liaise with the local authorities and other donors to establish the list of the sites to be rehabilitated in priority.

5. The appraisal mission will undertake all the surveys and the necessary technical and economical analysis needed to appraise the two projects and define the conditions of their implementation.

6. A project proposal will be prepared to satisfy the requirements of the EC Somalia Unit for NGO projects. This proposal will provide all the supporting documents, surveys and drawings needed for assessing the technical, economical feasibility of the projects, the monitoring of their implementation and the institutional action needed to guarantee the sustainability of the investment. The guidelines of the content of such proposal is attached.

Staffing

7. The appraisal team will be composed of:

- 1 Water/sanitation engineer of SAWA
- 1 Hydrogeologist of SAWA
- 2 local water/sanitation engineers
- 1 surveyor
- 1 local economist/coordinator

8. Somali Peace and Development Society (SPDS), a local NGO, will provide the logistic support to the appraisal team. If needed, the local authorities will also provide complementary assistance to the mission through surveyors and technicians and facilitate meetings with the local authorities. They will also help to define the most appropriate institutional building actions needed to guarantee the sustainability of the project.

Logistics

9. Since the appraisal mission will need to appraise simultaneously two different projects (rehabilitation of the water supply system of three towns and rehabilitation of drilling of water wells in villages and rural areas), the rental of three vehicles will be needed.

- 2 Four Wheel drive vehicles (one for each team)
- 1 Pick-up trucks for surveying equipment, used also as safety escort vehicle as required by UNOSOM regulations.

10. SPDS in Bossaso will provide space and accommodation and in collaboration with local authorities, will seek assistance with GTZ in Bossaso/Gardo to obtain geo-physical equipment and tools for boreholes inspection and logging.

Mission Period

11. The field mission period is tentatively scheduled for April to end of June 1995. Each team will spend about one month on the field to collect the basic data, undertake necessary surveying, prepare drawings, liaise with local authorities and one month in the headquarters to draft the interim and final reports.

Reporting

12. Draft reports (in 2 copies) will be sent to EC Somalia Unit within 6 weeks after the conclusion of the field mission.

The final report will be sent in 5 copies to EC Somalia Unit, four weeks after having received the comments of the EC Somalia Unit on the Draft.

Budget

13. Attached is the budget for the proposed mission.

ANNEX II: ITINERARY

Mr. Said Saleh left Holland to Djibuti for preparations
Mr. Bouman and Mr. Van Lieshout left Holland for Nairobi
Flight Nairobi to Djibuti; Meeting with Mr. Said Saleh
Meeting with Mr. Alexander von Braunmühl (GTZ)
Flight Djibuti to Bosaso; start as a team

Meetings: WFP (Mr. Rahama Rihood); UNDP (Mr. John R. Paulas); UNICEF (Mr. Moh. El-fathi (W&S coord. Somalia) and Mr. Said Ahmed); Regional Development Committee (Mr. H.Barre (Chairman) and Mr. M. Ainab Mohamoud (secretary)); delegations of elders
Meetings: Bosaso District Council; and many elder groups
Visit to wells in Bosaso Town;
Meetings: Africa 70 (Luigi N.Tessiore (Reg.Coordinator); delegation Muduq Region and delegation of elders
(friday); Meeting with delegation Nugal Region

Field visit Bosaso - Gardo - Dhahar - Xiddo;
Meeting with Somalian staff of GTZ-project in Gardo (e.g. Mr. Ahmed Abas and Mr. Ali Ahmed Osman)
Field visit tarmac road villages Xiddo - Bosaso

Priority discussion; delegation of elders

Field visit Bosaso - Ufayn - Timirshe
Field visit Timirshe - Buq - Hordio
Field visit Xafun
Field visit Hordio - Iskushuban
Field visit Iskushuban - Bander Bayla - Dhudo
Field visit Dhudo - Rako - Bosaso

Elaboration of data; meeting with delegation of elders
Elaboration of data

2 teams: 1 team in Bosaso Town; other team:
Bosaso - Meladeen - Xamurre - B.Dhidin
B.Dhidin - Dhadar
Dhadar - El Gal
El Gal - Ismadhaqa - B.Dhidin - Bosaso

Elaboration of data
Preparation of report; delegation of elder
One team: Visit Ba'ad, Bur Gaban
Other team: Bosaso - Garue (Nugal) - Gardo - Sherbi - Bosaso
Meetings: EDGS (Mr. Mukhtar Sheck Sharif; water engineer) and Representatives Nugal Region
Preparation of report;
Discussion report with team and with SPDS
Meeting with Regional Development Committee didn't materialize
Visit to "water factory" Al-Firdows and Italian wells
Visit to Aquater Drilling Rig in harbour
Departure Bosaso - Djibuti
Elaboration data/reporting
Flight Djibuti - Nairobi; meeting with Africare employee
Debriefing EU-Somalia Unit Nairobi
Briefing UNICEF-Somalia, Mr. El Fathi
Visit to Dutch Embassy, Mr. Wijkersloot, Mr. Wolters and Mr. Gooren.
Visit to WB/UNDP Regional Coordination Group, Mr. Hommelgaard
Departure Nairobi Mr. Bouman, Mr. van Lieshout
Arrival Amsterdam Mr. Bouman, Mr. van Lieshout
Meeting Mr. Said Saleh with Mr. El Fathi, Mr. Spring and the RPO for Somalia Northeast (UNICEF)
Meeting Mr. Said Saleh with Mr. Petrides, EU Somalia Unit
Meeting Mr. Said Saleh with Mr. Illing, Special Envoy of EU
Meeting Mr. Said Saleh with Mr. Petrides, EU Somalia Unit
Arrival Amsterdam, Mr. Said Saleh

Village	Afxarago	Armoyin	Ba'ad Bur Geben	Balli Dhidin	Balli Wa'atay	Bander Bayla	BOSASO	Buq	Dalwayn	Dhadar Villages	Dhahar	Dharjale	Dhudo
District	Qandala	Bosaso	Bosaso	Qandala	Qandala	B Bayla	Bosaso	Iskushuban	Gardo	Qandala	(NW-Somalia)	Iskushuban	B Bayla
Altitude	660	700	3	590	540	5	5	310	700	±1400	930	355	300
Houses	82	25	35	250	150	280	5000	60	80	(300)	120	50	160
Est. Population	1640	500	350	5000	3000	5600	40000	1200	1600	(6000)	3600	1000	3200
Seasonal factor	High	Low	High	High	High		Medium	Low	High	High	High	Low	High
Peak season	Hot		Wet	Hot	Hot		Wet		Hot	Wet	Dry		Dry
Main water source	Berkads	Berkads	Far spring	Berkads	Berkads	Spring	Boreholes	Spring	Berkads	Berkads	Borehole	Berkads	Spring
Berkads													
Lined	20	3		76	30				25	30		5	
Unlined	10	2		20					0	12			
Communal									1				
Total	30	5	(1)	96	30	0			26	42		5	0
Perc. broken	35%	0%	100%	7%					20%	14%			
Storage period				½-3 mnth						1-2 mnth			
Observations													
Wells & Springs	No	Borehole	Spring	No	No	Spring	Boreholes	Spring	Borehole	No	Borehole	No *	Spring
Type		Caces	open			Old capt		open	Aquater		Chinese		Open
Status		Never inst stones	Contami- nation			Poor/ looted	motor/pump		Demolished Stones		Gen/pump problems		Contami- nation
Distance village (m)		800	7,000 m			800 m	1500	100	(6200)		100		300 m
Quantity (m3/h)			o			+	o	+	?		+ (8,3)		+
Quality (EC in uS/cm)			-500			o (2800)	o	+	- (3629)		+ (1100)		-1500
Seasonality			seas-perm			permanent	permanant	permanant	-		permanent		permanent
Operator							yes	no			yes		
Water Ctee		no					no	no	no		yes		
Cost small Berkad US$				9,000					9,000				
Cost tanker US$/m3	19	18		14-23	19				9	19			
Selling custom	external			external					external		external		
Price berkad w US$/m3	4.6-9.2			1.8-4.6			0.9		4.5		1.1-4.5*		
Price boreh w US$/m3													
Observations	No trials well in togga		Permanent spring at 8,000 m	Borehole Aquater not appr: negative	No trials wells in togga		contamin shallow wells poor people		Altern. Casing at 1500 m	2 trials wells: neg at 20 m; ancient well closed	* Hartung94 Pool	Request pipes from bh D'Aley 11 km	

Village	El Dofar	El Gal	GARDO	Hurdio	Iskushuban	Ismadhaqa	Jiingadda	Jurile	Kala-Bayr	Kobdhaxad	Meladeen	Mudia
District	Bosaso	Qandala	Gardo	Iskushuban	Iskushuban	Iskushuban	Bosaso	Bosaso	Bosaso	Bosaso	Iskushuban	Alula
Altitude	670	290	790	2	290	150	580	700	550	430	350	650
Houses	200	120	2000	80	400	125	54	40	40	60	100	100
Est. Population	4000	2400	20000	800	8000	2500	1080	800	800	1200	2000	2000
Seasonal factor	Medium	High	Medium	Low	High	Medium	Medium	Low	High	Medium	High	Low
Peak season	Hot	Wet	Hot		Dry	Wet	Hot	Wet	Wet	Hot	Wet	
Main water source	Borehole	Well	Boreholes	dug pits	Springs	Seas pool	Borehole	Borehole	Berkads	Borehole	Sh. pits	Seas pool
Berkads												
Lined					0	1	2		3			
Unlined						1	8					
Communual												
Total	?	0		0	0	2	10		3	?		30
Perc. broken												50%
Storage period												½-1 mnth
Observations										bk for agric1 war		
Wells & springs	Borehole	Well *	Boreholes	Pits	Springs	Pool	Borehole	Borehole	Borehole	Borehole	Borehole	No
Type	Aquater	1955	Chinese/GTZ/old		EDGS		Aquater	Aquater	Caces	Aquater	Western G	
Status	Operating	Good (lined)	worn out genset/pump		Looted		Gen/pump problems	Pump fell down	Never inst stones	Operating Pipes leak	Handpump leaking	
Distance village (m)	1650	800 m	1000		200 m		750	1220	near	13,000 m	100	
Quantity (m3/h)	+ (21)	o	-/+	-	+		+ (15)	+ (8.6)		+	-	
Quality (EC in uS/cm)	+ (2300)	+ (460)	-/o	-	+ (1800)		- (3200)	+ (1350)		o (2600)	- (7600)	
Seasonality	permanent	Permanent	permanent	seasonal	permanent	seasonal	permanent	permanent		permanent	permanent	
Operator	yes	No	yes		Yes		yes	yes		yes	Yes	
Water Ctee	yes	No	no		Yes		yes	yes	no	yes	?	
Cost small Berkad US$											only house	11,000
Cost tanker US$/m3						23	14				9	
Selling custom		No								all	no	No
Price berkad w US$/m3												
Price boreh w US$/m3										1.8(-7)		
Observations		Aquater wadi well Looted Sh. Well queing pk	Urgent rehabilit needed of at least two wells	Aquater dist. tog well looted	Risk Contamin	Aquater dist bh Looted		Assistance Africa 79 Village moved				

Village	Sherbi	Timirshe	QANDALA	Qodax/ Xumbeis	Rako	Ufayn	Unuun	Wa'eye	Xafun	Xamurre	Xiddo
District	Gardo	Iskushuban	Qandala	B.Bayla	Iskushuban	Bosaso	Qandala	Gardo	Iskushuban	Iskushuban	Gardo
Altitude	860	310	5	560	710	440	510	920	2	290	940
Importance	Tarmac R	Road	District	Grazing	Grazing	Resort	Foot	Tarmac R	Coast	Water well	Tarmac R
	Grazing		function	(Boreh)	Borehole	Water	Mountains				Borehole
Founded	old		old	1963	1958	1958		1967	1928		60-ties
Houses	250	150	400	30	160	350	80	150	200	60	120
Est. Population	5000	3000	8000	600	3200	7000	1600	3000	2000	1200	2400
Seasonal factor		Med	High	High	High	High	High	High		Low	High
Peak season		Hot+Dry	Wet	Wet	Dry	Hot	Hot	Hot			Hot
Koran school	1	1	1	0	4	1	1			1	
Formal School	1	room	1	0	1	1	house			stones	
Interm school	0	0		0	0	1	0			0	
Health Centre	1	room	1	0	0	1	1			room	
Operational	+	+		-	-	+	+			-	
Disease ranking							10				
Malaria	10	10	10	10	10	10	9	10		10	10
TB/Coughing/		6		9	8	7	7	8			8
Anaemia		9		8		9		9		8	9
Hepatitus					7	8				9	
Kidney											
Blood pressure								7			
Diarrhoea	Child	5			9	not	6	8		<	7
Constipation	9							6			
Skin											
Reuma											
Malnourishment											6
Others		Measles/eye					Cancer 8				
Economic Sources											
Livestock	++	+	o	++	++	++	+	+	o	+	++
Frankinsence		+	++	-	-	+	-	-	-	+	-
Agriculture		o		-	-	+	-	-		o	-
Fishery		-	+	-	-	-	-	-	++	-	-
Commerce	+	+	+	-	-	+	+	+	o	-	+
Migrant Labour	+	+		o	-	+	+	+	++	o	+
Rich/poor appearance	Rich	Rich	Rich	Medium	Rich	Rich	Medium	Rich-Med	Rich	Medium	Rich
Main water source	Berkads	Borehole	Borehole	Berkads	Borehole	Spring	Berkads	Berkads	well	Well	Berkads
Number berkads	73	17	0	52	40+	5.00	46	49		0	60

Village	El Doofar	El Gal	GARDO	Hurdio	Iskushuban	Ismadhaqa	Jiingadda	Jurile	Kala-Bayr	Kobdhaxad	Meladeen	Mudia
District	Bosaso	Qandala	Gardo	Iskushuban	Iskushuban	Iskushuban	Bosaso	Bosaso	Bosaso	Bosaso	Iskushuban	Aluula
Altitude	670	290	790	2	290	150	580	700	550	430	350	350
Importance	Tarmac R	Water	District	Coast	District	Valley	Tarmac R	Tarmac R	Tarmac R	Road	Valley	Foot
	Water	Foot mnt	function		Water							Mountains
Founded	old	1935	old	1928	old							1983
Houses	200	120	3000	80	400	125	54	40	40	60	100	100
Est. Population	4000	2400	30000	800	8000	2500	1080	800	800	1200	2000	2000
Seasonal factor	Medium	High	Medium	Low	High	Medium	Medium	Low	High	Medium	High	Low
Peak season	Hot	Wet	Hot		Dry	Wet	Hot	Wet	Wet	Hot	Wet	
Koran school		1		1	1	1				1	1	1
Formal School		1		0	1	0				1	1	[illegible]
Interm school		0		0	1	0				0	0	0
Health Centre		0		0	Hosp	room				1	1	0
Operational		-		-	+	+				+	+	-
Disease ranking												
Malaria		10		10	8	10					10	10
TB/Coughing/		9				6					no	9
Anaemia		6			10	7					8	6
Hepatitus				9	7							5
Kidney						5						
Blood pressure						4						
Diarrhoea		8		<	9	9					9	4
Constipation												
Skin		7										
Reuma				8		8						
Malnourishment				6								
Others				Eyes 7	Snakes						snakes	Measles 8
Economic Sources												
Livestock	+	+	+	o	+	+	o	+	+	++	++	+
Frankinsence	-	++		-	-	+	-	-		o	-	++
Agriculture	-			-	+		Poultry	o		+	?	
Fishery	-			++	-		-	-		-	-	
Commerce	+		+		+	o	+	+		+	-	
Migrant Labour	+				+		+	+		+	+	+
Rich/poor appearance	Rich	Medium	Medium	Poor	Rich	Poor	Rich	Medium	Medium	Poor	Medium	Poor>Rich
Main water source	Borehole	Well	Boreholes	dug pits	Springs	Seas pool	Borehole	Borehole	Berkads	Borehole	Sh. pits	Seas pool
Number berkads	?	0	?	0	0	2	10		3	?	1 war	30

Village	Afxarago	Armoyin	Ba'ad Bur Gaben	Balli Dhidin	Balli Wa'atay	Bander Bayla	BOSASO	Buq	Dalwayn	Dhadar Villages	Dhahar	Dharjale	Dhudo
District	Qandala	Bosaso	Bosaso	Qandala	Qandala	B Bayla	Bosaso	Iskushuban	Gardo	Qandala	(NW-Somalia	Iskushuban	B Bayla
Altitude	660	700	3	590	540	5	5	310	700	±1400	930	355	300
Importance	Start valley	Tarmac R Displaced	Coast History	District function	Foot Mountains	Coast Water	Regional function	Water	Tarmac R	Mountain Historical	Grazing	Road Resettlemnt	Water
Founded	1969	1993	Old	old	± 1900	old	old	old	1960	1962	1965	1993	old
Houses	82	25	35	250	150	280	5000	60	30	(300)	120	50	160
Est. Population	1640	500	350	5000	3000	5600	40000	1200	1600	(6000)	3600	1000	3200
Seasonal factor	High	Low	High	High	High		Med	Low	High	High	High	Low	High
Peak season	Hot		Wet	Hot -	Hot		Wet		Hot	Wet	Dry		Dry
Koran school	1		0	4						3		1	1
Formal School	Tree		0	1						3		1	1
Interm school	0		0	0						0		0	0
Health Centre	0		0	1			Hospital			1		1	1
Operational	-		-	-						-		+	+
Disease ranking													
Malaria	10		10	10		<		10	10	9			10
TB/Coughing/	8			7		8			9	10			9
Anaemia	7		9	6		9			8				
Hepatitus	9			9		7				8		++	8
Kidney				5									
Blood pressure													
Diarrhoea	6		-	8		6			6	7			7
Constipation				4									
Skin										6			
Reuma	7												
Malnourishment									7				
Others				Eyes		gastr							
Economic Sources													
Livestock	+	+	++	+		+		+	++	+	++	+	++
Frankinsence	+		+++	+		-			-	+		++	-
Agriculture								+	-			-	o
Fishery			+			++	+		-			-	o
Commerce		+		o			++		+			+	o
Migrant Labour	o	+		+	++				+	++		+	
Rich/poor appearance	Rich	Poor	Poor	Rich	Poor	Medium	Medium	Medium	Rich	Rich; 1 Poo	Rich	Poor	Rich
Main water source	Berkads	Berkads	Far spring	Berkads	Berkads	Spring	Boreholes	Spring	Berkads	Berkads	Borehole	Berkads	Spring
Berkads	30	5	(1)	96	30	0	0	0	26	42		?	0

ANNEX IV: VILLAGE WATER DATA **SAWA/SPDS BARI WATER REH**

Village	Sherbi	Timirshe	QANDALA	Qodax/ Xumbeis	Rako	Ufayn	Unuun	Wa'eye	Xafun	Xamurre	Xiddo
District	Gardo	Iskushuban	Qandala	B.Bayla	Iskushuban	Bosaso	Qandala	Gardo	Iskushuban	Iskushuban	Gardo
Altitude	860	310	5	560	710	440	510	920	2	290	940
Houses	250	150	400	30	160	350	80	150	200	60	120
Est. Population	5000	3000	8000	600	3200	7000	1600	3000	2000	1200	2400
Seasonal factor		Med	High	High	High	High	High	High		Low	High
Peak season		Hot+Dry	Wet	Wet	Dry	Hot	Hot	Hot			Hot
Main water source	Berkads	Borehole	Borehole	Berkads	Borehole	Spring	Berkads	Berkads	well	Well	Berkads
Berkads											
Lined		10		37	40+	0	35	47		0	59
Unlined		7		15			10	0			0
Communal							1	2			1
Total	73	17		52	40+	0	46	49		0	60
Perc. broken	13%			10%	5%		14%	?			?
Storage period		2 month			2-3 m		1-2 mnth				
Observations											
Wells & springs	No	Borehole	Borehole	Borehole	Borehole	Spring	No	Borehole	Well	Open well	Borehole
Type		Western G	American	Old	Old	AGIP		Aquater	Protected	Traditional	Old
Status		Handpump leaking	system worn out	Abandoned in 1963	Pump blocked	Flowing Worn out		Demolished Stones	Reasonable	No protect	Pump rem. Stones
Distance village (m)		100 m	12000		200	11,400		3320	1,800 m	800 m	0
Quantity (m3/h)		o	o	-	+ (20)	+		?	o	o	o
Quality (EC in uS/cm)		+ (1700)	+		- (4000)	+ (800)		?	- (3750)	+ (500)	o
Seasonality		permanent	permanent		permanent pk 4000 m3/d	permanent			?	permenent	
Operator		Yes	yes		2	yes					
Water Ctee		Yes	yes		yes	yes		no		No	no
Cost small Berkad US$											9,000
Cost tanker US$/m3							19	18-27			-
Selling custom	external	all				external	Not	external		no	all
Price berkad w US$/m3	2.7							2.7			0.9-1.4
Price boreh w US$/m3		1.8	3.75								
Price spring w US$/m3						1.8-2.7					
Observations		Queing + other borehole at 12 km	Aquater dist bh Looted	< Q		Also House tariff ± 0.1 $/m3				Well in tog	Pump re-moved in 1989 < Q

Boreholes

Nr	Location	Driller	Yr	Source	Date info	Geol Form	Alt. masl	Depth bh	Depth wl	Piezo masl	Yield m3/h	Spec Yld m3/h/m	EC * µS/cm	TDS mg/l	Other observations	April 1995
	Gardo															
B1	Old bh	Gvt	57	Fai286	4/57	Kk	700	90	30	670	0.8		1750			abandoned
				Fai286	5/62	Kk							1800			
B2	College I	Gvt	-61	Fai286	1961	Kk	700	186	110	590	8					abandoned
B3	Xorgoble	Gvt	old	Fai286	1973	Kk	700	193	153	547	18				Fl=2.4 mg/l	abandoned
				Fai286	11/80	Kk									SO4=2000 mg/l	
B4	Xingood	Gvt	76	Fai286	2/81	Kk	700	200	139	561	20		3394			Operating; reh. pump/gen
				Fai286	8/82	Kk							3050			
				Vet125	11/92		700		90	610	15		4113>6380		pH7.4; FC=0,TU=0	
				Hart44	6/94			254			8		1750			
B5	GTZ-1 - Xingoole	GTZ	81	Fai286	9/81	Kk	700	240	143	557	15	1.50	3500		SO4>Cl;Ca>Mg	abandoned; needs reh
															KD=4.7-5.3; Ys=0.92 at 20m3/h	
				Fai286											Confined: 1861128	
				Fai286	11/80										SO4=888 mg/l	
B6	GTZ-3	GTZ	81	Fai286	10/81	Kk	700	240	143	557	42	1.62	2950-5000		SO4>Cl;Ca>Mg	abandoned
															GTZ2 collapsed; 252 m; Wl 148	
B7	GTZ Kawane			Vet125	11/92	Kk	700	200	80	620	15		5600		pH=6.8; FC=0;TU=15	Operating; needs gen/pump reh
B8	Xingalool	Chinese	84	Fai118	1986	Kk	700	113	60	640	6.6	0.43		3300	Cl>SO4;Ca>Mg scr 30-113!	abandoned
				Fai118	1986	Kk								4402	Fluor=2.4 mg/l	
B9	College II	Chinese	84	Fai118	1986	Kk	700	223	139	561	1.96	0.20		1630	Cl>SO4;Ca>Mg scr 122-222!	Bh needs rehabilitated
B10	"Gardo-Chinese"	Chinese	84	Fai118	1986	Kk	700	186	110	590						
B11	Adinsone	Gvt	old	Fai118	1986	Kk	750	174	154	596	2.2			3550	Cl>SO4;Ca>Na	
B12	Adinsone	Chinese	84	Fai118	1986	Kk	750	220	139	611	1.35	0.09		1640		Operating with problemsBh running
B13	Rako Raaxo 58	Gvt/It	58	Fai118	1986	Kk>Tx	710	420	298	412			4000		Tx at 310; water rose to 298	Not operating since 91; leaking
B14	Xumbaya/Qodmo	Gvt	61	FAi118	1986	Kk	560	215	142	418	0.8		3800			Abandoned 1963
B15	Jiddad 58	Gvt	58	Fai119	1986	Kk>Tx	610	320	174	436	3	0.30		4570	Tx at 285; Wl ! 174	Abandoned
B16	Jiddad	Chinese	84													Operating with problems
B17	Ceel Buh	Gvt		Fai118	1986	Kk?Tx	550	200	132	418	1.8	0.12				?
B18	Ceel Buh	Chinese	84	Fai118	1986	Kk?Tx	550	213	137	413	1.64	0.04		1730		?
B19	Usguray	Gvt		Fai118	1986	196Kk!	600	260						8000	Cl>SO4	Abandoned
B20	Qoton	AGIP	59	VET	1992"	Hf	290	180			good		good			Still open for nomads
				oral BB	1995	Qal	290	8	5	285						
B21	"BBeyla"	AGIP	59	VET	1992"	Hf	290	195			good		good			Abandoned

*: VETAID measurements are a factor 1.5 higher

Nr	Location	Driller	Yr	Source info	Date	Geol Form	Alt. masl	Depth bh	Depth wl	Piezo masl	Yield m3/h	Spec Yld m3/h/m	EC µS/cm	TDS mg/l	Other observations	April 1995
B22	Dhahar	Chinese	84	Fai118	1986	Kk	930	165	102	828	8.33			1100	Cl>HCO;Mg>Na	Pump broken 3/95
				Fai118	1986	Kk								1956		
B23	Buran			Fai118	1986	Kk	1000	139	118	882	4.5			1320		
B24	Gudad	Chinese	84	Fai118	1986	Kk	790	230	128	662	2.45	0.10		1610	Cl>HCO3;Ca>mg	Abandoned
B25	Xiddo	Gvt		oral	1995	Kk	940	230			little					Abandoned/stones
B26	Wa'iye	Saces	88	map		Kk	920	251	180	740						Abandoned/stones
B27	km 150	Saces	88	map		Kk?	820	402	78	742						Abandoned/stones
B28	km 142 (Sacescamp)	Saces	88	map		Kk?	800	402	208	592			3620		Aquater system for Dalweyn	Abandoned/stones
B29	Dalweyn/km137	Saces	88	map		Kk/Hf	770	270	164	606						Abandoned/stones
B30	km125	Saces	88	map		Kk/Hf	710	150	72	638						Abandoned/stones
B31	Jurille PP3	Saces	88	Aquater	1988	Kk/Hf	700	281	109	591	8.64		1358			Pump broken 1/95
B32	km118	Saces	88	map		Kk/Hf	700	200	64	636						Abandoned/stones
B33	Armoyin/km102	Saces	88	map		Kk/Hf	700	320	66	634						Abandoned/stones
B34	Ceel Dofar PS2	Saces	88	Aquater	1988	Hf(Kk)	670	180	20	650	20.88		2320			Operating
B35	Jingidda	Saces	88	map		Hf	580	125	75	505	14.94		3200			Pump/gen problems
B36	Kala Bayer/ km54	Saces	88	map		Hf	480	283	88	392						Abandoned/stones
B37	km47	Saces	88	map		Hf	440	127	52	388						Abandoned/stones
			88													
B38	Kod Dhehaad	Aquater	88	SAWA	1995	Hf	480	188					2600		Pump at 159	Operating/leakage
B39	Meladeen			Fai123	1986	Hf	375	220					high			
B40	Daan Meladeen		88	Fai123	1986	Hf	375	175	47	313			high			
B41	Meladeen	Western	89	oral	1995	Hf	375	45	21	354	little		7800			Poor handpump
B42	Dawa Aley	Aquater	88	Aqu/map	1988	Hf	470		235	235			810			Pump broken 3/1995
			88	SAWA	1995	Au?	470		>209							
B43	Timirshe	Western	89	oral	1995	Hf/con	310	75	35	275			1700			Handpump
B44	Timirshe/Labadhumood	Western	89													Abandoned/stones
B45	B.Dhiddin	Aquater	88	oral	1995	Kk					too little					Abandoned; <Q
B46	Ismadeqa	Aquater	88	Aquater	1988	Hf>kk							618			Abandoned; gen safe
				Oral	1995	Hf>kk	190		280		good		good			
B47	El Gaal	Aquater	88	oral	1995	Qal	300	<20								Abandoned
B48	Hurdio	AGIP	59	oral AA	1995	Hf							poor			Abandoned
B49	Xanda/Hurdio old	Italian	12	SAWA	1995	Qal	5	5	3	2			1350			Still in use
B50	Xanda/Hurdio new	Aquater	88	oral	1995	Qal	7	<20								Abandoned
Bosaso																
B51	P? low togga well	Aquater	89	SAWA		Qal	5		2				940			Abandoned (THW)
B52	PP1	Aquater	89	Aquater	89	Qal	12	20	9.22	5.78	16	112	2180		(SAWA 1800)	Abandoned
				SAWA	95								2000			
B53	PW1	Aquater	89	Aquater		Qal	17	19	15.79	4.21	4.32	1.82	1250			

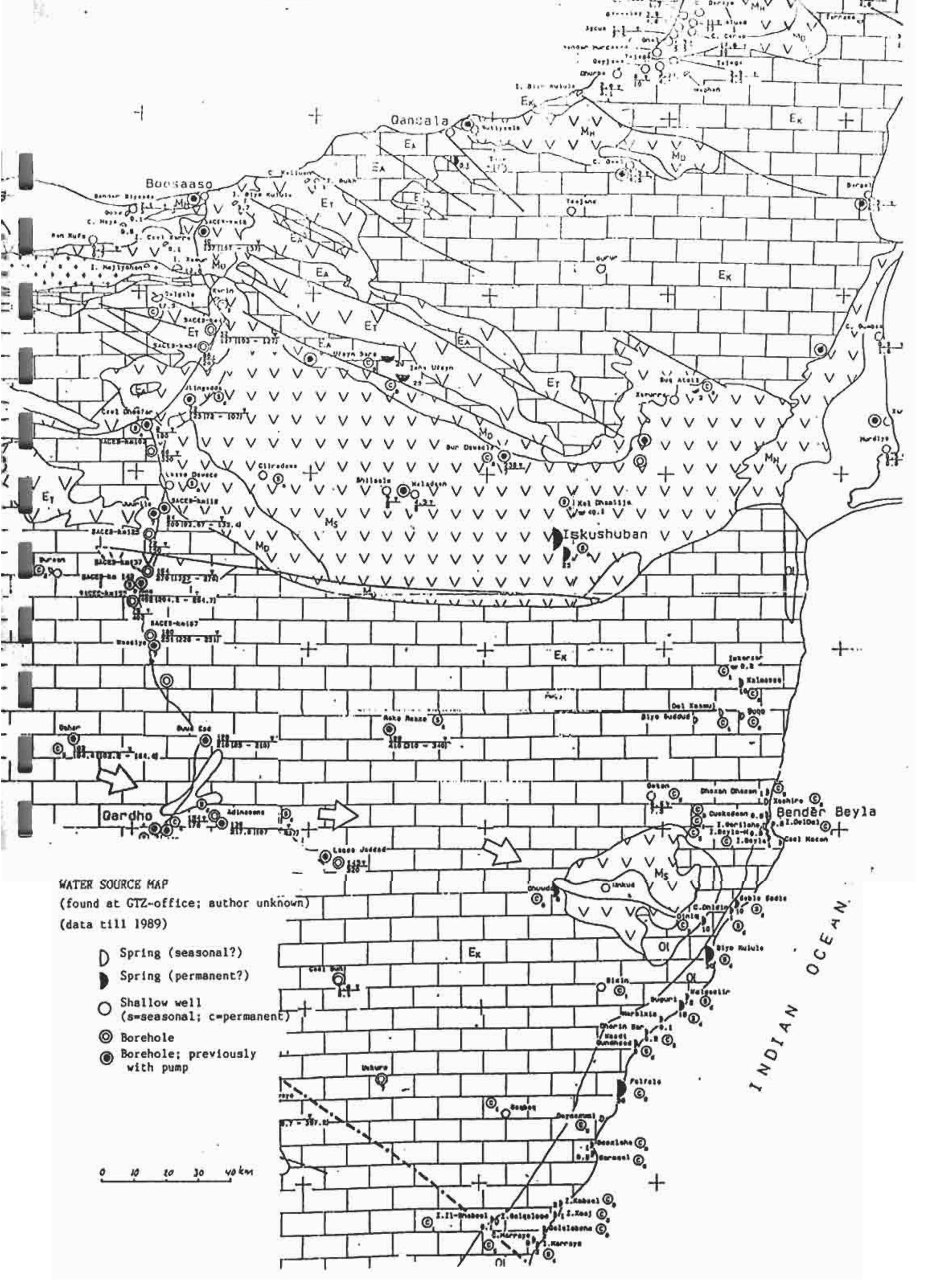
Shallow wells

		Source	Date	Geol Form	Alt	WL	Q	T	EC	Observations
W1	Bander Bayla	Fai042	1986	Hf/Qa					500	50%CO;70%Ca
W2	Hordio	Fai042	1986	Hf/Qa					4100	82%Cl;20%Na/K
		SAWA		Qd					2100-4800	
W3	Xafun	SAWA	1995	Qal					3850	
W4	Xafun	oral	1995	Qd					""sweeter"	
W5	Jambalusi; 12 km E of Ismadaqa	oral	1995	Qal/Hf					Salty	permanent
W6	Bargal	Fai042	1986	Hf/Qa						50%Cl;50%CO;50%Ca;50%Na
W7	El Buq ?Tog?	Fai114	1986	Qgyp					2725	90%SO4/Ca
		Vet119	11/92				low			Clay tog floor; column +6m
W8	Toggas 70 km NE Iskut	Fai127	1986	Qal					±500	
W9	God-dhurwa; 7 km E of Mel	Fai127	1986	Qal					3800	permanent
		Vet130	11/92	Qal					2700-3400	
W10	Meladeen	Fai125	1986	Qal						toggas with trees; Qal coarse
	Meladeen	Vet131	11/92	Qal					3850	
	Meladeen - flood pool	SAWA	4/95	Qal					2200	For surface water pool high; gypsum
W11	Shiilaale; 12 km W of Mel	Fai125	1986	Qal						permenent; toggas with trees; Qal coarse
W12	Uusgure	Vet120	11/92	Qal						2 months water
W13	Gardo/Kawane; 25 wells	Vet124	1992	Kk/gy			low			5-6m deep;permanent
W14	Laas Daawa; restaurant	SAWA	4/95	Qal					3600	NO3 = 35-50
W15	Elayu/pool	SAWA	1995	Qal					1500	
W16	Bosaso	Fai	1986	Qcalc	2-15					see map 1970 Faillace report
W17	Bosaso	SAWA	1995	Qcalc	3				2850	NO3 = 35-50
W18	Bosaso	SAWA	1995	Qcalc	2				3800	NO3 = 20-35

Springs

		Source	Date	Form	Ql/s	T	EC	Observation
S1	Isha Ufeyn	Fai076	1970	Au	15-39			
		SAWA	1995	Au			790	NO3<10
S2	Isha Ufeyn Sare	Fai077	1970	Au	30			
S3	Gaha	Fai077	1970	Au	>80			
S4	Galgalo	Fai077	1970	Au	8-17		390	Cl+SO/Ca
S5	Karin	Fai078/1	1970	Au/Tx	8-10		1300	SO4>HCO3;Ca>Mg; SAWA EC=1100
S6	Midisho ?	Fai078	1970	Au	21			
S7	Hot spring Bosaso	SAWA	1995			55 C	9000	
S8	Ba'ad	SAWA	1995	Kk?	>20		500	
S9	Buran	Fai119	1970	Kk	2.8		1900	Cl/Mg
S10	Iskushuban spring	Fai037	1986	Hf			2300	95%SO4;75%Ca
	Iskushiban/T.Dhut	Fai126	1986	Hf	3-7		2000	SO4>Cl;Ca>Mg; SAWA EC = 1800
	Iskushiban/T.Dhut	VET130	11/92	Hf			2740	TU0-3;pH7.8;FC50
	Ishushuban, man's pool	VET 130	11/92				4780	SAWA EC = 1800
	Iskushiban/T.Dhut	Hart41	dry s	Hf			1700-2100	
	Iskushiban/T.Dhut	Hart41	6/94	Hf			940	
	Iskushuban/Southern springs	SAWA	4/95	Travertine		32 C	1600-1900	NO4<5
S11	Iskushuban/T.Darror	Fai126	1986	Hf	1-5		3500	SO4>Cl;Ca>Mg
	Iskushuban/T.Darror	VET130	11/92	Hf			3500	
	Iskushiban/Western springs	SAWA	4/95	Travertine			1900	
S12	Jasup/Darror	Fai126	1986	Hf				
S13	Bug Atoti/Darror	Fai126	1986	Hf			<1000	SAWA EC = 960
S14	Dhudo spring	Vet134	11/92	Hf/Qal			2680	pH7.5;TU0;FC2000; SAWA EC=1350
								Tog base flow EC1560
S15	Bander Bayla	Vet133	11/92	Hf	3		5600	pH6.8;TU0;FC0; SAWA EC=2800
S16	Bander Bayla minor spr	Vet 133	11/92	Hf			5500-6500	SAWA EC = 2600 -2800
S17	Eyl	Fai120	1986	Kk?			5000	Cl>SO;Ca>Na
S18	Eyl	Vet143					4470-7400	polluted
	Berkhads							
	Xabeala Reer	Vet126	11/92	Kk			670	pH7.6; TU10; FC2000
	Nabadoon	Vet129	11/92	Kk			422	pH7.5;TU40;FC5
	Meladeen war	SAWA	4/95	Qal			2400	TU: reasonable

NNEX VI: WATER SOURCE MAP



WATER SOURCE MAP
(found at GTZ-office; author unknown)
(data till 1989)

ANNEX VII: DESCRIPTION OF SPRINGS
(source: Faillace)

(i) Isha Ufeyn

Isha Ufeyn (also known as Ufeyn Horse) is located 15 km northeast of Ufeyn village in a canyon of the T. Homboloh, near the outlet of the tug to the Darror Valley.

This karstic spring flows out from a large crack in the Auradu limestone about 2 m from the bed of the canyon. Water is piped from the spring to Ufeyn village by a 4 inch diameter, 15 km long pipeline. The yield of this important spring was estimated at 38.6 l/sec by Popov, ref. 37, but this is probably an overestimation. The Mineraria Somala, the oil company that piped the spring to the valley during the oil drilling exploration in 1958, estimated the amount of water piped to the drilling camps to be 6.9-8.3 l/sec. Since a little less than half of the water flowing from the limestone cracks was piped, a more realistic estimate of the spring yield may be 15 l/sec.

(ii) Isha Ufeyn Sare

This spring is located in a narrow canyon with steep walls, where water flows from five cracks in the Auradu limestone. Popov estimated its yield to be about 30 l/sec. Boulders filling the narrow togga bed prevent camels and cattle from reaching the water site. The only possible way of exploiting this spring is to pipe the water, presently disappearing into the coarse alluvium covering the bottom of the canyon, to the outlet of the canyon. The length of the pipeline is estimated at 4 km. A spring box of 50-60 m3, from where water would be piped to the open plain, should be constructed at the spring site.

(iii) Gaha Spring

This important spring in the Auradu limestone is located about 35 km south-southeast of Boosaaso. It has not been described by geologists, and the information reported below derives from ref. 3, as described by Paolo Teatini, District Commissioner of Boosaso in 1951. Mr. Teatini reported a yield of 80 l/sec 200 m downstream from the spring outflow.

the amount of water decreases progressively downstream and, after 7-8 km, disappears altogether in the alluvial plains where the togga has a very low gradient. A flow measurement in the togga bed about 6 km downstream from the spring site showed a yield of 10 l/sec. The water of this powerful spring is of good quality and could be used both for the Boosaaso water supply and for agricultural purposes.

(iv) Galgalo Spring

Galgalo spring is located about 40 km south-southeast of Boosaaso at an elevation of 875 m a.s.l. It flows out from six points. Its yield was 17.5 l/sec when measured by Popov in August 1970. SOGREAH estimated a flow of 8.3 l/sec in February 1986. Water gushes out from the karstified Auradu limestone. The available land is intensively irrigated; dates and vegetables are the major crops.

(v) Karin Spring

Karin is a well known oasis located about 40 km south of Boosaaso. Water gushes out from several points in the alluvial deposits of a small togga. The impermeable bed of the togga seems to be a limestone conglomerate. The spring yield has been estimated at 8-10 l/sec by several persons (Teatini, Wilson, Faillace, Merlo-Aquater) who visited the spring at different times.

The origin of this spring cluster is not clear. In the Agip map - "Çarta Geologica della Somalia e dell' Ogaden", Karin is located on a Karkar outcrop. According to Aquater "the springs outflow from a faulted positive structure in the Daban Formation. Nearby, apart from the Quaternary and Miocenic sediments, the Auradu limestone formation outcrops too". People using the spring have said that it has a rather stable flow regime and a relatively high yield. Thus, its recharge area must be in the mountainous zone covered by the gypsiferous Taleex Formation and the Auradu Formation. Water from the Karin spring is of the calcium sulphate type, with SO4>HCO3>Cl/Ca>Mg>Na+K. This chemical composition supports the idea that the Karin spring drains the two above-mentioned formations, which outcrop along a large belt dissected by a northwest-southeast fault reaching Karin.

The spring is extensively used for the cultivation of vegetables and date palm groves.