sawa

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BARI WATER REHABILITATION STUDY

Volume II

FINAL REPORT

On request of:
European Union
Somalian Unit
Nairobi

by:
SAWA
SPDS
Ede, September 1995

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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

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FINAL REPORT

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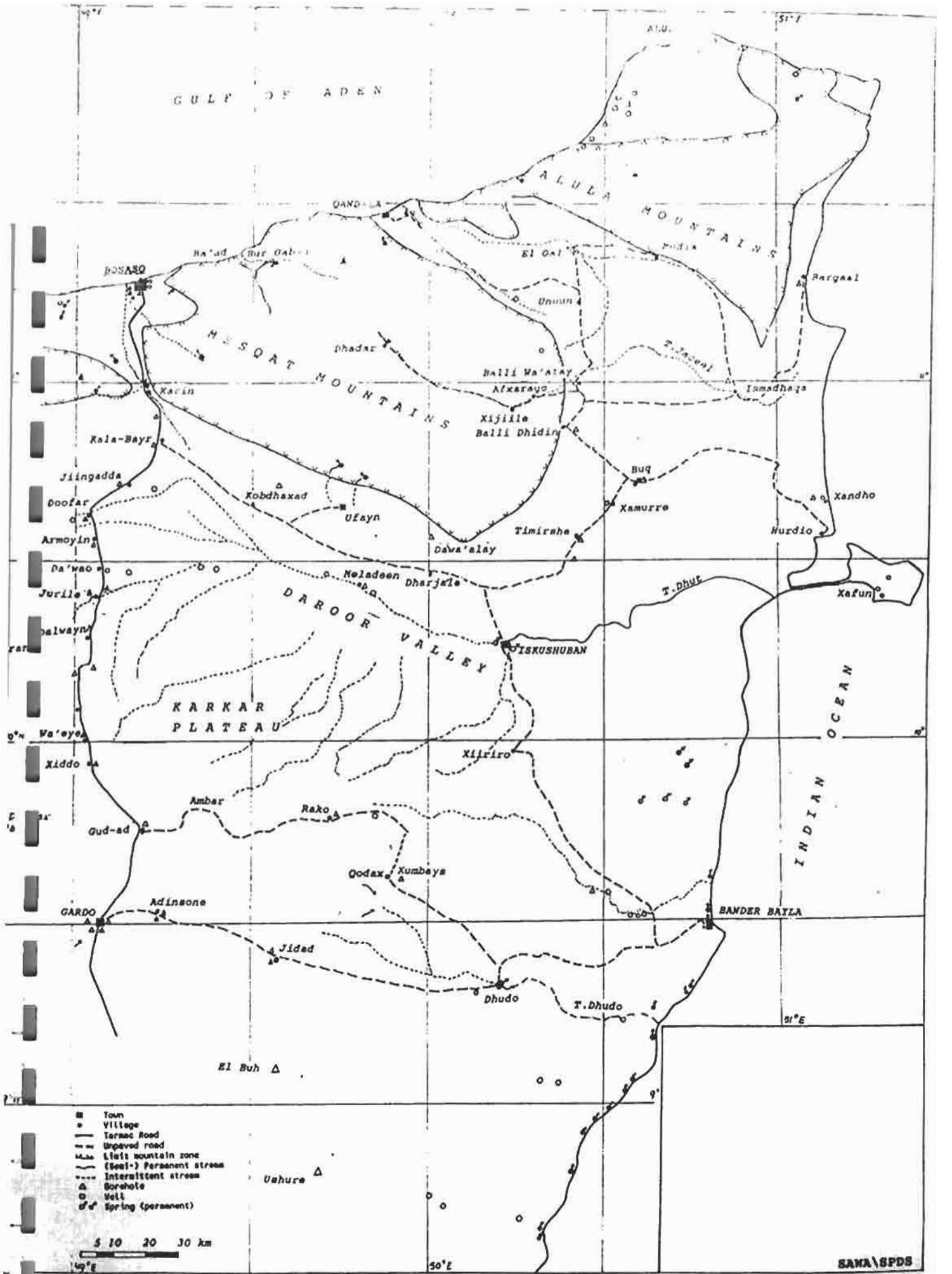
INTRODUCTION

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.

This volume presents the site reports and sketches of the villages and towns visited. All the information gathered is based on interviews and observations made by the study team. Where budgets and materials are summarised it should be clear that these are rough estimates only. The consultant used these figures for comparision, not for project preparation.

Volume I of the study describes the plan for water development in the Bari-region.



WATER REHABILITATION STUDY BARI REGION, SOMALIA,

Armoyin

description

The village of Armoyin is located 93 km from Bosaso in between El dooher and Iskushuban. It is a new village, created in 1993. It is a resettlement place for displaced people, which were living in Bosaso. At the moment, 25 houses were counted.

The village has a village committee, in which also 2 women are represented (20%). Committee members are selected by their input in community efforts. Economic basis of the households is unclear, but they have some livestock and some trading. At the beginning, the villagers got assistance from SPDS.

water supply

At present, the village has only 3 lined and 2 unlined berkads. When these are dry, people are supplied by tankers, which mainly refill the berkads. Last year, they ordered 30 times a tanker (July-September) for which they paid 800,000 to 1,000,000 each (40 drums). People share their money for the payment.

There is a borehole within 800 m from the village, but it is filled with stones. People tried to remove the stones, but had to stop at a depth of 2.5 meter.

request

Villagers made a request to rehabilitate the borehole. The request was already included in the original SAWA/SPDS proposal.

conclusion

The borehole is very deep (320 m), which was not known by the villagers. Water level was originally at 66 m. The water will have a conductivity in between 2000 and 3000 μS.

It is not known whether it will be feasible to rehabilitate the borehole. If stones can be removed till 120 m it will be sufficient. An India Mark II pump will do for the depth of 70 m.

(Afridev not reliable at that depth).

Ba'ad/Bur Gaban

general

Ba'ad and Bur Gaban are 2 related villages along the Gulf of Aden, 30 km East of Bosaso. Ba'ad is an old village, founded before Bosaso. It was destroyed by a cyclone in 1974, and few people still live in the ruined houses (18). Bur Gaban lays at the other side of the togga and counts 21 houses. It has a natural, but unprotected harbour, from which trade starts to Bosaso, Qandala and even the Arabic States.

Main source of income is frankincense, with livestock as a second source. Nowadays, fishery comes on the third place, only. The villages give not the impression of permanent dwellings. Men use it when they bring frankincense to the coast, or when they spend some time on fishing. Women and children are mostly with the livestock in the mountains. Bosaso seems to become the permanent base for the men.

Except for the mosque, there are no other services like schools or a dispensary. Malaria and anaemia are the major diseases; others are not prevalent.

People claim that when water supply is improved, people will resettle in Bur Gaban.

existing water supply

During the rainy season, water is found in pools at a distance of 5 km in the Togga Bukh, coming from the mountains. After the rains, people have to go further (7 km semi-permanent pools and 10 km to a permanent spring). Nowadays, water is collected with camels, but in the past, a lorry was used. Also the herds are partly relying on the spring water.

Instead of going to the pools, many people prefer to buy water in Bosaso and transport it by boat.

Spring water is of good chemical quality (EC = 500 uS/cm), pH = 7.8), but contamination is a risk, even at the highest spring, as many people are living upstream.

request of village

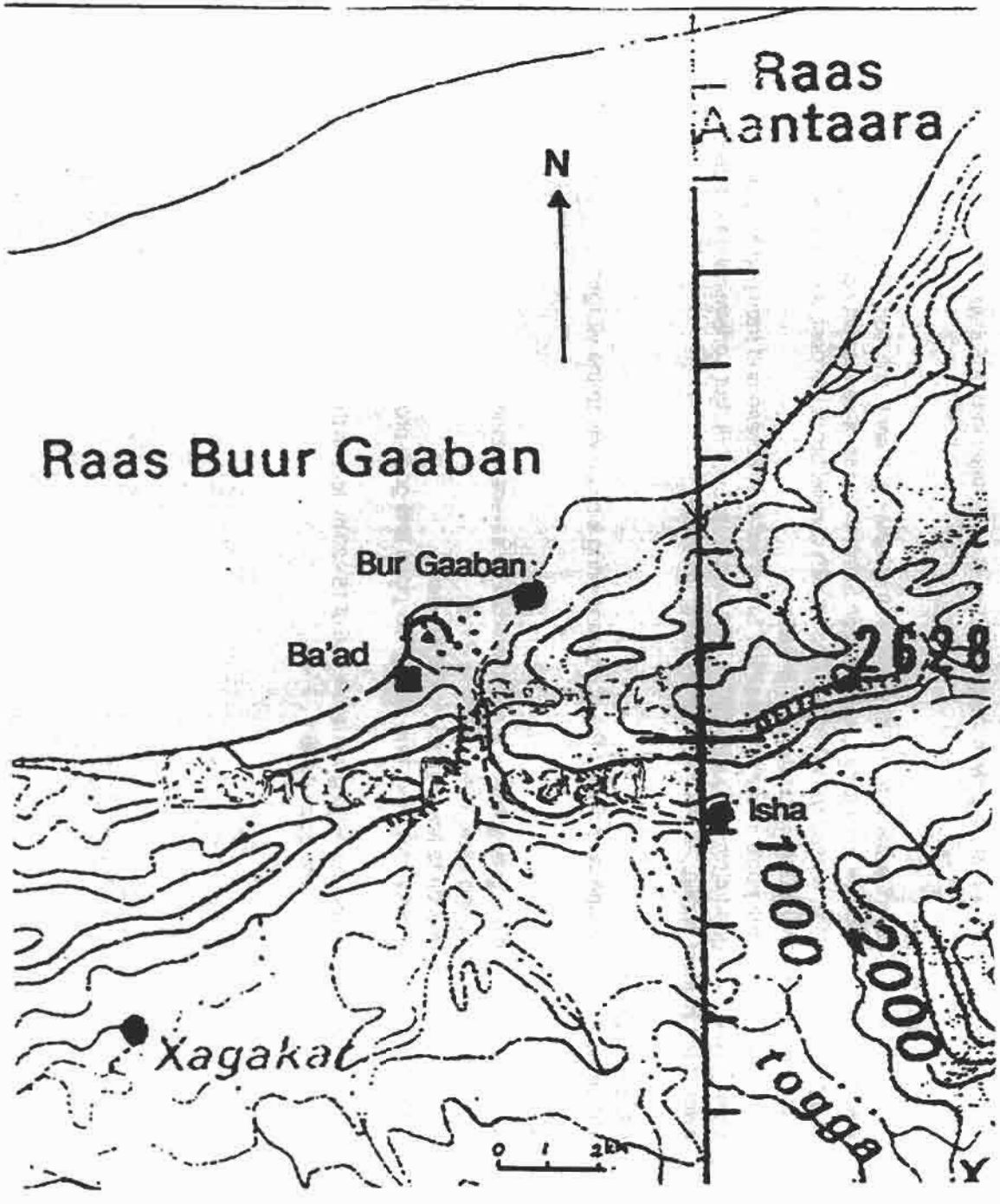
The request of the village is to protect the spring and bring it by gravity to the villages.

conclusions

Spring protection and a gravity supply are not feasible for several reasons:

* flood risks at the spring (max. water height = 3 m)
* long distance in relation to few inhabitants (high costs)
* flood risks along gravity main, requiring strong GS pipes and good protection.

Alternatives can be found by digging a shallow well of 15 - 20 m deep in the togga bed at a protected site on the alluvial fan in the coastal plain.



PLAN BA'AD/
BUR GAABAN
not to scale

Drawn by:
SAWA/SPDS Bari water rehabilitation study

Balli Dhidin

general description

Balli Dhidin is a large village along the Qandala Road, ca 80 km NE of Iskushuba. The former government was preparing the village getting a district function (government buildings, police office etc.). Balli Dhidin is located at the dissected foot slopes of the mountain zone at an elevation of 540 masl.

The village has a rich appearance. It has 4 koranic schools and 1 3-rooms formal school, which is used in 2 cycles. The dispensary is not used, at the moment. Livestock and frankincense are the major sources of income. Seasonal fishery has ceased (no boats) and people say not to rely on migration. The village is one of the major resorts for Qandala citizens during the hot season.

Main diseases are malaria and hepatitis ("a lot"). Other diseases are skin diseases, diarrhoea, "TB", "Blindness", anaemia and constipation. Apart from water their first need is a good supply of medicines.

existing water supply

Balli Dhidin is completely relying on berkads and tanker supply from Buq. It has 76 lined and 20 unlined berkads. Of the lined ones 5 are broken. Failures are found at the side walls, bottom and the connection between them. Mostly, mortar is used between the stones. The ones which have no mortar break easier, they say.

The berkad water is sufficient for 3 to 4 months, except during the hot season (September/October), when the village is crowded When the berkads are exhausted, many people return to Qandala. When the berkads dry, about 15 tankers a week visit the village, which sell the water for 15,000 to 25,000 per drum. People sometimes sell their water to strangers for 2,000 - 5,000/drum.

Aquater made a geophysical survey in 1988 and selected 3 sites. They drilled 5 km SE of the village, but reported the water to be insufficient. Other sources indicate that Aquater moved away, because of troubles. However, it is believed by the consultant that the marly sub-surface might be quiet impermeable.

request of village

Improvement of the water situation. They suggest a new borehole, nearby the village and improvement of berkads (and supply of materials).

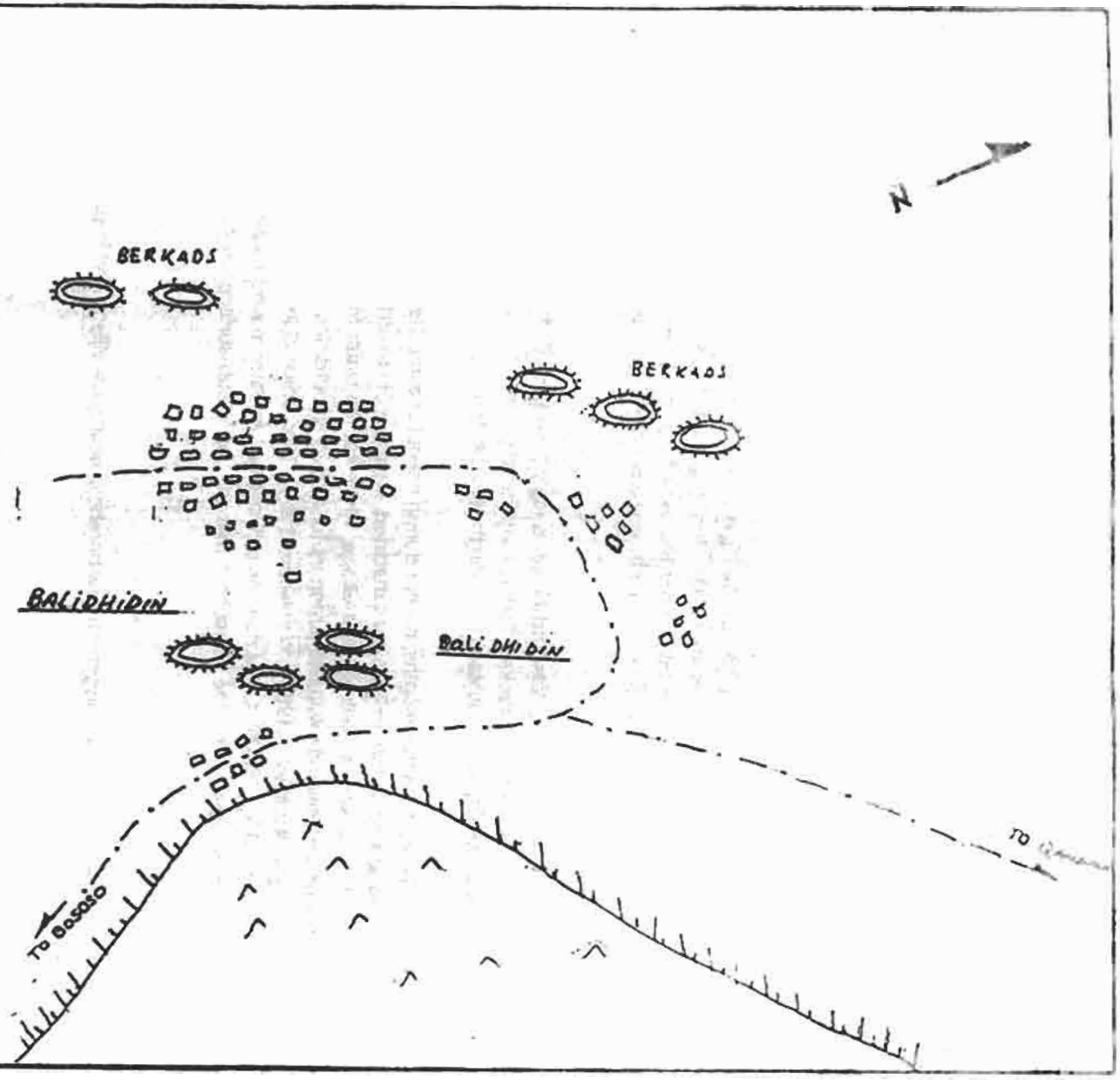
conclusions

The feasibility of a borehole can only be checked from the geophysical and borehole data of Aquater, but prospects are low (deep and little permeable).

Alternatives are almost absent, although there may be sites for surface water dams in the hills. Improved berkads are the short term solution.

PLAN BALLI DHIDIN

not to scale



Drawn by: Said Mohammed
SAWA/SPDS Bari water rehabilitation study

Belli Wa'atay

general description

Belli Wa'atay is found 15 km north of Balli Dhidin, along the Dardola Road. It is situated at 540 masl at the edge of a 3 km wide valley. The togga is 1 km away. The appearance of the village is less wealthy than Balli Dhidin, with many temporary houses. About 150 houses were counted. Few men were found in the village, relying on seasonal migration and frankincense. A school and a dispensary were found, but medical services are not available.

existing water supply

People rely on 30 berkads and tanker supply from Burq.
They never tried to construct a shallow well.

request of village

No.

conclusions

Conditions seem feasible to find shallow (perched) groundwater near the togga bed.

Bander Bayla

general description
Bander Bayla is located at the coast of the Indian Ocean and is a lifely fishery town. It is the capital of the district and it counts 280 houses and is increasing rapidly. The main sources of income are lobster and livestock. The fish they catch is only for consumption, there is no market for it (except for lobster and shark fins). Both men and women are employed in the fishery. Men off shore and women on shore. The main diseases are Anemia, Gastritus, Hepatitis, Rheuma, little Malaria and Diarrhoea (children).

Existing water supply
600 m. north of the town, several small springs emerge out of the rocks 3 m. above sealevel. The capacity of the main spring, which is used for the water supply is 2.5 lps. EC = 2.600 μS/cm, pH = 8, T.H. > 370 mg/l, NO_3^- < 5 mg/l. The smaller springs, used for bathing by the women have a capacity of less than 1 lps and the EC = 2.800 μS/cm.
The main spring was captured for the first time by the italians in 1956. They used a windmill to pump it into town. In 1964 the government installed a motor driven pump which functioned until Aquater came in 1988 and installed a new system without consulting the town. The Aquater system functioned until 1993. The town complained that they were never trained how to operate and maintain this system.
GTZ had agreed about rehabilitation of the system, including a distribution system with 3 standposts. The town wants to support possible works with labour. Not with cash, as they find themselfs to poor to do so. And it is difficult to convince as long as the system is not there. A system to collect revenues and management of the water supply still have to be worked out. They are ready to discuss when the activity starts.

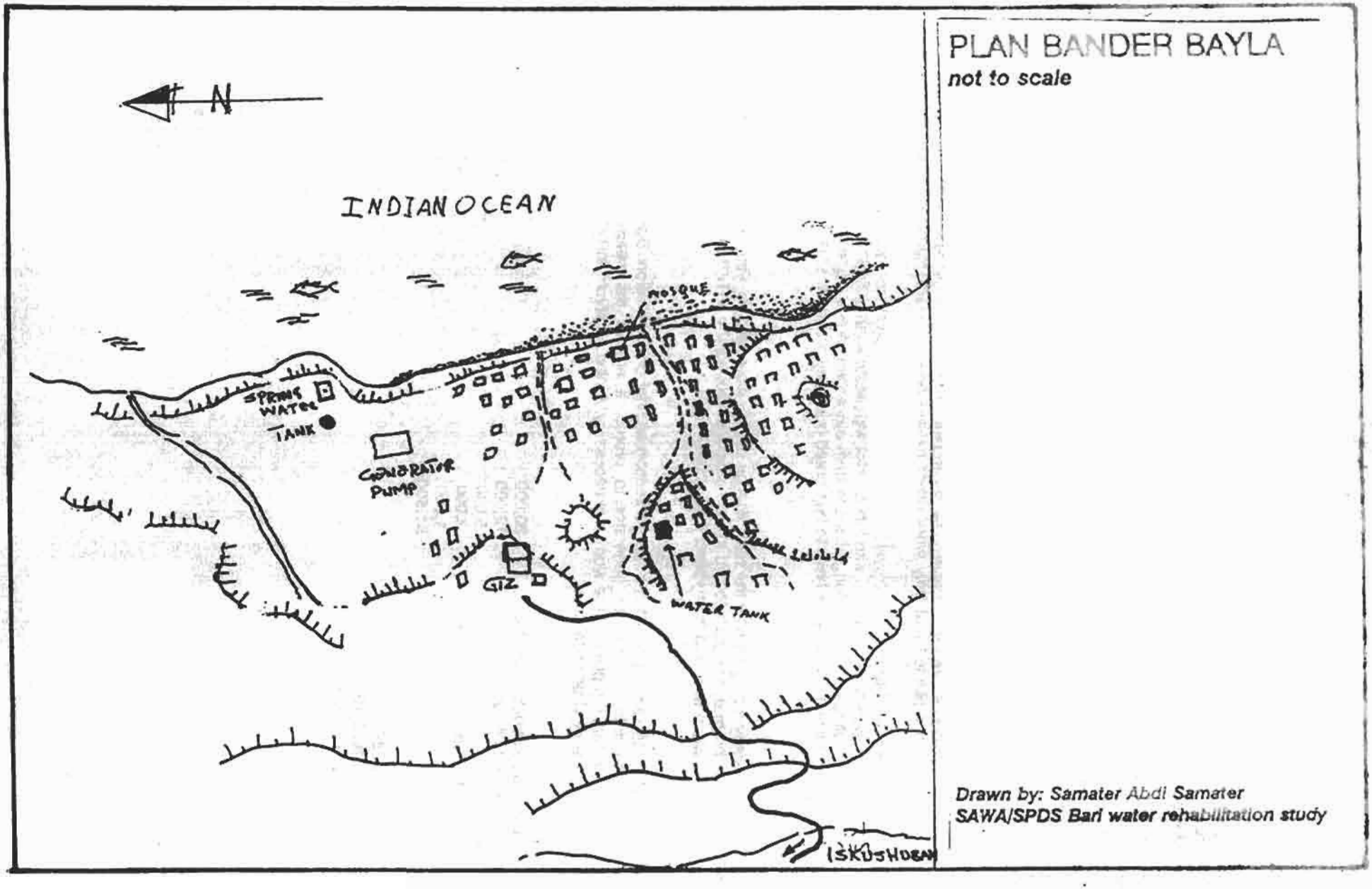
request of village
They are waiting already a long time for the rehabilitation of their water supply. First UNICEF wanted to help them but al the materials were looted in the harbour of Mogadishu. GTZ had already all the materials in Djibouti when they had to suspend their activity.

conclusion
For the rehabilitation the spring needs a better protection against contamination. Special attention should be given to solar pannels or generator to protect it against the seawater. Also an improvemnent of the bathing place of the women is necessary. A new reservoir and distribution net with 3-5 standposts should be installed.

cost estimate

Solar system, submersible pumpa:	30,000
Transportline 1,000 m. 2" GI	12,000
Reservoir 25 c.m.	5,000
Distribution 1,500 m. 50mm HDPE	3,000
3 standposts	1,500
Total	**51,500**

Number of houses: 280
Number of inhabitants: 5,600
Investment costs per capita: 9.2



PLAN BANDER BAYLA

not to scale

Drawn by: Samater Abdi Samater

SAWA/SPDS Bari water rehabilitation study

Bosaso

general description

Bosaso, located in the North of the Bari region, is the region's capital and main trade centre for the Bari-region. Its harbour is the port for the whole North East.

The present population is app. 40,000. Before the collaps of the government it had an estimated population of 15,000 inhabitants. An estimated 1,000 families live in shacks. This increasement is due to the migration of many people from Mogadishu and surroundings during and after the war. The town is almost fysical untouched by the war, with their electricity supply still functioning.

existing water supply

The water supply of Bosaso relies on two sources. The first are three private wells, from which the water is supplied with tankers to the houses. This water is sold for 1,000 SSh/drum.

These wells were originally meant for the farms around these places. With the increase of the town the owners have built up a commercial water business. These wells have a EC of 2,600 and 1,800 μS/cm respectively. The second source are 50 shallow wells, which are spread over the town. 25 of them are improved by UNICEF, THW, SORSO and Africa'70 by covering, putting an apron and a handpump. UNICEF has plans to do 50 more. The quality of these wells can be qualified as poor to bad. The EC ranges from 2,800 to 3,800 μS/cm (close to the sea) and we measured NO_3^- between 20 and 50 mg/l. Because of the high permeability and high density of latrines and defacation in the area, contamination of the wells occurs regularly. The latest outbreak of cholera was in 1994.

In 1989 Aquater drilled three boreholes, in the togga 2km. West of Bosaso and connected them to 50 m^3 reservoirs at the port and South of the hospital. The hospital was supplied with a seperate reservoir. The systems of Aquater were looted when the war broke out. In 1992 THW rehabilitated one borehole and connected one of the reservoirs again. This was done as a quick emergency activity, which caused rivalry with the conclusion that also these facilities were looted.

request of the town

The people of the town, represented by the RDC of Bosaso and the neighbourhood committees asked for a rehabilitation of the town water supply by providing sufficient standposts spread over the town.

conclusions

The regular outbreaks of epidemic diseases as cholera in the town can only be provided by securing safe water to all the citizens. Special the use of the shalow wells as source for drinking water should be discouraged. Therefore a reliable alternative has to be developed. A piped scheme with standposts, which later can be developed in a full distribution system is the best option. Therefore the following activities are necessary:

Technical

The technical activities will include the following:

- the rehabilitation of one borehole, installing a pump 30 m./75 m^3/h and generatorhouse with two generators.
- installation of a main 250 mm transportline (1.2 km.) along the road from the town to the airport
- construction of an elevated water reservoir of (15 m./200 m^3), at the location of the existing water tanks.
- installation of a distribution network with the following pipes:

PVC/HDPE inner diameters Class 10 PN

Diameter	Total Length
37 mm	3000 m.
50 mm	4800 m.
75 mm	4500 m.
100 mm	3500 m.
150 mm	1500 m.
200 mm	500 m.
250 mm	1400 m.

- 60 public standposts with 4 taps each.

- supply of materials for 10% houseconnections
- rehabilitation of office and store

Management
A community-based management will be set up. First discussions with both communities and RDC have taken place during this mission. Bosaso is divided in 30 neighbourhoods, which all have their own committee. Each neighbourhood will establish its own water committee, which will take care of the standposts in their neighbourhood.
A central water committee will be formed to take the overall responsability for administration, O&M and further development of the system.

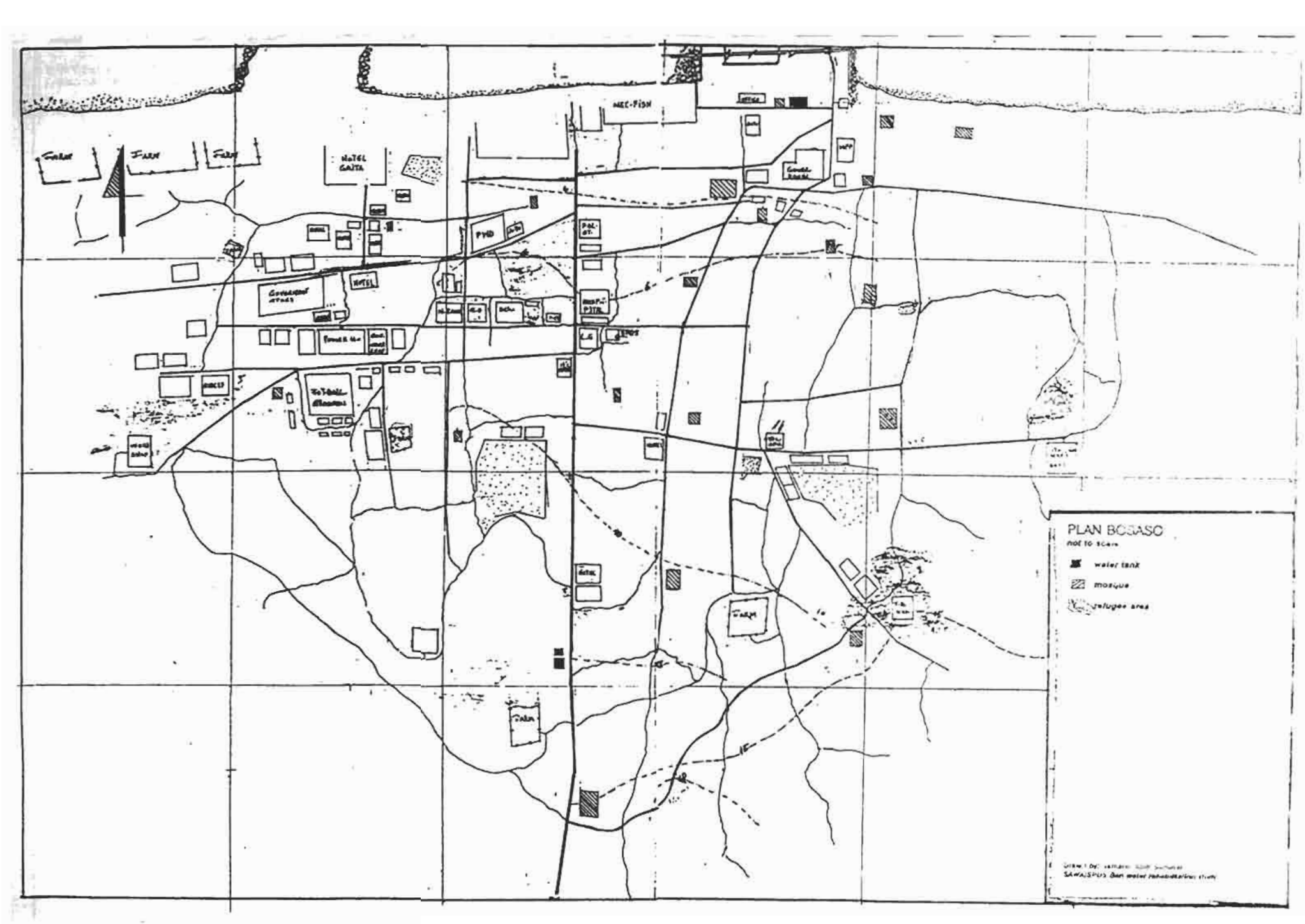
Health and sanitation
A health and sanitation programme, related to water will be conducted. The water committes in the neighbourhoods will play a central role in this programme.

Training
Trainings will be conducted in the following fields:
- technical for operators, caretakers and technicians:
  - * electromechanical training
  - * training of plumbers
  - * preventive maintanance on distribution systems
- administrative and health and sanitation education for watercommittees on neighbourhood level;
- administrative and storemanagement for the cental water committee.

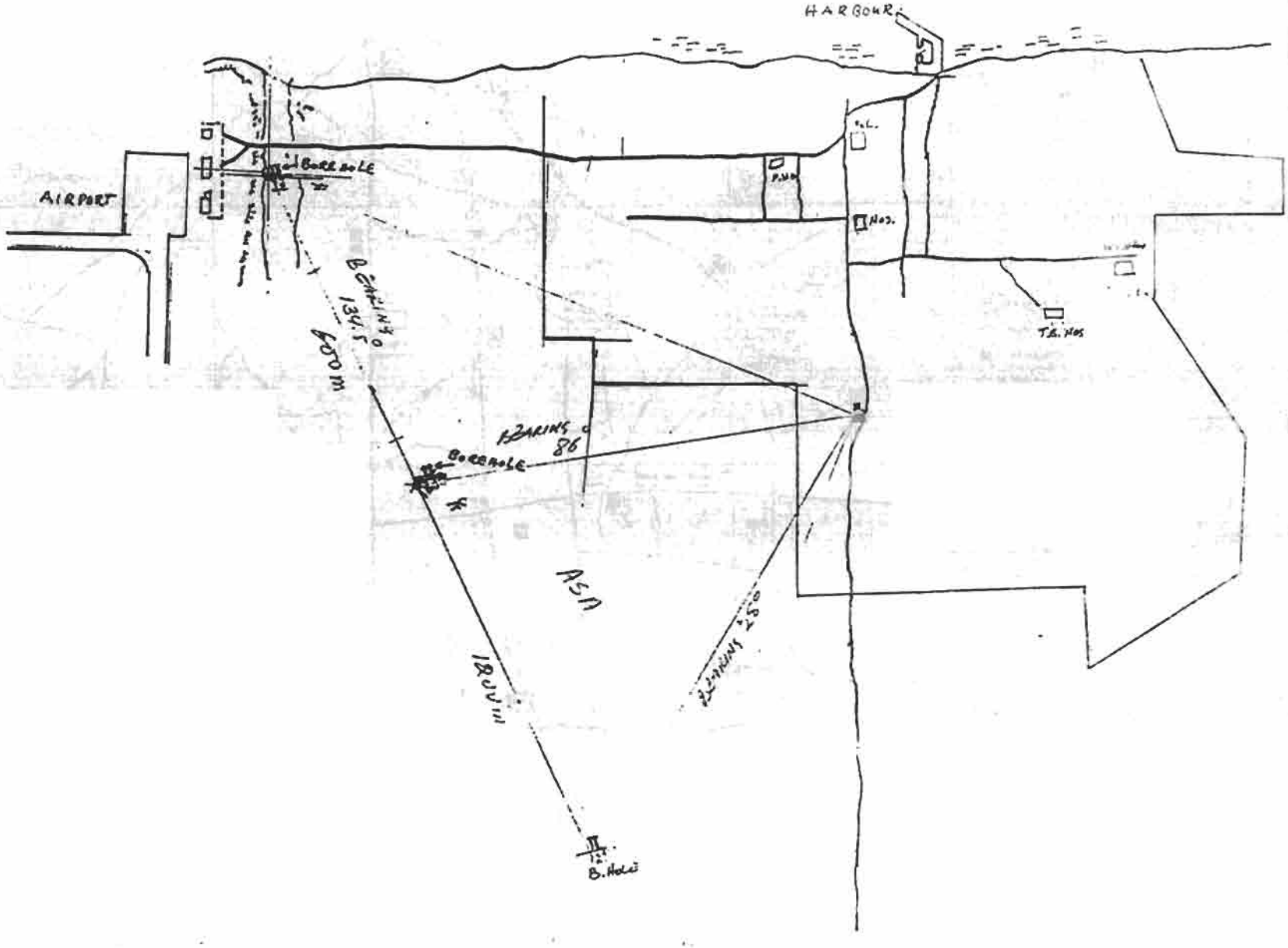
Cost estimate (USD)

Aquater/THW borehole gen.set + pump	60,000
Transportline 1,200 m. 10" D.I.	60,000
1 elevated reservoir	60,000
Distribution 19,200 m.	130,000
60 standposts	30,000
Inst. + house connections	20,000
Store + office	10,000
Total	**370,000**

Number of inhabitants: 40,000
Investment costs per capita: 9.3


PLAN BOSASO
not to scale
water tank
mosque
refugee area

4



PLAN BOSASO AREA
not to scale

Drawn by: Samater Abdi Samater
SAWA/SPDS Bari water rehabilitation study

Buq

general description

The village Buq (3[illegible] m.) is located 79 km. N-E of Iskashuban. It is ancient village situated on a floodplain in the togga. Geological it is on the transition of the Karsar and Hafun formations. It counts 60 houses and has as main source of income livestock and datepalms. The spring is the only permanent water source in a circle of 50 km and tankers and livestock come to fetch water during the dry season. The water is not sold to the tankers.
The main disease they suffer from is malaria.

existing water supply

In the togga several springs are emerging with a total capacity > 30 lps. The place where the people fetch their water has an estimated capacity of 4 lps. The EC = 960 μS/cm, pH = 8, T.H. > 370 mg/l. and NO_3^- = 25 mg/l. The place is at the same time used as drinking point for livestock.

request of village

The main problem the villagers suffer from is flooding. The village itself gets flooded and datepalms are washed away. The second problem is malaria and snakes. The third is that their spring is not protected against contamination. Next to this they would like a channneling of the springwater so they could extend their datepalm farming.

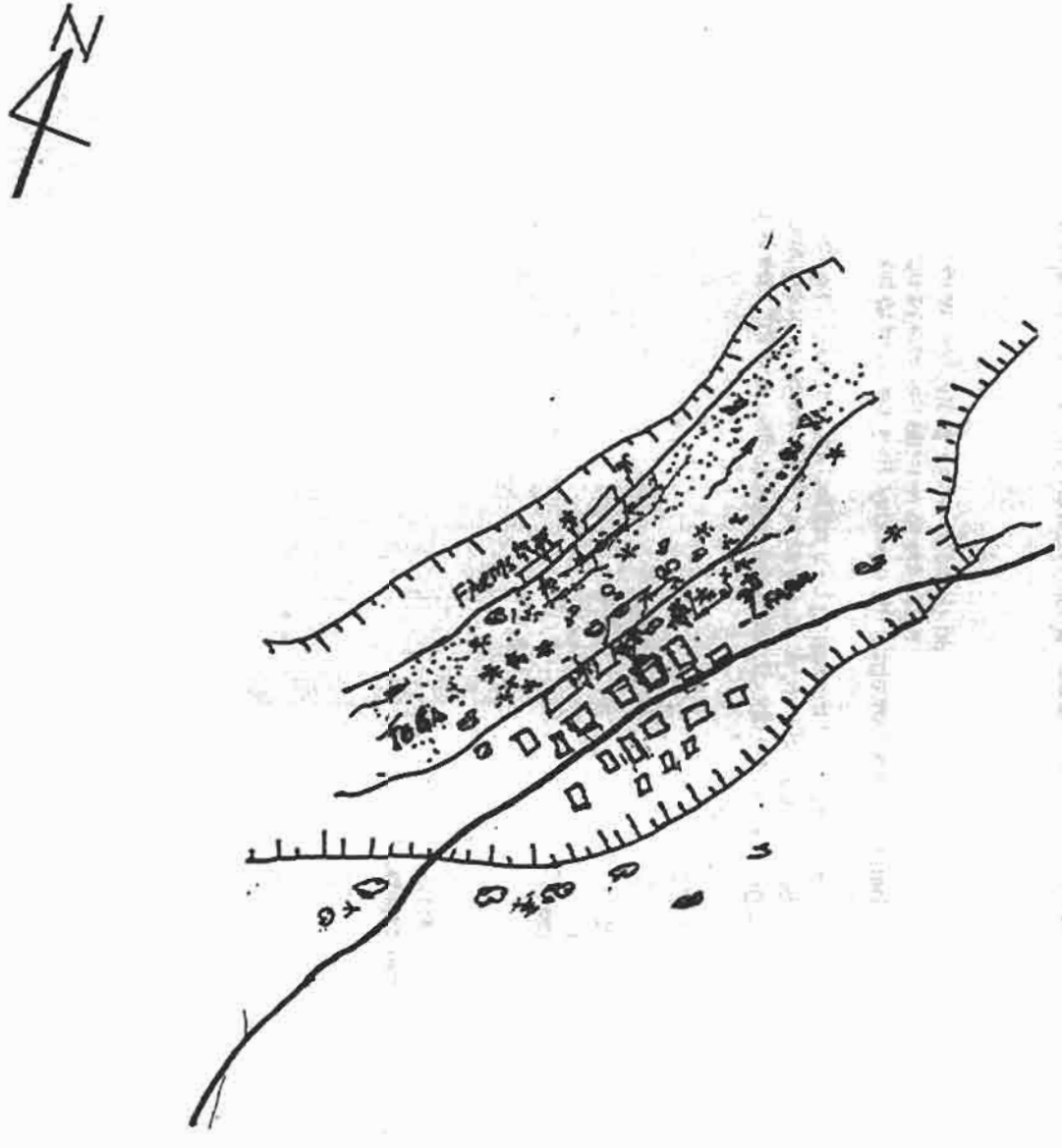
conclusion

We explained that protection against floods would demand major protection works, which can not easily be done. An alternative raised by an elder could be to resettle the village upwards on the hill and pump the water up. When we passed by again the next day, they seemed to be divided over this alternative.
Regarding the water supply a protection of the spring by a springbox and a light petrol pump to bring the water to the village should be considered. A sustainable O&M will be problematic because the people can easily go and get their water directly from the unprotected springs free of costs.

cost estimate

Spring box	3,000
Honda 2" petrol pump	350
plastic hoses 200 m.	200
Reservoir + standpost	5,000
Total	**8,550**

Number of houses: 60
Number of inhabitants: 1200
Investment costs per capita: 7



PLAN BUQ

not to scale

Drawn by: Samater Abdi Samater
SAWA/SPDS Bari water rehabilitation study

Dalwayn

description

Dalwayn lays 126 km south of Bosaso (and [illegible] km north of [illegible]). It is the last village in the Daror Valley before the climb to the Karkar Plateau

The village was founded in 1960 and extended in the 70-ties. At this moment it has about 80 houses. There is variation in habitation. In the driest months, more than 70% of the population moves to other places.

About 10 to 50 herds visit the village every day (3,000 to 15,000 animals).

The village has 1 primary school (3 rooms, of which 1 without roof) and 1 Koranic school (2 rooms). A nurse is stationed in the village and paid by them, just like the teachers.

First illness is malaria ('due to berkeds'), second is coughing and anaemia. Diabetic diseases are also mentioned. Diarrhoea is seasonal and only problematic for children. Death rate for children is not high, according to the (male) elder.

According to the elder, the surrounding marly hills have always been barren. The valley area was destroyed during the road construction, and no shrubs had re-appeared.

water situation

In the early 60-ties, the village didn't have an own water source. People were supplied by camels, coming from El doofar (45 km).

During the road construction in the late 80-ties, 2 boreholes were drilled. One 1.5 km north of the village, the other 6 km South of the village (at the Italian camp). The first was abandoned, although the people believe it had sufficient water, but relatively brackish. At the moment, the borehole is completely filled with stones.

The borehole of the Italian camp was used for the supply of the village. Water was pumped to a 25m3 tank at the top of an artificial hill, south of the town, and distributed to 1 standpost and 1 livestock trough. Unluckily, the operator died from a snake bite and the village could not prevent the theft of the pump and mains in the early 90-ties.

At the moment, the village has 25 private berkads, of which 4 are broken, and 1 unlined communal berkad, which is in disrepair. No action is taken for repair. Berkad water isn't sold to the villagers, but it is to the nomadic herds at a rate of 5000/drum.

Mentioned prices for small lined private berkads is 50 million, and for larger (communal) types 100 million

During 3 months (january/february and october) berkads dry and people have to buy water from the tanker for 10,000 sh/drum.

Many people cannot afford this and move to other places. About 30% stays in the village or even less (10%).

In the mid-eighties, people tried to find alternative solutions. A 35 m deep well was dug near the wadi, but no water was found, yet, and the well had to be filled at the time of road construction.

request

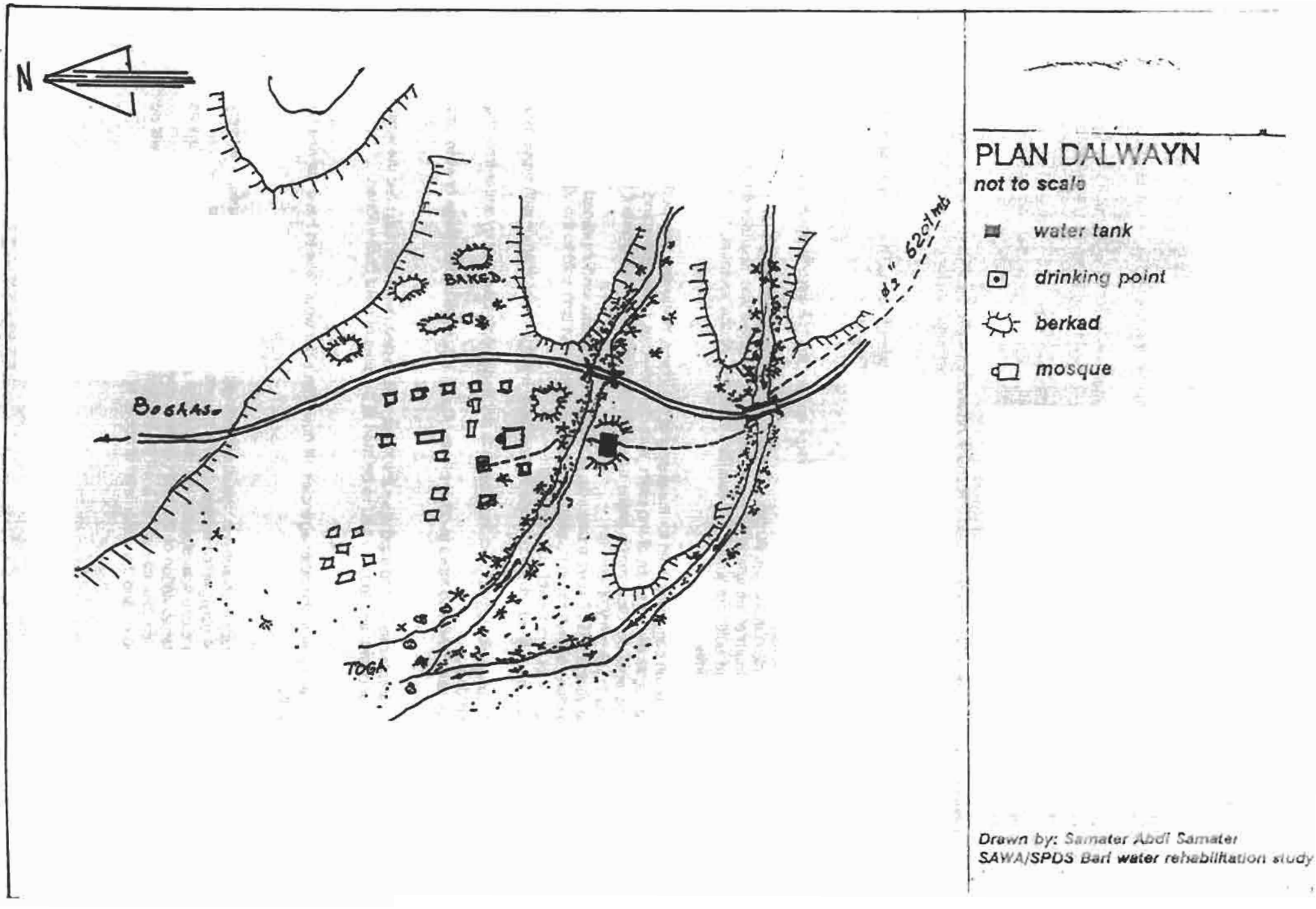
No formal request was made to the other agencies, till now. The elder would like to have the nearby borehole operational.

conclusion

The team evaluated alternative sources in the surroundings. The wadi-bed is bedded in very permeable colluvium (<10% clay), which means that no groundwater dam is feasible.

The borehole at the Italian camp was already too salty (3650 μS), and the second borehole was reported to be the same. Rehabilitation of the 2nd borehole doesn't seem to be feasible.

A new borehole will not be feasible, as well, as it will be brackish (3500-4000 μS), the aquifer will be found between 160 and 280 m, and the water level is about 170-200 m deep.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BAKED.
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62 m/m
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not to scale
water tank
drinking point
berkad
mosque
Drawn by: Samater Abdi Samater
SAWA/SPDS Bari water rehabilitation study

Dhahar

<u>description of the village</u>
Dhahar Village is located just west of the border of Bari Region, about 35 km NW of Gardo. The village is large; 120 houses were counted. The elder claim that about 2,000 people keep residence in the village, but most of them are nomadic and have no permanent stay. The village has a good infra-structure with a mosque, a school and a dispensary.

Dhahar plays a central role in the grazing lands of the south western part of Bari Region, despite of the fact that it isn't located near to the main road. Many herds visit the place. The elder estimate that about 10,000 head of livestock may visit the place on 1 day. The house pattern is organized and dense. People live within an area which is partly protected for floods. Rubbish is found every where around and in the village.

Dhahar is situated in the lowest point of the Haud Plateau. The depression has no external drainage. The village is flooded after heavy rainfall and stays inundated for a period of about 2 weeks. (Invisible) sinkholes drain the depressions and give recharge to the aquifer in the Karkar Formation.

Because of coming rains, the mission had to escape from the place to arrive home, safely. Therefore, the report is not complete.

<u>present water supply</u>
The present water supply is from a borehole (Chinese) and 1 mayor water pool near the borehole. An old borehole, made in the 50-ties by the Italian, is out of use.
The pool is filled with water that is diverted by a dike around the western part of the village. The pool has functioned since colonial rule, but needs to be deepened.
The borehole has a good capacity of 8.3 m3/h at construction. Water level is at 102 m depth. Water quality was good (1100 μS), but at the visit, the 'stagnant' water was two times more salty.
The village has maintained the water supply after 1990, but was unable to solve problems with the generator and pump. In 1993, the generator was replaced by a German NGO, but villagers complain about the reduction in capacity from 75 to 30 kW. The pump (Grundfus, 10A/380V/3,7kW) broke down recently and was replaced by a second hand pump of unknown characteristics, in the first week of April. Since then, the pump can run for a minute before the generator switches off, automatically. Most likely, the pump is of poor quality or is not designed for a water depth of more than 100 meters.
Other water sources are roof-collectors (a few) and berkads (unknown number).

Water from the borehole is sold for $1.1 to $4.5 (Hartung, June 1994). It is not known to who water is sold. In distant villages it was reported that in former days, they bought water from tankers from Dhahar.

<u>requests from the village</u>
Representatives of Dahar had made the request to the mission in the first week in Bosaso. The needs of the village are listed below:
1.Improvement of pumping system in Chinese borehole
2.Construction of a pipe line of 800 m which leads the water from the borehole to a raised place which is not flooded.
3.Diversion of the flow which comes north and east of the village by a dike and construction of a new pool
4.Delivery of materials for roof catchments and storage

<u>analysis</u>
pumping system
The village has proven its ability to run the borehole in a commercial way and has tried to solve the problems by their own means. It is advised to improve the pumping system by replacing the pump and the pump rising mains. The pump should be able to raise 8 m3/h over 150 m. Rising mains are written off. If the generator is not able to fulfil the energy requirements of the new pump, it should be

replaced as well, whereas the old one can be used elsewhere.

flood protected water supply
The need for a flood protected water point is justified. However, no analysis has been made of the feasibility and technical specifications. It is recommended to include a 25m3 raised water tank, a small booster pump and 800 m of 2" HPE.

diversion of flow to new pool
The need seems to be justified. However, the village can be considered to be able to organize labour and technical works themselves. They may request some technical input for a small land survey and a contribution of WFP for a food for work programme.

roof water catchments
Roof water catchment seems to be no economically feasible option in this arid climate, as storage will be a limiting factor and water basins can be considered as a risk for malaria. No follow up is advised for this request.

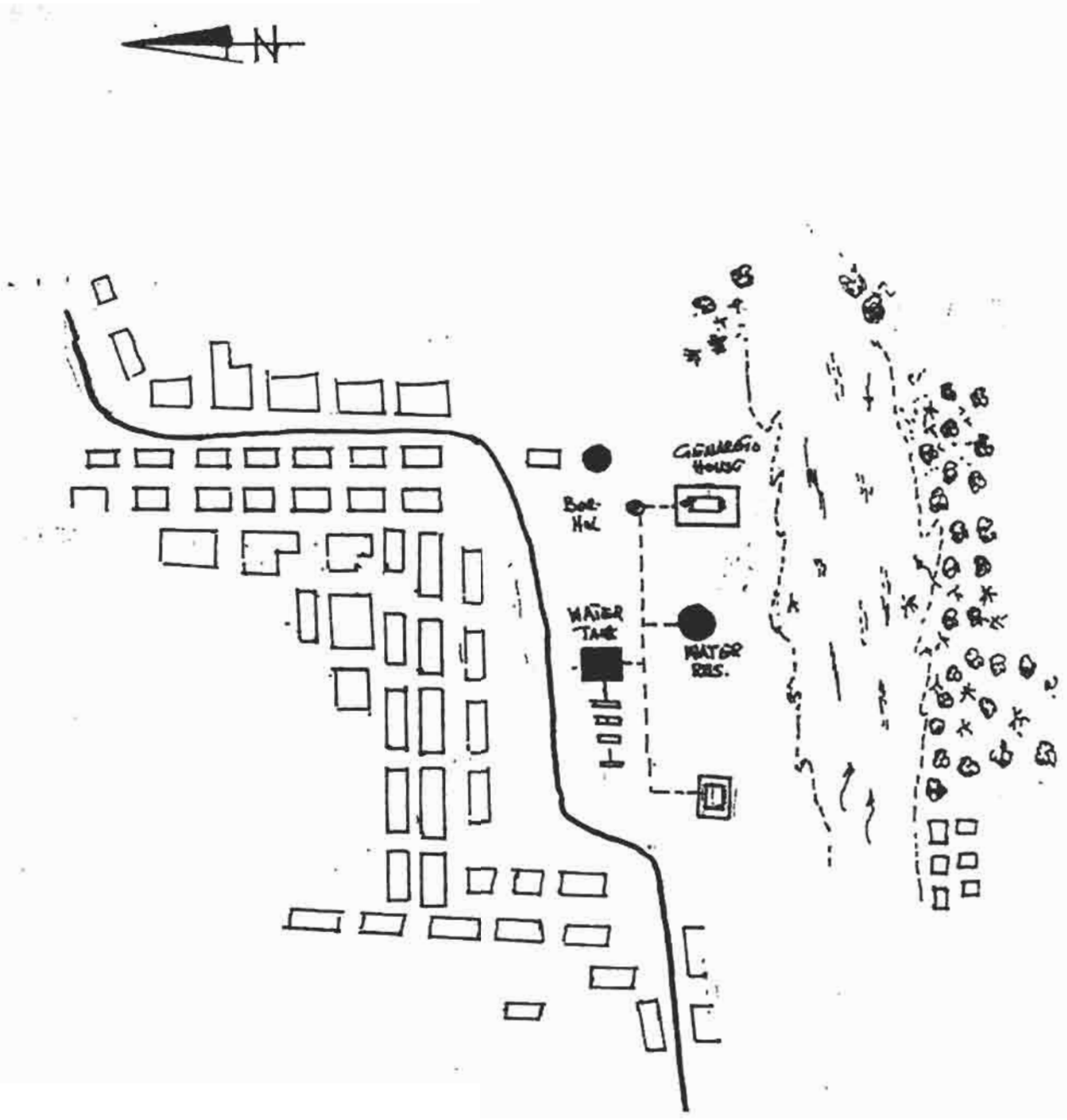
<u>technical specifications</u>

Borehole quality:	
Temp	**30.5 C**
Conductivity	**2300 µS (reservoir)**
pH	**7.5-8.0**
THh	**>370 mg/l CaCO3**

Pump;
original GRUNDFUS

now: unspecified

Generator:	**deutz motor 31,2 kVA/25 kW**
	generator: Stamford 30 kVA



PLAN DHAHAR

not to scale

Drawn by: Samater Abdi Samater
SAWA/SPDS Bari water rehabilitation study

Dharjale, Dawa'alay borehole

general description
The village Darjale (410 m.) is located 154 km. SE of Bosaso. The village counts 30 shacks and has a dispensary, a koranic school and a mosque. Frankincence is their main source of income. The villagers are resettled displaced people, most of 20-40 years old. They got assistance from SPDS and UNICEF for building the village. During night time it is a lively village with trucks stopping for some entertainment. In these frankinsence villages there is labour available as people go for two weeks into the mountains and stay two weeks at home thereafter.

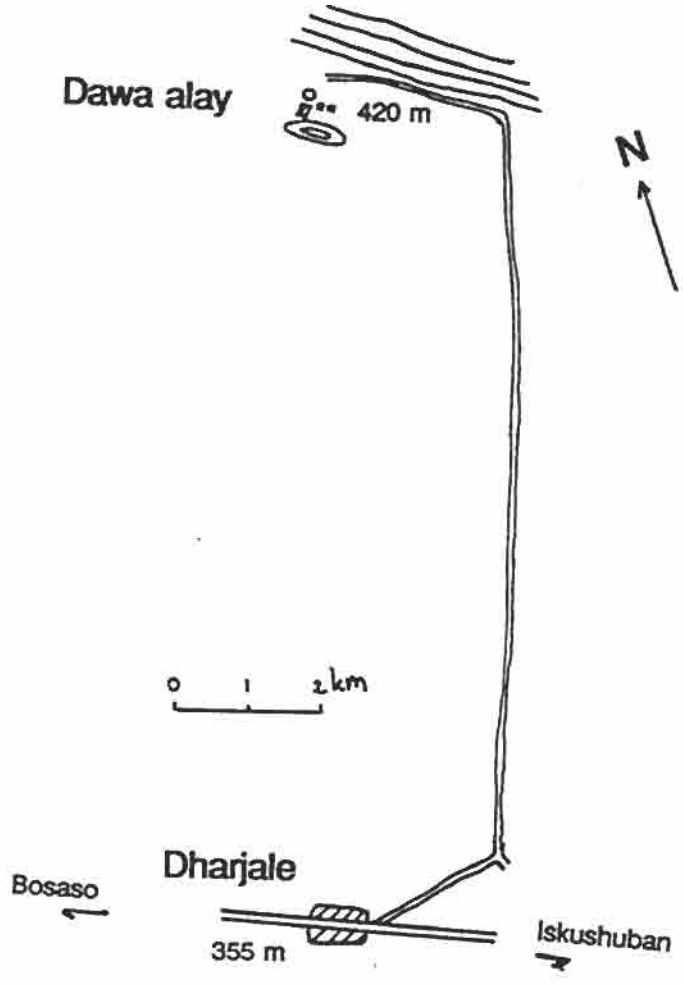
existing watersupply
The village has two sources for their water supply. They have 5 barkads and when these have dried up, they bring the water with a truck from the borehole Dawa'alay (470 m.).
This borehole is located 11 km. to the north. There are a few houses, where also the caretakers live. The depth of the borehole is unknown, the SWL is 209 m. The depth of the pump is 231 m. The EC = 810 μS/cm (information of Aquater) and the capacity is 4m^3/h.
When we arrived the generator was brought away for repair. A few weeks ago they lifted the pump and replaced the motor. For this operation they had to bring a crane from Bosaso which costed them 7,000 USD. We tried to measure the water level in the well, without success. Our sampler took only moist coarse material. Our impression was that the well was dry or the pump placed too high but this could not be verified with certainty.

request of village
The main request of the village was to install a pipeline from the borehole to the village, with a reservoir.

conclusion
There is the possibility that the well has runned out of water. This could not be verified during our stay. The transport of the water to the village would require a new pump system, tansportline and reservoir at the village.

Gen set, submersible pump	30,000
Transportline 11.000 m. 50mm HDPE	22,000
Reservoir 25 c.m. (incl.taps)	5,000
Total	**57,000**

Number of houses: 50
Number of inhabitants: 1,000
Investment costs per capita: 57



PLAN DAWA'ALAY/ DHARJALE

not to scale

Drawn by:
SAWA/SPDS Bari water rehabilitation study

Dhudo

general description
Dhudo (300 m.) is located 81 k.m. West of Bander Bayla. It still has a defence tower from the times of the kings. It counts 160 houses and is rapidly growing. Their main source of income is livestock, a little gardening and some people go to Bander Bayla for fishing. During the hot season the village gets more crowded. They have a hospital and a school and Dhudho is an important market centre for the area.
The main diseases are Malaria, TB, Hepatitus and Diarrhoea (children)

existing water supply
The water in the toggo is emerging just where the village is located. This place is used for getting drinking water, bathing and washing and also as drinking point for the livestock. In the dry season at some days 500 camels and 3 - 4.000 goats/sheeps pass by. Also trucks (4/day) come to collect water to supply the nomadic people and their livestock. The EC of the water is 1.500 μS/cm, pH = 7.5 and T.H. > 370 mg/l.
100 m. upstreams from where the road crosses the toggo Western Geophisics drilled a borehole and pumped water up to fill trucks. This well has disappeared under stones and sand.
A management system still has to be discussed. There has been no discussions yet on a payment system. They agreed that this has to be developped but also stressed that this takes time and should not be decided on in a hurry.

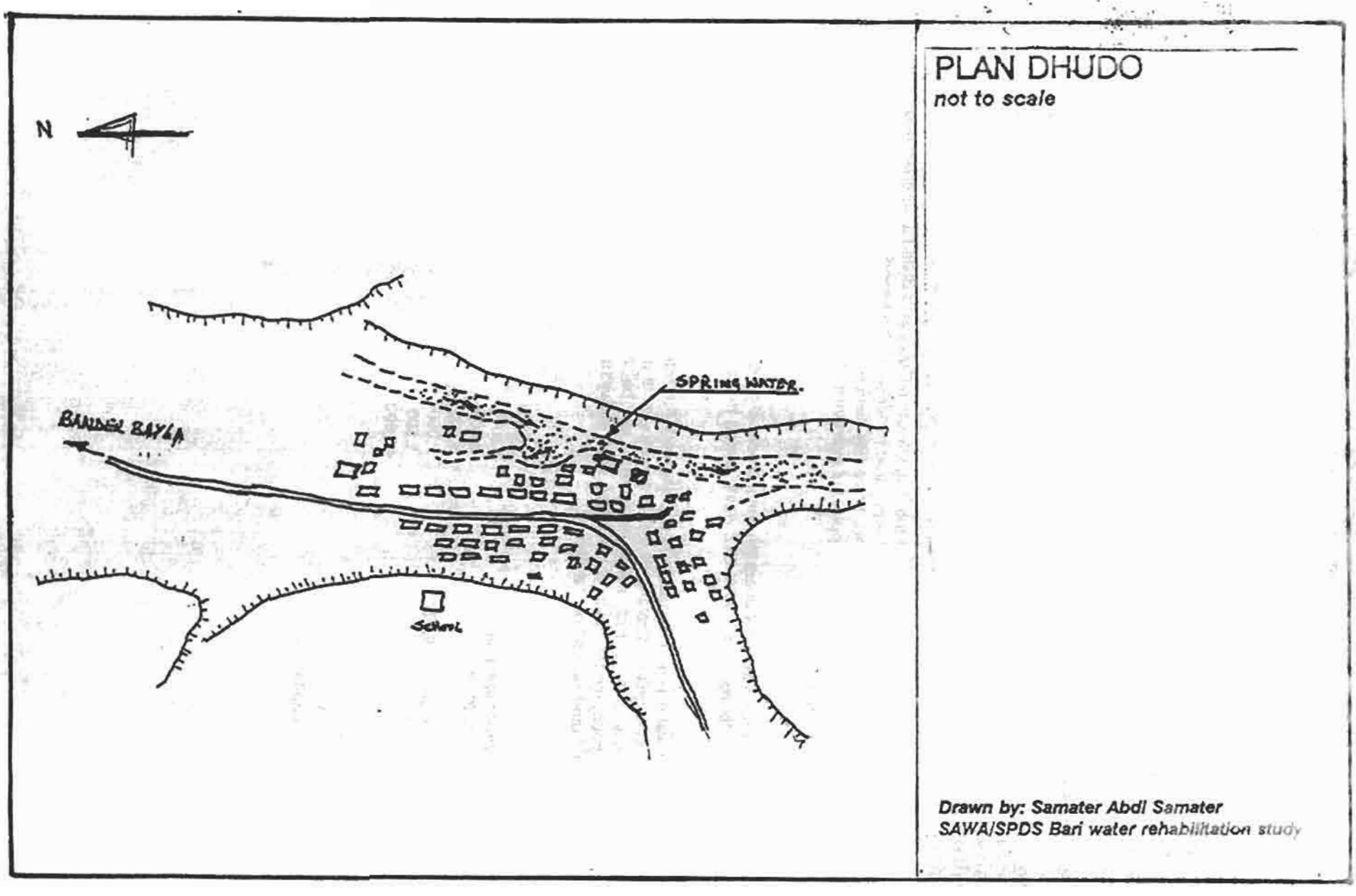
request of village
The village wants a pump in the pool where the water emerges out of the toogah. With a reservoir in town and several standposts. This is what GTZ was planning to do.

conclusion
At the intake of the water two problems have to be solved. Protection of the intake/pump against contamination and damages by flooding. A well in the toogah at a protected location is the best option. This probably means that some equipment will be needed (explosives/pneumatic rockbraking/high capacity mudpump) for construction. From the well the water should be pumped into a reservoir and distributed over a few standposts.

cost estimate

Intake well	3,000
Solar system, submersible pump	30,000
Transportline 400 m. 2" GI	8,000
Reservoir 25 c.m.	5,000
Distribution 1,000 m. 50mm HDPE	2,000
3 standposts	1,500
Total	**44,000**

Number of houses: 160
Number of inhabitants: 3,200
Investment costs per capita: 14



PLAN DHUDO

not to scale

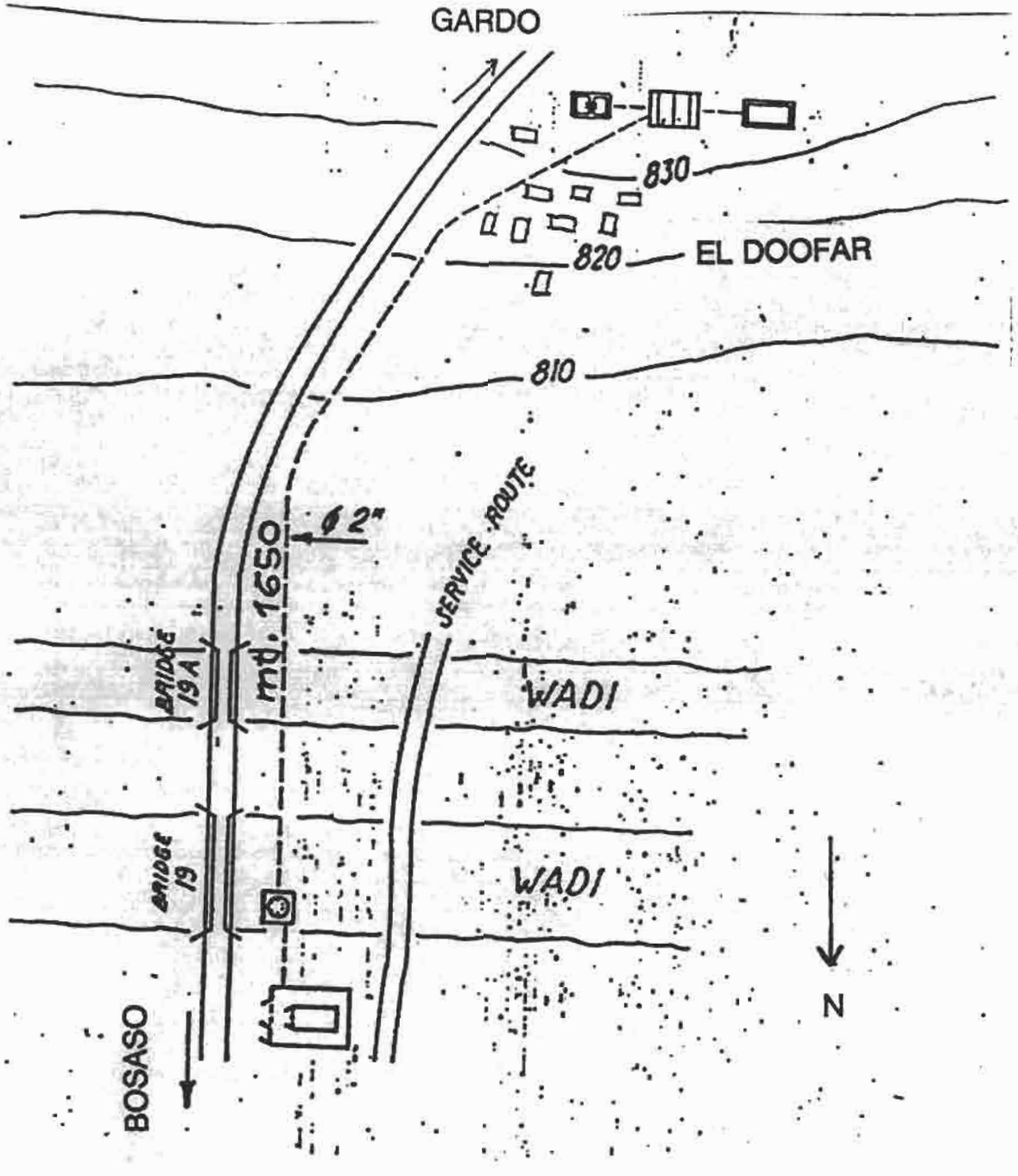
Drawn by: Samater Abdi Samater
SAWA/SPDS Bari water rehabilitation study

El Doofar

El doofar was paid a short visit because they have the only borehole built by Aquater along the road Gardo Bosaso, which is still in operation. The system is a borehole in the togga, a 25 m^3 reservoir in the village and a standpost as well as a drinking point for animals.
The discharge is estimated at 4,5 m^3/h, they pump for 6 hours a day. The quality: EC = 2 200 $\mu S/cm$, pH = 7.8, TH > 370 mg/l, NO_3^- = 10 mg/l.

Observations

- the fact that this village has been able to run this system until now, shows that in potention a motor operated pump system can be sustainable.
- after the water supply system started functioning, they moved the village towards the reservoir and standpost along the road.



PLAN EL DOOFAR

not to scale

Drawn by:
SAWA/SPDS Bari water rehabilitation study

El Gal

general description

El Gal is one of the ancient villages and resort during the dry season, as it has a water well since almost 200 years. [illegible] years ago it was transferred to the present side of the wadi. It has [illegible] houses. The houses along the main street are of stone, the others are temporary. Many displaced people settled in El Gal. A lot of young goats are found at the margin of the village. Frankincense and livestock are the main activities.
The village has a koranic school, a 2-room formal school, but no dispensary.
Malaria, 'TB' and diarrhoea were mentioned to be the most frequent, next to anaemia and skin diseases.
Livestock disease is their major problem.

existing water supply

The people use the 'Italian' well as their main source. It was built in the 50-ties and lined and found at 800 m from the village in the centre of the km wide wadi. A two decimeters high stone wall is preventing it from most severe floods. However, it is flooded every year, and the pulley has been washed away. Diameter is 1 m, water level at 3.0 m and well depth 8 m. Water quality is good (EC = 460 μS/cm), but risk of contamination is high. Even nitrates were found at elevated levels (NO3 20-25). During peak hours people go to the 'old' well, which lays 100 m further and is protected by a wall from floods.
The water level of the Italian well drops during peak use, till there is almost nothing. Hence permeability is a limiting factor.

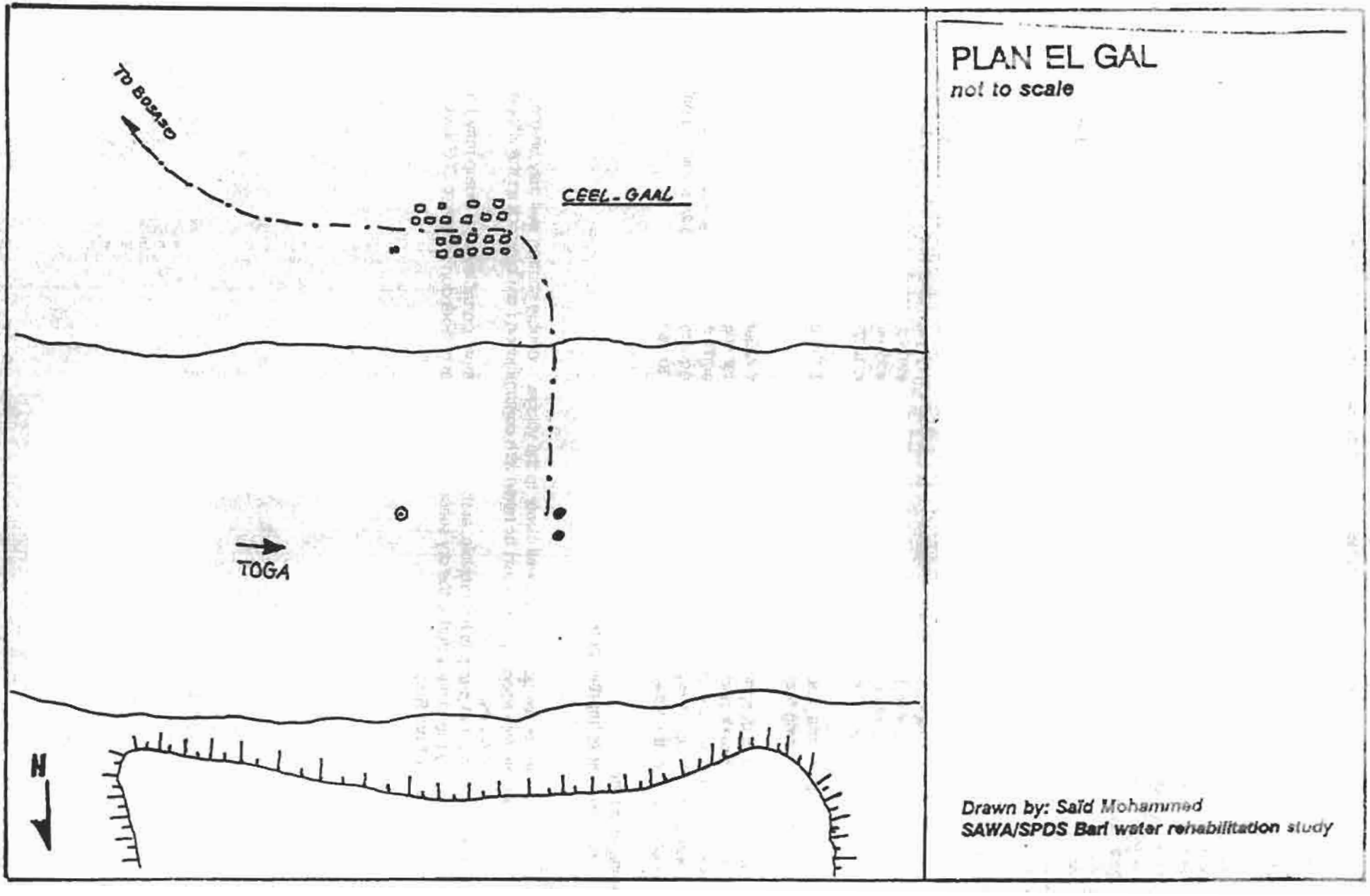
Aquater made a 15 m deep togga well about 200 m upstream of the Italian well, which they connected to a raised 25 m3 tank and 2 communal standposts. No operator was trained, and people never received the key. Generator, pump and pipes have been looted. People evaluate the pumping system to be too sophisticated. They advised to drill closer to the village. Aquater made also an investigation at the other side of the village but informed the people the water to be too hard.

request of village

Well closer to village; improve pumping system.

conclusions

The aquifer conditions are good to try a well closer to the village. A double shafted well may be tried to prevent damage from flooding. Care must be taken with contamination from livestock as the village produces a lot of nitrates.
Installing a sophisticated pump is not feasible, at this moment. A small portable petrol pump may be an option to supply the tankers during the dry season. It seems that tankers don't come to El Gal, yet, but get their water from Buq.



PLAN EL GAL

not to scale

Drawn by: Said Mohammed
SAWA/SPDS Bari water rehabilitation study

Gardo

general description
Gardo is the second major town of Bari ... is locate... 250 km south of Bosaso. It is an important cent... for nomads and an important commercial centre for the pastoral area of Bari and Sanag. The present population of this town is estimated at 30,000 inhabitants. The town is almost fysical untouched by the war, with their electricity supply still functioning.

existing water supply
The water supply of Gardo relies solely on two boreholes, Xingood and Kawane. From the borehole Xingood Aquater installed a 2... pipeline into the town with ...0 m³ reservoir and one public standpost. A distribution network was planned by the government b... these plans have never been executed. The transport of the water to the houses is done with wate... tankers. These wells have a EC of around 3,000 µS/cm. The state of pumps, generator and pipelines is desperate.

request of town
A urgent request was made to the mission to assist to rehabilitate the boreholes. The elder are very concerned that one day the system will brake down and they will stay without water supply.

conclusions
A complete rehabilitation of the system will be needed. This includes the following activities:

Technical
The technical activities will include the following:
- the rehabilitation of four boreholes (Xingood, Kawane, College and Hinghool), installing pumps and generatorhouses with generators;
- installation of 4 main 75 mm transportlines (8.0km.) from the boreholes to reservoirs in town;
- construction of 3 additional elevated water reservoirs (10 m./50 m³/each), at different locations in town;
- installation of a distribution network with the following pipes:
  PVC/HDPE inner diameters Class 10 PN

Diameter	Total Length
37 mm	2000 m.
50 mm	6000 m.
75 mm	2000 m

- 45 public standposts with 4 taps each;
- supply of materials for 10% houseconnections.
- rehabilitation of office and store

Management
In Gardo there is still a kind of water committee in function. The operators of the former WDA are still employed. Management tasks are for the time being done by the elders. A comparable community-based set up as in Bosaso will be used.

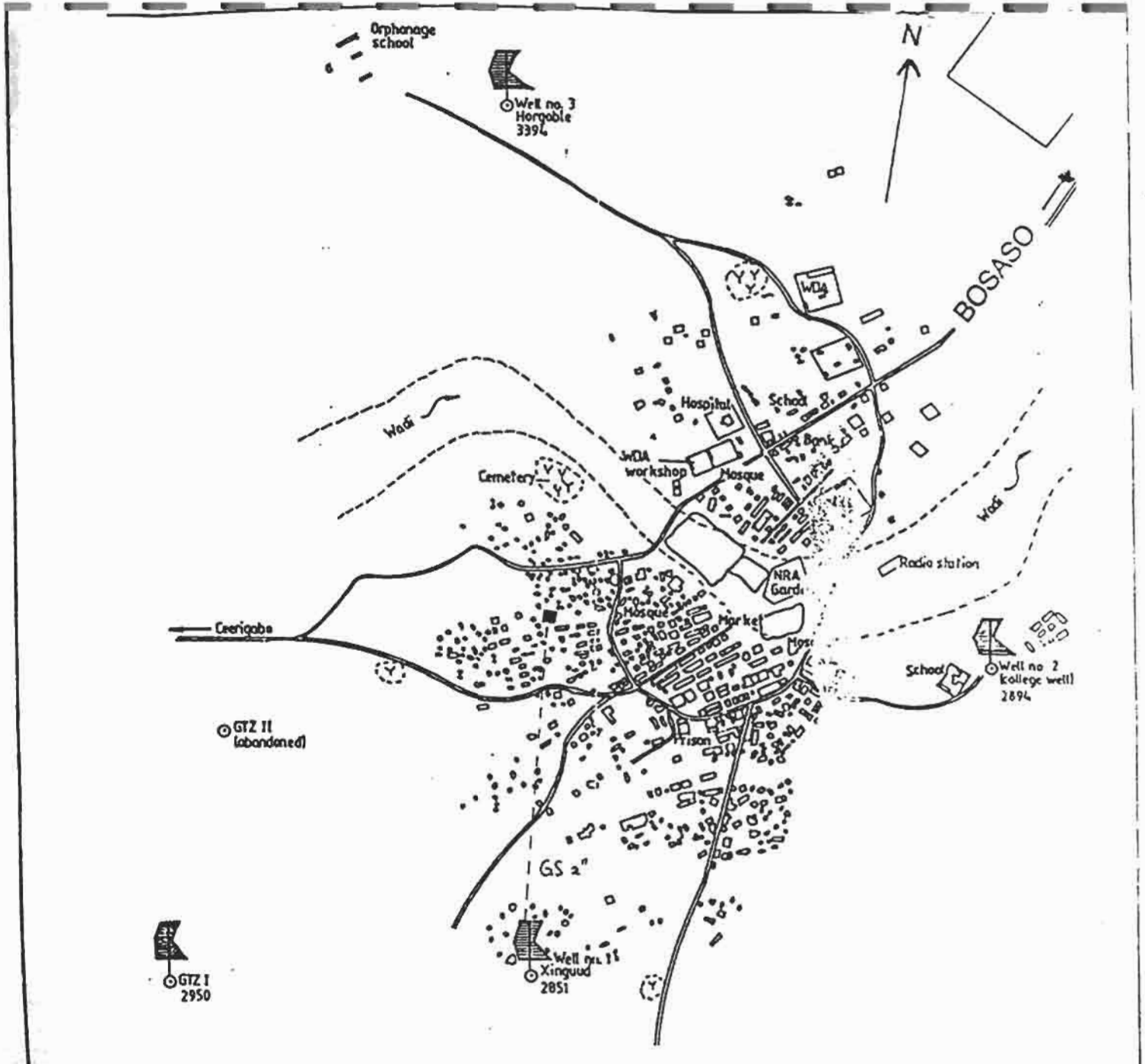
Health and sanitation
A health and sanitation programme, related to water will be conducted. The water committes in the neighbourhoods will play a central role in this programme.

Training
Trainings will be conducted in the following fields:
- technical for operators, caretakers and technicians:
  * electromechanical training
  * training of plumbers
  * preventive maintanance on distribution systems
- administrative and health and sanitation education for watercommittees on neighbourhood level;
- administrative and storemanagement for the cental water committee.

cost estimate (USD)

Borehole rehabilitation		20,000
Pumps and generators		80,000
Transportline 8,000 km. 90 mm PVC	48,000	
3 Reservoirs 50 c.m/each.		30,000
Distribution 10,000 m.		30,000
45 standposts		9,000
inst. + house connections		15,000
store + office		10,000
Total		**242,000**

Number of inhabitants: 20,000
Investment costs per capita: 12.1



PLAN GARDO

not to scale

Drawn by:
SAWA/SPDS Bari water rehabilitation study

Hurdio

general description

Hurdio is located on the coast of the Indian Ocean and was founded by the Italians in 1912 for the production of salt. the remains of the saltplant and the conveyerbelt over the bay to Xafun, to transport the salt can still be seen. The village counts 170 houses, many of them are the old baracks built by the Italians for the labours. Their main sources of income are lobster and some livestock.

Existing water supply

The people get their water nowadays from shallow wells in the dunes and in the saltplanes behaind the dunes. The EC of the first = 2,000, of the second 4,500 - 5,000 μS/cm. The wells in the dunes only give temporarily water of acceptable quality.

In the past they got their water from a shallow well in the togga near the village Xandho (ca. 10 km. north of Hurdio). This well was constructed by the Italians in 1912 has a depth of 3.5 m. and a SWL of 2.5 m. The EC = 1350 μS/cm, T.H. = 350 mg/l and pH = 7.5. Capacity is unknown. From there the water was pumped and transported to the village over a distance of 10.4 km. Aquater dug a new well in the middle of the togga in 1988. This well is 15 m. deep with a diameter of 500 mm. It is filled with sand. The SWL is estimated at 7 m. From there a 14 km. long pipeline went to the village and a 25 m^3 reservoir was constructed. The tank was only filled once. Before the system could be inaugurated by government officials, the war broke out and evrything was looted.

request of the village

The village made the request to bring a pipeline to the village for their water supply.

conclusion

We discussed three options with the village. A desalination installation, a truck for transporting water and the rehabilitation of the pipeline. The preference was in this order, which was mainly influenced by the high costs of the pipeline. For the option of desalination more information is needed and O&M has to be guaranteed through a service-agency.

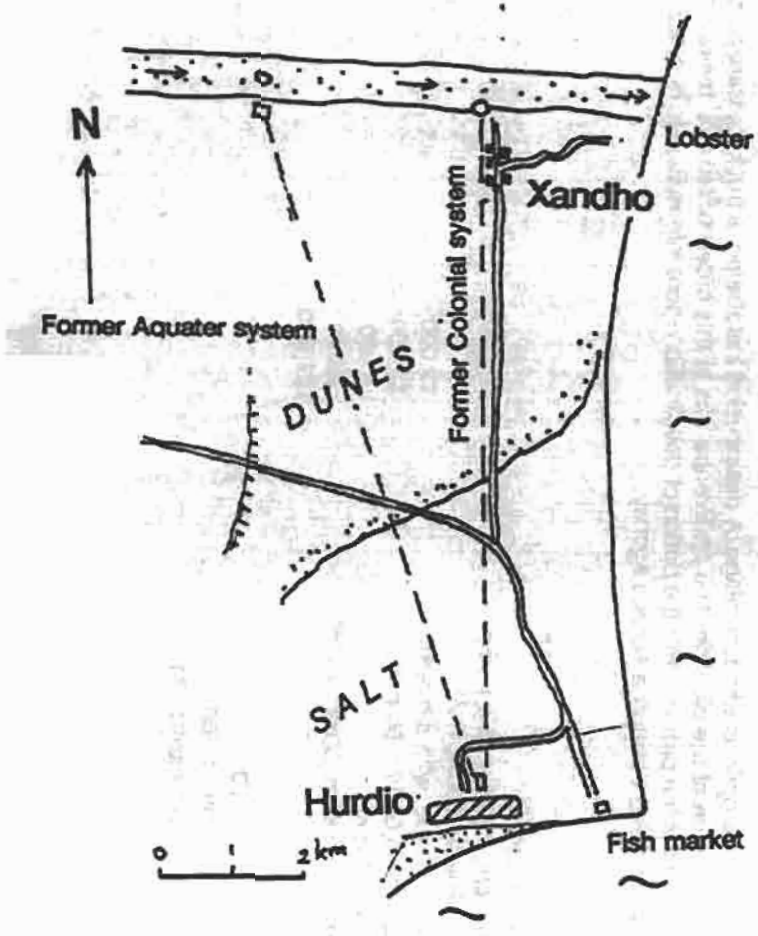
cost estimates

I. Xandho system	
Solar system, submersible pump	30,000
Transportline 4,500 m. 1/½", salt resistant pipe, with s.blocks	72,000
Transportline 6,000 m. 50 mm.	12,000
Reservoir 25 c.m.	5,000
Distribution 1,000 m. 50mm HDPE	2,000
Total	**121,000**

Number of houses: 170
Number of inhabitants: 1,700
Investment costs per capita: 71

II. Water truck	
Water truck	40,000
Reservoir 25 c.m.	5,000
Distribution 1,000 m. 50mm HDPE	2,000
Total	**47,000**

Number of houses: 170
Number of inhabitants: 1,700
Investment costs per capita: 28



PLAN HURDIO

not to scale

Drawn by:
SAWA/SPDS Bari water rehabilitation study

Iskushuban

general description
Iskushuban (290 m) is located in the centre of the Bari region and is a district capital. It is beautifully situated high above the two toggas which join here. It has 400 houses and the main sources of income are livestock and small gardening. It has a primary and intermediate school and a hospital. The main diseases are Anaemia, Diarrhoea(increased after pump was looted), Malaria and Hepatitus.

existing water supply
The people fetch their water from the springs in the southern togga, 30 meters below the village. The total capacity will be app. 30 lps. The spring emerges out of Travetin, which has deposited on an impermeable layer of solid rock. The EC of the springs is between 1650 and 1850 μS/cm, pH = 7,5 - 8, T.H. > 370 mg/l and NO_3 in the main pool < 5 mg/l. As the spring and pools are also used as bathing and washing places they are contaminated.
In 1992 EDGS had put a solar pump system in the stream and connected a pipe to the cement reservoir (20 m^3). Aquater had put a pump in the main pool and placed a 25 m^3 reservoir a little higher than the cement tank. THW has installed a pipeline (50 mm HDPE) to the hospital which is located at the other side of the village. They also installed 4 standposts along this line.
The solar system of EDGS has been looted 10 months ago and the standposts are damaged. The pipeline of THW is still for 80% in place. The Aquater system was partly taken by floods.
Until now people never have paid for the water, the womencommittee was not very in favour of this idea, but it could be discussed. During the dry season 2-4 trucks come to collect water for the nomadic people and their livestock in the area.

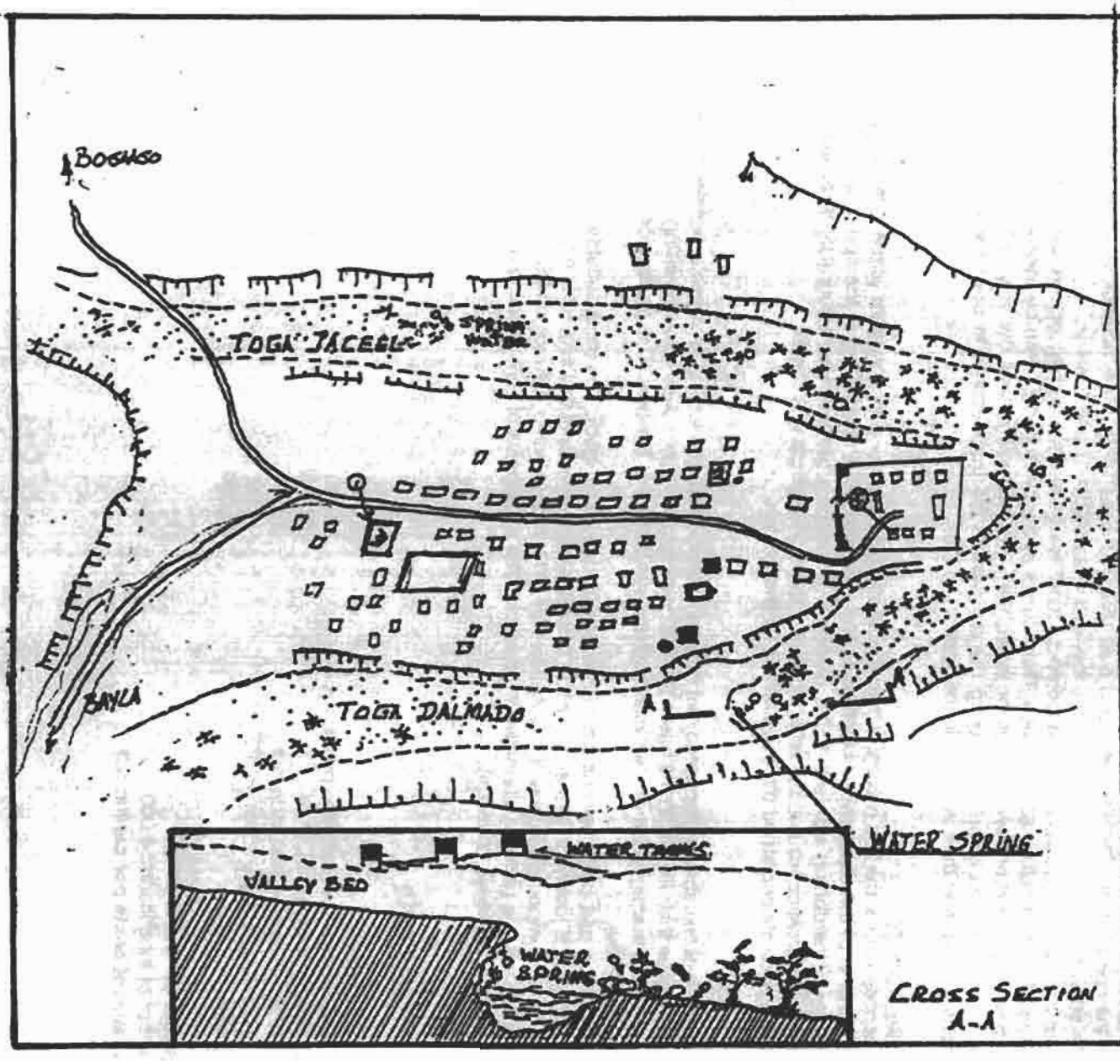
request of village
Womencommittee: the first request is the rehabilitation of the water supply system with a solar pump. An extension of the distribution is wished as well. The second is channeling of the spring water for extension of gardening activities. Other demands are income generating projects (UNDP example Bosaso was mentioned) and the rehabilitation of the market place with sheds.
The village chiefs confirmed the priorities set by the women.

conclusion
The people of Iskushuban explained that they were shocked by the looting of the solarpumps. It was considered as their lifeline. In the future this will never happen again. Also they are willing to develop a sustainable management of the system, which was lacking in the past. The discussion of this will need some time.
Technically, a part of the springs have to be captured in a springbox. The most suitable location for the springbox is just north of the main pool. The estimated capacity of this section is 6 lps. From here it has to be pumped preferable in the Aquatertank. The former pump (Grundfoss 3SP) had too little head to reach this tank. An alternative is advisable. The standposts of THW need to be rehabilitated and improved (proper drainage).

cost estimate (USD)

Spring box	3,000
Solar system, submersible pump	30,000
Transportline 500 m. 2" GI	6,000
Rehab. reservoir + standposts	2,000
Distribution 500 m. 50mm HDPE	1,000
Total	**42,000**

Number of houses: 400
Number of inhabitants: 8,000
Investment costs per capita: 5.3



PLAN ISKUSHUBAN

not to scale

1 - Hospital

2 - School

3 - GTZ office

Drawn by: Samater Abdi Samater
SAWA/SPDS Bari water rehabilitation study

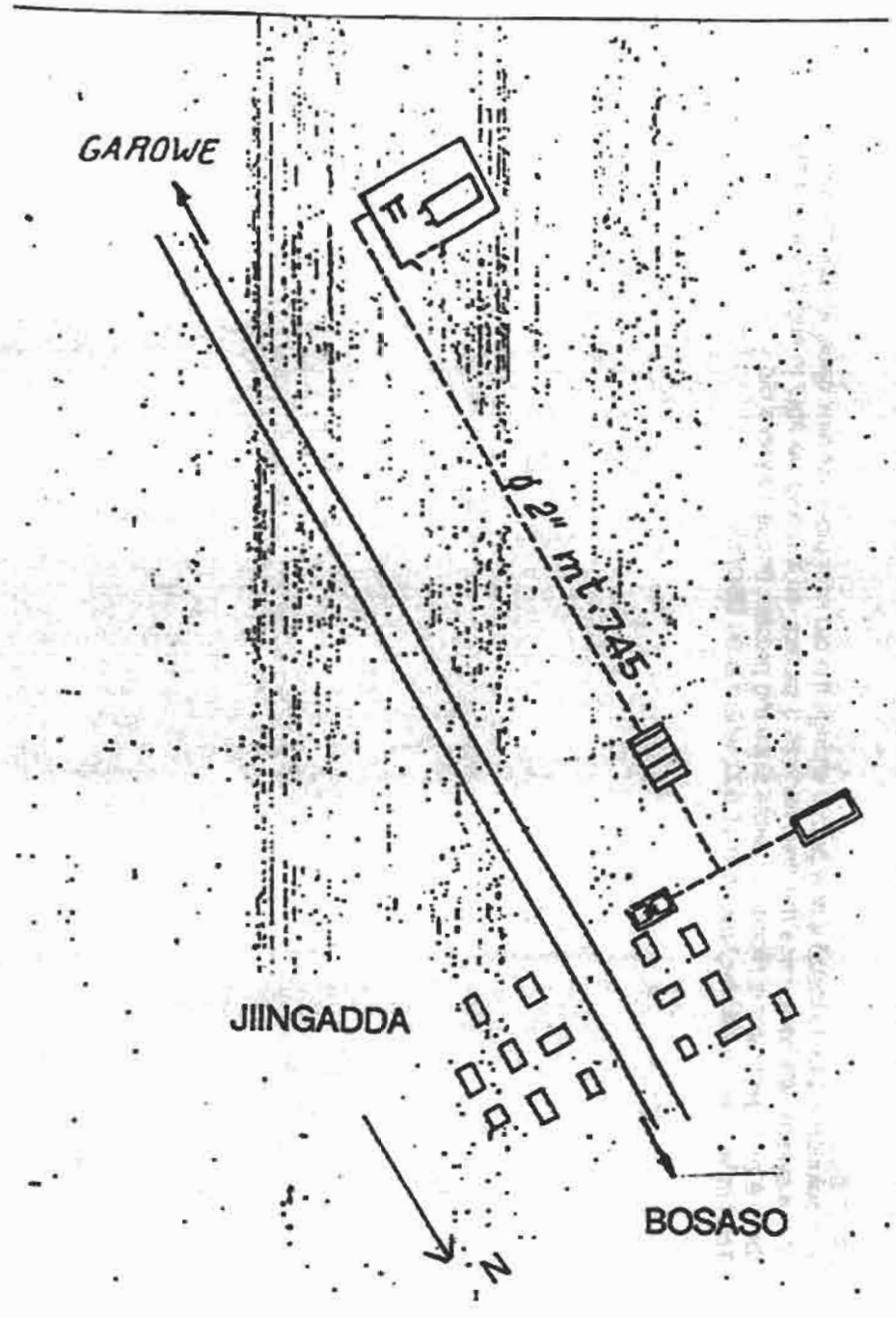
Jiingadda

<u>general description</u>
Jiingadda is a village with 54 houses, located 71 south of Bosaso. The area is not a grazing area, the only specific activity is a poultry farm which has recently started. Asked for diseases the people answered: 'we have no health complaints'.

<u>existing water supply</u>
There are 10 berkads, from which 2 are lined in this village. The fact that 8 berkads are not lined is because of lack of funds.
Often the villagers have to get their water from a truck from Bosaso. This costs about 13.000 SSh/drum.
There is a borehole in the togga south of the village made by Aquater. They also constructed a 25 m^3 reservoir and and a standpost as well as a drinking point for animals in the village. The pump broke down in 1993 and was repaired by THW. After the repair the capacity of the pump was reduced considerably. THW supplied also a new generator (DDR, 1985). After one year the system collapsed again. The quality of the water was described as 'hard'.
When the pump was running the water was supplied free of charge. They assured us that in the future they would charge for the water, and people would be willing to pay.

<u>request of the village</u>
The request is to supply them with a new pump for the borehole. They said they liked the generator of THW because it is on wheels (for work on site -type generator), so they can remove it from the togga when it is not used. So it is easier to protect it from theft and damages by flooding.

<u>conclusions</u>
The solution will be to install a new pump, change the old riser pipes for new ones. An improvement of the system will be to raise the reservoir with 3 meters, so it would be able to supply the poultry farm. A new generator is recommendable since the present one is 10 years old.
Total investment would be app. USD 15,000, which is 30 USD/c.



PLAN JIINGADDA

not to scale

Drawn by:
SAWA/SPDS Bari water rehabilitation study

Jurile

<u>description</u>

The village of Jurile is located 112 km south of Bosaso along the west side of the road. Number of houses was limited, whereas the borehole had been functioning till 4 months ago. People explained that they had moved the village from the other side of the very wide wadi, where the pump is, to the road side, where the tank is.

<u>water supply</u>

The village has a borehole at the opposite side of the wadi and a tank, standpost and livestock trough. Water is relatively sweet (1350 μS). The pump is not functioning since the end of 1994. Replacement of the pump was donated by Africa 70, but during replacement, the pump with 24 rods fell into the hole. The villagers asked GTZ for fishing tools, but were not able to lift it. Africa 70 promised the villagers to assist further.
The borehole water is also used for irrigation (in sandy soils!) and for filling tankers.

A second borehole was found 4 km north of Jurile. It was filled with stones and blocked at 50 m. According to the former guard the water was sweet and was able to fill 40 tankers per day (about 25 m3/h).

<u>request</u>

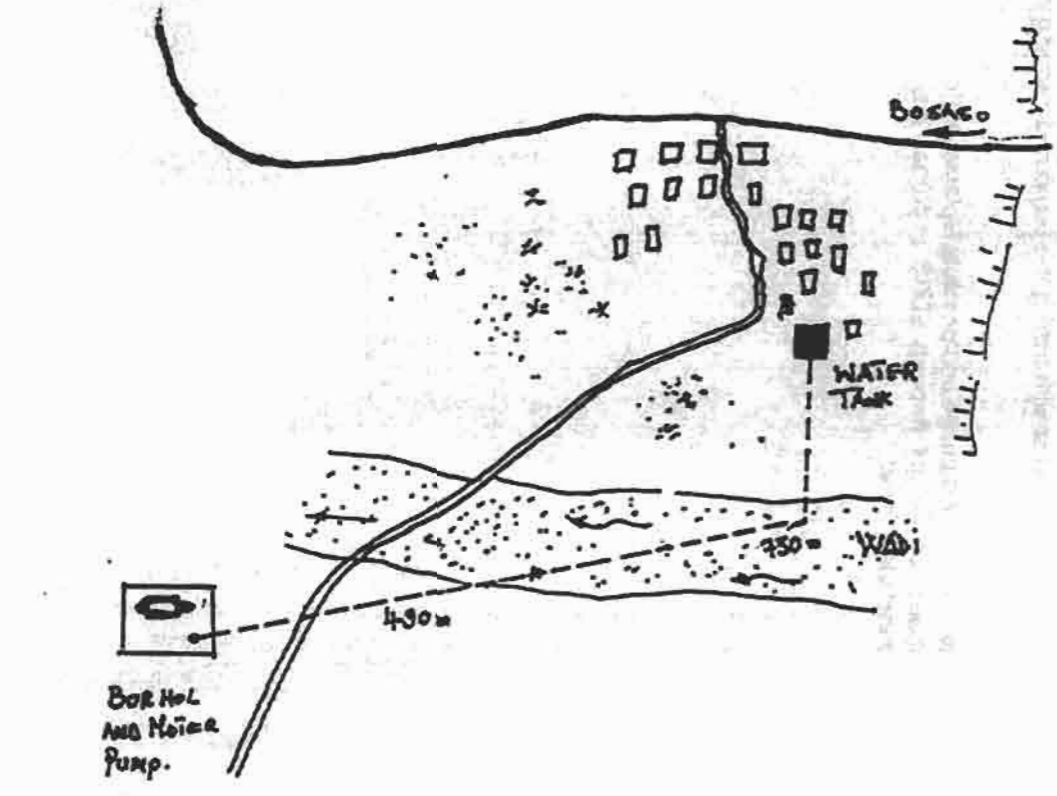
A request was made by the elder to assist with fishing the pump and carrying out repairs

<u>conclusion</u>

Fishing of fallen equipment, check of damage and possible replacement of damaged pump and rods are required. Advice should be sought through EDGS in Nugal. As Africa '70 is involved, the improvement will not be included, here.

PLAN JURILE

not to scale



Drawn by: Samater Abdi Samater
SAWA/SPDS Bari water rehabilitation study

Kala-Bayr
(visited by Peter van Doorn)

Description of the village
Kala-Bayr is a village situated circa 50 km. south of Bosaso along the main North-South tarmac road. At the moment of our visit i.e. 23-5-94) there were circa 200 people staying in the village. According to the people the number of inhabitants of this place will however drastically increase once the water supply over here improves.
Beside the people permanently staying in Kala-Bayr a lot of nomadic people visit the place.
The town is also said to be a major off load point for cattle which is then brought from here to the port of Bosaso for transportation to Saudi Arabia.

Existing Water Supply
During the wet months people drink water that has been collected in the 3 berkads which have been constructed in the vicinity of the village.
During the dry months water has to be taken with a truck from a borehole circa 6 - 7 km away from the village. This borehole was drilled by the Italians in 1987.
Circa 6 months ago the villagers received a submersible (GRUNDFOS) pump and a generator (Lister (9.5 KVA))from MEDIC Water Project to pump up water from this borehole.
Static water level in the borehole is 86 meter.
Dynamic water level in the borehole is 121 meter.
The pump is placed at 127 meter.
The pump has a capacity of 6 m3/hour (1,66 l/sec. According to the villagers there is plenty of water and the pump can pump non stop for 24 hours (i.e. yield borehole is bigger than 6 m3/hour).
Fuel consumption is according to the villagers circa 1 litre per hour.
During the dry season when the pump is being operated a watchman stays near the borehole to look after the generator.
The cost of one truck trip which takes 30 barrels (6 m3) from the borehole to the town is 200.000 shilling (circa $ 50, 1994).

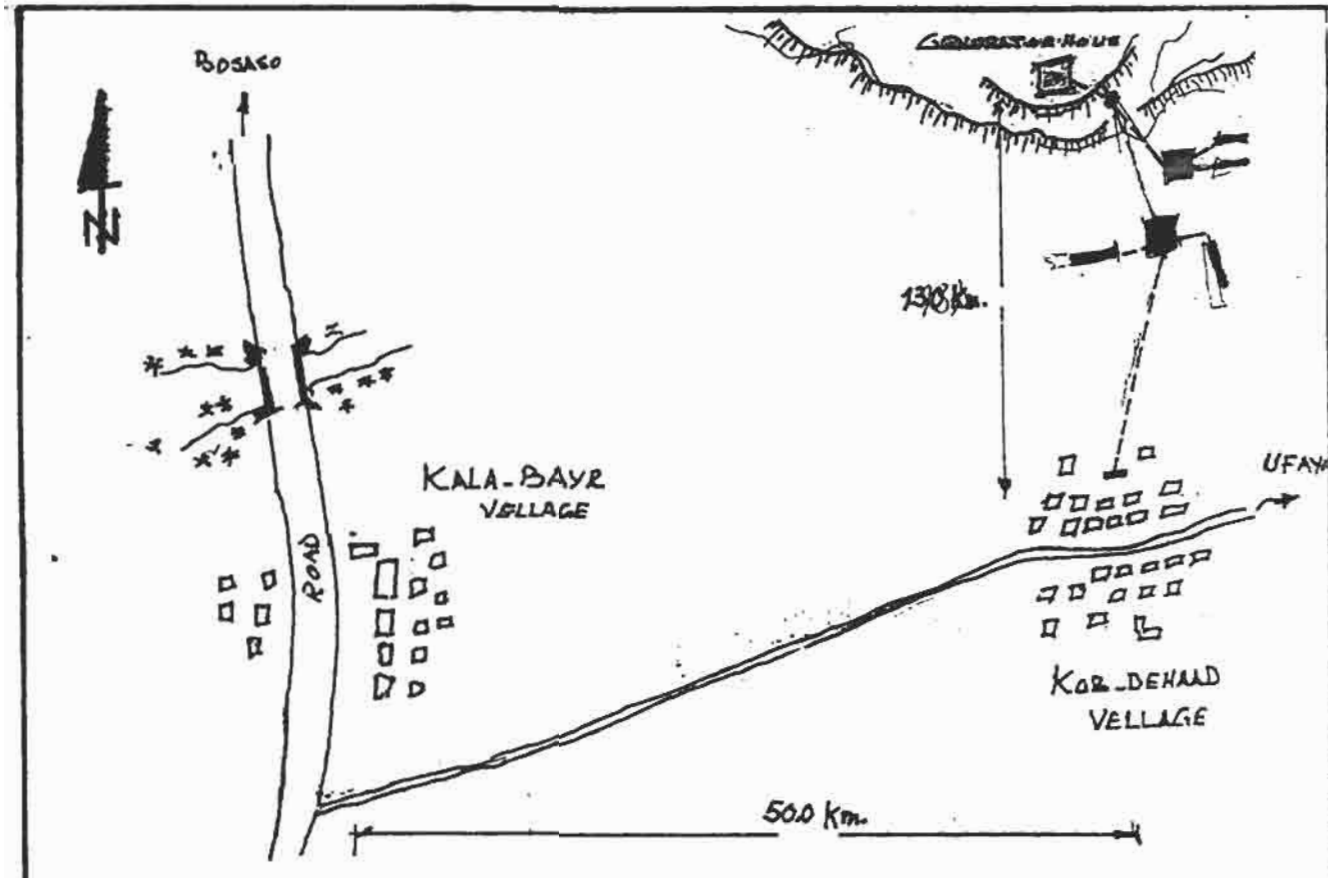
Request of the villagers.
The villagers requested to construct a pipeline to the village and a selling point so that they will not have to go every time with a truck to the borehole to take water.
Also opportunities for vegetable gardening etc. would arise once water is in the village.
It can be expected be that the number of people in Kala-Bayr will increase once the water supply has been improved thus relieving the population pressure on Bosaso.
If this water would be taken to the village it would also attract a lot of Nomads.

Conclusions
Constructional and Financial Aspects.
To realise the objects mentioned above it is necessary to lay a 2" pipeline from the borehole to the village.
This pipeline would be circa 7 km. long (distance measured by pedo meter so to be checked with measuring tape).
The pipeline will be taken along more or less flat terrain so pipe laying should not be a problem. There are a few small (dried up) river beds which have to be crossed but this should neither be a problem.

Due to the fact that the pump will have to deliver more head to pump the water through this 2" pipe to the village (friction loss for a flow of 0.5 l/sec through a 7 km long 2" pipeline is circa 23 meter and for 1 l/s circa 70 meter) the discharge of the pump will go down (probably till something like 0,5 l/sec).
A performance curve for this pump was not obtained but might still be with the villagers.
There is plenty of water even a flow of 0.5 l/sec would supply enough water in 10 hours for 900 people (assuming a consumption of 20 l per person per day).
For the time being a reservoir tank\selling point with a capacity of circa 15 m3 and one drinking point for animals
(storage capacity circa 3.6 m3) can be constructed.

The estimated cost for this project is circa $ 50.000.
The villagers said that they were willing to contribute in the project cost.
The village could contribute circa 10% of the project cost by providing all the necessary unskilled labour and the lodging and storage facilities.
It is however advisable to check first one more time the performance curve of the submersible pump to see how much extra head the pump can deliver and what the flow will be.

Time frame
It is expected that this project can be finished in circa 2 months. Supervision can be done by one foreman (permanently staying at the site) and one engineer (staying half of the time).
Operational and managerial aspects of the work.
The villagers said that after completion of the project they will take care for operation and maintenance of the system (i.e. fuel, maintenance of the equipment and salary watchman). This could be financed from the money that is obtained by selling the water.
Bosaso is very nearby so obtaining spare parts etc. should not be a problem.



PLAN KALA-BAYR

not to scale

Drawn by: Samater Abdi Samater
SAWA/SPDS Bari water rehabilitation study

Kobdhaxad

general description
Kobdhaxad (480 m.) is a village of 60 houses 92 km. SE of Bosaso (32 km. from Kala Bayr junction). Most of the houses are shacks. The main source of income is livestock and there is some gardening. There is a school, a dispensary and a mosque.

existing water supply
In 1988 Aquater drilled a borehole, 13 km NE of the village. There is a 25 m^3 reservoir at the borehole for the drinking point of the livestock. From the borehole a 2" transportline goes to the village, where another 25 m^3 reservoir has been installed. Aquater informed the people that nearby boreholes would be more salty.

The system is still running, although the condition is poor. The borehole is 188 m. deep. The EC of the water is 2.600 μS/cm, pH = 7.5 and the estimated capacity of the pump is 3m^3/h.

Next to this they have a few berkads, which are mainly used for gardening. The water is sold for 2.000 SSh/drum to the villagers and 4.000SSh/100goats. For a 5l. jerrycan people pay 200SSh. (=8.000 SSh/drum).

No maintenance on the system has been carried out. The people are afraid that they will break the system down, when they try to repair the leaking valves. There is a water seller who earns a average of 200.000 SSh/month, depending on the season. According to the villagers they don't make money with the system.

request of village
The people asked for rehabilitation of the system and spare parts for future repairs. A second request is to improve the berkads for the gardening.

conclusions
It is quite surprising that this system is still running after seven years without any maintenance (except replacement of worn out pipes) been carried out. The village still has a relative good water supply. Another observation is that the fact that there is a reliable water supply doesn't have a great attraction on people to settle here. The costs for major repairs will be 10,000 USD, which is 10 USD/c. The pipeline however requiers a full replacement within a few years.

Lasa Da'wao

[illegible] Da'wao [illegible] situated at [illegible] from Bosaso [illegible] between [illegible]/Arm[illegible] and [illegible]. The village has shallow wells as their water supply. One of the wells [illegible] R[illegible]od [illegible] the water was analyzed.
The water was brackish (3,600 μS), which will be caused by gypsum in the upper layers. Other figures: pH [illegible]5.8, Total Hardness > 3[illegible]0 mg/l CaCO3, Nitrate 25-50 mg/l. Nitrate is quite high. Although protected, the outer wall where people may urine, and the latrine were quite close.

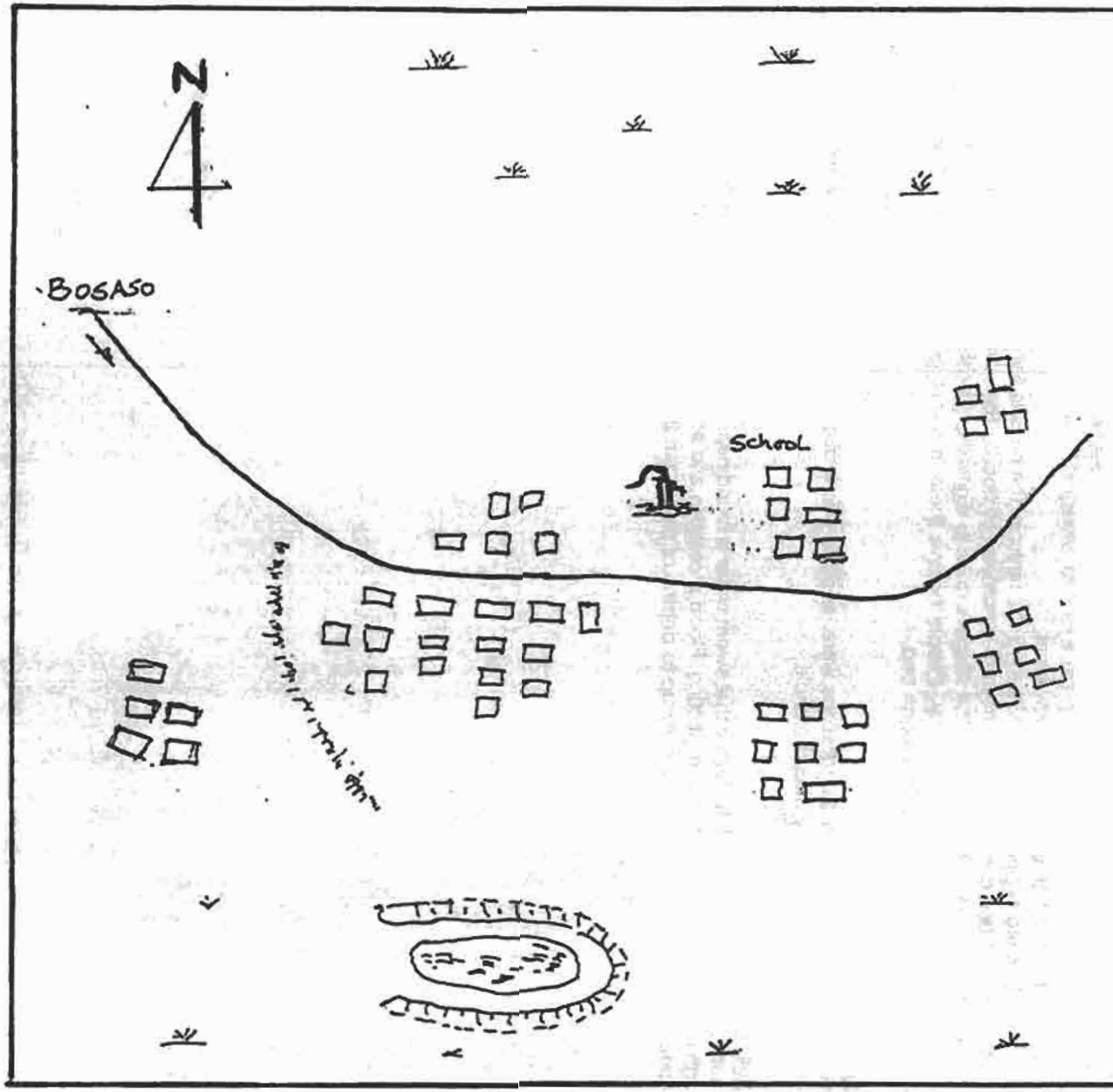
Meladeen

<u>general description</u>
Meladeen is located in the centre of the [illegible] Valley. At the time of visit, a flood had inundated the valley partly. Meladeen lays at [illegible] m asl, 80 km E of [illegible] from [illegible] at the tarmac road. With its 100 houses and surrounding grazing lands, it is an important village.
It is built on a slightly higher terrain, surrounded by the flood plain, covered by gypsum. Without a gympsum cover, the soil is suspect to erosion. A small decimeters high dike was built at the western side of the village as flood protection. Use of wooden walls and the many above ground water tanks, together with the organized street plan make it an attractive village. It appeared quite clean. The village has the basic services, but lacks a regular supply of medicines. Especially the anti-snake serum was highly wanted, as 3 people had been killed by snake bites within a month. Other diseases are malaria and diarrhoea.

<u>existing water supply</u>
The only nearby sources of water is a handpump on 45 m deep well at the edge of the village and a war, made by Africare. Water in the is too salty for human consumption, and the pump is hardly pumping water. Some people ([illegible]5 families) have built roof catchments and reservoirs, but water lasts for 1 month only, whereas the system costs 1.5 to 2 million Ssh.
During the rainy seasons, there are many pools around (EC measured above 2000 μS/cm). In the dry season people move to Gud-Bhekaad (7 km E) or to Shiiligi (12 km W), where the wells have permanent water, the latter being the most sweet.
Tankers from Bosaso supply water from Ufayn to the tanks at the houses for 16,000 Ssh/drum.
Berkads have not been constructed, as they are destroyed by floods. The villagers evaluate the war as very useful, but dries within a month. The villagers dried to dig wells, but the water table above the hard layer, found within 5 m, is seasonal. People believe there is sweet groundwater, that flows underneath the calcrete layers at the togga bed.

<u>request of village</u>
To improve the water situation. Suggestions were: another war, assist with digging of shallow wells through the hard layers, a very deep borehole.

<u>conclusions</u>
The consultants confirm the high chance that sweet water is found near the togga. Shallow wells, dug through the calcrete are the most prospecting. Flood protection and access during floods are points for attention. Deeper groundwater is salty up to depths of more than 220 m.



PLAN MELADEEN

not to scale

Drawn by: Said Mohammed
SAWA/SPDS Bari water rehabilitation study

Mudia

general description
Mudia is the only village in Ain Distr., visited by the mission team. It is located south of the Abola Mountain Range at 5 km from El Gal and serves as one of the commercial centres for frankincense trade because of its accessibility for motor transport. In appearance it isn't a rich village, but income should be high, and investments in berkads impressive. The village consists of at least 3 sub-villages, several km apart.
The village was founded in 1980, because of the up-coming frankincense trade. There are no services, except for 1 koranic school. Health situation is poor and living in the village is risky.

existing water supply
The villagers have invested a lot in the water supply through berkads. 30 berkads were constructed, of which 15 were leaking. However, half of them are leaking. People relate the failure of berkads to the soft soil (marls). Lack of cement is another factor. They have tried different masons, but it doesn't affect the quality. The mission observed the berkads to be deep and large, and people confirmed that the bigger ones are weaker than the smaller ones.
When the berkads fall dry people collect water from El Gal by camel. No tanker is hired.
One well had been dug in the togga bed at 500 m from the first sub-village. People were discussing if it had ever had any water, before it collapsed with a flood.
At 4 km East of the village a pool was encountered, which has water for many month a year. Many herds go there to water their animals.

request of village
People asked for cement and for assistance in improving well digging techniques.

conclusions
The regional groundwater level is too deep for a borehole. Berkad construction needs improvement. Digging shallow wells may be an option in these clayish soils, which give suspended aquifers.

Qandala
(visited by Simon Dermijn and Peter van Doorn)

Description of town
Qandala is the capital of Qandala District situated along the Gulf of Aden. The distance between the regional capital Bosaso and Qandala along the sea coast is some 100 km. Due to the inaccessability of the coastal area one has to travel app. 450 km by road implying a journey of 20 hours. A loaded truck needed three days to reach Qandala. By boat (fisherboat) it takes 7 hours. Due to rough seas this is not possible during mid May until mid September.
At the moment of the visit of the consultant only 5,000 persons were living in the town. In the dry season, May till September, many people are moving to settlements at the high plains scattered over the district due to the high temperatures. In September most people return now due to the lack of water in the town.

For several reasons there are at this moment no social services working. Clinic and school are closed due to the present political situation in the region. But the pattern of 'closing down' of the town because of the high temperature seems also an important reason.

The main economic activities are livestock, trade and collection of frankinsence. Till 1988 one of the mayor activities was also fishing. A fish factory gave direct employment to 500 men and 400 women and indirectly to almost 1,000 persons. The fish, tune, was canned and exported to Europe and the Arab countries.
In 1995 the people of Qandala started to build a new canning factory on a smaller scale (René van lieshout).

Population
The number of people staying in Qandala village was determined by going along every house and counting the number of families staying in each house. This was done based on information given by some of the elders of Qandala who accompanied us. This resulted in an estimated population of 11,760 persons.
However this number of 11,760 persons is the number of persons who have a residence in Qandala. Most people only stay a few months in the year in Qandala.
Especially during the dry season many people leave Qandala as it becomes too hot, the population of Qandala is in this months probably less than 2.000 people.According to the elders maximum 2/3 of this number of 11,760 persons will at the same time be present in Qandala.
Therefore the maximum number of people staying in Qandala is at present 11,760 x 0.66 = 7.840 persons.

Water demand
Present water demand
At the moment a water consumption of 20 l\person\day is considered normal.
We assume the water consumption by animals to be 10 % of the total water consumption.
Present water demand is therefore:
20 x 7.840 x 1.1 = 172.480 l/day = 2 l/sec.

Future water demand
For a design period of 20 years we assume :
- population increase of 30 %
- increase in the water consumption of 20 % (24 l/person)

The design flow will therefore be:
20 x 7.840 x 1.1 x 1.3 x 1.2 = 269.069 l/day = 3.11 l/sec

Existing water supply scheme
The present water source is a well which is situated in a dry river bed at circa 15 km south east of Qandala near a place called Butyalo.
The yield of this well is ca. 1,2 litre per second.

Nowadays daily ca 15-16 m3 is pumped to the town in a period of ca. 13 hours which is not enough if there are many people in town. During the day time no water is being pumped to the town because of fear that the pump breaks down if it is used too much. The present pump was bought by the villagers ca. 4 months ago. A pump given by the German organization THW in November 1993 is not functioning well and is therefore not being used.
During the day time especially in the dry season sometimes water is sold to people who come here with a truck with barrels.

The water is pumped through a ca. 18 km. long pipeline of 1 1/2" and 2 " galvanised iron pipe.
The pipeline runs through a dry river bed, a lagoon and along the beach to Qandala town where the water is stored in some reservoir tanks. From here the water is sold to the people (1 barrel (200 ltr) for 3000 Shilling (= $ 0.75))
Some parts of the pipeline have been replaced by the German organization THW last year.
There are however still parts of the pipeline which are not in a good condition.

Every year however the pipeline at the lagoon site is seriously damaged by floods etc. and the water supply is blocked for some time.

The distribution scheme in the town is not in a very good condition. Most of the tanks/ water selling points are leaking somewhat and need to be replaced.

So the 2 main problems of the present water supply scheme are:
- There is not enough water if there are many people in town.
- The pipeline is damaged every year by floods.

Alternatives for improving the water supply
There are 2 alternatives for improving the water supply of Qandala town, one is the rehabilitation of an existing scheme consisting of 2 boreholes, a pipeline and a reservoir tank which was constructed by the Italian company Aquater in 1991 just before the civil war broke out. The other alternative is the construction of a new gravity flow scheme using a source (Tooh) in the mountains near Qandala.

AQUATER SCHEME

This scheme was constructed by the Italian company Aquater. It was not completely finished because the work had to be stopped when the civil war broke out.

Intake

The source of the scheme consists of 2 boreholes of a 50 meter deep which are situated in a dry river bed close to the well of the present water supply scheme (Butyalo). The 2 boreholes are still in good condition. Probably the 2 submersible pumps are still in the boreholes however this could not be observed as it was not possible to open these boreholes.
On a higher place at the side of the dry river bed the Italians constructed a powerhouse where 2 generators to generate the pumps were installed.
The powerhouse has been completely destroyed.
The 2 generators are still in a store in Qandala. Some parts of the generator are missing. It might be possible to use them again but they would need of lot of revision; it is therefore probably better to replace them by new ones.
The yield of the 2 boreholes and the capacity of the pumps is not known. It was tried to obtain this information from Aquater without success so far.

Pipeline

From the boreholes the water can be pumped through a 10 kilometre long mainline of 2" and 2 1/2" coated ductile iron (CDI) to the town of Qandala. This mainline is still in a good condition although at some places the coating of the pipe is damaged and/or pieces of pipe have been taken out.
This mainline was surveyed and a long profile was drawn to get some more insight in the hydraulic functioning of the scheme.
It might be better to build a BPT in the mainline at the last hill before Qandala because otherwise pressure problems could occur at some places in the pipeline.
2 air valves have been taken out of the pipeline.
A big problem is that the pipeline near the boreholes is running through a river bed where very big floods can occur when it rains. The pipeline was buried less than a meter over here and damaged by the floods.
In case one wants to rehabilitate this scheme one will have to lay the pipe at a depth of 3 meter at places where floods occur and secure the pipeline with gabions 2x1x1 m3 every 6 meter.
However according to the locals even this will probably be washed away when floods occur.

Distribution Scheme

In the town of Qandala the Italians constructed a reservoir tank of 54 m3 which is still in a good condition.
From the reservoir tank there is a 2 " pipeline that goes to a selling point in the town.
If one would choose for this scheme a new distribution scheme in the town consisting of 8 new selling points would have to be constructed.

TOOH SCHEME

Description

The source for this scheme is situated in a dry river bed in the mountains ca. 12 km south east of Qandala at an altitude of ca. 750 m. a.s.l..
From here the water will have to be taken by gravity through a 12 kilometre long pipeline of galvanised iron (GI) to the town of Qandala. At 2 places river beds have to be crossed but over here the floods are not as rough as the floods that occur at the river beds near Butyalo.
Between the source and the town 3 break pressure tanks and 3 drinking points for animals will have to be constructed.
In the town a new distribution scheme consisting of 8 new selling points would have to be constructed.

Water Quality

The following water quality tests were carried out with the water of the Tooh source.

Conductivity	: 650 µS/cm
Turbidity	: < 5 NTU
Nitrate content	: < 5 mg/l
Cl2 content	: < 0,1 mg/l
Iron content	: < 1 mg/l
pH	: 7.8

Request of the village

The local community is very much in favour of the Tooh scheme. There is not much confidence in a rehabilitation of the Aquater scheme. One reason for this, besides the flood problem is the fact that the community was not involved in the survey and construction of this scheme.
The community regards the Tooh scheme as a much more reliable system as the Aquater scheme.

Conclusions

The consultant would like to advise to construct the Tooh scheme rather than rehabilitating the Aquater scheme because:

- **The Tooh scheme is cheaper and easier to maintain (no pumps or generators).**
- **The Tooh scheme has a lower running cost (no cost for fuel)**
- **There are problems with floods near the intake of the Aquater scheme. According to the locals it will be very difficult to solve these problems.**
- **The local community is very much in favour of the Tooh scheme. There is not much confidence in a rehabilitation of the Aquater scheme. One reason for this, besides the flood problem is the fact that the community was not involved in the survey and construction of this scheme.**
- **So far no information about the yield of the Aquater scheme was obtained and it is not sure when and wether Aquater will give this information. In case one chooses for the Aquater one would have to do a pump test if the yield of the source is not known. This would delay the implementation of the project seriously.**

- **A disadvantage is the fact that constructing the Tooh scheme is ca. $ 110.000 more expensive than rehabilitation of the Aquater scheme. However in the long run this scheme is cheaper because of the lower running and maintenance cost.**

The scheme that is being used at the moment will be left as it is and might serve as a stand by if people want.

Qayaad Same

description
Qayaad Same is located 75 km from Garoe on the road to Iskasi. It is in the narrow valley between the Nugaal plateau and the Darcor valley. There were only 2 houses, but two "passes" serves for by-passing nomadic herds between 2 main grazing areas.

water supply
At present, the elder had 1 berkad, which leaked considerably. The berkad was collecting drainage water from the ditch along the tarmac road. He had a second berkad under construction, which was dug by 20 man during 3 month. Half of them were paid. The elder had no money, yet to finish, as many of his livestock had died.
Normally he didn't sell his water, but because of the leakage he was selling the berkad water for 300 sh/drum, only.

request
The old man asked for materials to finish his berkad.

conclusion
The team looked for alternative solutions (groundwater dams), but these don't seem to be feasible. No response will be given to individual requests, but the example shows that there should be developed a kind of revolving fund for berkad construction. People can easily sell the water from the berkad and earn money to return the loan.

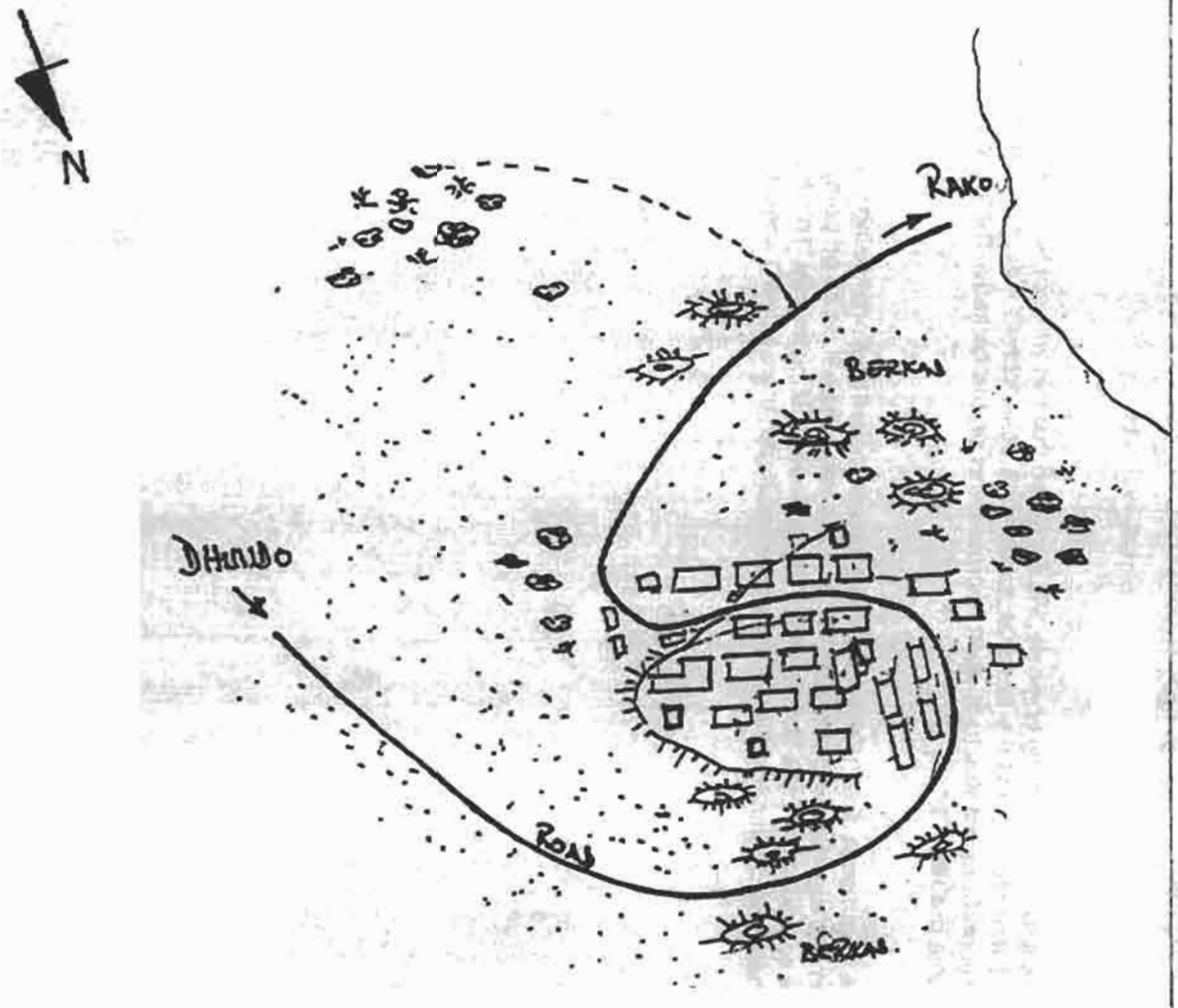
Qodax/Xumbays

<u>general description</u>
Xumbays/Qodax (60 m) is located 130 km. West of Bandar Beyla. It counts 30 houses and is growing rapidly. It is a livestock area. It is located on the bottom of wide depression which is filled with sediments. A togga ends in the depression close to the village. They have no dispensary or school. Children attend however lessons under the trees. The main diseases are Malaria, coughing and Anaemia.

<u>existing water supply</u>
They have 37 lined berkads (which are owned by groups of four) and 15 unlined. They sell the water for 3.000 SSh/drum. Every year 2-3 berkads have cracks, most of them at the connection of floor and wall. They estimate the evaporation at ca. 1500 mm/year in a covered berkad. They claim that the taste of the water deteriorates during time, and that black layers develop (algae?). Every year a layer of 25 cm. of sediment settles in the berkad.
When the berkads have dried they buy the water from trucks. From Dhudo it costs 20.000 SSh/drum, from Gardo and Iskushuban 25-30.000/drum.
In 1960 there has been drilled a borehole, which functioned until 1963.

<u>request of village</u>
Their first question was to rehabilitate the borehole. We explained that this was not feasible because it is completely filled with stones, and the fact that it was soon abandonned indicates that it is a negative well. The second request was to support improvements on the berkads. The price of the cement is their biggest problem.

<u>conclusion</u>
We visited the togga which ends close to the village. The circumstances look promissing to construct a subsurface dam in this togoga and drain water out to a well from where it could be pumped. More investigation on the composition of the bottom of the togga however is necessary. This could have been done by a simple handauger. However in the whole Bari-region there doesn't seem to be one.



PLAN XUMBAYS

not to scale

Drawn by: Samater Abdi Samater
SAWA/SPOS Bari water rehabilitation study

Rako

general description
Rako (+10 m) is located 60 km West from the airstrip Boari 87 km NE of Gao. It is a livestock centre, counts 150 households and has a school and a dispensary. They claim that 2,000 families of 8 surrounding villages are depending on the Rako well. The main diseases are Malaria, Diarrhoea (they relate it directly to the water), TB, Hepatitis and some kidney problems.

existing water supply
At present they have 40 big berkads and several smaller ones. The communal ones are not lined. There is a borehole at the border of the village, which is 430 m. deep. The SWL = 298 EC = 4.000 µS/cm (Faillace). The borehole was drilled in 1958 and was maintained by the W.D.A. until 1990. Every half year W.D.A. lifted the pump for replacing leaking riserpipes. The W.D.A. was also responsible for the administration and selling of the water. They employed three operators, from which still two of them are there. Next to the borehole are two reservoirs and several drinking points for animals.
At the generator house is a brandnew generator (DEUTZ, 48 kVA), which they say was placed by Aquater but this information seems very unlikely. The pump was replaced in 1990 and had a capacity of 20m^3/h. They claim that the older pump had a bigger capacity. They tried to lift the pump with a crane but without success.

request of village
They want a rig to lift the pump, replace the leaking pipes and are confident that the system will run again. When this is not possible they want alternatives. They suggested wars. Their experience with unlined berkads is that they dry in 1-3 months. They claim that they dugged wells up to 30 m. deep without finding water.

conclusion
It is advisable to check the possibilities of the well. Rako is fundamental as waterpoint for the livestock. The people said that the water from the well is to salty for them but good for the livestock. They themselfs would continue to use the berkhad water.
What is needed for an attempt to rehabilitate the well is the following:

- crane with a lifting capacity > 3 ton (available in Bosaso)	9,000
- 75 1½" 6 m. GS pipes	5,000
- 5 1½" GS tees, elbows and unions, each	200
- a spare pump, with 360(?)m. head, max. 28 kW, 3-phase, 1½" riser outlet for if the existing pump is in bad condition.	2,500
	16,700 USD

This could be an emergency-action. For the longer term the set-up of watercommittee and a proper administration has to be discussed with them, because otherwise they will need outside help within a year after the repair.

PLAN RAKO

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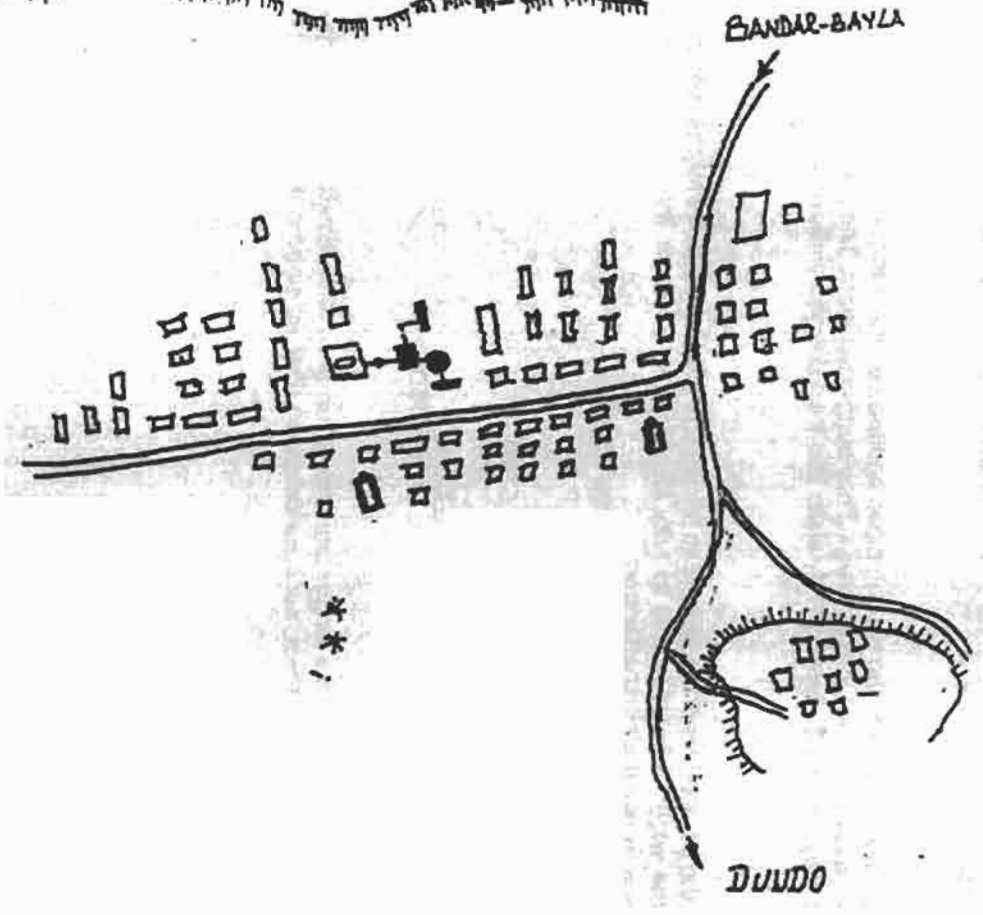


Drawn by: Samater Abdi Samater
SAWA/SPDS Bari water rehabilitation study

Sherbi

general description
Sherbi is located 25 km. North of Gardo. It is an old village and a livestock centre. The people say that the village counts 500 houses, what could not be checked by the mission because it was dark already. They have a school and a small hospital.
The diseases they sulfer from are: malaria, constipation and occasionally others. Children suffer from diarrhoea during the dry season.

existing water supply
The water supply exists of 73 berkads, from which 10 are broken. They have another 10 berkads under construction. In 1973 the government tried to drill a borehole. The attempt was stopped when it appeared that the drill was too small.
For relatives the water is free, to others they sell the water for 1.00 SSh/drum. During the dry season water is delivered by tankers from Gardo (15.000 SSh/drum) or Bosaso (20.000 SSh/drum).

request of village
The request of the village is a borehole. Acording to the village one of their main problems is that the cattle destroys all the vegatation around the village. When they have one borehole they expect less damage to the environment.

conclusions
A borehole is the only alternative for the berkads. Expectations on quality and quantity are moderate.

Timirshe

general description

Timirshe (310 m.) is located 40 km. NE of Iskushuban. It counts 150 houses and it has only a koranic school. Private rooms are used for education and health care. Their sources of income are livestock, frankinsence and rainfed farming. The latter is an exclusive men business. The gardening area is 12 km. outside of the village and its production at the moment is low.
Main diseases are: Malaria, Anaemia, Measles, eyeproblems and for the children: bronchitis, TB and diarrhoea.

existing water supply

There are two sources of water in Timirshe. The first are 10 lined and 7 unlined berkads. These berkhads are used by 15 people and last for 2 months. The second is a borehole 150 m. outside the village. This borehole was drilled by Western Geophysics, which carried out seismic oil investigations in the area. They abandonned the well and drilled another one 12 km. to the South (Dhumoodle), which is not in use.
In 1992 THW placed a Karda handpunp on the well, with a capacity of 1.3 m^3/h. The depth of the well is 72 m., the SWL is at 21 m. and the pump at 30 m. The EC = 1.700 μ/cm, pH = 8, T.H.> 370 mg/l and NO_3^- = 10 mg/l. The water is sold to everyone for 2.000 SSh/drum

request of village

The main request of the village is to supply the well with a solar pumped sytem and a tap in the centre of the village. During the dry season when there are a lot of nomads with their livestock the women complain about long rows at the well. In these periods they pump the whole night (21 hours/day). The women even prefer that the other borehole (Dhumoole) will be rehabilitated, so that the nomadic people can go there with their livestock.
The women also expressed their urgent need for a health centre and access to credit facilities.

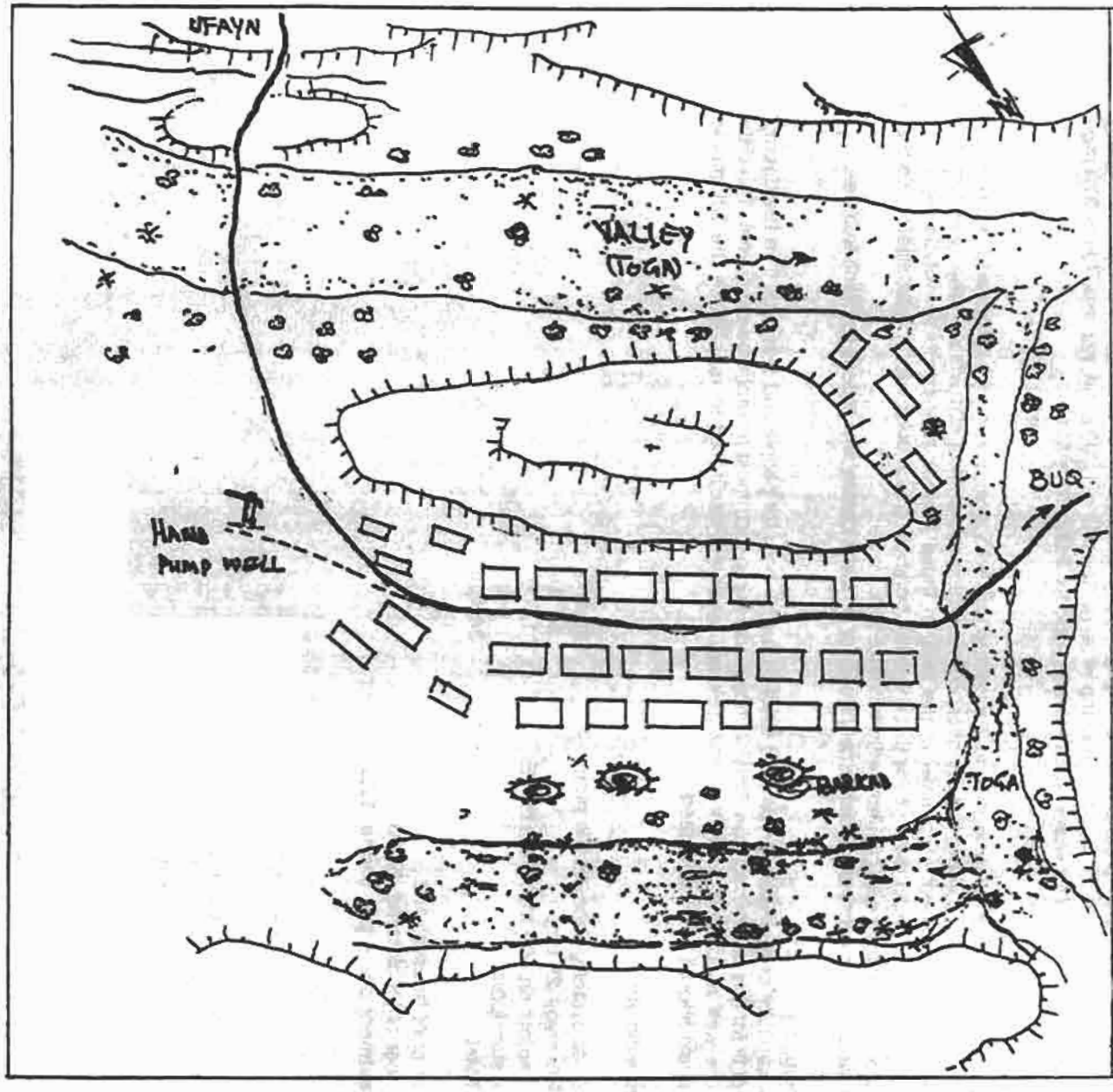
conclusion

The capacity of the handpump is too small to supply both for people and livestock. The handpump is not fit for this heavy duty use. Raising mains and pump rods must be replaced every year. The data on the well assume that higher capacities are feasible. Possibilities to rehabilitate the Dhumoole borehole should be investigated.

Cost estimate

Solar system, submersible pump	30,000
Reservoir 25 c.m.	5,000
Distribution 500 m. 50mm HDPE	1,000
1 standpost	500
Total	**36,500**

Number of houses: 150
Number of inhabitants: 3,000
Investment costs per capita: 12.1



PLAN TIMIRSHE

not to scale

Drawn by: Samater Abdi Samater
SAWA/SPDS Bari water rehabilitation study

Ismadhaqa

general

Ismadhaqa is located in Iskushuban District along the road from Timirshe to Bargaal along the valley of Togga Jaceel. It is a hot and dusty town, as altitude is at 150 m and the village is not exposed to sea winds.

The village has a trade function, but, according to the villagers, livestock and frankincense are the major sources of income. Since the collapse of the economy, fishing has ceased as an economic activity.

Public services are poor with only 1 koran school and a dispensary in a private house. People say the place is very unhealthy with malaria and diarrhoea as the major diseases.

existing water supply

Since long, the villagers were promised to get a reliable water supply. Therefore they didn't invest in alternatives, like berkads. Only 2 berkads were constructed, till now. The village got a borehole fed water supply from the Aquater project, but the pump has never operated and keys were never handed over. Pipes were partly looted, others washed away with floods. The generator is still guarded and said to have the capacity of that of Jurile.

People were not content with the location of the borehole, at 2.6 km from the village; 50 m above the village. Pipes have to cross the wild togga bed.

Aquater had indicated other sites near the village, but villagers were told the water to be too salty. Probably, the drilled well is tapping the Karkar Formation (at >200 m depth), whereas around the village, the water comes from the Hafun Formation.

Seasonal pools in the togga bed are the major water source. The pools are only formed when floods leave a thick clay layer at the bottom. Sometimes, floods remove the clay layer, and no water is found afterwards.

In the dry season, tankers supply the drums near the houses. Livestock is moving 12 km east where a salty well is found. The salty water explains the high incidence of kidney diseases.

On the advice of GTZ, people tried to construct wells in the togga bed and on the valley slope, but these failed: no water was found. The wells were dug by well sinkers from Bosaso (Ethiopia).

request of village

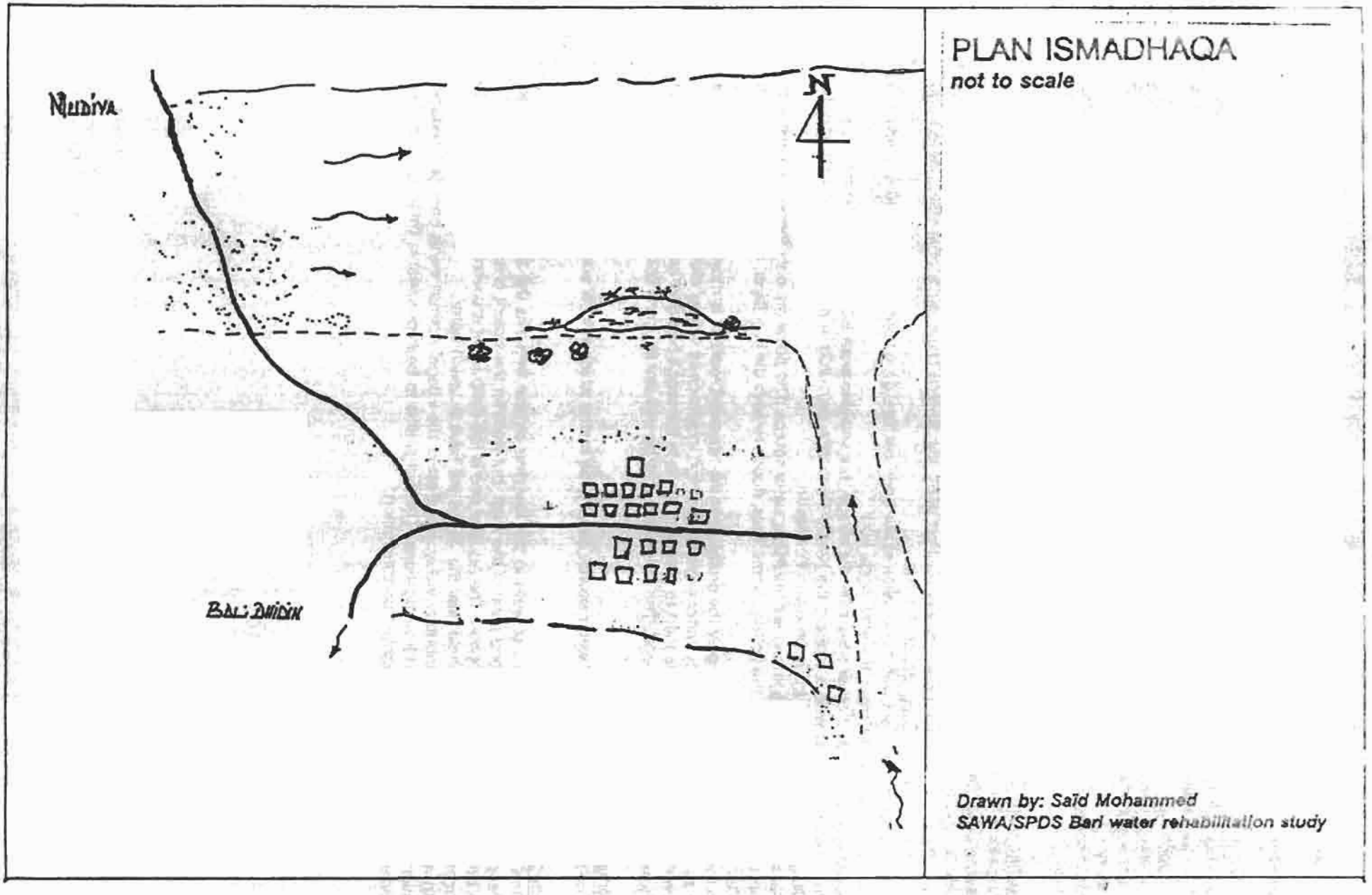
The village prefers to have a water source nearby, no matter which kind of source.

conclusions

One solution may be a series of wells in the low river terrace between the togga and the village. People accept wells in the flood plain of the wadi, but warn for the violent character of the river.

A borehole seems to be no option. The Aquater one is too deep to be recovered, and pipes have to cross the river again. A borehole near the village will have brackish water.

An alternative is found in a tributary valley, just East of the village. A small earth dam (subsurface) might be tried after good soil investigations. The soil seems to be impermeable (marls). Preventive measures should be taken against contamination.


PLAN ISMADHAQA
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NUUDIVA
BAL: DWIDIN
Drawn by: Said Mohammed
SAWA/SPDS Bari water rehabilitation study

Ismadhaqa

general

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The village has a trade function, but, according to the villagers, livestock and frankincense are the major sources of income. Since the collapse of the economy, fishing has ceased as an economic activity.

Public services are poor with only 1 koran school and a dispensary in a private house. People say the place is very unhealthy with malaria and diarrhoea as the major diseases.

existing water supply

Since long, the villagers were promised to get a reliable water supply. Therefore they didn't invest in alternatives, like berkads. Only 2 berkads were constructed, till now. The village got a borehole fed water supply from the Aquater project, but the pump has never operated and keys were never handed over. Pipes were partly looted, others washed away with floods. The generator is still guarded and said to have the capacity of that of Jurile.

People were not content with the location of the borehole, at 2.6 km from the village; 50 m above the village. Pipes have to cross the wild togga bed.

Aquater had indicated other sites near the village, but villagers were told the water to be too salty. Probably, the drilled well is tapping the Karkar Formation (at >200 m depth), whereas around the village, the water comes from the Hafun Formation.

Seasonal pools in the togga bed are the major water source. The pools are only formed when floods leave a thick clay layer at the bottom. Sometimes, floods remove the clay layer, and no water is found afterwards.

In the dry season, tankers supply the drums near the houses. Livestock is moving 12 km east where a salty well is found. The salty water explains the high incidence of kidney diseases.

On the advice of GTZ, people tried to construct wells in the togga bed and on the valley slope, but these failed: no water was found. The wells were dug by well sinkers from Bosaso (Ethiopia).

request of village

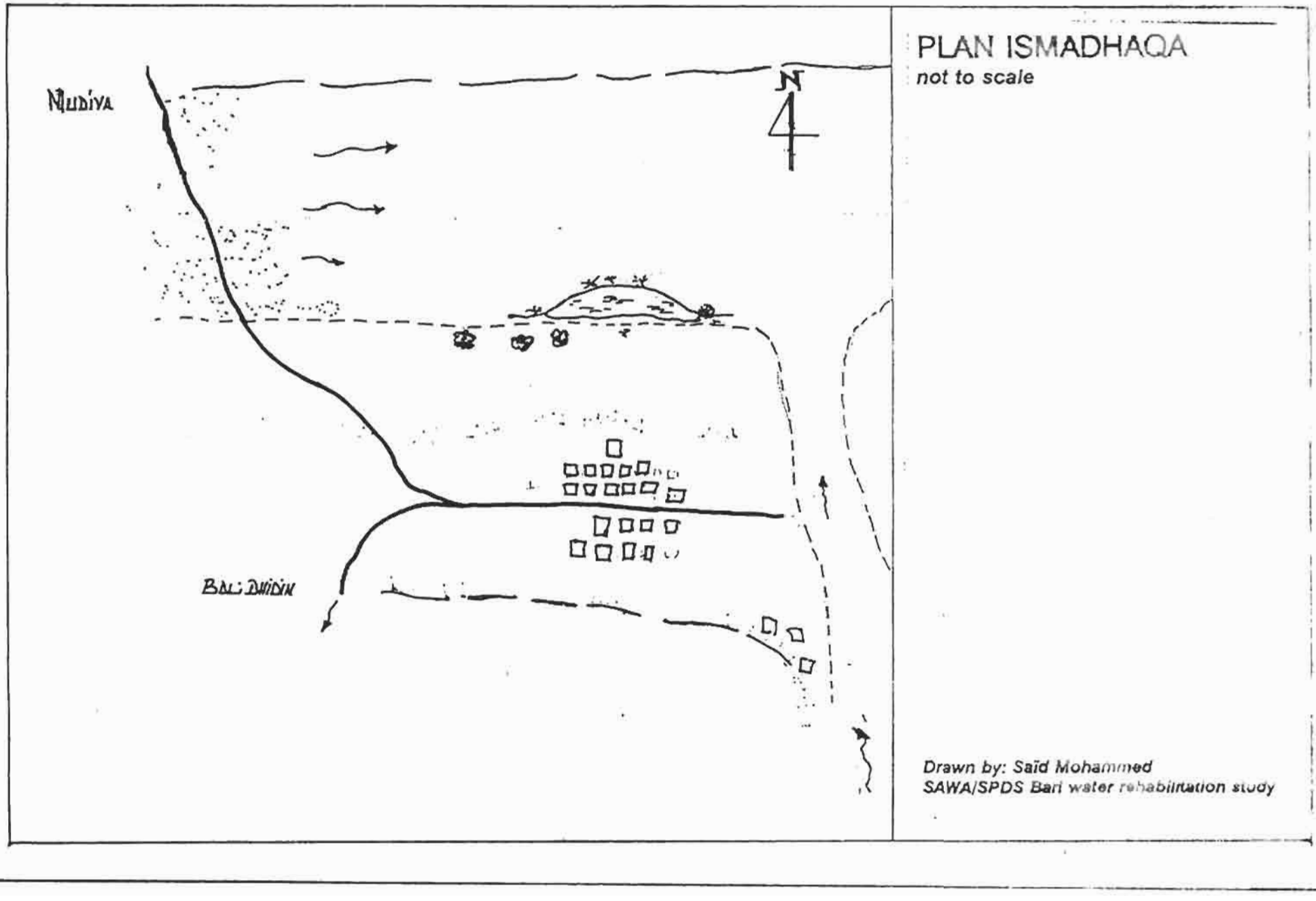
The village prefers to have a water source nearby, no matter which kind of source.

conclusions

One solution may be a series of wells in the low river terrace between the togga and the village. People accept wells in the flood plain of the wadi, but warn for the violent character of the river.

A borehole seems to be no option. The Aquater one is too deep to be recovered, and pipes have to cross the river again. A borehole near the village will have brackish water.

An alternative is found in a tributary valley, just East of the village. A small earth dam (subsurface) might be tried after good soil investigations. The soil seems to be impermeable (marls). Preventive measures should be taken against contamination.


PLAN ISMADHAQA
not to scale
N
Drawn by: Said Mohammed
SAWA/SPDS Bari water rehabilitation study

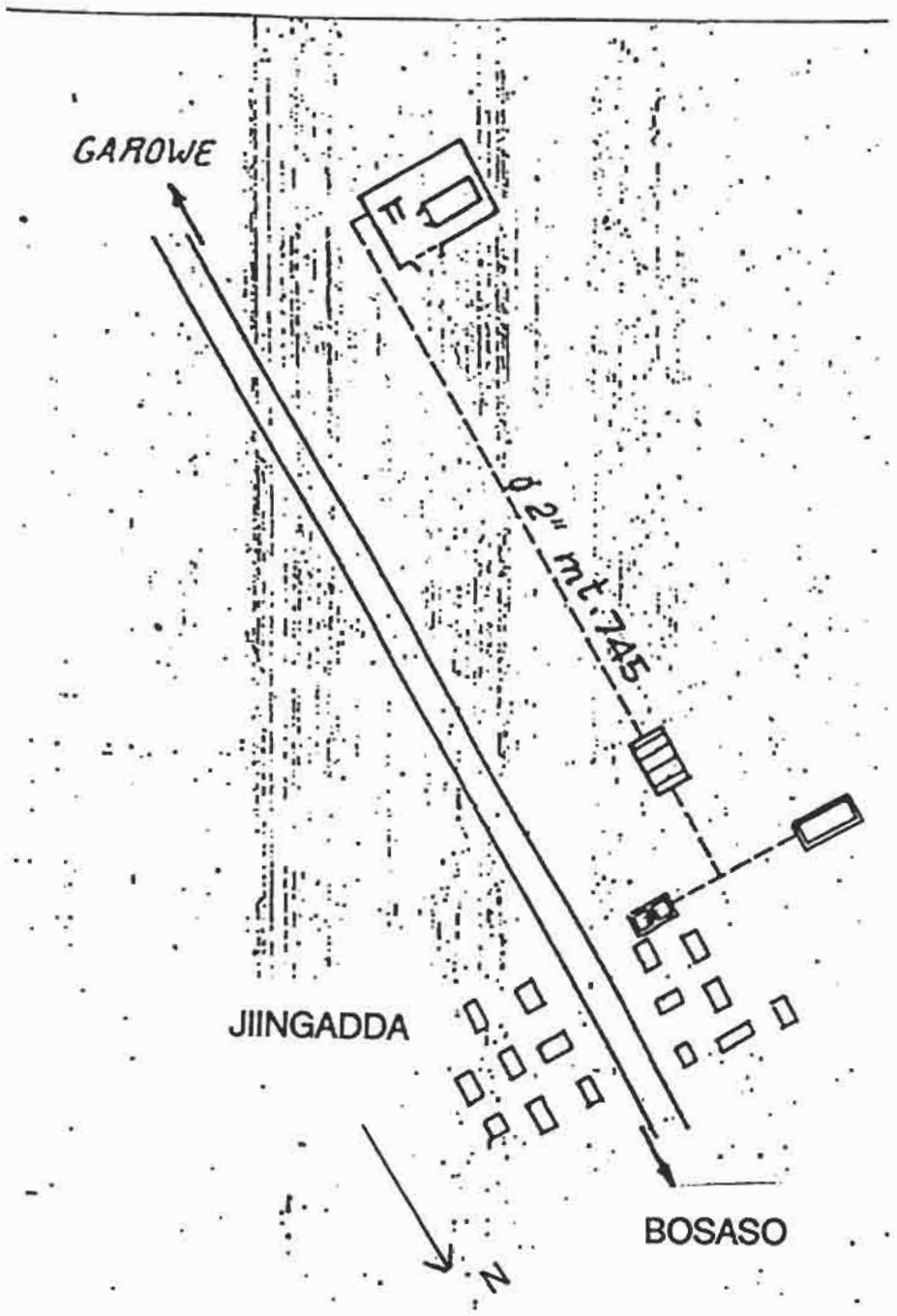
Jilingadda

general description
Jilingadda is a village with 54 houses, located 7 l south of Bosaso. The area is not a grazing area, the only specific activity is a poultry farm which was recently started. Asked for diseases the people answered: "we have no health complaints".

existing water supply
There are 10 berkads, from which 2 are lined in this village. The fact that 8 berkads are not lined is because of lack of funds.
Often the villagers have to get their water from a truck from Bosaso. This costs about 13.000 SSh/drum.
There is a borehole in the togga south of the village made by Aquater. They also constructed a 25 m^3 reservoir and and a standpost as well as a drinking point for animals in the village. The pump broke down in 1993 and was repaired by THW. After the repair the capacity of the pump was reduced considerably. THW supplied also a new generator (DDR, 1985). After one year the system collapsed again. The quality of the water was described as 'hard'.
When the pump was running the water was supplied free of charge. They assured us that in the future they would charge for the water, and people would be willing to pay.

request of the village
The request is to supply them with a new pump for the borehole. They said they liked the generator of THW because it is on wheels (for work on site -type generator), so they can remove it from the togga when it is not used. So it is easier to protect it from theft and damages by flooding.

conclusions
The solution will be to install a new pump, change the old riser pipes for new ones. An improvement of the system will be to raise the reservoir with 3 meters, so it would be able to supply the poultry farm. A new generator is recommendable since the present one is 10 years old.
Total investment would be app. USD 15,000, which is 30 USD/c.



PLAN JIINGADDA

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Drawn by:
SAWA/SPDS Bari water rehabilitation study

Jurile

description

The village of Jurile is located 112 km south of Bosaso along the west side of the road. Number of houses was limited, whereas the borehole had been functioning till 4 months ago. People explained that they had moved the village from the other side of the very wide wadi, where the pump is, to the road side, where the tank is.

water supply

The village has a borehole at the opposite side of the wadi and a tank, standpost and livestock trough. Water is relatively sweet (1350 μS). The pump is not functioning since the end of 1994. Replacement of the pump was donated by Africa 70, but during replacement, the pump with 24 rods fell into the hole. The villagers asked GTZ for fishing tools, but were not able to lift it. Africa 70 promised the villagers to assist further.
The borehole water is also used for irrigation (in sandy soils!) and for filling tankers.

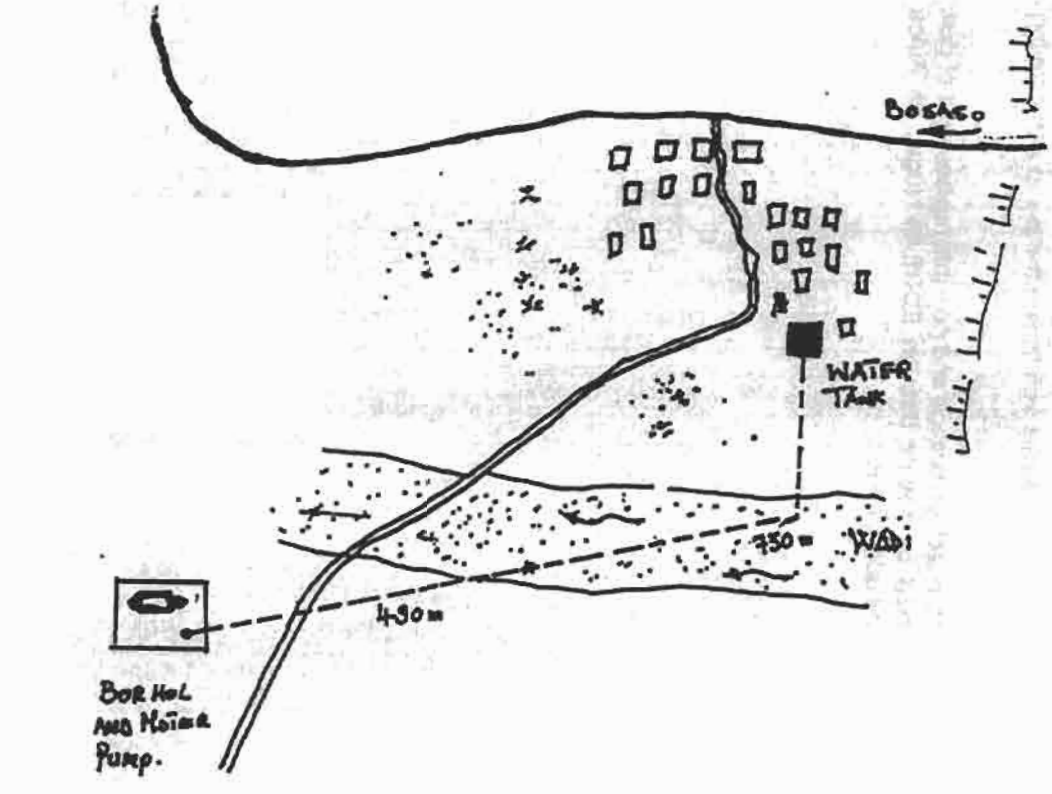
A second borehole was found 4 km north of Jurile. It was filled with stones and blocked at 50 m. According to the former guard the water was sweet and was able to fill 40 tankers per day (about 25 m3/h).

request

A request was made by the elder to assist with fishing the pump and carrying out repairs

conclusion

Fishing of fallen equipment, check of damage and possible replacement of damaged pump and rods are required. Advice should be sought through EDGS in Nugal. As Africa '70 is involved, the improvement will not be included, here.



PLAN JURILE

not to scale

Drawn by: Samater Abdi Samater
SAWA/SPDS Bari water rehabilitation study

Kala-Bayr
(visited by Peter van Doorn)

Description of the village
Kala-Bayr is a village situated circa 50 km. south of Bosaso along the main North-South tarmac road. At the moment of our visit (i.e. 23-5-94) there were circa 200 people staying in the village. According to the people the number of inhabitants of this place will however drastically increase once the water supply over here improves.
Beside the people permanently staying in Kala Bayr a lot of nomadic people visit the place.
The town is also said to be a major off load point for cattle which is then brought from here to the port of Bosaso for transportation to Saudi Arabia.

Existing Water Supply
During the wet months people drink water that has been collected in the 3 berkads which have been constructed in the vicinity of the village.
During the dry months water has to be taken with a truck from a borehole circa 6 - 7 km away from the village. This borehole was drilled by the Italians in 1987.
Circa 6 months ago the villagers received a submersible (GRUNDFOS) pump and a generator (Lister (9.5 KVA))from MEDIC Water Project to pump up water from this borehole.
Static water level in the borehole is 86 meter.
Dynamic water level in the borehole is 121 meter.
The pump is placed at 127 meter.
The pump has a capacity of 6 m3/hour (1,66 l/sec. According to the villagers there is plenty of water and the pump can pump non stop for 24 hours (i.e. yield borehole is bigger than 6 m3/hour).
Fuel consumption is according to the villagers circa 1 litre per hour.
During the dry season when the pump is being operated a watchman stays near the borehole to look after the generator.
The cost of one truck trip which takes 30 barrels (6 m3) from the borehole to the town is 200.000 shilling (circa $ 50, 1994).

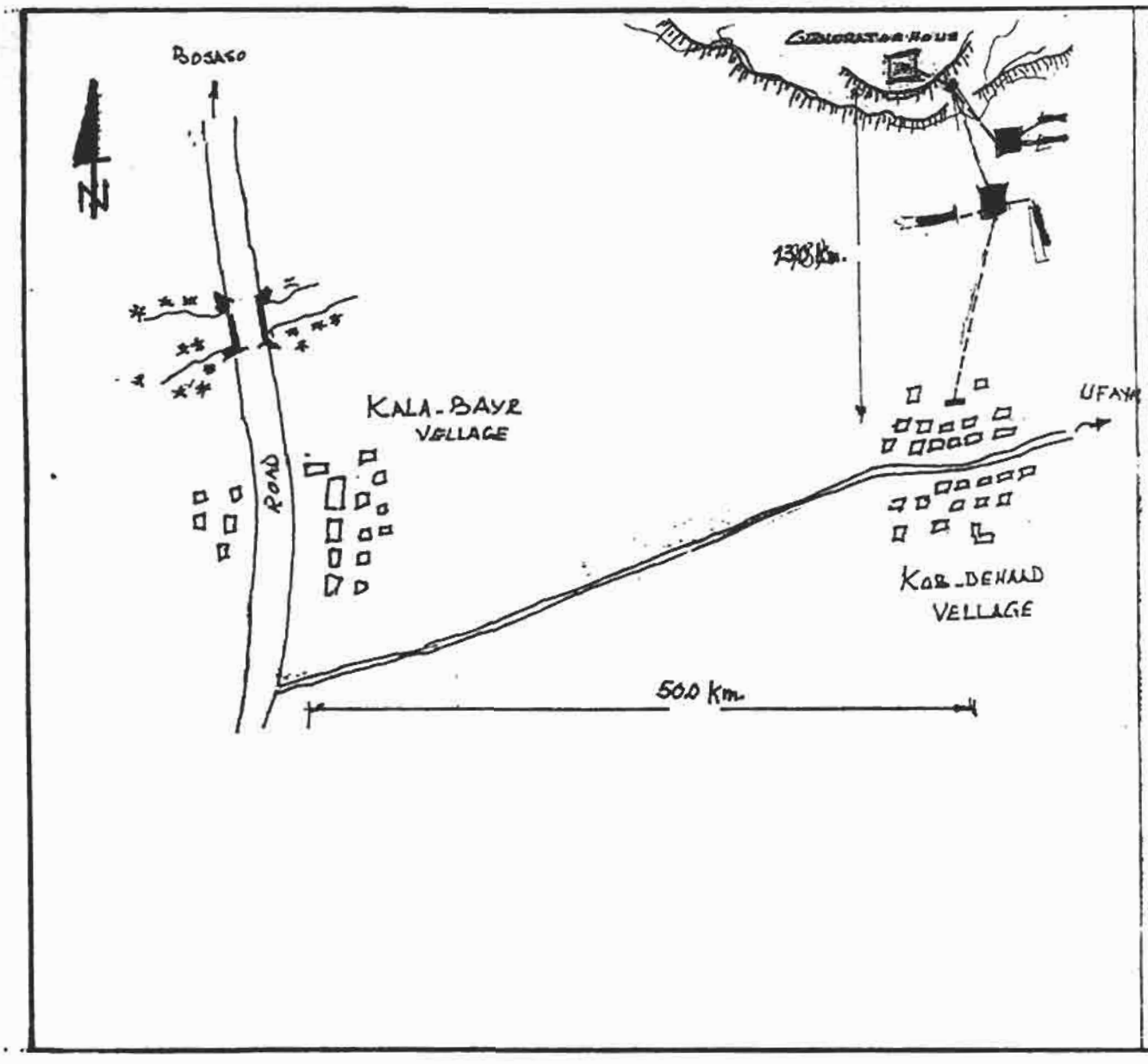
Request of the villagers.
The villagers requested to construct a pipeline to the village and a selling point so that they will not have to go every time with a truck to the borehole to take water.
Also opportunities for vegetable gardening etc. would arise once water is in the village.
It can be expected be that the number of people in Kala-Bayr will increase once the water supply has been improved thus relieving the population pressure on Bosaso.
If this water would be taken to the village it would also attract a lot of Nomads.

Conclusions
Constructional and Financial Aspects.
To realise the objects mentioned above it is necessary to lay a 2" pipeline from the borehole to the village.
This pipeline would be circa 7 km. long (distance measured by pedo meter so to be checked with measuring tape).
The pipeline will be taken along more or less flat terrain so pipe laying should not be a problem. There are a few small (dried up) river beds which have to be crossed but this should neither be a problem.

Due to the fact that the pump will have to deliver more head to pump the water through this 2" pipe to the village (friction loss for a flow of 0.5 l/sec through a 7 km long 2" pipeline is circa 23 meter and for 1 l/s circa 70 meter) the discharge of the pump will go down (probably till something like 0,5 l/sec).
A performance curve for this pump was not obtained but might still be with the villagers.
There is plenty of water even a flow of 0.5 l/sec would supply enough water in 10 hours for 900 people (assuming a consumption of 20 l per person per day).
For the time being a reservoir tank\selling point with a capacity of circa 15 m3 and one drinking point for animals
(storage capacity circa 3.6 m3) can be constructed.

The estimated cost for this project is circa $ 50.000.
The villagers said that they were willing to contribute in the project cost.
The village could contribute circa 10% of the project cost by providing all the necessary unskilled labour and the lodging and storage facilities.
It is however advisable to check first one more time the performance curve of the submersible pump to see how much extra head the pump can deliver and what the flow will be.

Time frame
It is expected that this project can be finished in circa 2 months. Supervision can be done by one foreman (permanently staying at the site) and one engineer (staying half of the time).
Operational and managerial aspects of the work.
The villagers said that after completion of the project they will take care for operation and maintenance of the system (i.e. fuel, maintenance of the equipment and salary watchman). This could be financed from the money that is obtained by selling the water.
Bosaso is very nearby so obtaining spare parts etc. should not be a problem.



PLAN KALA-BAYR

not to scale

Drawn by: Samater Abdi Samater
SAWA/SPDS Bari water rehabilitation study

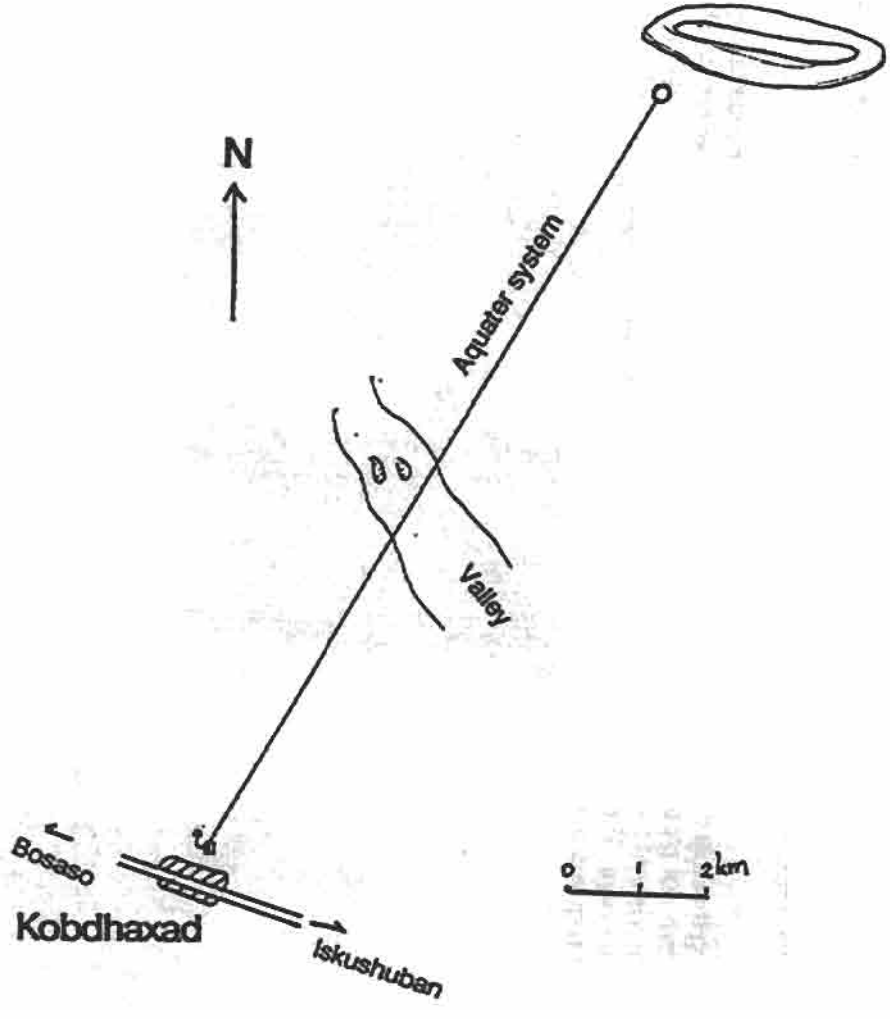
Kobdhaxad

general description
Kobdhaxad (480 m.) is a village of 60 houses 9... km. SE of Bosaso (32 km. fr... n Kala Bayr junction). Most of the houses are shacks. The main source of income is livestock and there is some gardening. There is a school, a dispensary and a mosque.

existing water supply
In 1988 Aquater drilled a borehole, 13 km NE of the village. There is a 25 m^3 reservoir at the borehole for the drinking point of the livestock.From the borehole a 2" transportline goes to the village, where another 25 m^3 reservoir has been installed. Aquater informed the people that nearby boreholes would be more salty.
The system is still running, although the condition is poor. The borehole is 188 m. deep. The EC of the water is 2.600 μS/cm, pH = 7.5 and the estimated capacity of the pump is 8m^3/h.
Next to this they have a few berkads, which are mainly used for gardening. The water is sold for 2.000 SSh/drum to the villagers and 4.000SSh/100goats. For a 5l. jerrycan people pay 200SSh. (=8.000 SSh/drum).
No maintenance on the system has been carried out. The people are afraid that they will break the system down, when they try to repair the leaking valves. There is a water seller who earns a average of 200.000 SSh/month, depending on the season. According to the villagers they don't make money with the system.

request of village
The people asked for rehabilitation of the system and spare parts for future repairs. A second request is to improve the berkads for the gardening.

conclusions
It is quite surprising that this system is still running after seven years without any maintenance (except replacement of worn out pipes) been carried out. The village still has a relative good water supply. Another observation is that the fact that there is a reliable water supply doesn't have a great attraction on people to settle here. The costs for major repairs will be 10,000 USD, which is 10 USD/c. The pipeline however requiers a full replacement within a few years.



PLAN KOBDHAXAD

not to scale

Drawn by:
SAWA/SPDS Bari water rehabilitation study

Lasa Da'wao

Lasa Da'wao is situated at 10[illegible] km from Bosaso in between El Dootar/Armoyin and [illegible]urile. The village has shallow wells as their water supply. One of the wells (in Rasood Restaurant) the water was analyzed.
The water was brackish (3,6[illegible]0 µS), which will be caused by gypsum in the upper layers. Other figures: pH 7.5-8; Total hardness > 370 mg/l $CaCO_3$; Nitrate 25-50 mg/l. Nitrate is quite high. Although protected, the outer wall where people may urine, and the latrine were quite close.

Meladeen

general description

Meladeen is located in the centre of the Dumor Valley. At the time of visit, a flood had inundated the valley, partly. Meladeen lays at 350 m asl, 80 km ESE from Kala-Bayr at the tarmac road. With its 100 houses and surrounding grazing lands, it is an important village.

It is built on a slightly higher terrain, surrounded by the flood plain, covered by gypsum. Without a gympsum cover, the soil is suspect to erosion. A small decimeters high dike was built at the western side of the village as flood protection. Use of wooden walls and the many above ground water tanks, together with the organized street plan make it an attractive village. It appeared quite clean. The village has the basic services, but lacks a regular supply of medicines. Especially the anti-snake serum was highly wanted, as 3 people had been killed by snake bites within a month. Other diseases are malaria and diarrhoea.

existing water supply

The only nearby sources of water is a handpump on 45 m deep well at the edge of the village and a war, made by Africare. Water in the is too salty for human consumption, and the pump is hardly pumping water. Some people (25 families) have built roof catchments and reservoirs, but water lasts for 1 month only, whereas the system costs 1.5 to 2 million Ssh.

During the rainy seasons, there are many pools around (EC measured above 2000 μS/cm). In the dry season people move to Gud-Bhekaad (7 km E) or to Shiiligi (12 km W), where the wells have permanent water, the latter being the most sweet.

Tankers from Bosaso supply water from Ufayn to the tanks at the houses for 16,000 Ssh/drum.

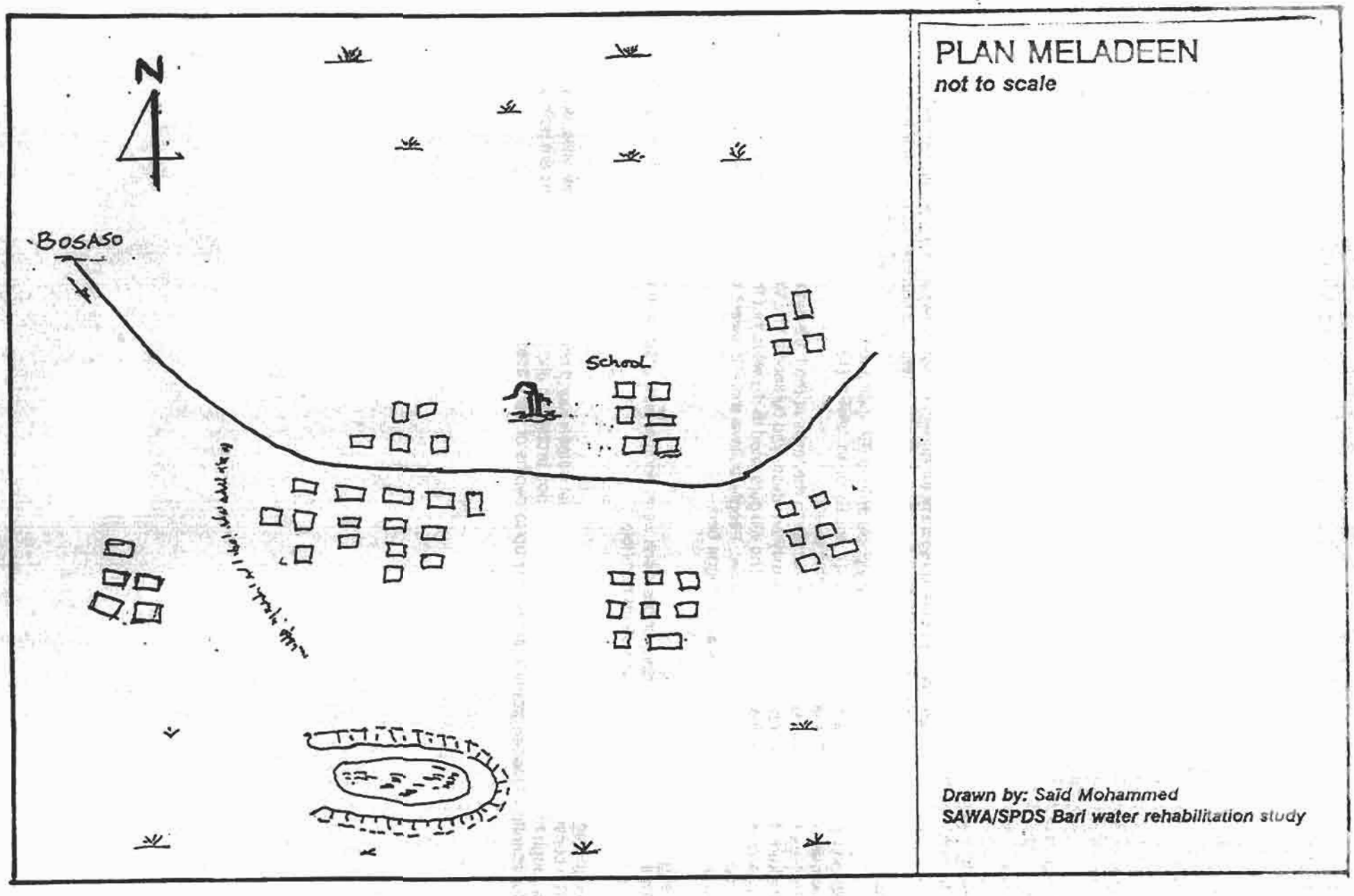
Berkads have not been constructed, as they are destroyed by floods. The villagers evaluate the war as very useful, but dries within a month. The villagers dried to dig wells, but the water table above the hard layer, found within 5 m, is seasonal. People believe there is sweet groundwater, that flows underneath the calcrete layers at the togga bed.

request of village

To improve the water situation. Suggestions were: another war, assist with digging of shallow wells through the hard layers, a very deep borehole.

conclusions

The consultants confirm the high chance that sweet water is found near the togga. Shallow wells, dug through the calcrete are the most prospecting. Flood protection and access during floods are points for attention. Deeper groundwater is salty up to depths of more than 220 m.



PLAN MELADEEN

not to scale

Drawn by: Said Mohammed
SAWA/SPDS Bari water rehabilitation study

Mudia

general description

Mudia is the only village in Alula District, visited by the mission team. It is located south of the Alula Mountain Range at 32 km from El Gal and serves as one of the commercial centres for frankincense trade because of its "accessibility" for road transport. In appearance it isn't a rich village, but income should be high, and investment in berkads is impressive. The village consists of at least 3 sub-villages, several km apart.

The village was founded in 1983, because of the up-coming frankincense trade. There are no services, except for 1 Koranic school. Health situation is poor and living in the village is risky.

existing water supply

The villagers have invested a lot in the water supply through berkads. 30 berkads were constructed, of which 15 were leaking. However, half of them are leaking. People relate the failure of berkads to the soft soil (marls). Lack of cement is another factor. They have tried different masons, but it doesn't affect the quality. The mission observed the berkads to be deep and large, and people confirmed that the bigger ones are weaker than the smaller ones.

When the berkads fall dry people collect water from El Gal by camel. No tanker is hired.

One well had been dug in the togga bed at 500 m from the first sub-village. People were discussing if it had ever had any water, before it collapsed with a flood.

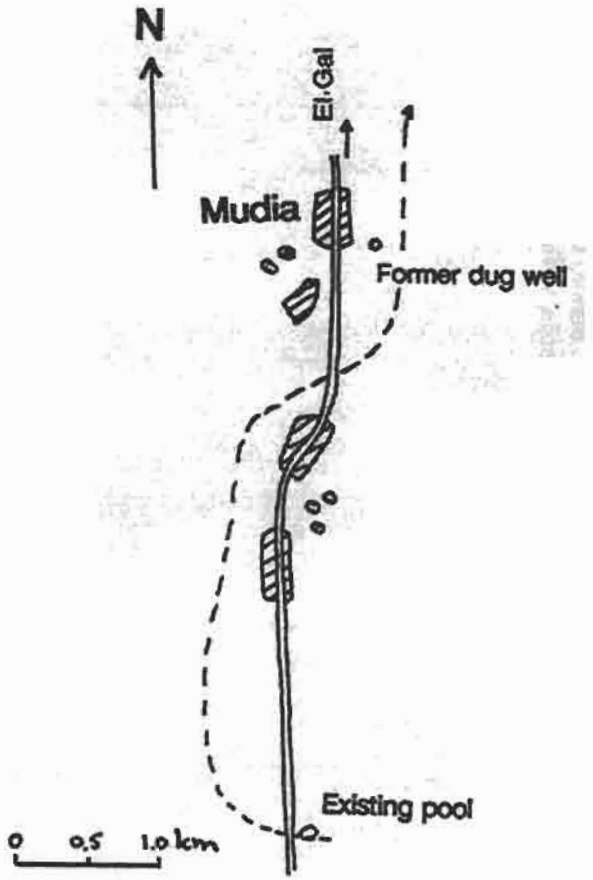
At 4 km East of the village a pool was encountered, which has water for many month a year. Many herds go there to water their animals.

request of village

People asked for cement and for assistance in improving well digging techniques.

conclusions

The regional groundwater level is too deep for a borehole. Berkad construction needs improvement. Digging shallow wells may be an option in these clayish soils, which give suspended aquifers.



PLAN MUDIA

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Drawn by:
SAWA/SPDS Bari water rehabilitation study

Qandala
(visited by Simon Dernign and Peter van Doorn)

Description of town
Qandala is the capital of Qandala District situated along the Gulf of Aden. The distance between the regional capital Bosaso and Qandala along the sea coast is some 100 km. Due to the inaccessability of the coastal area one has to travel app. 450 km. by road implying a journey of 20 hours. A loaded truck needed three days to reach Qandala. By boat (fisherboat) it takes 7 hours. Due to rough seas this is not possible during mid May until mid September.
At the moment of the visit of the consultant only 5,000 persons were living in the town. In the dry season, May till September, many people are moving to settlements at the high plains scattered over the district due to the high temperatures. In September most people return now due to the lack of water in the town.

For several reasons there are at this moment no social services working. Clinic and school are closed due to the present political situation in the region. But the pattern of 'closing down' of the town because of the high temperature seems also an important reason.

The main economic activities are livestock, trade and collection of frankinsence. Till 1988 one of the mayor activities was also fishing. A fish factory gave direct employment to 500 men and 400 women and indirectly to almost 1,000 persons. The fish, tune, was canned and exported to Europe and the Arab countries.
In 1995 the people of Qandala started to build a new canning factory on a smaller scale (René van lieshout).

Population
The number of people staying in Qandala village was determined by going along every house and counting the number of families staying in each house. This was done based on information given by some of the elders of Qandala who accompanied us. This resulted in an estimated population of 11,760 persons.
However this number of 11,760 persons is the number of persons who have a residence in Qandala. Most people only stay a few months in the year in Qandala.
Especially during the dry season many people leave Qandala as it becomes too hot, the population of Qandala is in this months probably less than 2.000 people.According to the elders maximum 2/3 of this number of 11,760 persons will at the same time be present in Qandala.
Therefore the maximum number of people staying in Qandala is at present 11,760 x 0.66 = 7.840 persons.

Water demand
Present water demand
At the moment a water consumption of 20 l\person\day is considered normal.
We assume the water consumption by animals to be 10 % of the total water consumption.
Present water demand is therefore:
20 x 7.840 x 1.1 = 172.480 l/day = 2 l/sec.

Future water demand
For a design period of 20 years we assume :
- population increase of 30 %
- increase in the water consumption of 20 % (24 l/person)

The design flow will therefore be:
20 x 7.840 x 1.1 x 1.3 x 1.2 = 269.069 l/day = 3.11 l/sec

Existing water supply scheme
The present water source is a well which is situated in a dry river bed at circa 15 km south east of Qandala near a place called Butyalo.
The yield of this well is ca. 1,2 litre per second.

Nowadays daily ca 15-18 m3 is pumped to the town in a period of ca. 13 hours which is not enough if there are many people in town. During the day time no water is being pumped to the town because of fear that the pump breaks down if it is used too much. The present pump was bought by the villagers ca. 4 months ago. A pump given by the German organization THW in November 1993 is not functioning well and is therefore not being used.
During the day time especially in the dry season sometimes water is sold to people who come here with a truck with barrels.

The water is pumped through a ca. 18 km. long pipeline of 1 1/2" and 2 " galvanised iron pipe.
The pipeline runs through a dry river bed, a lagoon and along the beach to Qandala town where the water is stored in some reservoir tanks. From here the water is sold to the people (1 barrel (200 ltr) for 3000 Shilling (= $ 0.75))
Some parts of the pipeline have been replaced by the German organization THW last year.
There are however still parts of the pipeline which are not in a good condition.

Every year however the pipeline at the lagoon site is seriously damaged by floods etc. and the water supply is blocked for some time.

The distribution scheme in the town is not in a very good condition. Most of the tanks/ water selling points are leaking somewhat and need to be replaced.

So the 2 main problems of the present water supply scheme are:
- There is not enough water if there are many people in town.
- The pipeline is damaged every year by floods.

Alternatives for improving the water supply
There are 2 alternatives for improving the water supply of Qandala town, one is the rehabilitation of an existing scheme consisting of 2 boreholes, a pipeline and a reservoir tank which was constructed by the Italian company Aquater in 1991 just before the civil war broke out. The other alternative is the construction of a new gravity flow scheme using a source (Tooh) in the mountains near Qandala.

AQUATER SCHEME

This scheme was constructed by the Italian company Aquater. It was never completely finished because the work had to be stopped when the civil war broke out.

Intake

The source of the scheme consists of 2 boreholes of a 20 meter deep which are situated in a dry river bed close to the well of the present water supply scheme (Butyalo). The 2 boreholes are still in a good condition. Probably the 2 submersible pumps are still in the boreholes however this could not be observed as it was not possible to open these boreholes.
On a higher place at the side of the dry river bed the Italians constructed a powerhouse where 2 generators to generate the pumps were installed.
The powerhouse has been completely destroyed.
The 2 generators are still in a store in Qandala. Some parts of the generator are missing. It might be possible to use them again but they would need of lot of revision; it is therefore probably better to replace them by new ones.
The yield of the 2 boreholes and the capacity of the pumps is not known. It was tried to obtain this information from Aquater without success so far.

Pipeline

From the boreholes the water can be pumped through a 10 kilometre long mainline of 2" and 2 1/2" coated ductile iron (CDI) to the town of Qandala. This mainline is still in a good condition although at some places the coating of the pipe is damaged and/or pieces of pipe have been taken out.
This mainline was surveyed and a long profile was drawn to get some more insight in the hydraulic functioning of the scheme.
It might be better to build a BPT in the mainline at the last hill before Qandala because otherwise pressure problems could occur at some places in the pipeline.
2 air valves have been taken out of the pipeline.
A big problem is that the pipeline near the boreholes is running through a river bed where very big floods can occur when it rains. The pipeline was buried less than a meter over here and damaged by the floods.
In case one wants to rehabilitate this scheme one will have to lay the pipe at a depth of 3 meter at places where floods occur and secure the pipeline with gabions 2x1x1 m3 every 6 meter.
However according to the locals even this will probably be washed away when floods occur.

Distribution Scheme

In the town of Qandala the Italians constructed a reservoir tank of 54 m3 which is still in a good condition.
From the reservoir tank there is a 2 " pipeline that goes to a selling point in the town.
If one would choose for this scheme a new distribution scheme in the town consisting of 8 new selling points would have to be constructed.

TOOH SCHEME

Description

The source for this scheme is situated in a dry river bed in the mountains ca. 12 km south east of Qandala at an altitude of ca. 750 m. a.s.l..
From here the water will have to be taken by gravity through a 12 kilometre long pipeline of galvanised iron (GI) to the town of Qandala. At 2 places river beds have to be crossed but over here the floods are not as rough as the floods that occur at the river beds near Butyalo.
Between the source and the town 3 break pressure tanks and 3 drinking points for animals will have to be constructed.
In the town a new distribution scheme consisting of 8 new selling points would have to be constructed.

Water Quality

The following water quality tests were carried out with the water of the Tooh source.

Conductivity	: 650 µS/cm
Turbidity	: < 5 NTU
Nitrate content	: < 5 mg/l
Cl2 content	: < 0,1 mg/l
Iron content	: < 1 mg/l
pH	: 7.8

Request of the village

The local community is very much in favour of the Tooh scheme. There is not much confidence in a rehabilitation of the Aquater scheme. One reason for this, besides the flood problem is the fact that the community was not involved in the survey and construction of this scheme.
The community regards the Tooh scheme as a much more reliable system as the Aquater scheme.

Conclusions

The consultant would like to advise to construct the Tooh scheme rather than rehabilitating the Aquater scheme because:

- **The Tooh scheme is cheaper and easier to maintain (no pumps or generators).**
- **The Tooh scheme has a lower running cost (no cost for fuel)**
- **There are problems with floods near the intake of the Aquater scheme. According to the locals it will be very difficult to solve these problems.**
- **The local community is very much in favour of the Tooh scheme. There is not much confidence in a rehabilitation of the Aquater scheme. One reason for this, besides the flood problem is the fact that the community was not involved in the survey and construction of this scheme.**
- **So far no information about the yield of the Aquater scheme was obtained and it is not sure when and wether Aquater will give this information. In case one chooses for the Aquater one would have to do a pump test if the yield of the source is not known. This would delay the implementation of the project seriously.**

- **A disadvantage is the fact that constructing the Tooh scheme is ca. $ 110.000 more expensive than rehabilitation of the Aquater scheme. However in the long run this scheme is cheaper because of the lower running and maintenance cost.**

The scheme that is being used at the moment will be left as it is and might serve as a stand by if people want.

Oayaad Same

description
Oayaad Same is located 75 km from Gardo on the road to Bosaso. It is in the narrow valley between the Karkar plateau and the Daroor valley. There were only 2 houses, but the "pass" serves for by-passing nomadic herds between 2 main grazing areas.

water supply
At present, the elder had 1 berkad, which leaked considerably. The berkad was collecting drainage water from the ditch along the tarmac road. He had a second berkad under construction, which was dug by 20 man during 3 month. Half of them were paid. The elder had no money, yet to finish, as many of his livestock had died.
Normally he didn't sell his water, but because of the leakage he was selling the berkad water for 300 Sh/drum, only.

request
The old man asked for materials to finish his berkad.

conclusion
The team looked for alternative solutions (groundwater dams), but these don't seem to be feasible. No response will be given to individual requests, but the example shows that there should be developed a kind of revolving fund for berkad construction. People can easily sell the water from the berkad and earn money to return the loan.

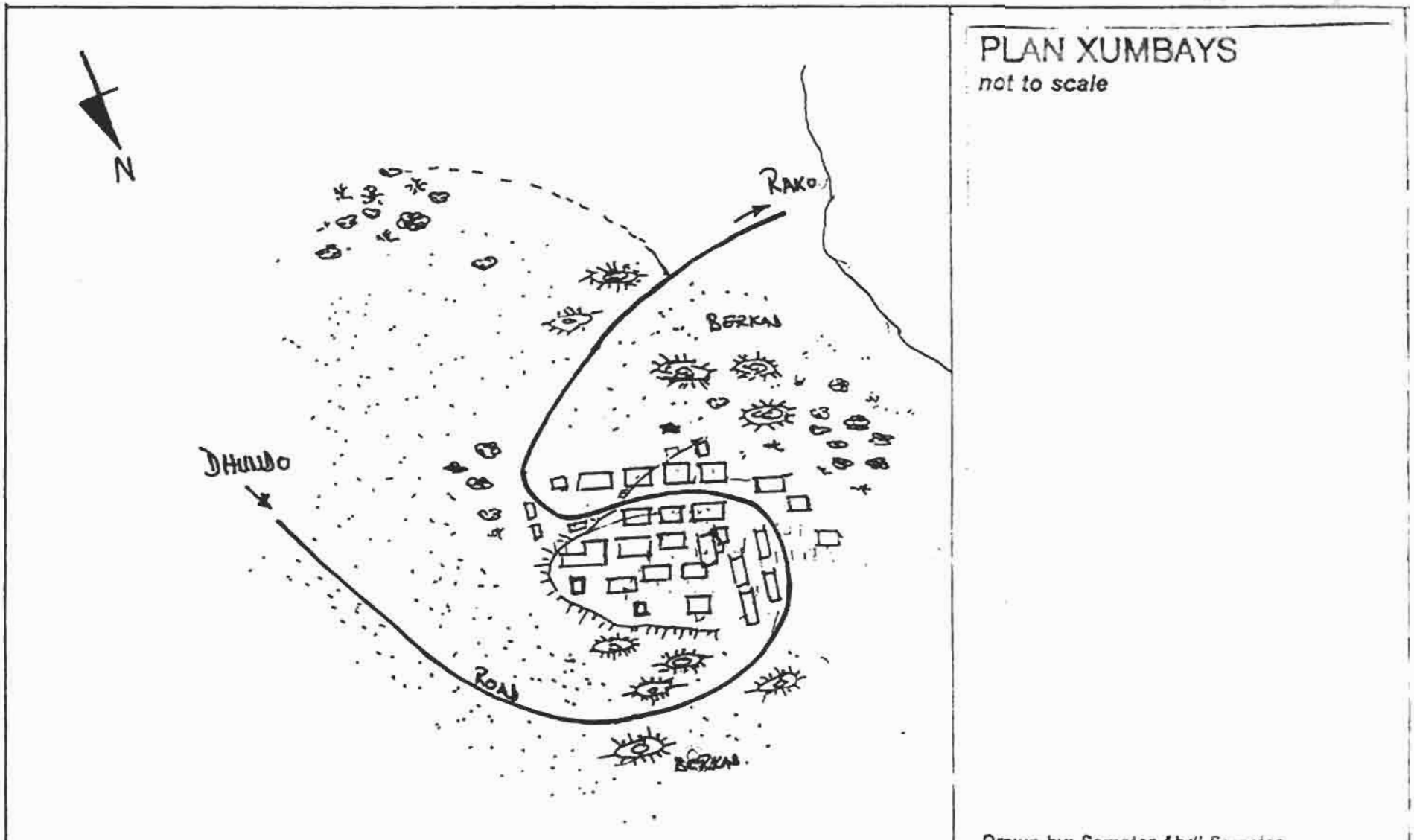
Oodax/Xumbays

<u>general description</u>
Xumbays/Oodax (560 m.) is located 130 km. West of Bander Bayla. It counts 30 houses and is growing rapidly. It is a livestock area. It is located on the border of wide depression which is filled with sediments. A togga ends in the depression close to the village. They have no dispensary or school. Children attend however lessons under the trees. The main diseases are Malaria, coughing and Anaemia.

<u>existing water supply</u>
They have 37 lined berkads (which are owned by groups of four) and 15 unlined. They sell the water for 3.000 SSh/drum. Every year 2-3 berkads have cracks, most of them at the connection of floor and wall. They estimate the evaporation at ca. 1500 mm/year in a covered berkad. They claim that the taste of the water deteriorates during time, and that black layers develop (algae?). Every year a layer of 25 cm. of sediment settles in the berkad.
When the berkads have dried they buy the water from trucks. From Dhudo it costs 20.000 SSh/drum, from Gardo and Iskushuban 25-30.000/drum.
In 1960 there has been drilled a borehole, which functioned until 1963.

<u>request of village</u>
Their first question was to rehabilitate the borehole. We explained that this was not feasible because it is completely filled with stones, and the fact that it was soon abandonned indicates that it is a negative well. The second request was to support improvements on the berkads. The price of the cement is their biggest problem.

<u>conclusion</u>
We visited the togga which ends close to the village. The circumstances look promising to construct a subsurface dam in this togoga and drain water out to a well from where it could be pumped. More investigation on the composition of the bottom of the togga however is necessary. This could have been done by a simple handauger. However in the whole Bari-region there doesn't seem to be one.



PLAN XUMBAYS

not to scale

Drawn by: Samater Abdi Samater
SAWA/SPDS Bari water rehabilitation study

Rako

general description
Rako (710 m.) is located 60 km. West from the tarmac road, 37 km. NE of Gardo. It is a livestock centre, counts 160 houses and has a school and a dispensary. They claim that 2,000 families of 8 surrounding villages are depending on the Rako well. The main diseases are Malaria, Diarrhoea (they relate it directly to the water), TB, Hepatitus and some kidney problems.

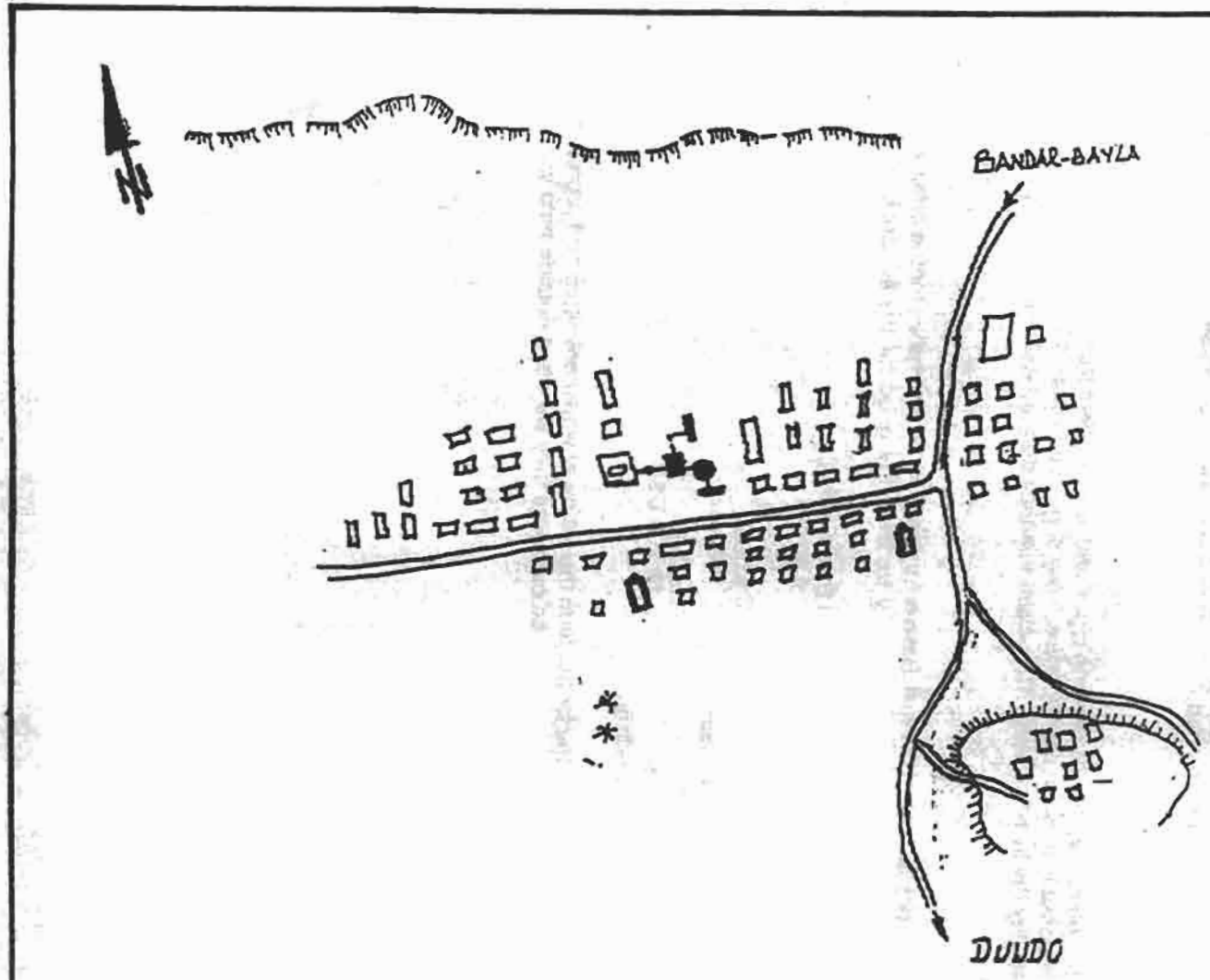
existing water supply
At present they have 40 big berkads and several smaller ones. The communal ones are not lined. There is a borehole at the border of the village, which is 330 m. deep. The SWL = 298 EC = 4.000 µS/cm (Faillace). The borehole was drilled in 1958 and was maintained by the W.D.A. until 1990. Every half year W.D.A. lifted the pump for replacing leaking riserpipes. The W.D.A. was also responsible for the administration and selling of the water. They employed three operators, from which still two of them are there. Next to the borehole are two reservoirs and several drinking points for animals.
At the generator house is a brandnew generator (DEUTZ, 48 kVA), which they say was placed by Aquater but this information seems very unlikely. The pump was replaced in 1990 and had a capacity of 20m^3/h. They claim that the older pump had a bigger capacity. They tried to lift the pump with a crane but without success.

request of village
They want a rig to lift the pump, replace the leaking pipes and are confident that the system will run again. When this is not possible they want alternatives. They suggested wars. Their experience with unlined berkads is that they dry in 1-3 months. They claim that they dugged wells up to 30 m. deep without finding water.

conclusion
It is advisable to check the possibilities of the well. Rako is fundamental as waterpoint for the livestock. The people said that the water from the well is to salty for them but good for the livestock. They themselfs would continue to use the berkhad water.
What is needed for an attempt to rehabilitate the well is the following:

- crane with a lifting capacity > 3 ton (available in Bosaso)	9,000
- 75 1½" 6 m. GS pipes	5,000
- 5 1½" GS tees, elbows and unions, each	200
- a spare pump, with 360(?)m. head, max. 28 kW, 3-phase, 1½" riser outlet for if the existing pump is in bad condition.	2,500
	16,700 USD

This could be an emergency-action. For the longer term the set-up of watercommittee and a proper administration has to be discussed with them, because otherwise they will need outside help within a year after the repair.



PLAN RAKO

not to scale

Drawn by: Samater Abdi Samater
SAWA/SPDS Bari water rehabilitation study

Sherbi

General description
Sherbi is located 75 km. North of Gardo. It is an old village and a livestock centre. The people say that the village counts 500 houses, what could not be checked by the mission because it was dark already. They have a school and a small hospital.
The diseases they suffer from are: malaria, constipation and occasionally others. Children suffer from diarrhoea during the dry season.

existing water supply
The water supply exists of 73 berkads, from which 10 are broken. They have another 10 berkads under construction. In 1973 the government tried to drill a borehole. The attempt was stopped when it appeared that the drill was too small.
For relatives the water is free, to others they sell the water for 3.000 SSh/drum. During the dry season water is delivered by tankers from Gardo (15.000 SSh/drum) or Bosaso (20.000 SSh/drum).

request of village
The request of the village is a borehole. Acording to the village one of their main problems is that the cattle destroys all the vegatation around the village. When they have one borehole they expect less damage to the environment.

conclusions
A borehole is the only alternative for the berkads. Expectations on quality and quantity are moderate.

Timirshe

general description
Timirshe (312 r.) is located 40 km. NE of Iskushuban. It counts 150 houses and has only a koranic school. Private rooms are used for education and health care. Their sources of income are livestock, frankincence and rainfed farming. The latter is an exclusive men business. The gardening area is 12 km. outside of the village and its production at the moment is low.
Main diseases are: Malaria, Anaemia, Measles, eyeproblems and for the children: bronchitis, TB and diarrhoea.

existing water supply
There are two sources of water in Timirshe. The first are 10 lined and 7 unlined berkads. These berkhads are used by 15 people and last for 2 months. The second is a borehole 150 m. outside the village. This borehole was drilled by Western Geophysics, which carried out seismic oil investigations in the area. They abandonned the well and drilled another one 12 km. to the South (Dhumoodle), which is not in use.
In 1992 THW placed a Karda handpunp on the well, with a capacity of 1.3 m^3/h. The depth of the well is 72 m., the SWL is at 21 m. and the pump at 30 m. The EC = 1.700 μ/cm, pH = 8, T.H.> 370 mg/l and NO_3^- = 10 mg/l. The water is sold to everyone for 2.000 SSh/drum

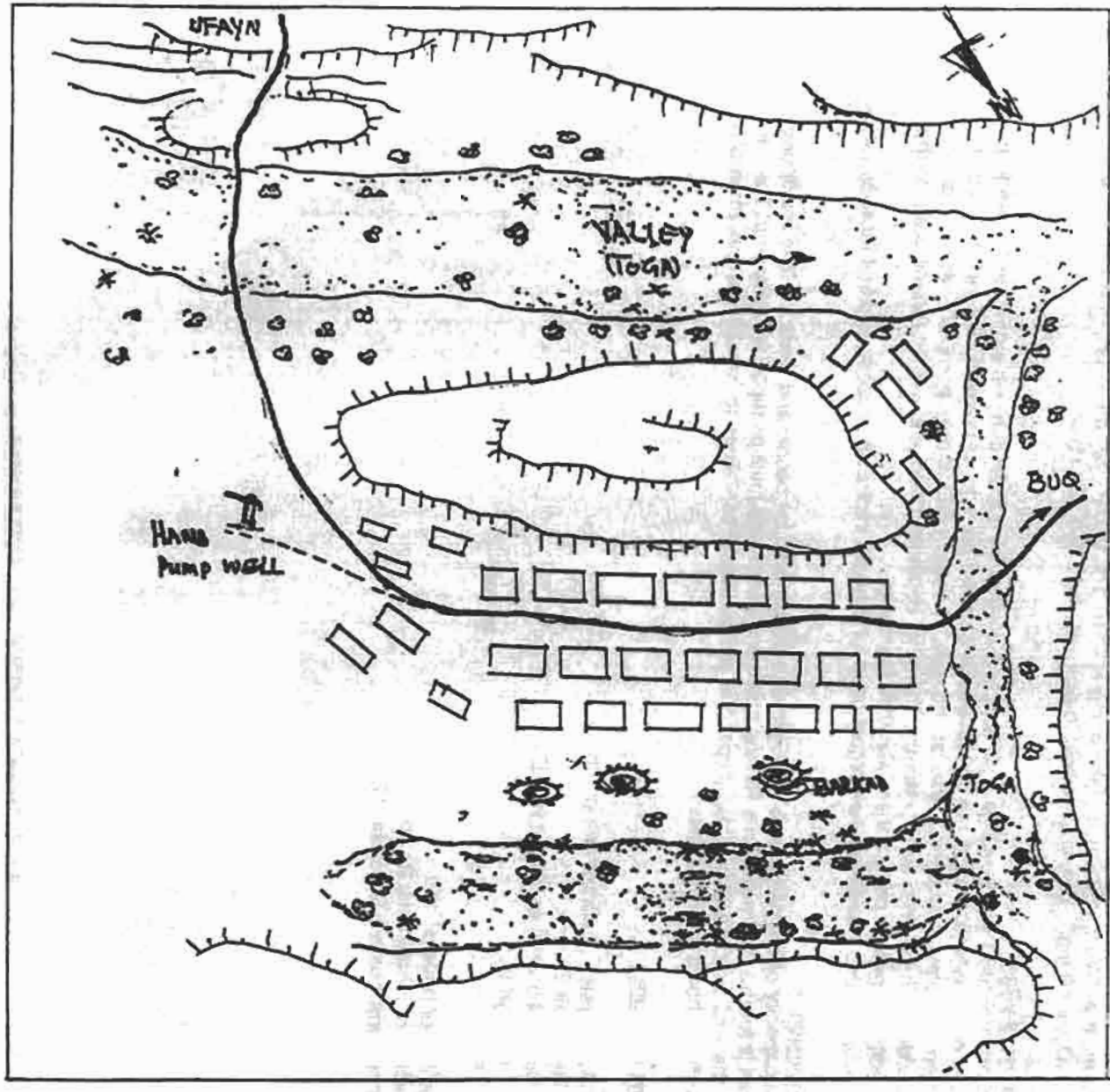
request of village
The main request of the village is to supply the well with a solar pumped sytem and a tap in the centre of the village. During the dry season when there are a lot of nomads with their livestock the women complain about long rows at the well. In these periods they pump the whole night (21 hours/day). The women even prefer that the other borehole (Dhumoole) will be rehabilitated, so that the nomadic people can go there with their livestock.
The women also expressed their urgent need for a health centre and access to credit facilities.

conclusion
The capacity of the handpump is too small to supply both for people and livestock. The handpump is not fit for this heavy duty use. Raising mains and pump rods must be replaced every year. The data on the well assume that higher capacities are feasible. Possibilities to rehabilitate the Dhumoole borehole should be investigated.

Cost estimate

Solar system, submersible pump	30,000
Reservoir 25 c.m.	5,000
Distribution 500 m. 50mm HDPE	1,000
1 standpost	500
Total	**36,500**

Number of houses: 150
Number of inhabitants: 3,000
Investment costs per capita: 12.1



PLAN TIMIRSHE

not to scale

Drawn by: Samater Abdi Samater
SAWA/SPDS Bari water rehabilitation study

Ufayn

<u>general description</u>

The town of Ufayn (465 m.) is located 123 km. SE of Bosaso ([illegible] km. from tarmac road). It counts 350 houses, has primary and intermediate schools and a dispensary. The place was founded when in 1958 the oilcompany AGIP captured the spring Ufayn. Nowadays it has a market function for the region and during the hot season people use it as a resort. The main sources of income are livestock, frankinsence and gardening.
The most common diseases are malaria (which people take from elsewhere according to the villagers), TB, anaemia, hepatitus and little diarhea. The people regard Ufayn as a healthy place.

<u>existing water supply</u>

In 1958 AGIP captured the spring Ufayn (575 m.) which is located 11.4 km. North of the town. The water is transported with a 3" GS pipe. This is the system which still functions. In 1988 Aquater laid a 2" line parallel, but this pipe broke down already, despite the water of the good quality. In 1979 the government started to make a parallel system, but they stopped halfway. These pipes are used for replacement of the old AGIP-pipes. Next to this THW delivered some pipes in 1992. Finally Africa'70 supplied 50 bags of cement and steel cables to support and fix the pipeline where it gets damaged in case of strong floods in the togga. They also supplied a new storage tank which hasn't been assembled yet, because they think there is no water pressure to fill the tank.
In the transportline there are several branches for gardening and livestock. There are no wash outs or airvalves (taken away).
The spring is easy to reach by car, while the last kilometer has to be walked. The WDA made nice stairs which gives the impression of a touristic mountain walk between the frankinsence trees and the 'monkey caves'. The capacity of the spring is estimated at 15 lps (Faillace), the EC = 790 μS/cm, pH = 7.6 and the Total Hardness = 350 mg/l. The springbox is overflowing, but the mission could not make a discharge measurement. Other springs drain in the same section of the togga.
The town has a small distribution net with 100 houseconnections (30-40 functioning) and 3 standposts. The storage capacity is app. 70 m^3, which is only used as an emergency (when pipes are washed away by flooding) storage. The network is branched with GS-pipes of 2", 1¼" and 1"-diameter pipes. The condition of both transport- and distribution system is very poor.
During the day the water is supplied to the people and livestock, during the night it is used for the gardens. Distribution and management appears to be on ad hoc basis and unformal.
Until July '94 the water was supplied free of charge. At present the water is sold for 3.000 SSh/month. People with a houseconnection pay 5.000 to 10.000 SSh/month, depending on the existance of a home tank. They try to sell the water to nomads for 2.000-3.000 SSh/drum, but it is difficult to convince the nomads that free spring water is not free of charge. The revenues are just enough to cover the costs for the fuel of the old landrover with which they carry out the necessary repairs. There is a water committee (4 men, 1 woman) in which the woman is included because she has to represent the women headed households.
During the government period there was a WDA-workshop, which employed 12 people, from which the most of them are still in town or available.

<u>request of village</u>

Their main request is to install a new 3" transportline parallel to the existing one. The purpose will be combined domestic water supply and water for live stock and gardening. Next to this they asked for tools (weldingtrafo, pipecutters, flushing pump) for maintenance.
On our question if they would accept HDPE-pipes which have to be burried in the ground, they replied that they preferred an excavator to do the job and did not trust plastic pipes under the rocky conditions and in a pastoral society. But for the last 3 km. they accepted the plastic pipes, where as the soil is more suitable for excavation and regular control possible.

<u>conclusion</u>

Although at the moment Ufayn is still supplied with good water, the system is completely worn out. It will take a few years at maximum before they will not be able anymore to carry out the necessary repairs.

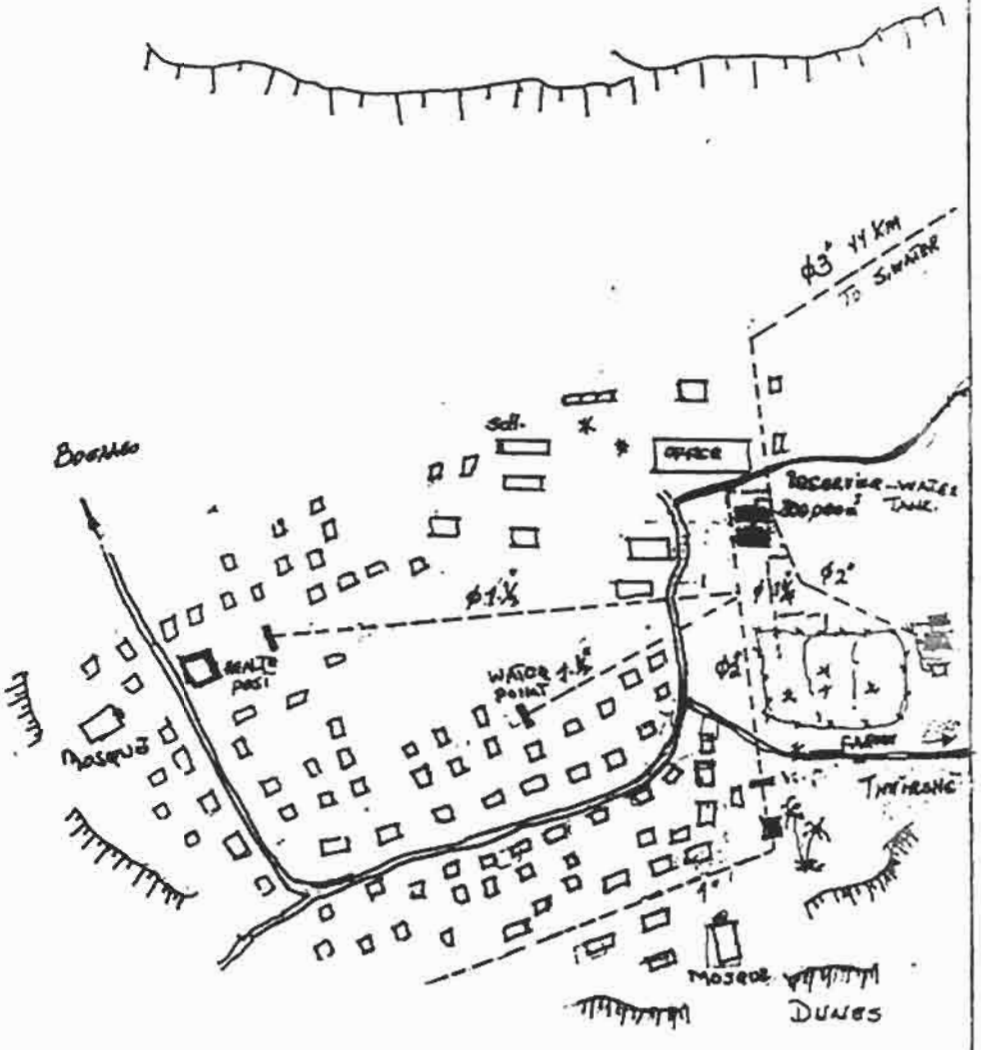
cost estimation (USD)

Transportline 3,000 m. 90 mm. PVC	18,000
Transportline 8,200 m. 3" GI	200,000
Reservoir 50 c.m.	10,000
Distribution 2,500 m.	4,000
12 standposts	6,000
Inst. + house connections	5,000
Rehab. office + store	10,000
Total	**253,000**

Number of houses: 350
Number of inhabitants: 7,000
Investment costs per capita: 36

PLAN UFAYN

not to scale



Drawn by: Samater Abdi Samater
SAWA/SPDS Bari water rehabilitation study

Unoun

general description
The village of Unoun, indicated on the RAF map as "village name unknown", is located at the Qandala Road between Balli Dhidin and El Gal, just a few km before the junction to Qandala. It lays at an altitude of 52m m near the edge of the plateau. 80 houses were counted, of which a number temporary. Appearance was not very wealthy, but better than Balli Wa'atay. Income comes from livestock, commerce and migration.
There is a koranic school and a dispensary, whereas a formal school was found in a private house. Mentioned diseases were malaria, "TB", cancer (!), anaemia and a lot of diarrhoea.

Existing water supply
The village is relying on berkads and tankers. It has 35 lined berkads, 10 unlined ones ("unfinished"). 5 berkads were broken. Berkads are sufficient for 1 to 2 months. Up to El Gal there is no other water source, people said. Tankers come from Buq, for which they pay 20,000 Ssh/drum. The tankers are arranged by the elder in Bosaso. Tankers normally fill the drums, and not the berkads. People do not trust the water in which the mosquito larvae are evident; they believe they get malaria by drinking.

request of village
No

conclusions
Berkads seem to be the only possible source. Ground water in marly aquifers will not be found within 200 m. No wadi can be used.

Wa'eye

general description
Wa'eye is a village with app. 150 houses (according to elders 500), located 61 km north of Gardo. The village was founded in 1967 and has the same resort function as Xiddo. Main source of income is livestock. The village has high fluctuations in population.

Existing water supply
When they first started the village, the water was brought in by trucks. Later they started to build berkads. There are app. 50 berkads, from which two are communal. The first one was built in 1975 by the community itself, the second one with help from Africare in 1994. Africare supplied tools, cement and fuel for the trucks.

In 1988 Aquater has drilled a borehole for the construction of the road Gardo-Bosaso. The borehole depth is 250 m., watertable at 180 m. The borehole is blocked with stones. The quality was said as to be the same as the water from Dhahar. The story is that this borehole was operated for 4 months, mostly during the nights. They took the pump with them when they left the village and promised to come back with one with a bigger capacity. This didn't happen because of the collapse. Aquater also constructed a 25 m^3 reservoir and 2 standposts in the village. All the pipes are looted during the war.

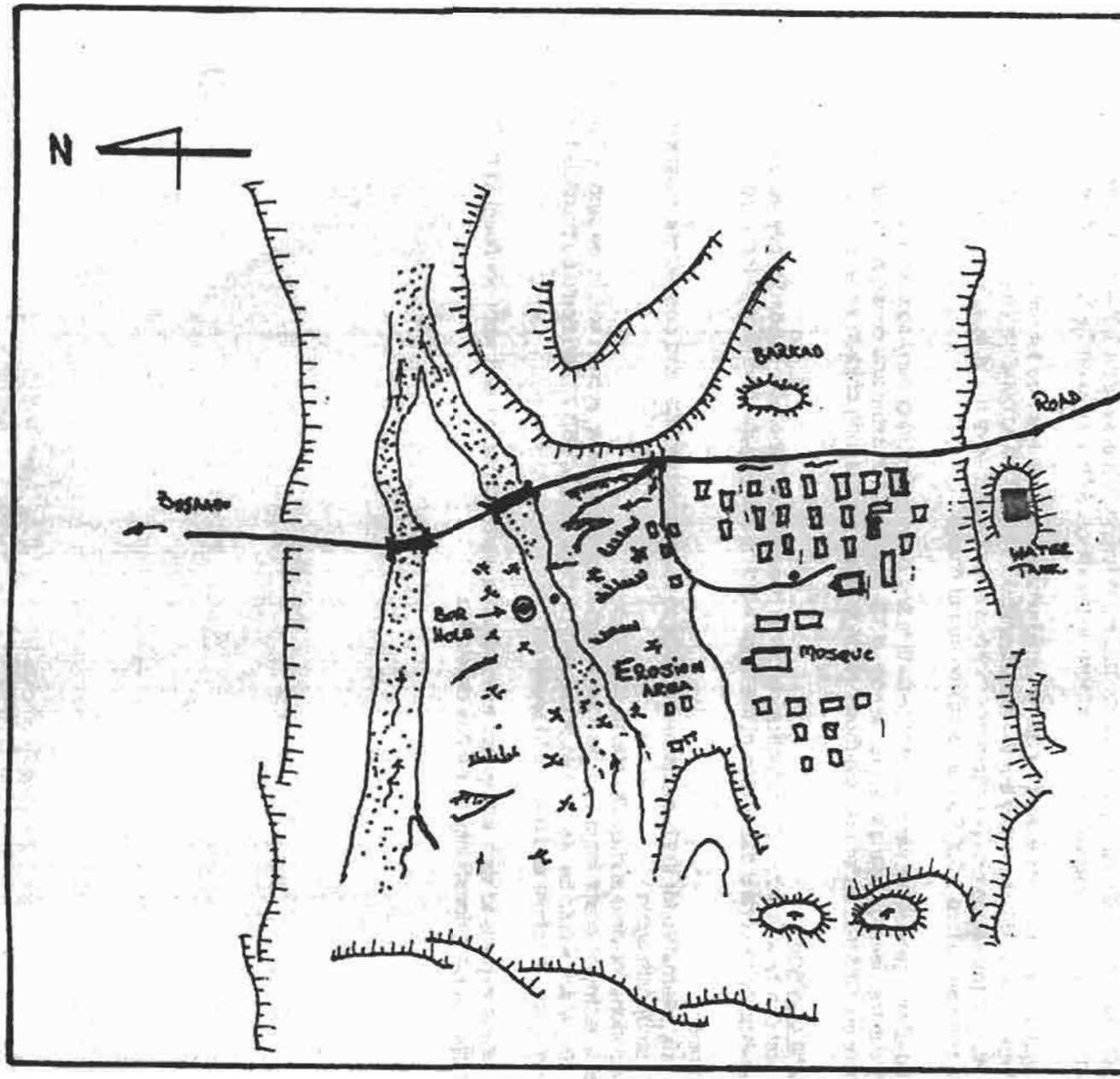
The water of the berkads is sold for 3.000 SSh/drum for livestock. It is free for domestic use. When the berkads have dried out they buy the water from trucks for 20.000-30.000 SSh/drum. It is estimated that 40% of the village can not afford this tanker-waterprice and leave the village. The nomads who pass and can't afford 3.000 SSh are supplied free of charge.

Asked after diseases we were told that malaria is first (increases during rainy season and is clearly related to the berkads by the villagers), second is TB. High blood pressure and constipation were also mentioned. Children suffer from diarrhoea. No high death rates among chidren were reported.

request of village
The first prority was put at the rehabilitation of the borehole and pipelines. Secondly they asked us for assistance to control the erosion of the togga which is affecting the northside of the village.

conclusion
The only alternative for the berkads seems to be to drill a new borehole, and connect the reservoir and standposts again.
Expectations for yield and quality are: medium to low.
Total investment costs for a complete rehabilitation of the Aquater system would be app. USD 100,000, which would be >67 USD/c. A reduction in price to app. USD 75,000 could be possible by drilling a new borehole and relocate the reservoir.

The village expressed their willingness to establish a water committee and were confident in their capacities since a community sense has developed.



PLAN WA'EYE

not to scale

Drawn by: Samater Abdi Samater
SAWA/SPDS Bari water rehabilitation study

Xafun

general description
The village of Xafun is located on the island for the coast of Hordio and counts 200 houses. It can be reached by road from the south (Bander Bayla). We took the boat to the former harbour on the north side of the island and walked almost 30 km. to the village and back. Therefore we had little time to sit down quietly with the villagers. They were also not very happy that we arrived unannouced. They would have organised a closer landing to the village by boat. Their next complain was that they received several missions each month (?!) but this never altered in concrete support. Xafun has the same history as Hordio but looks a lot more better off.

Existing water supply
Xafun gets its water from a well in the dunes, 1.6 km. outside the village. The SWL of this wqell is 5 m. and the EC = 3750 μS/cm, pH = 8, T.H. > 370 mg/l.
There is another well 6 km. outside the village with sweeter water, which could not be visited by us, which has little capacity according to GTZ. It is however possible that this well can be developed better and will deliver sufficient water.

request of village
The people of Xafun were divided over which well they preferred to be developed. They agreed on the request for a transport line to the village and a storage tank with a sellingpoint.

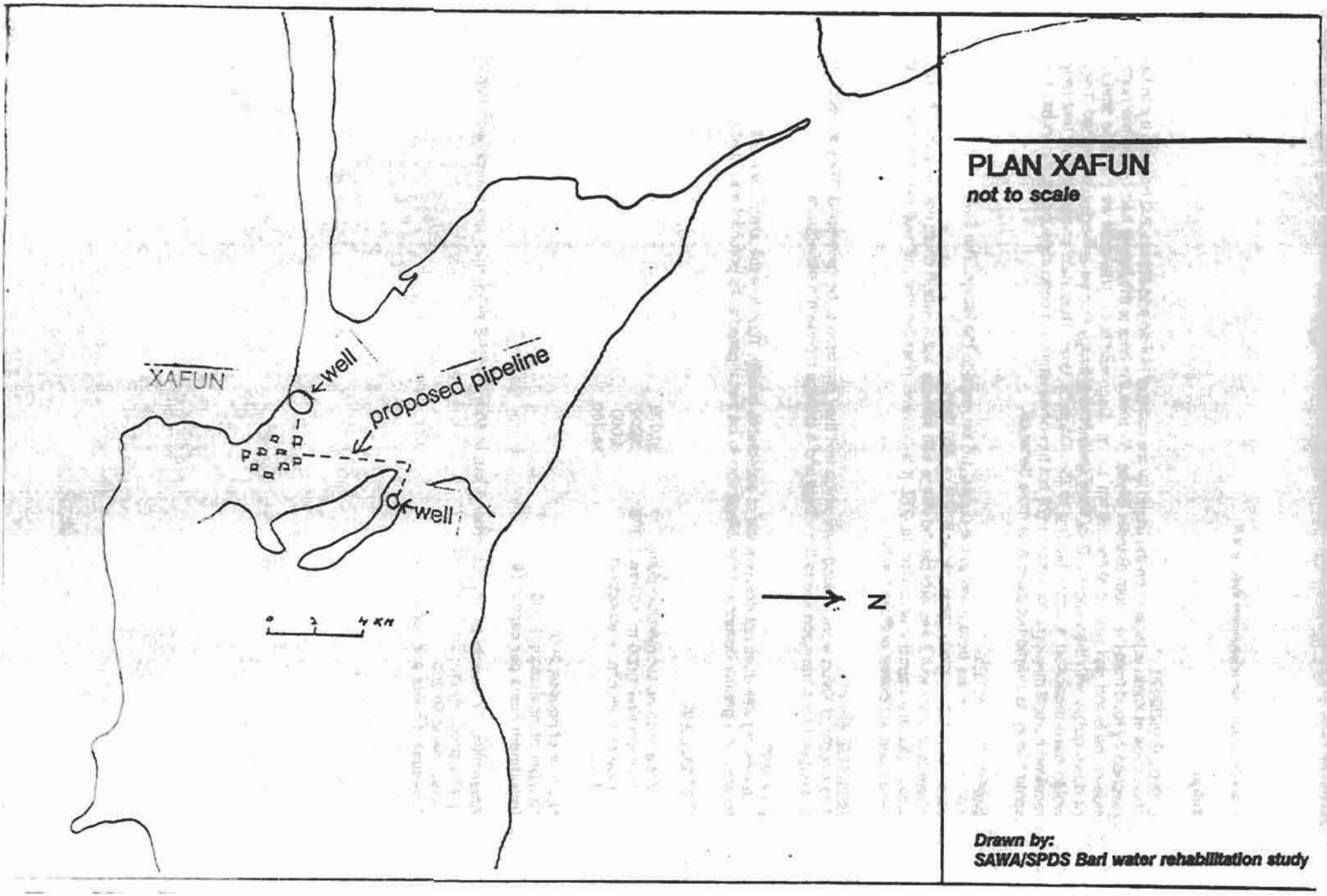
conclusion
The existing well does not deliver water of acceptable quality. Therefore the alternative well which is located at a greater distance of the village should be investigated at its potential and quality.

Cost estimates

Solar system, submersible pump	30,000
Transportline 1,600 m. 50 mm. HDPE	3,200
Reservoir 25 c.m. + standpost	5,000
Total	**38,200**

Number of houses: 200
Number of inhabitants: 2,000
Investment costs per capita: 19

Alternative: if enters in priority list: order 6 km. of 50 mm HDPE extra, than the source with better quality probably can be developed.
Total costs: 50,200
Investment costs per capita: 25



PLAN XAFUN

not to scale

Drawn by:
SAWA/SPDS Bari water rehabilitation study

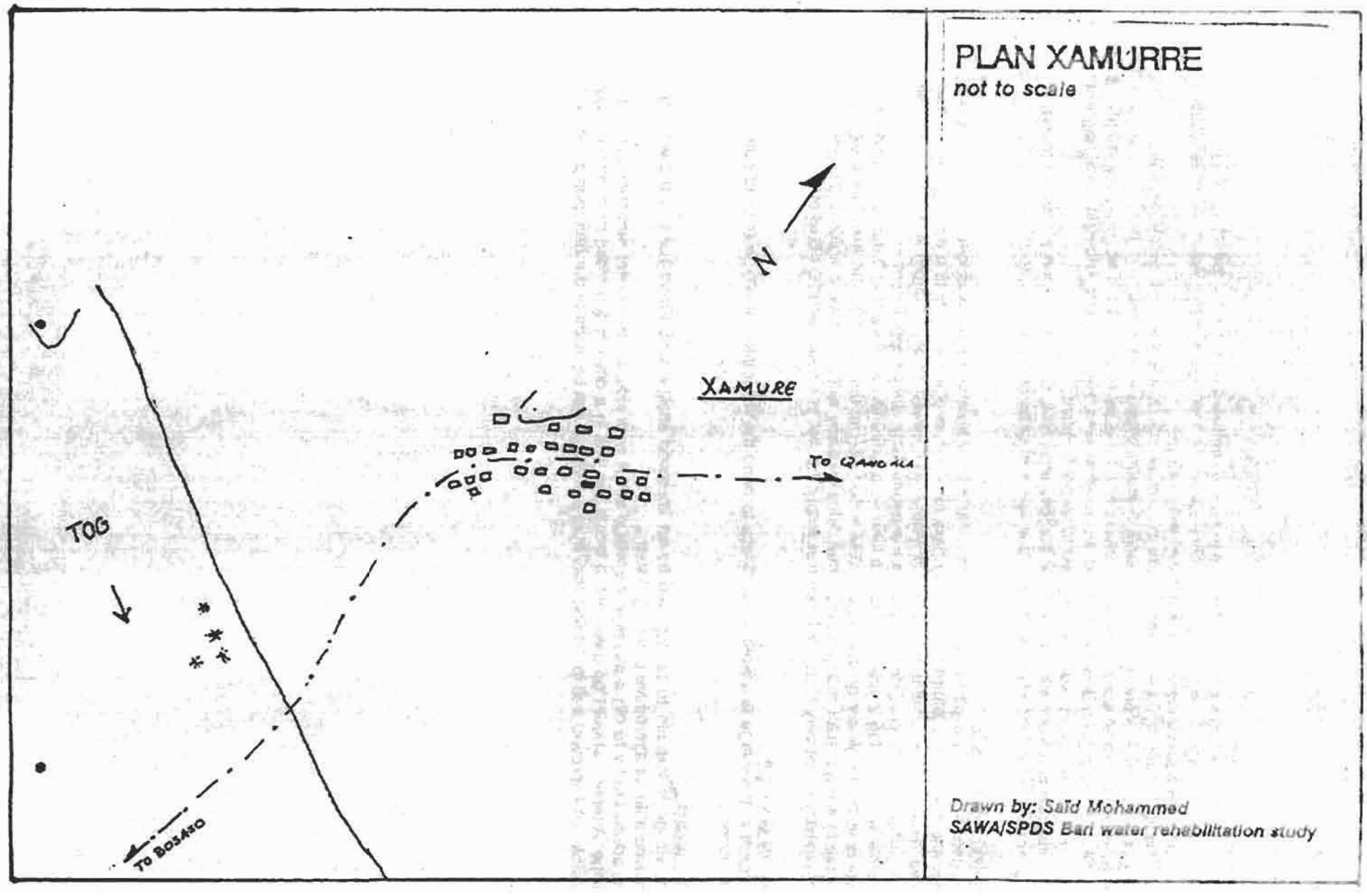
Xanaurre

general description
Xanaurre is situated 20 km NNE of Timirshe along the Qandala Road at an altitude of 740 masl. It lays in the centre of a widening valley, which comes from the foot slopes of the Mountain Zone. Wildish small and big boulders cover the kilometres wide valley.
The village doesn't give a lively impression; most of the men being else. Few small shops are found. Houses are partly in stone, partly temporarily. Surroundings are not clean.
Services are 1 koranic school and a dispensary is in a house. Medicines are not regularly supplied. The village has collected stones to build a school. Malaria, Hepatitis and Anaemia are is highest ranking diseases; diarrhoea was answered to be not frequent.
Frankinsence and livestock are the major sources of income, but some farming plots are found, of which one uses water from a well. Commerce was said to be of importance, too.

existing water supply
Villagers have dug a pit in the wadi bottom at 800 m from and at 8 m below the village. It has permanent water, but after flooding, they have to construct again. They built a new well on a small levee in the wadi bed, but the difference in water level between the wadi bottom and the water in the well, just after some rain, demonstrates a low permeability of the upper layers.
Another well was dug 2 years ago near a farm on another levee. The well is 3.6 m deep and water level is at 2.1 m. Water quality is good (EC = 500 µS/cm; transparent). The 4 m3 were dig by 3 people in 4 days (0.33 m3/man day). They didn't take any safety measures against falling stones. Permeability is not very high, as 4 men can empty the well in 4 hours with 20 l buckets.

request of village
Request of the village is a water lifting device to bring the water into the village (a wind pump was mentioned).

conclusions
The village is suitable to be supplied by an improved shallow well. Flood risks in the wadi are unfavourable for alternative pumping systems.
It is advised to try to dig a well near the village at the wadi side, as the aquifer stretches below the village. Attention should be given not to locate the well in a drain or too close to a latrine. If not feasible, an improved well in the first wadi from the village can be made and a handpump installed.


PLAN XAMURRE
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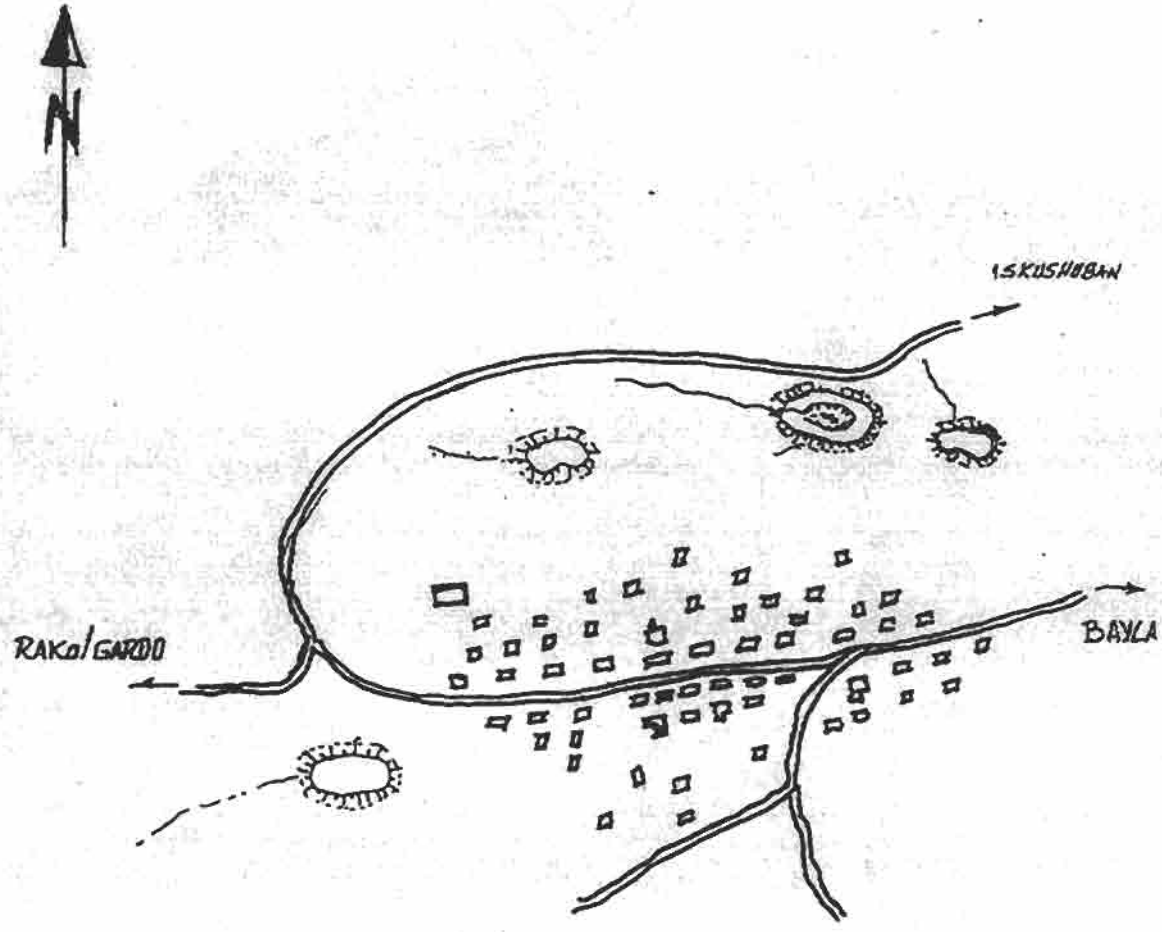
XAMURE
TO QANDALA
TOG
TO BOSASO
Drawn by: Said Mohammed
SAWA/SPDS Bari water rehabilitation study

Xiriiro

general description
Xiriiro (520 m.) is located 45 km. SE from Iskushuban. It is a fast growing village with ... houses. It is a village which lives from livestock. We stopped here to drink a tea and talked with a captain of a ship who staid home for health reasons. He remembered the place as being one house 45 years ago. He explained us on our question that we saw very few children that until the age of seven most of the children staid with the nomads.

existing water supply
The village has 50 lined berkads, from which 5 were broken. The water last for app. 5 months. In 1962 a borehole was drilled 25 km. away, but found to be dry. No other specifications available.

request of village
No direct request was made by the village. But the need was expressed for a general improvemnet of the berkhads.



PLAN XIRRIRO

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berkad

Drawn by: Samater Abdi Samater

SAWA/SPDS Bari water rehabilitation study

Togga Jaceel/Mountain part

general description

The mission brought a 1,5 day visit to the mountain part of the Togga Jaceel in Dandala District, running from Dhadar in the higher mountains to Belli Waaley in the lower reaches. The mission had a look in more than 14 villages with 10-80 houses. An estimated number of 550 houses were seen from the road, representing 7,000 to 10,000 inhabitants. The villages included Afxarago, Anjel, Xijille/Tuurmasaale, Dharin, Harayo, Kurdini, Qudha, Dantamale, Daly Madaw, Gaadir, Sheba, Kayaxa, the 3 Dhadar villages and the 2 Dasan villages.

Three examples are given below: Afxarago, Dhadar and Shebab/Kayaxa.

The mountain area is inhabited already for many centuries, but permanent settlement only started 30 years ago, when the berkads were introduced, and the villagers opened the road/track along the Togga Jaceel.

water situation

The area was selected to represent an area of difficult groundwater and surface water conditions. Permanent groundwater is very deep, shallow groundwater might be available on a permanent basis in only few exceptional locations and the river runs only a few days per year.

People have constructed berkads and collect river water in plastic drums after incidental rain storms. Water stays for some months in the berkads, and are replenished by tankers from Buq, for which people pay 18,000-20,000 SSh/drum in all places.

A few places were encountered where there have been seasonal wells in the past. East of Dhadar a place was indicated where people recorded an ancient well, which had been closed three generations ago after an epidemic. Near Daly Madaw people indicated a place in the river bed where there had been a temporary well, before. Near Shebab there is a dug pit with seasonal water, just below a water fall in a branch river.

West of Xijille/Turmasaale there are some seasonal ancient wells in the wider valley area.

All these places represent situations with a temporary aquifer on top of a impermeable bed, but do not represent a permanent solution.

Solutions

There are no easy solutions for the water problem in this area. It is difficult to find water with shallow wells, and these wells are easily destroyed by floods and never permanent.

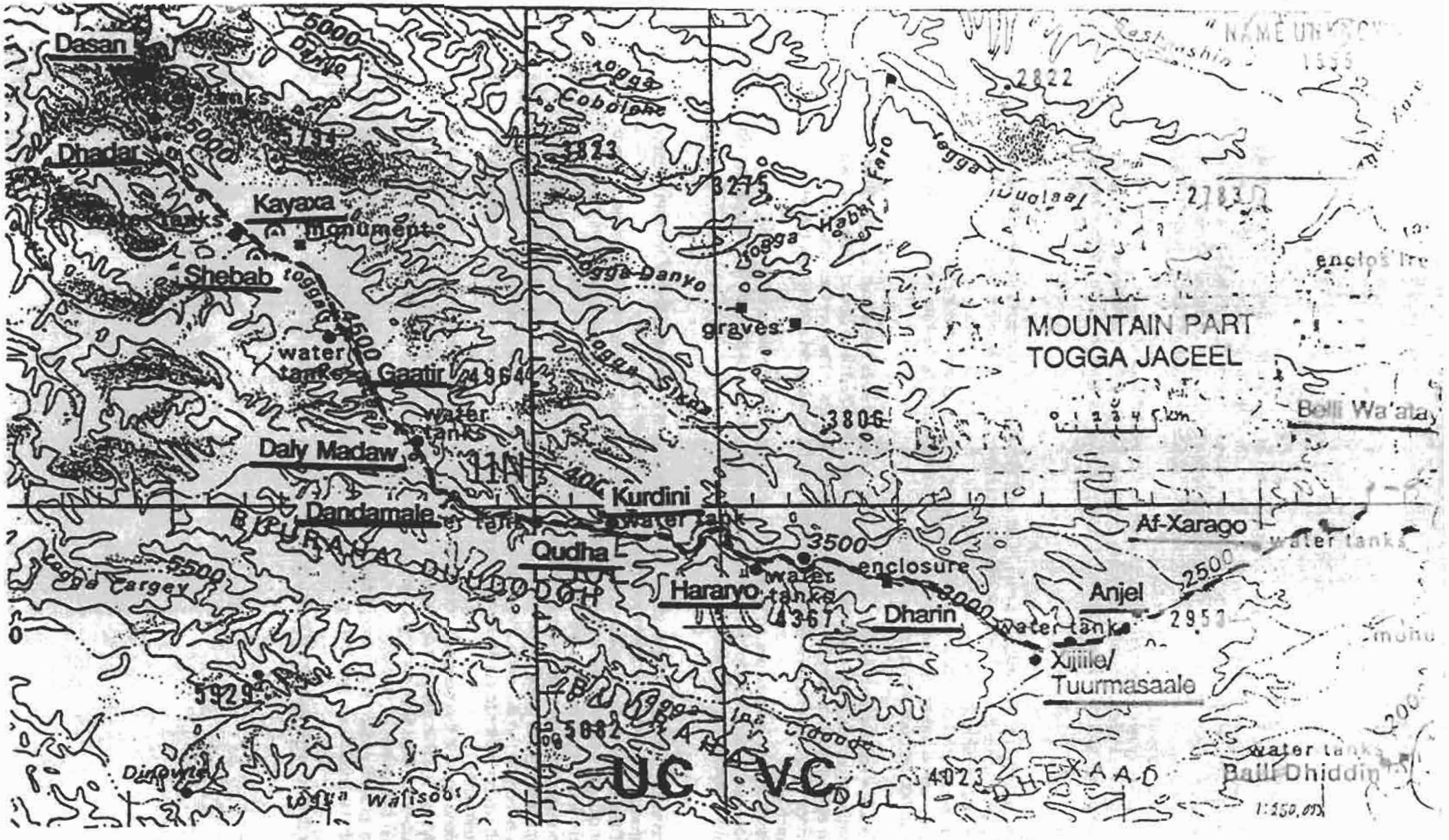
Also in the Dhadar plains, the prospects for shallow water is limited. The ancient well was made under different conditions. later erosion has lowered the water table in the depression, which is the reason why no water was encountered in two recently dug wells of almost 20 meters each.

An exceptional situation was encountered in a depression between the three Dhadar villages, where a semi-permanent pool is used by the communities. Probably, the water is on a suspended aquifer, which does not dry in the dry period. Improving this pond is risky, as the impermeable basis can be destroyed. it will be better to construct another pool adjacent to the existing without destroying the delicate equilibrium.

Other solutions may be the construction of small dams (surface or sub-surface dams). The mission could hardly find suitable sites during the short visit to the area. Major problem is the permeability of the marly sub-soil. There were some good sites for sub-surface dams, but the risk is high that the sub-soil will drain the reservoirs quickly.

A site for a potential dam was demonstrated by one of the Dhadar village leaders. This site is promising and worthwhile to give it a try. Another site was found just downstream of the water fall of Shebab.

In the lower area, downstream from Dharin, protected shallow wells might be an option which should be tried.



MAP MOUNTAIN PART TOGGA JACEEL

Afxarago

general

Afxarago lays in Qandala District, 12 km west of the Balli Dhadin-Qandala Road at the entrance of the mountain stretch of the valley Togga Jaceel, coming from Dhahar. Afxarago lays at an altitude of 690 m, and has around 80 houses, of which most of stone and plastered. The village was founded in 1969, after the construction of the road to Dhahar. It lays 12 km east of Xiglis Tuurmasaale, a similar but historically more important village (residence of the "beedaaje"), which was shortly visited by the mission team.

People come in the high season from the coast to the village. Services are minimal with only a koranic school, where as the children get formal education in the shadow of a tree. Malaria, Hepatitis and Anaemia rank highest among the diseases.

Attempts to start farming have failed, so far, because of the short length of the rains.

existing water supply

The village is relying on 20 berkads and a tanker supply from Buq. In former days, the water was brought by camels. Shallow wells have never been tried, but the river is wild and wide.

Of the 20 berkads, 5 are broken. An extra 10 unlined berkads is waiting for materials to finish. Soil is sometimes too soft (marls). Some berkads collect the water from the village, which leads to high contamination. Nomads can buy the water for 5,000 - 10,000 Ssh/drum.

In dry periods, the tanker comes 10 times a week (70 m3/week), but in some years, there is no need. Tanker price is 20,000 Ssh/drum. Water is supplied to drums and berkads.

request of village

The request is to improve the water supply. Their ideas are: bigger berkads, supply of digging tools or come with an excavator. Other ideas are welcomed.

conclusions

The village makes a huge investment on berkad construction and made an attempt for rain fed agriculture. People are prepared to participate.

The marly hills indicate that clay layers may form local impermeable layers on which suspended lenses can be found.

Small tributary valleys, coming from the marly hills may give some potential sites for groundwater or surface water dams. But the permeability of the rock as well as the sensitivity for soil erosion are limiting factors.

Berkad improvement and search for shallow groundwater are the only possibilities.

Dhadar

general description

Dhadar is one of the 6 villages which are located in a depression in the higher mountain zone at an elevation of 1330 - 1450 masl. It is reached along the valley of Togga Jaceel. The village was founded in 1963, after the self-help road construction and one of the settlers arrived with cement to build a berkad. However, the area has been occupied already for centuries with probably ancient settlements. Remnants of graves were found everywhere. The ancient ancestors of the clan are buried in this area, as well.
The central part of the depression is frequently inundated, and small areas of green grass were found. The other part of the area is deforested, and erosion started already decennia ago.
The group of villages have about 300 houses. It is said that about 20,000 people are based in this part of the mountains. One village has a poorer appearance than the others. The link to Bosaso and Qandala is quite strong. People can reach the towns by foot in 2 days. Most of the villages are occupied by women and children. Major source of income is seasonal migration labour. Other sources are livestock and frankincense.
In total, the 6 villages have 3 koranic and 3 formal schools. The only dispensary is out of use. Major diseases are "TB", malaria and hepatitis. Cholera is sometimes epidemic.

existing water supply

The villages mainly rely on berkads; 30 lined ones and 12 unlined. Five or six berkads are leaking. The first 35 years old berkad is still functioning, but technology didn't evolve, afterwards. Water is sufficient for 2 months for people and 1 month for people and livestock. There is 1 pool between the 3 central villages which keeps water for 3 months.
For the remaining period, people rely on tanker supply over the very bad road, 10 times a week, for which they pay 20,000 Ssh/drum. They don't sell the berkad water themselves.

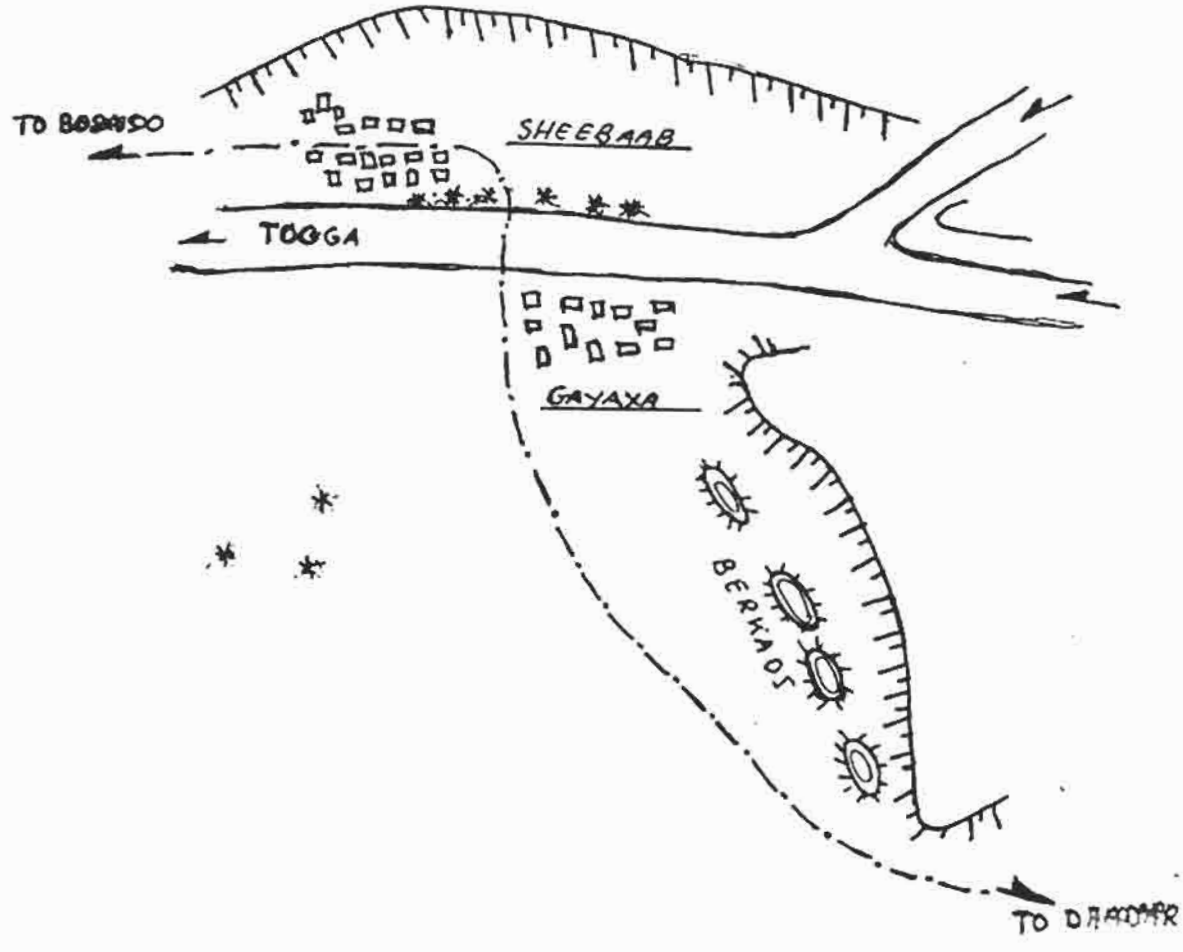
A young man has tried to dig 2 shallow wells with labour from Bosaso ("Ethiopians"). At 15 m they reached marlstone, but no water. One site was shown where there had been a well, 4 generations ago. But a disaster (e.g. cholera) had killed thousands of people and the well was abandoned (filled). One of the elders had bought 1,000 bags of cement to build a small dam, but was unable to organize the labour.
No roof catchment has been constructed, yet.

request of village

The villagers are seeking for alternatives for water supply and asked advice.

conclusions

For the 2 pilot wells, it was recommended not to dig deeper. For other attempts in other places, a pre-survey with hand augers (or a small bore machine) is recommended to safe labour. Down the ancient well may be a good site, but erosion has probably dropped the ground water level.
Other alternatives is surface water collection. Reasonable dam sites can be found, of which one was indicated by the elder. Spill way design, connection with the hill slopes and environmental aspects need further consideration.
A war can be constructed (manually) just downstream of the present pool. It is recommended not to deepen the present pool, as the suspended aquifer might be disturbed by such an action.
Hence, the area has sufficient potential to look for alternative water sources.



PLAN SHEBAB/KAYAXA

not to scale

Drawn by: Said Mohammed

SAWA/SPDS Bari water rehabilitation