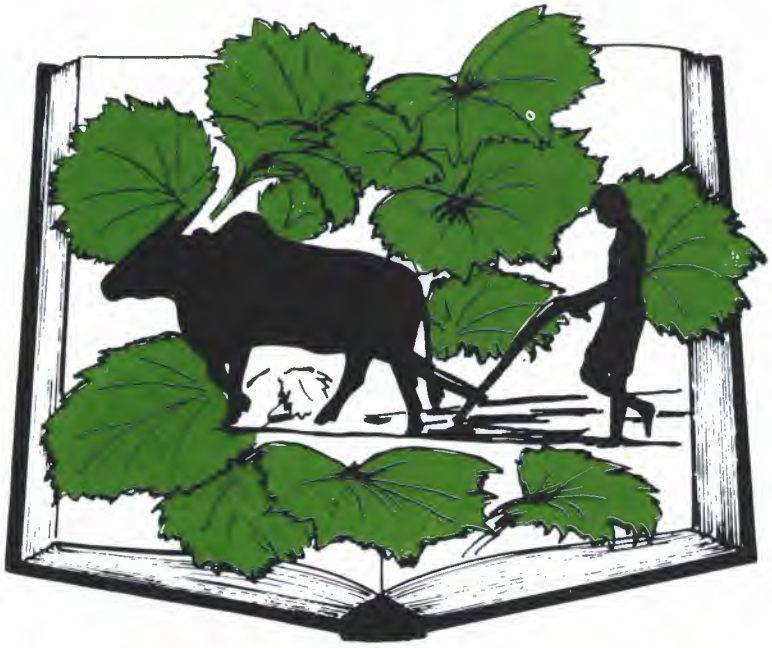
NORAGRIC
NORWEGIAN CENTRE FOR INTERNATIONAL AGRICULTURAL DEVELOPMENT
AGRICULTURAL UNIVERSITY OF NORWAY

Evaluation of the NORWEGIAN RED CROSS - SUDAN RED CRESCENT SOCIETY'S Integrated Rural Development Project (IRDP) in Sinkat District, Red Sea Hills, Sudan

NORAGRIC REPORT, JUNE 1989



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EVALUATION OF THE NORWEGIAN RED CROSS - SUDAN RED CRESCENT SOCIETY'S INTEGRATED RURAL DEVELOPMENT PROJECT (IRDP) IN SINKAT DISTRICT, RED SEA HILLS, SUDAN

JUNE, 1989

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1. INTRODUCTION

1.1 Project Background

In response to the drought in the Sahelian region in 1984-86, the League of Red Cross and Red Crescent Societies (LRCS) established an extensive relief program in Sinkat District, Red Sea Hills Province. NORCROSS provided both funding and delegates for this operation.

As the situation in the area gradually improved, the NORCROSS coordinator of relief suggested that NORCROSS consider the Red Sea Hills as a target area for rehabilitation and development work. This would be in line with the "prevention is better than cure" philosophy developed by the Nordic Red Cross Societies. Discussions ensued on the possibility of LRCS and NORCROSS involvement in disaster prevention activites in Sinkat District. The result was a signed agreement between LRCS and NORCROSS in 1986 and the establishment of the "Sudanese Red Crescent-Norwegian Red Cross Joint Disaster Prevention and Development Project" (also referred to as the Integrated Rural Development Project, IRDP).

As stated in the original application for NORAD funding in 1985, the main objective of the project was to establish the means of subsistence for up to 250 000 Beja-nomads following a prolonged drought and to prepare both the population and the environment for coping with climatic changes in the future. The project received funding for an initial three year period, with the possibility of extension, in the amount of NOK 15 million from NORAD's SSE-Unit, as well as NOK 6 million from NORCROSS.

Prior to implementation, NORCROSS commissioned a feasibility study for Sinkat District. The study was comprised of three separate reports: a water potential study by NOTEBY A/S, a socio-anthropological study by Leif Ole Manger from the University of Bergen, and an agricultural study by Bjørn Stang of NORCROSS.

These reports were to provide the information necessary to develop a more detailed plan of implementation.

Originally, the project intended to focus on home gardening and tree planting. After the above studies, however, it became clear to the project staff that the Beja themselves prioritized water resource development. The project focus was adjusted accordingly. A second prioritized subject was pastoralism.

Currently, the three main components of the program are: water resources management, agricultural improvement and institutional development. The development of water resources management methods, which comprises the bulk of the project activities and budget, involves the construction of various structures such as dams, wells, and hafirs for the harvesting and storing of water for drinking and irrigation purposes.

The agricultural component focusses on the improvement of techniques for growing sorghum (durra), the grain staple of the area. Horticultural activities are also being encouraged through plot observations and extension work. Forestry efforts have included the introduction of tree species which are able to withstand the harsh climate.

The third component of the program is institutional development of the Sinkat branch of the Sudanese Red Crescent. Although institution-building was not originally a main component of the program, its importance became apparent when considering how certain project activities would be continued as NORCROSS involvement decreased in the future.

1.2 Evaluation

At the request of NORCROSS, and with the approval of all of the parties involved in the program, an evaluation team was commissioned to assess the progress of the program and make recommendations as to how it should proceed. The evaluation team was composed of the following members:

Mr. Henning Svads, M.Sc. Agriculture. Director of Consultancies, NORAGRIC. Norwegian citizen. Team Leader.

Dr. Sally Sutton, Ph.D. Hydrogeology. Consultant. British citizen.

Dr. Abdel Ghaffar M. Ahmed, Ph.D. Anthropology. Professor, University of Khartoum. Sudanese citizen.

Ms. Ingrid Nyborg, M.Sc. International Agricultural Development. US-citizen. Research Scientist, NORAGRIC. Observer, assistant.

The team was provided with a Terms of Reference (see appendix 1) which suggested topics the team members might address in their evaluation of the project.

The team was in the Sudan during the period April 12 - 25, 1989. The first 4 days were spent in Khartoum in meetings with those institutions involved with the project (for persons met, please refer to appendix 4). After receiving travel permits midday on April 16th, we traveled by car to Kassala, and on to Sinkat the following day. The next five days were used to visit the project sites, interview some of the local Beja, meet with project staff, as well as local (Sinkat) and regional (Port Sudan) authorities and institutions. Unfortunately the person in charge of the agricultural sector of NORCROSS, Mr. Mohammed Bedawi was in Port Sudan trying to recover from a painful back injury and could not attend the field trips. Although a meeting was arranged at his sickbed, the agricultural report will obviously suffer from his absence in the field.

The team returned to Khartoum April 22nd by charter plane from Port Sudan. A meeting was held at NORAD's office in Khartoum April 23rd where preliminary results of the evaluation were

presented. Those present at the meeting in addition to the team were:

Arne Dahlfeldt,	Country Representative, NORAD/KHARTOUM
Dan Prewitt,	Director, League of the Red Cross/ Red Crescent Societies
Ibrahim, M.Osman	Secretary General, Sudanese Red Crescent/ Khartoum
Roy Sanders,	Technical Supervisor, NORCROSS project.

The team (excluding Dr. Abdel Ghaffar) returned to Oslo on April 25th. From that point each team member worked independently on their sections until meeting June 1st to discuss the draft report which was to be presented June 2nd at NORCROSS in Oslo. The final report was compiled by the team leader and presented to NORCROSS by 22 June, 1989.

It should be noted that due to delays in receiving travel permits to Sinkat, the original time planned for the field visit was cut short. The team felt that this was unfortunate, since the time spent in the field was critical in gaining an overall understanding of both the project activities themselves and their physical, social and political environment. In addition, the evaluation took place during the fasting month of Ramadan, a time when office hours were shorter than normal and there was little activity in general. This, combined with the lack of a reliable telephone system in Khartoum, made the planning of meetings more time consuming than they might otherwise have been. The fact that NORCROSS provided the team with a car and driver in Khartoum, as well in Sinkat, was critical in performing the evaluation. We hereby thank NORCROSS for its supporting role throughout the visit period.

2. MAIN CONCLUSIONS & RECOMMENDATIONS

2.1 Social & Organizational Aspects

Conclusions

The Hadandawa, who are the target population for the project, are the major Beja group inhabiting the area. They are a pastoral and semi-pastoral people, and keeps few animals (goats and sheep, donkeys, a few camels and cattle), and practice little cultivation during the rainy season. Like the rest of the Beja in the region, they have developed over time a high sense of territory with great cultural and emotional attachment to their land. Their residential patterns, traditions and values reinforce this attachment and strengthen the value of individual or group rights to a certain piece of land.

They live in a male dominated society which divides clearly the activities of the members of the household on the basis of age and sex. The elementary family is the basic production and consumption unit. Cooperation between different basic units of this size is governed by highly organized relations of production. Traditional collective labour systems are well known and their field of utilization is well defined. Their prevalence before the famine period was well pronounced.

The traditional leadership is still in power. However, though Omdas may seem to have some power in dispute settlement and control of resources the Shaykhs can only be referred to as first among equals in any gathering (meglis) for discussion of tribal issues. Educated young men holding minor government posts are competing, these days, with this traditional leadership.

The Hadandawa adaptation system is characterized by flexibility. Their roles, statuses, rights, traditions and values, though they may seem rigid to an outsider, are very quickly adapted to changing situations. It has been important to explain further

such flexibility which was referred to in the feasibility studies and hence it is elaborated upon in appendix 2.

Famines seem to have happened often in the recent history of the target population. Their social system, in addition to the relief support they get, seems to bring them back to their normal situation in reasonable times.

However, this is the first time that relief activities have been followed by development action. The community based project of NORCROSS in cooperation with SRC has been lauded, by the target group the regional authorities, and central authorities. It is appreciated that such an effort is undertaken in an area where even the national and regional institutions have shied away. Although there may be some criticism and hesistance in accepting the strategy used by the project administration, where popular participation is often mixed with payment of wages or work for food, no organization relevant to the project has any negative view about the principles on which the project is based.

Linkages with various government departments and coordination with the SRC branch committee, regional office and national headquarters needs to be strengthened in order to improve on the project performance. The improvement of such linkages at this stage is essential for the future since the project is obviously growing out of the frame of reference of national or international NGOs.

Recommendation

As a community based project the emphasis so far, is on the programme of harvesting water resources and focusing on extension activities in the field of agriculture. However, being a project whose target population is pastoral and semi pastoral people, more effort has to be made to make the project activities much more relevant to the daily occupations of the target group in the short run. This cannot happen without an in-depth understanding of the socio-economic system and the cultural context of

Hadandawa life. More intensive studies in these fields are required. This activity can be effectively linked to the Red Sea Research Programme conducted by the staff and the students from Bergen and Khartoum universities in the area. The presence of someone on the project staff with the special task of collecting socio-economic information about the target population and their reaction to the project activities as well as recording the output from the agricultural activities and the impact of the project on human population and animal herds is necessary. Such a person can link with the personnel on the Bergen Khartoum programme and the socio-economic unit in the land conservation department as well as any other relevant institution in the region. The coordination of the action of such a researcher can, in the future, lead to the creation of socio-economic research unit for the region.

NORCROSS administration should make more effort and take more time to explain its project principles and its action strategy to the local people, the SRC local committee, the regional authorities and government departments. This is not meant to say that this task has not been undertaken at different stages in the history of the project, but it is generally felt that there is still a lack of clear understanding and misconceptions on the part of those related to the project activities. The quick turnover of project coordinators and the change of regional officers in government department contributed to this state of affairs.

The project being one that is targeting towards creation of a demonstration effect in and outside the project area has mainly concentrated on supporting the "winners". Those winners are, however, of a limited number in this marginal situation and the justification of spending so much on such a few might be difficult in the long run. The base of those who can benefit from the project activities has to be widened. This will call for more effective efforts in mobilization and motivation within the local communities. This task cannot be done without the presence of a qualified person on the project administration.

Further strengthening of the capabilities of the SRC committee and their reintegration in the project activities in rural areas will be a valuable asset in the process of mobilization and motivation. At the same time the involvement of the council authorities in the project activities and more close coordination with them can be beneficial.

Local staff training, especially those who are dealing with the administrative and extension activities, is very important. Study programmes offered by national institutions in areas such as project management, monitoring and evaluation can be useful and do not take a long time and hence will not keep people away from their jobs. Some of these programmes can be even specially designed and given in the project vacinity as can be seen from the case of those offered by the Development Studies and Research Centre at the University of Khartoum.

Secondment of specialist from government departments in the area of socio-economic studies or the technical side may offer an opportunity to exchange expertise and facilitate the smooth transfer of the project to Sudanese hands in the future.

2.2 Water Resources and Exploitation

Conclusion

The project's present form and achievements need to be viewed in the light of the environment and times in which it is set. The Red Sea Hills are a marginal area, with poor and extremely variable water resources. The floods which provide recharge for groundwater are sporadic, and when they do occur, often very destructive and erosive. The five years previous to project inception were generally felt to be of below average rainfall. Thus conditions for water resource development were very difficult; if the solution had been easy it would have already been established by people who were by then being forced out of the area by the water shortage. Very little information on water resources, especially over time, was available to the project

when it was conceived, making planning and decision making difficult. Government departments had also found the environment difficult to operate in and had no comprehensive plan for the area.

The target group of the project was particularly the nomadic population which made up about two-thirds of the population of the area. Traditionally, water sources in this area had been temporary structures used with minimum maintenance and expected to require re-construction after floods. As is common with nomadic people inputs to construction and maintenance have been small compared with that which settled people are prepared to invest.

The project recognised the need for more information and employed a Consultant (NOTEBY) to undertake first a preliminary resource assessment, and then the survey and design of structures to supply water to eleven sites. The second phase included establishing siting and design guidelines which could be applied by the project to other places. It is on these two studies which the development of water resources by the project has been built and they have provided a good foundation despite the minimal data available. The main areas where further consideration was required where perhaps in a) the assessment of siltation and its effects on recharge schemes, and b) the need to draw attention to hydrological conditions throughout catchments rather than just in the immediate vicinity of planned works when assessing new sites. This is particularly true where flood water routes can change over short periods of time, and groundwater paths of flow may not always coincide with them. The project has found no problem in modifying designs in relation to siltation, but the second feature involving the geomorphology/evolution of groundwater and surface water paths of flow may still need further consideration in some areas. Problems such as this would benefit from further short inputs from the Consultant.

The achievements in construction have been impressive and of a high standard. The first units completed are regarded as

experimental and partly also for demonstration purposes. For this reason they have involved both the use of paid labour and methods of construction which have improved progress, but which are not necessarily compatible with community participation in other areas and could not be contemplated without outside funding. This has caused some mis-understandings of "levels of technology", which as far as the design is concerned are appropriate and the minimum necessary for provision of permanent structures with minimum maintenance. Methods of construction should be re-assessed during the next phase, when levels and methods of community participation may also be considered.

Considering that the works to date are considered as experimental and perhaps even as a test ground for ideas transferable to other semi-arid (and in particular sub-Sahelian) areas, there is at present insufficient monitoring information. The performance of units so far installed cannot therefore easily be assessed. Results of infiltration schemes are encouraging, but it is not possible to establish how far they have improved conditions over those which prevailed before. There is a need for setting up observations on existing project schemes, and for comparison, on other sites which may be developed in the future, and some which will not.

The only other area in which the project has perhaps suffered, is in it's lack of shared experience with other organisations working in the same field. These range from government departments (particularly Soil Conservation and NRWC), to university groups such as the RESAP scheme of Bergen and Khartoum Universities, and the Civil Engineering Department of Khartoum University, which is active in water harvesting schemes. Some use of local knowledge (eg. changes in conditions over time, water divining etc.) might also have been of benefit. These links were difficult to set up when the project was only just beginning, particularly when most discussion and data collection was by people not permanently connected to the project. However, it is important that these links should now be established and

maintained, to allow easier transferrence of the scheme to other organisations at a later date.

Recommendations

A great deal has been achieved in the time, and much experience gained. With so much of an experimental nature, and conditions varying very much from year to year, there is a need now to slow down on new construction and to set up good monitoring systems to assess the performance of what has already been constructed. The main field for further experimentation should probably be in the construction of small "family-sized" hafir, and the improvement of their water quality for domestic use. Construction would be limited to well rehabilitation, completion of the diversion schemes started, and possibly the repair of the main dam at Erkawit, if this were acceptable to local and government administration. Consideration should also be given to the ways in which alternative construction methods could be geared to community mobilisation as already achieved, with less use of imported equipment and skills.

Monitoring should include the setting up of rain gauges in co-operation with the Meteorological Department, and the establishment of monthly monitoring networks to establish variations in groundwater quantity and quality in areas affected by, and some not affected by, project activities. For this some inputs might also be considered by RESAP, which could also be involved in other research activities which would help in future planning of water resource development.

For assessing design modifications, new sites and the performance of schemes so far completed, short inputs by the Consultant and the involvement of Khartoum University Civil Engineering Department should be considered. Several members of the project team have been trained in site selection methods, and the Engineer has used the siting quidelines to set up schemes at sites not surveyed by the Consultant. However, an opportunity for the field members of the project to discuss sites and design

modifications with the Consultant would still seem beneficial for schemes in the near future. Similarly discussion with government departments on planning, experiences elsewhere relevant to design and implementation, and monitoring (perhaps including the secondment of a civil engineer, as has previously been invited from NRWC) would also be useful and would improve understanding of the aims of the project. It would also help to get these organisations more involved, so that they might be more prepared to provide continuity for the schemes at a later date.

2.3 Agricultural Resources

Conclusions

From an agricultural point of view the Sinkat district is a marginal area. This is mainly due to the climatical conditions, in particular the rainfall which ranges from 150-0 mm a year, indicating that the precipitation is very unreliable and variable. The rainfall may also occour in heavy showers during short periods causing heavy erosion problems due to the topography and sparse vegetation of trees and shrubs.

Other constraints are the physical and chemical conditions of the soil. Most of the soils are loamy sand or sandy loam with predominance of medium to coarse sand. They are well drained, but poor in moisture holding capacity and nutrient retention. The soil pH is very high and will create deficiency of micronutrients as well as phosphorus fixation. Some soils in the area have a very high salt concentration and are saline-alkali soils. In addition these soils also have high natrium concentration. Other soils, however, have a high pH, but do not have salt problems. Nitrogen content is low in most of the soils. The level of potassium is in the sufficient range, but high content of calsium and magnesium may cause potassium imbalance in the potassium uptake.

Thus the climate and soil conditions leave the Beja with few agricultural options of production, the most important being

pastoralism and growing of sorghum. Under normal weather conditions both pastoralism and sorghum cultivation are adopted in the area. However, the Sinkat district is very vulnerable in the absence of rain leaving the area barren due to overgrazing and drought.

Since the time NORCROSS started its integrated rural development project, the area has also been affected by insect damages to the sorghum crop; stem borer in 1986 and desert locust in the two following years. In the first case NORCROSS advised the growers to destroy all the plant residue by burning, which has worked well. But to protect the crop against locust attack the area has to rely on the Sudan Locust Control. So far the protection has been insufficient leaving the farmers with no grain to harvest.

It is therefore very important to find ways to secure food production and to re-establish the natural vegetation, promote water and erosion control, find solutions to water catchment systems and to improve the people's diet by introducing additional crops. The NORCROSS feasability study conducted in the area in 1986 provided background information for an action plan in the field of agriculture for a more sustainable production. The plan focuses on sorghum cultivation, forestry and the introduction of fruit and vegetables.

So far the activities have included the development of water catchments for durra production, some seed distribution, the establishment of nurseries for tree seedling production, the development of introduction of methods to protect tree seedlings from browsing, and the establishment of test gardens for fruit and vegetable growing. In cooperation with the water resources section, efforts to control soil erosion have included contouring and gully-filling.

The NORCROSS agricultural program should be characterised as a period of research because the information needed to make a realistic program is lacking. Therefore one should not expect to see too many actions directed towards the farmers' problems at

this stage. However, in the project's water catchment program for a sustainable sorghum production, systems are already developed for practical use. In other sectors of new crops like vegetables, fruit trees and forestry, the program needs some more time to adjust the right species, varieties and cultivation methods to the environment before advice can be given. In this connection good relations with local government extensionists is important.

NORCROSS has not yet engaged itself in the field of pastoralism despite the fact that animal keeping is a very important agricultural activity among the Beja. We believe that studies on carrying capacity will be necessary to balance animal production with the growth of natural vegetation.

Recommendations

Since the start in 1986 NORCROSS has started many agricultural projects in Sinkat district. A great deal has been achieved and much experience gained. However, under such extreme environmental conditions varying very much from one year to another, there is a need for longer term research periods before significant solutions can be reached. It is, therefore, recommended that NORCROSS prioritize its efforts on projects already initiated. New projects should only be started after considering the need for such investigations.

An important field should be a survey of the carrying capacity of the grazing areas in the region to estimate the number of animals one can feed without destroying the vegetation. Again, the study should be carried out over time so that changes in climatical conditions influencing the changes in vegetation are taken care of. The project should be staffed by people with good botanical knowledge and an understanding of the pastoralism practised in the area.

To improve the pastures, reseeding of deteriorated areas may be a solution. When doing so, it is important to use the most suitable

species and varieties of grass and legumes adapted to the area. In this respect, test plots shoulds be established to observe growth performance of the different grass and legume species.

In rainfed sorghum production the most crucial thing is the availability of water, which can very considerably. To secure a more sustained yield it is recommended to expand the water catchment program based on the experience gained so far.

Erosion, particularly in Erkawit is a serious problem, and erosion control measures should continue as an important part of the project. To some extent water catchments have a positive effect on erosion control, but other precausions like contour lines and gully control should be introduced in areas susceptible to erosion.

In the forestry sector testing of tree species is regarded as important, but so is also to find safe protection methods for tree seedlings.

In the field of extension the project has experienced a great need from the people in the area to be guided in their agricultural production. It is recommended that as many people as possible should benefit from the extension carried out. This would include not only the local farmers but also district agricultural officers, teachers, public health officers etc. This would help to strengthen the already existing extension system whose role in the project is expected to increase as the project is gradually put under local control.

3. PROJECT AREA DESCRIPTION[1]

3.1 Geographical Position

Sinkat District is located in the Red Sea Hills Province in northeastern Sudan, which is bordered by Egypt to the north, Eritrea to the south, the Nubian desert to the west, and the Red Sea to the east. Sinkat Town rests at ca. 18° latitude, 36° longitude, 800 meters above sea level, with the surrounding hills reaching up to 1200 meters above sea level. Khartoum lies approx. 600 km to the southwest, and Port Sudan, the closest urban center, lies approx. 100 km north-northeast of Sinkat.

Prior to 1979, the railway stretching from Khartoum to Port Sudan was the main form for transportation to and from Sinkat, aside from unpaved tracks which were difficult to manoeuver. In 1979, a paved highway was completed between Khartoum and Port Sudan via Kassala and Wad Medani (ca. 1208 kilometers long). This is now the main transport route, both for goods by truck and people by bus. There is also an airport in Port Sudan, which has fairly regular flights to other cities bordering the Red Sea, as well as to Khartoum. Telecommunications are mainly by radio.

3.2 Climate

Sinkat is situated in the Sudano-Sahelian zone of Sudan, and can be classified as hyperarid to arid Saharian marginal zone (Ibrahim, 1984), or dry hot desert climate (BWh-zone, Koppen).

Average temperature ranges from 26-32°C, max in June/July above 40°C, min in January/February 14-20°C. Temperature is fairly constant from year to year. The high mean annual temperatures

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[1]) The information in this section is based on team observations as well as previous reports on the area by NOTEBY (1988) and Gammelsæter (draft, 1989). Its intent is to orient the reader on the conditions present in the area.

create a high rate of evapotranspiration and thereby influence the water balance in the area.

The main rainy season in the Sinkat area, is from June to September, with a minor season in the early month of the year although there are often a few intense showers in April. Accurate precipitation figures for recent years are not available due to a discontinuation of data collection after 1982. Data collected from 1951-1982 indicates that precipitation in Sinkat ranges from 0-150 mm annually (see figure 1 below).

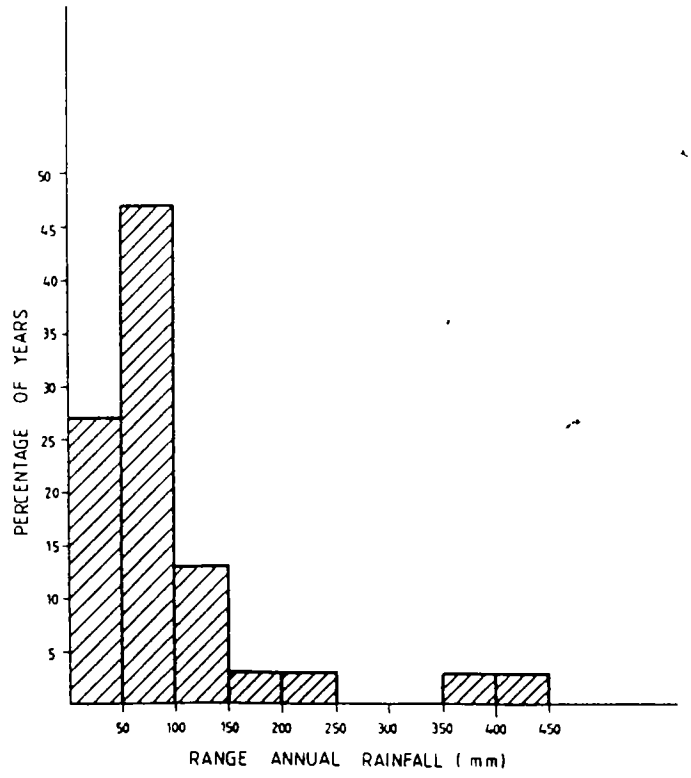


Fig. 1 Annual rainfall distribution, from NOTEBY (1986)

In addition, rainfall is extremely variable, both quantitatively and spatially. Annual variations in rainfall 1951 - 1982 show a downward trend in Sinkat Town.

An important example of the degree of local variation in precipitation within the district is the case of Erkawit. Erkawit receives an average of 200 mm rain annually, and its rainfall is considerably less variable than in Sinkat. In addition, Erkawit recieves moisture in the form of fog. It is therefore difficult to identify drought conditions in the area as a whole from localized data collection.

3.3 Geology

The Red Sea Hills consist of a portion of the Arabian-Nubian Shield. The shield was formed by great faults in a Precambrian formation due to precambrian folding. Early tectonic activity in the area resulted in relative uplifts of tectonic blocks intersecting several regional faults. The Red Sea depression forms a part of the Rift Valley (Afro-Syrian Rift Valley), where recent rifting has reactivated the faulting in the hills. This has resulted in large regional faults with a trend of N-S and NW-SE.

The Basement Complex consists of crystalline basal rock groups of the Shield and is interspread with intrusive rocks aging from Proterozoic to Mesozoic.

The basement rocks are made up of the Kashebib Series (including granite gneiss of about 2000 mn years), Nafeirdeib Series, Hamagar Series, and Awat Series. A more detailed description can be found in NOTEBY (1986). The area also contains a large proportion of tertiary to recent sediments. The tertiary sediments are visible as raised terraces along the Red Sea coast. More recent sediments are the alluvial sediments and aeolian deposits (Pliocene/ Quaternary). The whole area shows evidence of recent changes in base level, and drainage systems, probably

developed in periods of higher rainfall, are continuously changing their routes and gradients.

3.4 Water Resources

The project area covers catchments which total more than 13000 km^2, draining both to the Red Sea and the Nile. Catchments average just under 1000 km^2 and the existence of several low watersheds suggests that some of the khors have been diverted to new paths as a result of climatic and base level changes. Average rainfall is around 100-120 mm per annum (increasing with altitude), but this amount is only achieved in about one in four years. Rain typically falls with great intensity for short periods, from storms whose extent is usually limited to small areas. Run-off is therefore also often violent and short-lived.

Perennial water is rare, being linked mainly to mineralised seepages in khors where bedrock is near the surface. The source of most supplies is therefore groundwater, which accumulates through the infiltration of run-off. Infiltration occurs mainly where water runs from hard rock surfaces onto scree and alluvium, and where flood water runs passes over coarse sands and gravels in the khor bed. The further the water has travelled underground, and the slower it travels, the more dissolved solids are picked up, making the water less and less potable. Water is therefore generally of better chemical quality higher up the catchments, deteriorating as gradients decrease towards wide basins and coastal plains.

Most water is found in assosiation with alluvial deposits in khors. The topmost layer of sand and gravel is quickly saturated by flood flows, and the water then passes more slowly into the underlying silts. Beneath these lie weathered basement rocks which appear to act as a drain to the system, since they are generally more permeable than the silts. Excavations for wells and dams have almost always found water lying in the weathered zone rather than in the overlying deposits. Paths of groundwater flow are dictated both by structural features such as fault zones

and dykes, and by geomorphological features such as previous routes of surface water flow.

3.5 Soils and Erosion

Very little data on the soils of the area could be found for the evaluation. In general, they can be said to be alluvial khor sediments and windblown sediments classified as sand, sandy loam and sandy clay. These sediments are found mainly on the lower hillsides and the valleys and khors.

In 1986 NORCROSS collected 10 soil samples from the project area. The samples were brought to Norway and analysed at the Norwegian Agricultural Service laboratory. The results have been evaluated by the Department of Soil Science at the Agricultural University of Norway. In tables 1 and 2 the results are presented.

Table no. 1 Physical properties, 9 soil samples, Sinkat district 1986

Sample no.	Sample place	Sample depth	% Sand 2,0-0,6	% Sand 0,6-0,2	% Sand 0,2-0,06	% Silt 0,06-0,02	% Silt 0,02-0,006	% Silt 0,006-0,002	% Clay <0,002 mm	Organic matter %
1	Testplot I, Bahramia	10-30 cm	20	33	24	9	3	1	10	1,4
2	Testplot II, Bahramia	10-30 cm	18	37	24	8	2	2	9	1,5
3	Sinkat Nursery	10-30 cm	12	22	36	14	4	1	11	2,3
4	Sinkat Nursery	Mixed soil	12	23	29	17	4	1	14	2,5-3,0
5	Sinkat Nursery (new site)	Seed bed	17	22	22	16	5	0	18	3,7
6	Nazet	10-30 cm	3	10	33	24	11	3	16	2,8
7	O'Neil	10-30 cm	14	27	24	14	6	1	13	2,2
8	Erkawit	10-30 cm	4	19	27	21	9	5	15	2,6
9	Erba	10-30 cm	7	15	25	31	7	2	14	3,2

Based on the mechanical analysis data, most of the soils are loamy sand or sandy loam with predominance of medium to coarse sand. They are easy to plough and well drained, but at the same poorer in moisture holding capacity and nutrient retention. Organic matter content of all the soils except No. 1 and 2 is in the range normally found in the African soils. The soils 5 and 9 have medium to high organic matter.

Table no. 2. Chemical properties, 10 soil samples, Sinkat district 1986

Sample no.	Sample place	Sample depth	pH $CaCl_2$	Electrical conductivity	Tot. N g/100 g DM	Tot. P %	Tot. K %
1	Testplot I, Bahramia	10-30 cm	7,6	0,2	0,03	0,075	0,27
2	Testplot II, Bahramia	10-30 cm	7,2	1,7	0,02	0,100	0,31
3	Sinkat Nursery	10-30 cm	7,7	20,0	0,02	0,063	0,24
4	Sinkat Nursery	mixed soil	7,8	14,0	0,04	0,068-0,062	0,24-0,26
5	Sinkat Nursery (new site)	seed bed	7,7	1,5	0,05	0,090	0,31
6	Nazet	10-30 cm	7,7	0,7	0,06	0,088	0,32
7	O'Neil	10-30 cm	7,8	13,0	0,04	0,018	0,24
8	Erkawit	10-30 cm	7,9	0,7	0,05	0,048	0,30
9	Erba	10-30 cm	7,8	20,0	0,06	0,078	0,36
10	Odross	10-30 cm	7,4	3,0	0,04	0,055	0,33

Soil pH

The soil pH of all the soils is very high and will create deficiency of micronutrients as well as P fixation. These soils need amendments to make them suitable for crop production.

Electrical Conductivity

Soils 3, 4, 7 and 9 have very high salt concentration and are saline-alkali soils. In addition to salt concentration, these

soils also have high Na concentration. Thus, soils 3, 4 and 9 are saline soils and the soil 7 is an alkalic soil. Other soils though have high pH, but do not have salt problem. Soils 3 to 9 also have high Ca content which again may create nutrient imbalance and fixation of P as well as micro-nutrients cations.

Total N

Nitrogen content is low in most of the soils.

Total P

The total P of the soil is of no direct practical importance. The range of total P in these soils are within the normal range found in the tropical soils.

Available K

Although K levels in all the soils is in the sufficiency range, high content of Ca and Mg in these soils may cause K imbalance in the K uptake. Soil 9 and 10 are fairly high K and may not respond to K fertilization in the first few years.

Summary

Soils 3, 4, 7 and 9 are not suitable for crop production without reclamation. These soils need physical or chemical means to remove salts and excessive Na.

Soils 1, 2, 5, 6, and 8 though low to medium in soil fertility can be used for crop production with appropriate amount of fertilizers.

Soil 10 also has relatively salt concentration, crop tolerant to high salt concentration can be grown in these soils.

All these soils also need to be analysed for $CaCo_3$ and micronutrients to assess their crop production potential.

Erosion is a serious problem throughout Sinkat District. Flood flows carry very high sediment loads, and the catchments are atypical in the accumulation of considerable amounts of silt even in their upper reaches. In some areas, such as Erkawit, gullying is developing fast, leading to both the removal of valuable silt

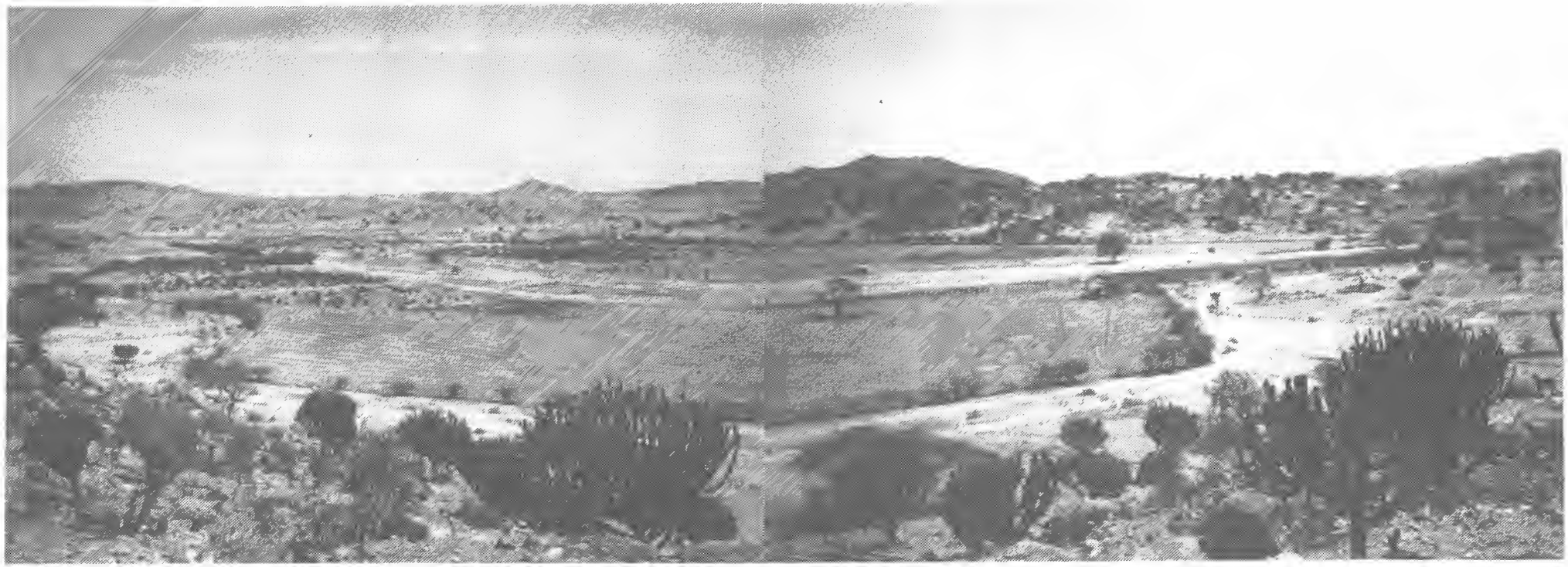
deposits, and of the groundwater storage capacity which was available before the local baselevel fell. The silt which is transported by the floods acts as a very good medium for plant growth, especially when in conjunction with animal manure which also tends to be picked up by flood waters. On the other hand, the deposition of silt where gradients decrease, such as behind natural and artificial barriers, reduces the infiltration capacity of the ground, and so may effect groundwater recharge rates. Thus, measures to control soil erosion and those to improve recharge are often closely related, and their effects upon each other need to be considered.

3.6 Vegetation

Vegetation in the Sinkat area is presently rather sparse, due to the earlier drought. It is a semi-desert area dominated by Acacia tree species and desert scrub. Also, "ousha" Euphorbia is quite prevalent in the area. This tree is extremely drought resistant, and takes root at the first sign of moisture. In many of the khors it is the dominating tree species.

Vegetation could be found mainly in the valleys and khors, and sometimes on the lower slopes of the hills. The amount of vegetation varies widely according to the amount of precipitation and soil conditions. Certain areas were completely barren, covered only by black rock baked by the sun. Although no statistical data is available on past vegetation levels in the district, impressions from local elders and historical travel accounts indicate that vegetation has decreased dramatically even over the last generation.

Following the rains of last year there has been a marked improvement in the vegetation cover according to verbal accounts. It is evident, however, that serious regeneration problems exist. There are very few large, older trees. Many did not survive the drought and have been used to produce charcoal. The increasing demand for charcoal fuel from Port Sudan may be resulting in the cutting of trees before they are dead. Younger trees are almost



ERKAWIT

Exemplifies agricultural potential in the Khor, where there are currently governmental agricultural test gardens.
Photo: H.C. Svads

non-existent, and new tree growth is difficult to establish mainly due to the grazing pressures of an ever-increasing goat population.

Erkawit, with its greater precipitation and fog conditions, represents a pocket of unique vegetation in the Sinkat District. There is a relatively greater cover of vegetation, dominated by Candelabra trees which are able to make use of the extra moisture in the air. Here too, there are indications that vegetation cover is decreasing on the hillsides, something which has certainly contributed to the serious erosion seen in the area.

3.7 Population

The Project area is mainly inhabited by the Hadandawa who constitute the largest Beja group in Eastern Sudan. Although they share close cultural and linguistic affinity with groups such as the Amarar, the Basharin, the Bani Amir and other minor groups, the Hadandawa, in many cases emphasise their individuality. Minority groups in the area like the Ashraf and the Artiga with their varied Beja cultural background attempt to establish a Hadandawa identity that could be utilized to justify their claims over political and economic resources. These claims are usually strengthened through affinity, cognation and political alliance. Some of these groups have subsequently adopted new patterns of social and cultural adaptation which has fostered the altering of many of their original cultural traits. In many Hadandawa settlements (i.e. Sinkat, and Gebeit) it is possible to confuse a non-Hadandawa with a Hadandawa by appearance unless ethnic allegiance is inquired about. Only then is it revealed that individuals can be assimilated into Hadandawa culture through dress, hair-style etc., without originally being Hadandawa. Hadandawa identity has been symbolized by adherence to Hadandawa traditions and by assimilating non-Hadandawa, normally Beja, into Hadandawa culture and social institutions.

The Third National Census 1983 does not include ethnic figures

but gives the following figures for Sinkat District which the target area for the Project :

Settled	Nomads	Total
18,383	44,689	63,072
Sinkat town		7,918
Gebeit town		7,002

These figures have changed significantly since the drought of 1984/85.

Population figures broken-down by sex as follows:

Location	Female	Male	Total
Sinkat town	4040	3888	7918
Gebiet town	3004	3988	7002
Rural Sinkat	16652	21087	37739
Rural Gebiet	3139	3811	6950
Totals	26835	32774	59609

Source: Sinkat District Area Book, Oct. 1987, local stencils.

The Hadandawa claim that their homeland is the centre of the Beja peoples. They describe it as the country South of Port Sudan, North of Kessala, East of Atbara River and West of the Sudan's border with Ethiopia. Geographically this area lies between lat. 15°15' and 18°45' North and Long. 35°30' and 36°45' West. It lies within low rains arid zone which joins the semi-desert in the northern fringes. The southern country is more fortunate with better pasture and a good supply of water throughout the rainy season which extends from late June to September. The Northern part which includes Sinkat district (the project area) may have

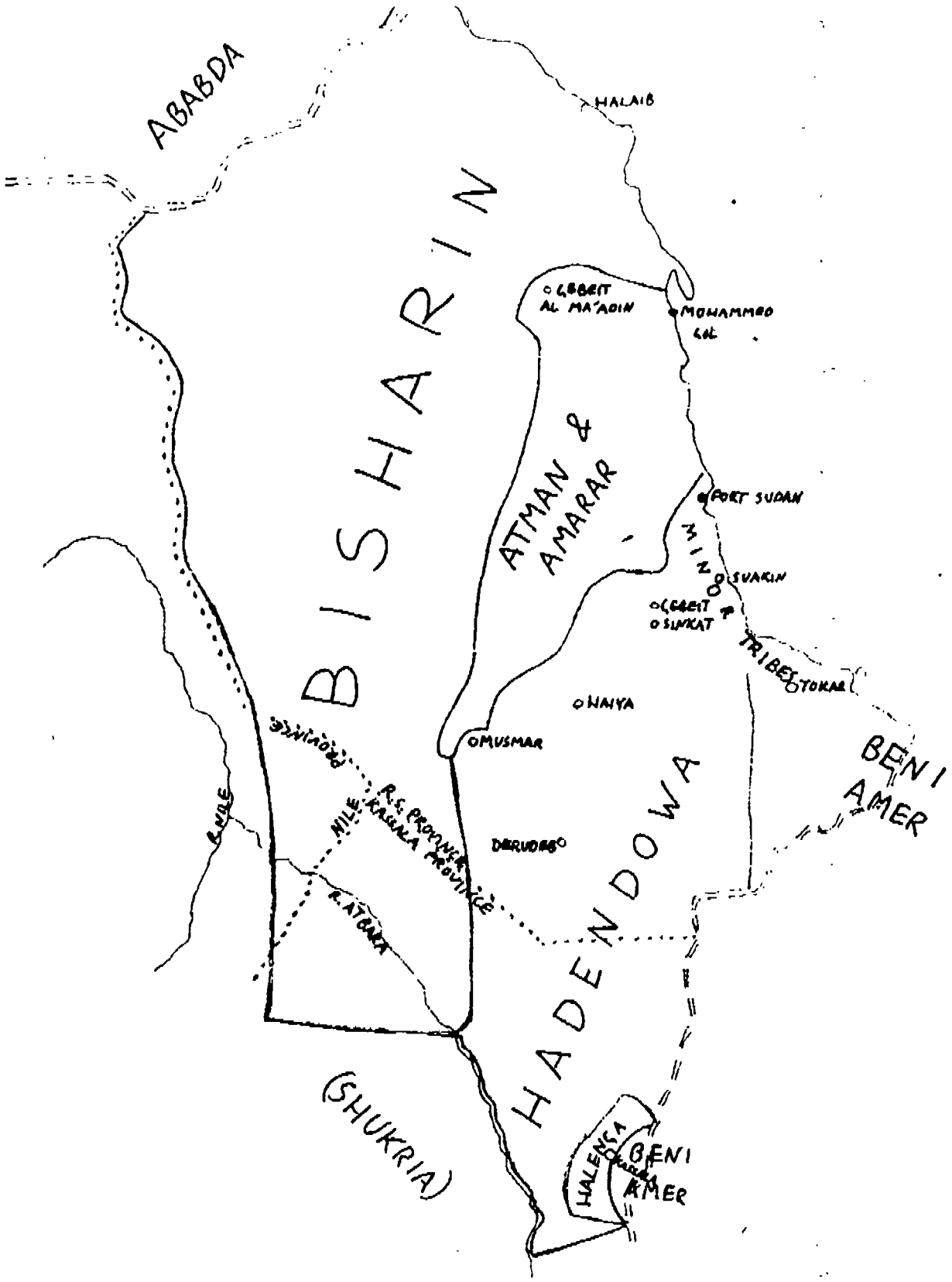
some rains during the early month of the year. However, obtaining drinking water for both human and animals is extremely difficult during the dry season especially in the area far from the dry river beds (khors) or where there are no wells or water reservoirs. The Gash and Tokar deltas are the main seasonal water sources in their region. The main river is the Atbara, lying well below the plain level with a marked band of eroded water channels, known as "kerrib" cutting through from plain to valley. The Atbara River in flood is deep and imposing but it dries out to a series of pools, often of large size, during the period between the rains. (See map).

The ecology of the Hadandaw in general is biased towards camel and goat pastoralism except for in the Gash and Tokar deltas and Atbara River where cattle and sheep pastoralism is possible. Rainfed cultivation seems to be impossible in the northern and northwestern fringes of the Hadandawa land yet the Hadandawa never stop attempting to cultivate in these areas. Flood cultivation is predominantly practised in the Gash and Tokar deltas and the Atbara River. Sorghum (dura) is the main food crop while cotton and caster- oil are the main cash crops. Within this frame most of the Hadandawa are semi-nomadic herding goats, sheep, camels and cattle in some southern areas. Some make regular long- distance pastoral migrations; to the coast in winter and inland in summer, while others, particularly in the higher hills, stay on their lineage territory making short, unpredictable movements off it when they hear news of rain and good pasture.

4. SOCIAL AND ORGANIZATIONAL ASPECTS

4.1 Introduction

This part of the report will attempt a general review of the social context in which the project is set. The related existing structure and the cultural frame as well as the indegenous knowledge and its impact on the performance of the project will



THE BEJA AREA

1:4 000 000

National Boundary

Provincial Boundary

Boundary of tribal territory

be evaluated. A detailed description of the various elements of social organization of relevance to the project implementation are given as an appendix to this report. This is being especially emphasized due to the realization that the base-line data on the topic at the stage of the implementation of the project was not adequate. The extent to which this frame is taken into consideration when the implementation process has started will be given special attention. Also this part of the report will evaluate the extent to which local communities have understood the principle of the implementing agencies and the objectives of the project. The degree of participation these communities have attempted will be assessed. One major question that will be addressed is that of the degree of organization, coordination and involvement of local community members, NORCROSS and SRC staff and government departments as well as other NGOs in the project activities. Specific and general recommendation directed towards improving the activities of the project will be given.

4.2 Relief, Recovery and Development

The shift from relief to development in Sinkat District came in the form of a proposal of a community based development project. The basic idea was to apply the principle of prevention being better than cure and come with a project which is small, simple and safe. Such a project will depend mainly on local people's participation and utilize their cultural skills and organizational capacities.

Aware of the fact that such a project should have a long lasting impact and may in the process need guidance from a national agency Norcross proposed that its development initiative should be implemented in collaberation with the SRC and it was seen important, in the field, to establish and maintain good relations with the regional office of the SRC and its Sinkat Branch. The support of the development of the SRC was seen as a ruling objective of the project. Conscious attempts were made to ensure that the proposed project took into consideration the local people's wishes for development and focuses on the improvement of

their productive base. The activities were identified as tree-planting, to meet the serious deforestation due to charcoal-burning and cutting of trees for animal food; water-control; orchard-development and poultry farms.

A major long term objective of the project is to prepare the participants in such a way that if and when in the future they are hit by a severe drought they will be better qualified to meet and survive the disaster with the least possible dependency on relief operations. Out of all the follow up of the emergency relief work undertaken by other agencies in the area, this suggestion seem to be the best and the most welcomed by local community members, regional authorities and national authorities. The SRC, with its limited capacity on the national, regional and local levels, has actively engaged itself in realizing the project objectives. It was noted since the inception of the project that such community based projects inevitably take time under favourable conditions, and in the case of a marginal area like the Red Sea Hill, an ample time frame must be taken into consideration whenever the results are evaluated.

4.3 The Feasibility Studies

Prior to the implementation of the project careful investigations of the area and the different project components were undertaken. It was highlighted that the project differs from the Red Cross principles which emphasise that the target group for any intervention should be "the poorest of the poor". Such a category in the Red Sea context is seen not to be able to "benefit from and carry on project support different from general relief aid i.e. food, water, clothing and medical treatment". The project, therefore, is "directed towards those families that still have resources enabling them to take active part in the programme". At a later stage appropriate projects for the poorest should be looked for, planned and hopefully implemented. Concentration at the start of the project should be on areas, sites and people that have a chance to achieve fair results rather than seeking the extreme and gamble with people's hope, project funds,

goodwill etc. From the description given above of the social adaptation aspects of the project area it means that the target population for the project are those people who have devised and used a successful strategy for survival during the last famine and have emerged as "winners" in their struggle. They are possibly now willing to start building a capacity in readapting to the changing circumstance in the area and break away from dependancy on relief.

The feasibility studies covered the socio-economic structure of local communities, a hydrological survey and a project proposal carrying cost estimates and budget. They covered their topic extensively. However these studies suffered from fact that they were not related to an overall governmental plan for the area. The obvious reason for this is that such a plan does not exist and as it will be noted later this led and will continue to lead to some difficulties if coordination with governmental plans or government department activities is not taken into consideration.

The anthropologist report which covered the socio- economic structure of local communities focused on physical and natural characteristics, human adaptation and productive activities, social organization, etc. It showed the general context in which the project is proposed and emphasised the fact that the Hadandawa adaptive system is flexible. It is seen as important in this report to elaborate on this issue of flexibility as addressed in the appendix. Also elaboration is made on certain aspects of organization of production in order to show that if they are taken into consideration some improvement in the performance of the project may be achieved.

On the whole the wealth of information gathered and details of the proposal drawn have paved the way for a systematic approach to a community based sustainable development project in a marginal area.

4.4 NORCROSS Approach to Development in Sinkat District

4.4.1 Community based development

The project consists of a number of activities ranging from tree-planting to the establishment of vegetable gardens. Basic to all these activities is the availability of water and the participation of the local community in the process of implementation. Norcross therefore tried to list, during the feasibility studies, the participant needs and found out that food and water for drinking of both human and animals are the most immediate ones. Water is the bases for all the project activities suggested and hence became the basic principle guiding the project, i.e. ensuring future provision of water through water harvesting techniques. The concentration of effort, when it came to the participants to take part in the activities, was mainly on "winners". The idea being that a demonstration effect will be created in the area and the replication of the activities elsewhere in the region or the country may be possible. That is not to say that loosers are ignored but they are to be taken care of in the meantime through the traditional relief activities.

In order to implement the project on the basis of its community orientation, the project administration together with the SRC branch committee in Sinkat made an effort to reach the local community leadership to get it involved in the project activities and to secure its participation and hence the participation of the local community as a whole. Norcross administration needed the cooperation of the SRC branch at this stage in order to penetrate the hard shell of the Hadandawa culture. Outsiders find it difficult, and the SRC branch in Sinkat together with Norcross local staff hoped to use their knowledge of the area and the culture of the expected participant to sell the project idea.

The direction of the activities and the principal of having a community based project with the idea of helping people to help themselves is being lauded by local leadership whether "tradi-

tional" i.e. Omdas or shaykhs or rural council authorities. The regional authorities, especially in relevant government departments such as the land conservation department, highly praise the principal but have their reservation about the strategy. It is generally felt that the principle of popular participation is mixed together with use of high technology to the extent that people's effort cannot be seen. After a short while participants disappear and the project resorts to paid labour either in wages or food.The project justification for payment is it is found necessary to compensate people for the time they are spending on project activities rather than trying to go elsewhere for income generation to support themselves and their families. This strategy seems to present NGO's and government departments with many problems. It can be suggested in view of the description of the social organization of production given in the appendix that such activities where participants are involved should not extend over more than a short period of time.

With the progress of the project activities the SRC branch in Sinkat as well as the SRC regional and National offices have had their own difficulties that hindered their participation in the process of guiding the implementation of the project activities. This situation had its negative impact on the interaction between the local communities and the project administration. The project administration had to use its own local staff in order to carry out motivation activities and attempted to utilize the existing indegenous knowledge within these communities. However, the lack of availability of enough experienced persons among the Norcross local staff has led to some difficulties. Examples of these can be seen in the approach made to support one paramedical person to make a terrace for water on the road to Erkawit. The individual concerned was directly approached (or he approached the project administration) and action was taken before consulting the traditional leadership i.e. the Omda of the area. The Omda took the action as an attempt to undermine his position and hence intervened to stop the implementation and later took a hostile attitude towards all project activities in his administration areas. This has been further complicated by the project

administration involvement, in Erkawit village, directly with the teachers in the school without paying attention to the sensitivity of the relation between the teachers and the Omda who represent different forms of leadership within the community and compete for status.

The case of Sinkat garden where a number of families came together to plant vegetables and orchard-trees is another case of lack of deep understanding of organizational capacities in the local community. Effort should have been made to transfer the community inherited forms of collectivity of labour to create a cooperative-like unit of those families interested in taking part in the project activity. The result of giving help in terms of a fence structure, water basin etc. without supervising the organization of participants led to the whole work being in the hands of one family. The objective of cooperation has been defeated.

The participants' degree of understanding of the shift from relief operations to a community based project where people are helped to create a sustainable activity for themselves leaves a lot to be desired. It points to the fact that the extension work to raise the motivation standard is not given the attention it needs. The local community members still expect things to be done for them; and if they take part in any activity they do not stay on it long enough until it is completed. After a few days participants' patience runs out and they leave the job to attend to some other personal tasks that they may feel are more important. They have also seen that even when they withdraw from the activity the project personnel continue to do what is expected and the job gets done.

It is also not clear whether the project administration has understood the relation of man to land and the tenure system governing the utilization of this asset when it suggested a cooperative-like arrangement of communial gardens like the Sinkat one. It is doubtful whether they have understood the reasons behind the lack of cooperation of local community

members with the farmer in Baharothey. The performance of the participants and degree of involvement of the project administration in those social organizational issues point to a gap in understanding. This should not come as a surprise since a project, which is community based, is implemented in a cultural context that is not easy to comprehend. In-depth studies should have accompanied the implementation process very closely.

4.4.2 Consequences of the approach

The feasibility study showed that the Hadandawa while emphasing their need for water and food expressed their wish to have more animals. Any family unit attempting to maintain a living in a pastoral community would require a certain minimum number of animals to justify its adoption of such a style of life. It is obvious that most of the Hadandawa families have lost that minimum number of animals during the drought period; or had to leave their animals with other relatives and seek another strategy for survival as indicated earlier. However, now that the grass cover is improving due to the good rains of last year some families that moved back to their lineage territory started rebuilding their herds or getting back what they have left with others for sometime. It is noticeable that so many young goats can be seen in the project area. The restocking strategy adopted by some NGOs in the area may have also led to the present herd increase.

With the possible future improvement of water supply it can be expected that herds will increase further. This raises a dilemma for anybody dealing with human population in arid regions. Can the suffering of such people be relieved without lying the grounds for ecological degradation in the future? Can a project that increases water resource for animal owners not lead to an increase of herds to a certain point beyond the carrying capacity of the area? Experiences from other places in the Sudan, which are even less marginal than the project area, have shown that increases in water supply lead to overstocking and hence ecological degradation (i.e. the case of Northern Kordofan). The

feasibility studies have not attempted to make use by referring to such experiences, nor did they pass any judgement on the carrying capacity of the project area.

It is important to take this point seriously at this stage of the project and carry a study of the carrying capacity of the area. This will help in determining the areas where large concentrations of animal and human population could be avoided around watering points. Reasonable distances should be maintained between such points in order to allow for a balanced growth of herds. Different livestock species have different herd growth rates (Haaland, 1989) and it is important that an approximation of this rate be found through studies accompanying the implementation of the project activities at this stage. This will help in redirecting the project.

4.4.3 Project linkages and coordination

In order to reach the target population the project staff cooperated closely, at the start, with the SRC branch and went out into the rural areas to explain the project principles to the local community leadership and members alike. However, the idea was to establish motivation much more than to work on needs identification. Reasonable success was achieved at this early stage and some settlements seemed to be willing to take part in the project activities. The role of the SRC branch at this stage of motivation was very important indeed due to the fact its members seem to have a good understanding of the way in which the local communities operate and the correct manner in which they should be approached. The SRC branch committee members seem to command high respect in Sinkat centre and the rest of the district. This can be seen from the fact that the president of the committee managed to win the constituency seat for the National Assembly in the 1986 election.

However, the link between the project and the SRC branch was not that stable and it depended mostly on the charisma of the

committee leadership. This relation has its ups and downs related to the problems that the SRC faced in its contact with the regional office and the National office. The fact that the SRC branch has limited facilities and it consists of volunteering members who have to undertake many tasks in daily life hindered their degree of involvement. Their ability to move in the rural areas and to establish activities of their own, other than those related to the project, is limited by the fact that they have neither the personnel resources nor the logistic to cover the area. The lack of a full time employee of the SRC was one of the main obstacles that constrained its ability even to coordinate properly with the project administration. The project was well aware of this fact and took the step recently to help in finding and financially supporting the establishment of such a coordinator.

In response to the difficulties it faced in its daily activities the SRC branch, after consultation with both the SRC regional and National offices, and with the knowledge of Norcross project administration (one of whose principle objectives is to strengthen the SRC branch in Sinkat District) decided to limit its activities to the small urban centre of Sinkat. This meant that it stopped its involvement with the project staff in the process of motivation which they jointly carried in rural areas. This appears to be a rather unfortunate decision which deprived the project from the cooperation of members of the community who have a good knowledge of the surrounding social and enviromental context and enjoy the respect of a large number of the target population. At the same time this meant that the project had to depend on its own local staff in getting the project ideas through to the local communities. From the existing links with these communities, and the kind of misunderstanding referred to above, the performance of the project local staff leaves a lot to be desired. The fact that most of the staff lack experience and consist of very young people who spent most of their life in urban or small urban areas of the region reflects very clearly on their ability to understand the social context in which they

are operating. The major problem facing this local staff is to mediate between the level of ideas and cultural context of the expatriate members of the project and that of the members of local communities. A lot of management of information is taking place and very little of it is transmitted to the expatriate administration. The language barrier which is very obvious in retarding the link between the SRC branch and the project seems to be also having an effect and limiting the smooth flow of information between the local staff members and the expatriate members of the project.

It has to be noted that the SRC committee at present seems to have a good understanding of the tasks it hopes to undertake. It is also willing to cooperate with the project activities in rural areas and happy to have a coordinator who could make the proper link. When discussing the role of the SRC branch with the SRC regional office it was clear that the branch was left on its own. This is an obvious underestimation of the capabilities of the branch leading committee and hence very little support and interest is given to its action.

Both the SRC regional office and its national office are interested in the project activities and follow closely their progress. Although they are supposed to be partners in the action, they do very little by way of suggestions or actually being involved in what happens in the field. The fact that they are not contributing substantially to the process of implementation seems to make them shy away from pronouncing any comments that may be regarded as negative.

The link between the project administration and the SRC on one side and the rural council authorities on the other side also seems to be rather weak. Few meetings bring the three organizations together from time to time. The council authorities seem to have satisfied themselves by having some of the council leading personnel on the SRC committee. However, it had to be noted that the council authorities seem to understand and support very strongly the project activities. This appears clearly in their

response to the Rural Water Department request to suspend the project activity in the area (ref. the Rural Water letter dated 22/11/1987 in Arabic). They went out for full support of the project activities and assumed the responsibility for giving the go ahead and were willing to take the matter to the province commissioner (ref. commissioner's letter dated 21/5/1988 in Arabic).

The project linkage with the regional government departments seems to be very weak and in certain cases led to hostility as in the case of the Rural Water Department mentioned above. This is not surprising and is even acknowledged by all parties and attributed to the lack of the existence of a regional development plan. As already mentioned, government departments like Land Conservation seem to strongly support the principle of a community based approach like the one advocated by the NORCROSS project. They themselves are engaged in similar activities. However, as explained earlier they have their reservation with reference to the strategy used. Moreover they would like to see better links drawn between their activities and those of the project so that the project does not start creating islands of better life in a sea of poverty and leads to some form of distortion of the socio-economic context of the local communities. They also would like to see equal opportunity, even at the stage of experimentation, given to a large number of people rather than concentrating on a few winners. A further point that is raised relates to the cost and the type of techniques used. It is felt that the costs are too high and there will be no, or very little, chance of having the activities replicated by the local population. Also it is felt that the engagement in the creation of diversion dams of a permanent nature may be a waste of resources since khors tend very often to change their routes in a short time.

What can be emphasised in relation to this linkage is that there seems to be a gap in understanding. Both the project and the government departments have to make an effort to explain and coordinate their activities. It is in fact very important for

the project to have this cooperation as one of its immediate objectives because it is going to be one of those government departments which in the long run takes over the project activities and hopefully ensures its continuity. The SRC may initially take some of the activities and help in the identification of new ones and keep up the process of motivation but the development activities have to go to the relevant government departments.

Another link that the project has is with the British Red Cross and the Ahfad University in relation to the activities on women and development in the area. It has already been stated that the Hadandawa is a male dominated society. It is difficult for non-community settlement members in rural areas to attempt to draw women into activities removed from their traditional roles. With the movement to small urban centres and the road side some efforts to engage women in income generating activities were undertaken by some NGOs. The women's centre in Sinkat is one of these efforts. The Ahfad University came, as a national institution, to take part. The project is now supporting some of the centre's activities and is housing it in the compound. When the British Red Cross stops its support in the near future, as planned, it will be very important for the project to take more responsibilities in relation to the women centre such as provision of equipment for development of health education material.

Another linkage that was expected to exist is the one between the Bergen-Khartoum Universities Red Sea Research Programme and the project. Many of the points raised directly or indirectly in this report with reference to base-line data on social or national environment could be answered by the programme researchers. However, very little contact seems to exist between the programme and the project. What can be said in this connection is that an urgent meeting needs to be held between the project administration and the senior researchers responsible for the programme in the two universities. Such a meeting should clearly identify areas of cooperation and see the extent to which

the base-line data collected by research may be made available to the project administration with the purpose of helping to improve on its performance.

4.5 Building the Capacity in the District

4.5.1 Staff and staff training

A limited number of expatriate staff was proposed to take part in the project and all through the process of implementation. So far only two expatriate staff members are on the project at any time. This approach is by far better than attempts undertaken by many other NGOs or other international agencies involved in relief and development in this part of the world. One major advantage that such an approach has is that it makes the project close to the social environment and is not imposed on it. However, the rapid change of coordinator (three coordinators in three years) did not allow for the continuity that is needed at the start of the project. Previous experience was not particularly relevant to the programme. It is also important to note that one of the two expartriate staff was not present at the time of the evaluation team's field visit. Also absent due to illness was the only Sudanese senior staff member, who is responsible for agriculture and extension.

As far as the Sudanese staff goes, only one person is qualified enough to be in a decision making position. The rest are high secondary school graduates or unskilled and skilled labour with little or no education. As far as those who are taking administrative or supervision tasks their appointment was based on introduction by previous acquaintanceship rather than opening the posts for competition. There was also an attempt to continue to provide work for those who had assisted in the relief efforts in the area. No equal opportunity for people who may have relevant experience was given. The arguement given in support of this approach is that the labour market for people of the calibre required by the project is limited. Such an arguement does not hold since many people from the area who are not physically

present there could have been drawn had the jobs been announced. The point here is that the project seems to have denied itself a chance to a wide selection. However, this is a point related to the procedure and should by no means be taken as a criticism of the performance of the local staff who seem to be offering the best of their knowledge in the circumstances of the project.

The local project staff linked to the technical activities of the project are getting good training through the project workshop. The local staff taking part in administrative matters and supervision will benefit very much from further training if they are to stay on the project and help in promoting the future expected demonstration effect in the region and elsewhere. The short term course offered by national institutions such as the ones offered by the Development Studies and Research Centre of the University Khartoum, to name only one example, may be very useful. This should not exclude training abroad for the most senior of this staff if institutions relevant to the future activities of the project can be found.

4.5.2 Cooperation and secondment

In line with the process of building the capacity of the region the cooperation between the project and government departments may help in giving some support and chance to government department staff to join the project on secondment. Such staff can bring some experience into the project and will also learn a lot from being in contact with expatriate staff on the job. Such an arrangement also will allow for the smooth transition of the project to Sudanese hands and government department administration in the future.

4.5.3 Base-line data collection

The fact that knowledge of the natural and social environment of the area is limited seems to be a basic statement in every document on the region. For any project like this one to succeed detailed information about the ecological setting in all its

dimension is necessary. In collaboration with the Bergen-Khartoum Universities Research Programme some data can be collected and some of the project staff (administrators and supervisors) can be involved in the stage of data collection. Senior researchers can do the analysis and make the results available to the project administration. This activity should be seen as an ongoing process and may at a later stage help in creating a regional research unit.

5. WATER RESOURCES AND EXPLOITATION

5.1 Introduction

The project area in the Red Sea Hills is characterised by very low rainfall and very sparse data on the water resources of the area. Much of the rain which does fall is lost to the area by evaporation or run-off to the Nile or Red Sea, and in recent years no rainfall records have been collected. Rainfall and groundwater levels may vary enormously from year to year, and observations at one season, or over one year may bear very little relation to conditions one or two years later.

Before the start of the project, existing sources were generally scoopholes in the khor bed, which were deepened as water levels dropped, and re-dug when flood flows filled them in. Only close to settlements, and where the government had constructed wells were more permanent structures to be found. Similarly for water spreading and harvesting there had been a history of temporary earth dams for diversions and semi-circular bunds to retain sheet flow, but these had generally not been much maintained in recent years. Hafirs, bunded reservoirs to store surface flows, which are common elsewhere in the Sudan had not been much used in the area. Most of the people in the target group are nomadic, and are used to living as much as five kilometres from their source of water, bringing herds to drink there, but carrying most water for domestic consumption back to their temporary house. Inputs to maintenance and construction have traditionally not been large

compared with the investment which settled people are prepared to put into water supply.

Thus the project, with one of its primary aims to improve water supplies, particularly for nomadic people, was established in a marginal area of very scarce water sources, of limited yield and variable quality. It was started at a time when the five preceding years of rain appear to have been below average. Initially the project had very little hydrological information over time or space available to it to help in decision making. There were therefore two stages of pre-study, a preliminary report as part of the feasibility study, and later field investigations both carried out by NOTEBY.

5.2 Pre-studies

5.2.1 Term of reference, preliminary study

The lack of necessary information was recognised by the project at an early stage, and led to the commissioning of Noteby to provide a study of water resources in the area. This was originally to be related to the drilling of boreholes, but, as a result of their preliminary findings and recommendations, was changed to solutions more appropriate to the resources, materials and skills locally available.

The Assessment of Water Potential carried out by NOTEBY (called the Preliminary Report in this evaluation) "should establish all facts with regard to the present water supplies, the types of existing water sources and their evaluation and characteristics. Possible means of harvesting run- off and schemes to increase the recharging of the aquifers shall be evaluated. An implementation strategy for developing and improving the water sources shall be outlined." (Scope of works, p 4). This assessment was required before the integrated development plan for the project could be formulated and was carried out before the project had an engineer on the ground to contribute and provide continuity.

5.2.2 Activities and general conclusions, preliminary report.

The resulting report provides a good outline of groundwater resources and systems, to form the basis for planning the project. It combines a desk study of the limited information already available, with field reconnaissance to identify areas of greatest potential. It also provides clear descriptions of some mechanisms for inducing recharge, and establishing water spreading systems which appear relevant to the groundwater conditions.

At this stage the project needed to link together the findings of this initial report, with demands and population distributions, and with the plans of other government departments active in the same field (principally Soil Conservation and National Rural Water Corporation). Possibly, from the scope of works, the Consultant could have helped to form a bridge with such departments in the search for information on existing expertise, and with local people involved in water harvesting schemes. However, the Consultant's input was only short term, the scope of works angled towards the engineering aspects of water supply and government departments not too interested in a project not yet on the ground. Thus the water supply part of the project became slightly isolated as a technical item, and early data gathering, done before the project had an engineer on the ground, could not be used as a springboard to form links with other interested bodies.

At this early stage, when planning was the main activity, it would seem that more attention might have been paid to

a) local knowledge and skills (eg. water harvesting and well siting/construction)
b) Sudanese experience and experiments locally and elsewhere within the country (earth diversion dams, soil conservation, and hafirs)
c) government plans for the region (dam sites already surveyed, and those planned)

d) the need for a more continuous technical input on water resource development in an area of such difficult conditions (eg. regular consultation by the project with the Consultant)

Of the above only a) and possibly part of b) were included as part of the Scope of Works for the Consultant, which are taken to be Norcross's requirement, in the absence of a detailed Terms of Reference.

5.2.3 Terms of reference, field investigations and implementation programme

Again detailed Terms of Reference are not available, but the Scope of Works state that " the main aim of the hydrogeological survey was to establish environmental knowledge of the areas and especially obtain and gather knowledge which can have impact on later additional surveys looking for water. In addition the survey should look into the possibilities of establishing different water harvesting schemes, both surface and sub-surface. The specification and design work should focus on intermediate technology methods, utilizing local (sic) available materials and skills." A training element was also included.

5.2.4 Activities and general conclusions, field investigations and implementation programme.

The second survey by the Consultant included a great deal of survey work done to define as carefully as possible, the hydrogeological conditions at each site. Proposals were completed to outline design stage, and whilst specifications are mentioned in the Scope of Works, the overall aim seems to have been only to look at "possibilities of establishing different water harvesting schemes" not their detailed design. " Later surveys looking for water" are referred to in the Scope of Works, and the survey concentrated on refining the most suitable survey methods, and training project members in the necessary techniques.

As requested by the Scope of Works, the Consultant has set out intermediate technology solutions, and recognising that this requires flexibility in timing, has left the detailed programming to the discretion of the project.

5.2.5 Hydrogeological/hydrological systems defined by the surveys.

Investigations show that the river bed aquifers are generally thin, with less than a metre of sands and gravels overlying 2-3 metres of silts, which are generally very hard, but loosen up when wetted. Underneath these layers lies a weathered zone which appears to be thicker and more permeable than the silts and in which groundwater is most frequently found. The survey concentrated on defining the extent of the top two layers, and looking for places where unweathered bedrock might cut off groundwater flow in them, and the role of the unweathered zone is less clearly defined.

Most schemes proposed include infiltration trenches to improve the contact between the coarse sands of the khor bed and the lower silt layers/weathered zone, to encourage greater storage of water. However the geometry and properties of the weathered bedrock, which seems to act as a drain to the silts could not be defined by the survey methods used. There is therefore a danger that infiltration trenches will need very careful siting to ensure that water transmitted into the lower silts and weathered zone is not lost again to the system by underdrainage, where lines of flow are more related to structure or geomorphology than to surface topography. This is particularly true where khors flow in shallow channels within 'misfit' valleys which date back to times of much higher rainfall (as is the case in most middle and lower khor sections).

An aspect of hydrology which is only easily observable after periods of heavy rain, which might not have been apparent at the time of the survey, is the very high silt load in flood water. While most flash floods carry a high sediment load, the presence

of thick silt deposits even quite high up in catchments, mean that flood water carries a greater proportion of fines than is typical of most mountain catchments. Any structures which impede flow, reducing the gradient, will quickly become silted up. Accumulation of more than a metre of silt a year has been observed at Hashteribab. Thus any attempt to improve infiltration by ponding water is counter-productive, as the permeability of the surface layers is very quickly reduced. The tendency is for water ponded on silt to lie there until removed by evaporation. This means that low gabion recharge dams are not suitable in this area.

5.2.6 Design concepts

The Implementation report provides approximate siting and outline design for sand dams, sub-surface dams, diversion dams, infiltration systems, and hafirs. The required level of design is unclear from the Scope of Works, and the project would appear initially, to have regarded the designs presented as sufficiently detailed for immediate construction. In most cases, however, detailed design was still necessary, to make the job of the Engineer on site easier, and to allow for ground conditions which were not quite as predicted. Also essential details such as relationship between diversion dam spillway height and offtake canal invert level still needed to be defined. This all required a more long term involvement of the Consultant, especially where structures were regarded as experimental. It was perhaps fortunate that the Engineer provided continuity between the study/design phase and the construction, as the outline designs would not have been easy for someone to apply, who had not been on site with the Consultant during the field investigations.

As mentioned above, structures previously established by local people have all been of a temporary nature. Earth dams and bunds were 'fail-safe' mechanisms which were expected to fail if flows were too great, and would be re-built as necessary. This protected the area for water spreading from flows of too high a velocity, which might lead to gullying and erosion. It would

seem that in designing more permanent structures in the same, or similar areas, consideration should perhaps be given to the effects this will have. It is appreciated that one of the great imponderables is exactly how much flow any dam will have to deal with, but it is important to ensure that diversion schemes will not lead to the destruction of land suitable for cultivation. A spillway of fixed height will take a fixed proportion of the flood water, forcing increasing volumes of water down the feeder channel as flood levels rise. Once in the area of water spreading, large bunds, especially those which are re-inforced with stones, will concentrate large flows of high velocity into fairly small channels between bunds, where scouring may occur. Temporary structures, admittedly requiring much higher levels of maintenance, were, through trial and error, usually geared to fail before damaging rates of flow were achieved, and small bunds could always be breached if dangerous scouring started. The comparative effects of permanent structures should be observed before more systems are installed, and some calculations done on critical flows.

Permanent check dams have also been proposed at several sites, to improve recharge. The problems of siltation have already been mentioned, but it is also worth referring to the findings on the Preliminary Report on conditions at Erkawit. Here the report remarks on the poor recharge conditions brought about by the dams constructed by the British, but attributes it to dams being built too high. The dams adversely affected both water quality and quantity, and the same is expected to happen with any check dams constructed, regardless of their height. This is because eddying on the upstream side of the dam seems to cause a scour pool to form and silt to be deposited in considerable quantity, even when dams are less than one metre high. Thus recharge rates are reduced, and salts tend to accumulate in the silts when drying, being released into any subsequent flood water which manages to percolate through. The project has recognised this problem and has therefore not constructed check dams.

The problems of siltation and surface flow regimes also apply to sand dams. Where depth for accumulation is greatest, ie. nearest to the dam, there is a tendency for silt to be preferentially deposited. Sand tends to be dropped in a delta at a level immediately above the dam height, where velocities fall and water enters the pool made by the dam. It seems more attention needs to be paid to gradients and khor geometry upstream of the dam, and predictions made of how these will be affected by intermediate stages of natural backfilling. Experiments should be made to see whether concentrating the flow through a spillway can reduce the effects of eddying, promote higher velocities nearer the dam, and allow the drainage of silt-laden water. Silt will still be laid down towards the sides of the dam, but it is hoped that a core of sand may form which would provide better infiltration characteristics to the storage behind the dam.

The designs offered are good community level solutions, which provide sufficient water for several family groups. It would seem, however, that where water is scarce, households living at great distance from each other, and community participation difficult to organise, some attention might also be paid to solutions for family level implementation. The hafir at Baharothey, constructed with project initiative, is one such scheme. In particular, methods for improving drinking water quality, and extending the time surface water is available could be further explored, seeking solutions which are less complicated and demanding of labour and materials than those proposed in the report.

5.2.7 Conclusions

The study and outline design phases have provided a valuable foundation for the projects activities in water resource development. Experience is being gained from the concepts proposed, most of which have turned out to be suitable for the physical conditions, and some of the negative aspects, such as problems of siltation, have been put to good use in learning lessons aplicable to soil conservation measures.

The main draw-back has been that the employment of a Consultant was regarded as a short-term input, isolated from implementation. Since some of the solutions proposed were untested, and others not previously tried in that area, periodic involvement of the Consultant would be valuable to discuss details and enable modifications to be made to future designs. This has ,in part, been done by the project, but the work load of the Engineer is high, and he has signified that opportunities to confer with the Consultant would have made his job easier, and might have meant avoiding some of the problems encountered.

The isolation of field study and design phases from the rest of the project has also meant water has been regarded mainly as a physical resource. The Consultant has mentioned social aspects on occasion, and the Engineer has also a good grasp of problems which arise over water rights, tribal divisions etc. However it does seem that no over-all plan has been made, which knits together demands, potentials, the plans of other organisations, or resolves the problems of how family or government wells could be included without strife. No-one seemed to know the basis upon which the eleven sites were chosen for detailed survey. (Two of the sites have been the subject of recent tribal disputes, according to the Engineer, and so regardless of their potential, would not be available for development.) A more general plan would be a good starting point for involving those government departments active in the same field, and could bring them into discussions, making them more prepared to help take responsibility for existing installations in the future. It would also help in liaison with the Red Crescent, who seem to channel many of the requests for help, but may not be aware of other plans and priorities set by local and national government. This would seem to be where the Co-ordinator should become involved in the water sector.

ABOVE AND BELOW - Dam and well at Hashteribab following rain shower.
Photos: S. Sutton

5.3. Actual Situation

5.3.1 Progress

Since the provision of the draft Implementation Programme report in July 1987, the project has undertaken an enormous amount of work. Construction has been carried out to an extremely high standard, using a mixture of community participation (with food for work) and paid crews. Despite the time needed to mobilise and motivate communities, progress has been fast, especially when it is remembered that little or no construction is carried out during the period when flash flood risks are high (May-Sept).

By April 1989, some 25 infiltration trenches had been excavated and filled. In addition five new wells had been constructed, and three existing ones rehabilitated. Five dams had been completed or were in the process of being completed. This has involved the excavation of more than 5000 m^3 of alluvial deposits, and the collection, transport and placing of some 7000 m^3 of stones in gabions, trenches and masonry. Stones have also been collected for micro-catchments and tree protection.

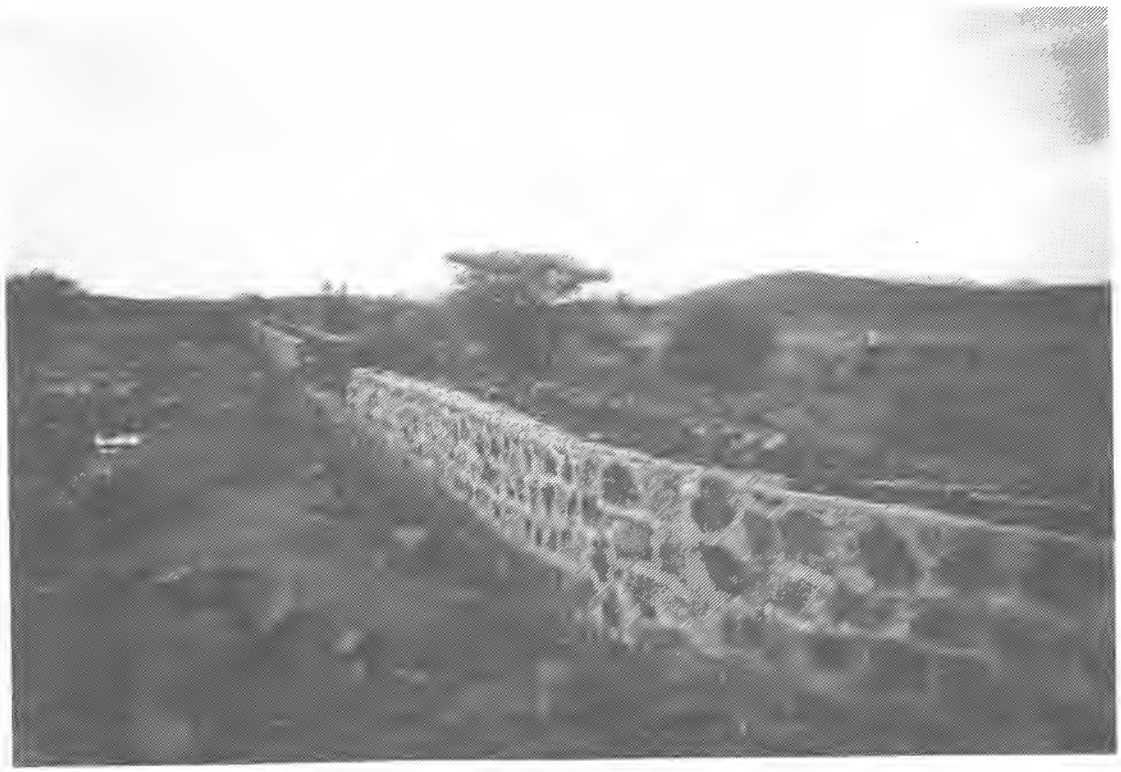
In summary the following progress has been made (for additional information see the 1988 Project Annual Report):

Hashteribab.

- Eight infiltration trenches above government well
- Four infiltration trenches upstream of diversion dam
- Test well 4.5m deep to bedrock
- *Diversion dam (4m high, and of masonry and gabions) to bedrock, spillway to be raised when feeder canal offtake is completed
- Well 8m deep (8.6m from top of rings) with associated check dam/gabions for infiltration

Aqaba Test Sand dam

- *Dam now just over 4 metres high, with associated well, total depth 4.85m from top



BIRAMFE - ABOVE: Diversion dam for sorghum irrigation scheme.

BELOW: Check dam at end of irrigation scheme.

Photos: S. Sutton

Ayshaf

- *Rehabilitation of one well, with two 2m deep infiltration trenches connected to it. Still under construction

Biramfe

- Seven infiltration trenches
- New well under construction at the side of the khor
- Diversion dam and check dam, plus bunding of field areas for irrigation
- New well in main wadi (under construction)

*(Types of structure as per Imp Report, but sites changed)

Erkawit

- Two rehabilitated wells (Khor Harresab and Khor O'Neill)
- One subsurface dam with well and two infiltration trenches (Halgeit)

Also hafirs at Eikam and Baharothey

* Proposed in Implementation Report by NOTEBY

As can be seen from the above, the progress which has been made is impressive, and site inspection shows the standards of construction to be high. Much has been learnt during this construction, both about social aspects such as food for work, the priorities people set on different activities, such as durra planting versus building of permanent structures, and about construction methods and behaviour of structures in floods. The Engineer should perhaps try to set some of this down in writing, as the experience gained is unique and would be extremely useful to other similar projects.

5.3.2 Time scale and technology

The proposals put forward by the Consultant are intermediate technology solutions which were to be adopted by the project at

the rate it felt most suitable, and in those places which it felt had most priority and chance of success. In that most designs had an element of experiment in them, a pre- requisite in an area where so little about hydrological conditions has previously been recorded, the project decided to construct test units of each type over a fairly short time span. There was also obviously a wish to get something 'done on the ground' to show that the project was a practical implementing agency, not just a forum for discussion with no concrete achievements. This was as important for its image in Sinkat and Khartoum as in Oslo.

The result is that whilst designs employ low to intermediate technology, suitable for adoption at local level with little outside input, construction methods have incorporated some higher technology elements to aid relatively rapid completion. Whilst local people collect the stones, they are transported by lorry even when the source area is near. Concrete for well rings is made in a mechanical mixer, put in moulds imported from Norway and compacted by an electrical vibrator run from a generator. Wells are pumped rather than bailed dry to allow deepening and gabions cages are often welded on site. These activities are all done by teams of people trained locally, aided by unskilled labour from the communities which will benefit.

Whilst the reasoning behind using these techniques is perfectly understandable, the image projected by such methods presents some problems, especially to those poorly informed about the aims of the project. Government organisations which have heard of the project but have not been involved in it, tend to dismiss the solutions as inappropriate, because they hear of the construction methods, but do not look at the overall concept. Their view may also be a bit coloured by the fact that they themselves are without sufficient funds and facilities to carry out similar works, although quite capable in other respects of doing the work.

Local people are likely to feel that they cannot adopt the principles being tried because they are unable to provide the

sort of equipment they see being used. The project needs to break down this image if solutions it has adopted for water resource development are to be regarded as applicable elsewhere, and able to be taken up without so much outside funding. This can be done by

a) emphasising the experimental nature of the work so far carried out, and the need for demonstration schemes to encourage communities to mobilise themselves

b) looking at how the designs adopted and the methods of construction can be modified to be more suitable to community participation among nomadic people. This may vary from a) short-term (unpaid) local inputs on construction/maintenance tasks which require less than a week, and getting an earth-mover/excavator to do the most time-consuming work, to b) long-term local inputs of paid labour but with greater dependence on local skills and equipment. Both would require some modifications to designs, and both accept the implication that in an area such as this, no schemes can really be carried out without some provision of funding or equipment by outside organisations, whether it be government or NGO.

and

c) assessing the degree to which NGO's should be involved, long term, in the provision of major water harvesting structures, and how they can best co-operate with government to serve the area in this sector.

5.3.3 Data collection and monitoring

Much of the justification for what has been achieved so far is that it is an attempt to set up experimental solutions to the problem of water resources in a Sub-Sahelian part of Africa. The experiences learnt from this should be applicable elsewhere, as well as helping to produce more efficient low cost systems for the Red Sea Hills. Ideas are evolving all the time, and structures already established should be beginning to have a beneficial effect on local groundwater regimes. The area is also one of

extremes in hydrological terms. The present groundwater resources are the product of several dry years and one or two major storms. Conditions can change dramatically over short periods of time, and most of the dams and infiltration trenches installed are expected to produce long term effects from events which bring them into operation for only a few hours in a year. It is therefore very important to know the magnitude of these storms, and the response of sytems, both natural and modified, to the floods so generated.

At present, the only records which are regularly kept are those of structures as built. This is valuable as their siting and form has often had to be modified from that originally proposed when more information has become available on ground conditions at the site. Some notes on reasons for modifications would also be of use to those trying to employ the same principles elsewhere.

Rainfall records will be critical to the assessment of the performance of the systems set up to improve water availability. Unfortunately no rainfall records are collected anywhere in the area at present, except some sporadic measurements at Odrus by the NRWC. The Meteorological Department's monitoring network has broken down almost completely, through lack of funds, and from a very extensive system of over 1300 stations countrywide, it has now only 222 working. From 1982, in the period covering the worst of the drought, and the recovery of 1986 onwards there are no records. The Meteorological Department (Deputy Director, Khartoum) has signified that it would welcome a chance to co-operate with the project in the re-vitalising of stations in the area, and this would seem an important first step. Rainfall gauging stations should also be set up in those catchments with diversion schemes and if possible also where infiltration trenches have been made.

In the past eighteen months, efforts have, of necessity, been concentrated on construction, and little time has been available for data collection. This means that for most schemes there is no information on conditions before attempts to improve recharge and

storage of groundwater, or soil conservation. The physical impact of schemes cannot therefore be assessed quantitatively.

5.3.4 Results so far

The Pre-Studies provided both standard outline designs and siting guidelines for different types of structure. These were combined at eleven sites to provide proposals for improved groundwater resources and their exploitation.

As can be seen from the list in 5.3.1 only three schemes completed follow directly the proposals made. The rest are adaptations because of variations from the site conditions predicted by the initial survey, or applications of standard designs to new sites because of local demand. Thus both the design concepts and the siting criteria have been tested.

In general the siting conditions predicted have been found, although soundings at Khor Ayshaf and Baharothey found less alluvium than predicted by the geophysical surveys, so that construction plans had to be abandoned. Perhaps the main points which have arisen from the siting exercises are that surface and groundwater systems are dynamic, not static, and that the system at any one time is the product of many changes in the past, and prone to dramatic changes in the future. This means that:

a) more attention needs to be paid to the khor course upstream, and its stability
b) where groundwater is to be augmented/ exploited, care should be taken to see that there is no chance that its paths of flow might deviate from those predicted by looking at surface drainage patterns.

Construction of dams leads to a build up of sediments behind the dam, eventually up to the height of the spillway or crest. This change of gradient may cause water to try and flow along a different route before it reaches the dam, especially if there is

any low point in the interfluve immediately upstream. Alternatively, where gradients are low upstream and braiding common, there is a risk that the khor may take a completely new path before reaching the dam site. This happened with the proposed dam site at Biramfe, leading to the decision to construct the dam elsewhere. A similar risk was found with the Ayshaf site, and Hamesh Yameb erosion has completely changed the site. Thus although local demands may be to consider a specific site, and site investigations may be done there, surveys must first be done of the catchment as a whole to see how the site proposed fits into the systems, and what changes it has undergone or is likely to undergo during the life of the scheme proposed.

The same is true with groundwater systems. Especially where infiltration trenches are proposed in association with wells, it is vital to be sure that the recharge induced by the first is available to the second. For instance at Hashteribab, the khor flows against a rock slope on one side, but is at the edge of a wide plain which borders it on the other. At various times surface water will have flowed along different courses and at different levels on this plain. There is no guarantee that bedrock confines groundwater flow to the same path as the present surface water course, indeed it is most unlikely to be so. In this situation, putting infiltration trenches in upstream of a well may not help the yield of the well, for the groundwater recharged may move sideways, towards the plain rather than downstream in the khor, towards the well. Those involved in siting schemes need to be aware of these characteristics of khor surface and groundwater regimes so it would perhaps be a help if guidelines drew attention to them.

Of the outline designs proposed, most seem to have been able to be constructed without too much problem, and their operation to date has been generally satisfactory. The main problems have been the difficulty in achieving a water tight seal between different layers of masonry (as is necessary with sand dams and sub-surface cut-offs) and energy dispersion downstream of spillways. Masonry dams requiring construction in stages, either

because of the size of the dam, or to encourage build up of sand, tend to leak at the junction of layers constructed at different times. Strenuous efforts have been made to achieve better bonding, but without sucess. The Consultant suggests that indented (like a rampart) completion of intermediate layers, and prolonged (at least two days) soaking might improve the situation. Such indenting may make bonding at the angles more difficult, but the longer soaking, if not already tried, might improve the seal.

The apron at Halgeit sub-surface dam was smooth and became badly undercut after the floods in 1988. However in general the dams constructed have rough aprons or are founded on bedrock on the downstream side and have suffered little damage since construction. The dam at Hashteribab is stepped on the downstream side which means that the force of the water over the spillway is broken, but this requires an enormous amount of materials in construction. Gabions especially if not all at the same height would help to disperse the energy, and the Engineer is also planning the installation of cusps (in this case half well rings) to slow flow.

The difficulty of bonding new layers to old in sand dams means that the one so far constructed has not been too successful. To this may be combined the lower than predicted increase in groundwater storage, and the accumulation of silt rather than sand, in casting doubt on the principle in this area. Both for these and sub-surface dams it is a problem to reduce seepage at the junction with the bedrock to an acceptable level. Until the foundations have been dug it is not possible to tell how fissured the bedrock may be and how watertight a seal can be achieve. Even small leaks will so reduce storage that perennial supplies may seldom be achieved.

Most efforts so far have been put into completing infiltration trenches. Preliminary results from these look hopeful, although more information is necessary to show the magnitude of their effect. At Biramfe the trenches have been installed upstream of a

natural rock barrier. Initially this was to be augmented by a sub-surface cut-off, but subsequent observations suggest that this is not necessary (and anchoring of the dam to be difficult). Before construction of the trenches in March/April 1988 trial pits found standing water about 6.2 metres below ground level, in weathered rock, approximately 100 metres upstream of the barrier and static water level in infiltration trenches at about 4.5 m. After the floods of June to August, static water levels were at the surface, and remained within two metres of the surface up to March 1989. This suggests good recharge and storage. Unfortunately there are no measurements in the area over a longer period to show whether the response to the floods was normal, or as local people indicated, improved by the works undertaken.

Similarly the infiltration trenches at Halgeit (near Erkawit) in conjunction with the cut-off dam provided water all the year round (1988/89) in the associated well. This has been used throughout by the people who requested the well/dam because of lack of perennial water. Surveying might be done to see how water levels in the lowest part of the Halgeit khor compare with those in the Khor O'Neill which has water within a metre of the surface over the section for a kilometre either side of their confluence.

5.3.5 Future plans of the project in water resources development

The Project recognises the need to slow down construction at this stage, and to consolidate on what has already been achieved. This will allow time for the proper establishment of monitoring, the revival of links with government bodies and clarifying the objectives of the project with those who have misunderstood and perhaps therefore misjudged its aims. Time may also be found for simplifying construction techniques and establishing methods for the consequent longer term inputs which such a change will need.

The two diversion schemes (Hashteribab and Biramfe) need to become operational and then be observed in action for at least two years, to assess how such permanent structures will work in

LEFT: Well Rehabilitation with infiltration ditches

BELOW: Hand-dug wells

Photos: S. Sutton

relation to the amount of water diverted. The project recognises that some adjustments may be necessary. Also time is needed to see how land holders manage to co-operate over the division of flood flows from this system, when flow is so variable and unpredictable.

Over the next eighteen months to two years, the project plans to concentrate construction teams on well rehabilitation, and soil conservation, with the possibility of completing one additional sub-surface cut-off dam. Well rehabilitation has been discussed with people in the Halalgobay area, where three wells are in need of improvement. Other work is scheduled for this area, both for soil conservation and infiltration trenches, but the timing has to be flexible, as the project feels that people are not yet interested enough to be able to offer sufficiently long-term labour. Similar investigations and discussions are being carried out at Baharothey, where there is demand for a well with infiltration system, but tribal difficulties may take a while to resolve.

Interest has been shown by people in the Adhalef, Hamesh Shebaib, Aishaf, Nazet and Bramio areas in soil and groundwater retaining dams, and they have been taken to see the work at Biramfe. Thus preparations are being made, and public relations exercises carried out, to generate more demand for works, and this will be consolidated over the next year.

It would seem that the plans for the next phase are realistic and will allow other aspects of the project, (especially monitoring and liaison) time to catch up. The temptation to respond quickly to interest raised by the demonstration systems will be difficult to resist, but should try to allow time for these systems to be tested, and for a co-ordinated plan to be established. This should be discussed with local and regional government wherever they show willingness to be involved.

5.3.6 Staff and training

Those involved in water resource development number approximately 22, including the Project Engineer. He is responsible for construction and works with a team consisting of:

- 1 foreman
- 3 trained + one apprentice bricklayer
- 1 trained and 1 apprentice welder
- 3 drivers
- 8 labourers
- 2 cooks
- 1 night watchman

In addition to their training in their own particular field, some of the team have gained expertise in specific skills relevant to the water sector. Four men are now competent in surveying and setting out for construction sites, all the brick layers have experience of rough stone masonry. One bricklayer and the foreman have been responsible for ring making, and three people have been involved in soundings for the selection of dam and well sites.

From a purely technical point of view, there is a broad enough base to the training undertaken, that activities would not have to be halted because one man was absent. The main area where further training and staffing seems to be required is in the recording, collation and treatment of data which is relevant to all aspects of the project.

5.3.7 Cost benefits

The provision of water to such a widely scattered population in an area of scarce water resources cannot be done cheaply. However, the level of provison is a minimum, with many people travelling five or more kilometres to the water source. Irrigation supplies are unpredictable and the number of people who will benefit in any one year is highly variable, ranging from zero to about 300 on the largest scheme.

If it is assumed that around half the total budget of the project is expended on water-related activities (ranging from vehicle maintenance to staff housing, as well as to support of permanent field staff and temporary helpers), some 10 million NOK has been available for development of water resources. This will benefit around 2500 people at a maximum. Thus cost per head would work out at about 4000 NOK. This is a high figure for such a level of provision, but that is to be expected in such an area, and only helps to illustrate why government agencies with limited funds have generally concentrated their activities in areas where more people can benefit from any one scheme and per capita costs are lower.

5.4. Recommendations

5.4.1 Monitoring

There is at present little or no comparative information over time. Isolated measurements give little idea of systems' behaviour, and may even be misleading when seasonal variations are large. Regular monitoring, as well as spot measurements are therefore needed to allow for better evaluation of the effects of the project's work, and to help in the assessment of areas for further works.

A monthly monitoring round should be set up, during which water levels and conductivity would be measured in existing project wells, and in nearby sources. Similar measurements should be taken in areas where the project has plans to work in the future. Datum marks will need to be established at each site, and gauging posts be set up at dam sites in conjunction with calibration of dam spillways. Total depths of wells should be measured bi-annually with unlined well depths measured monthly. Special attention should be paid to places such as Wadi Ayshaf, where an unmodified traditional well lies within two hundred metres of a rehabilitated well with infiltration trenches. Elsewhere, where infiltration or sub-surface cut-off systems are planned, existing wells should be monitored before hand, or even new wells should

initially be installed without infiltration. Alternatively negotiations should be made to install infiltration trenches in association with a dry well whose history in known. (Whilst this has been done with the government well at Hashteribab, the well does not reach bedrock, and permission has not been given to modify the well).

Meteorological measurements, especially of rainfall, should be started again as soon as possible. Long term averages have been fairly well defined in the past, but there is a great need for records of individual storms which will affect project works, and also a longer term picture of whether climatic conditions in the area really are changing. The Meteorological Department used to have gauges at each railway station, and at Post Offices, as these were regarded as having staff permanently present, and working regular hours. Health centres and school might also be considered, but staff are prone to more frequent transfers at the former, and often leave for holidays from the latter. Places with long records such as Erkawit, Gebiet and Sinkat should receive priority, followed by sites related to project works. This might be an activity in which Red Crescent contacts and continuity would be useful. The Meterological Department can provide locally made rain gauges, and some measuring cylinders at cost, but funding will also be necessary for paying observers, and some additional cylinders if many are required. Any results should also be sent to the Meteorological Department who can provide record cards for this purpose.

Following recharge events, spot measurements should be made of conditions where infiltration is being induced. Excavation of alluvium immediately downstream of a trench, and some distance (50 m or so) away should be tried to see whether wetting zones are significantly greater in the former. Measurements of flood flows through spillways, and notes on peak flow indicators (eg driftwood and goat manure) should also be collected, with some estimate of the time flow lasted. At soil conservation sites surveys should be made of silt accumulation after rain, and of any problems downstream of dams.

To do all this data collection will be time consuming and will require some new equipment. Some measurements can be done during journeys to construction sites, but it would seem that, for continuity, either someone already in the project team, or someone recruited locally especially for the task, should be given responsiblity for monitoring.

The equipment necessary is not complicated or very expensive. The project already has one dip meter, but should consider buying a spare because of the time replacements take to arrive. The existing conductivity metre has no temperature compensator and so can be erratic, since thermometers have a very short life expectancy in such an environment. A meter with automatic compensation, and/ or a metal thermistor would provide more accurate and reproducible results, allowing comparison of readings by different operators and at different times of year. These two items would cost about 4000 NOK. A flow meter, for run-off measurements of low gradient khors with wide courses, and for use on feeder canals , or stage recorders, both costing in the region of 20,000 NOK each might be more appropriately thought of in relation to the university research projects.

The University of Khartoum in conjunction with the University of Bergen, are working in the Red Sea Hills area. To date the contact between the NORCROSS project and the research teams has been limited, and discussion with the students and the project team showed that neither had a clear idea of what the other was doing. Only coincidentally did any aspects of the research programmes have any bearing on the objectives of the project. This is disappointing as each have advantages to offer the other. The project can collect information over a longer period of time, and is doing experiments which the university students do not have facilities to do. The students have time and facilities to help investigate the effects of what is being done, and to provide information which would help later stages of the project.

The following fields within the water sector would seem particularly in need of research:

a) traditional water use (including division of flood water, downstream water rights, attitudes to water quality etc.)

b) instrumentation of a catchment for rainfall/run-off/infiltration studies (relating also to ecological changes and soil conservation measures.

c) effects of changing base levels on surface and groundwater regimes

d) distribution water points in relation to carrying capacity and ecological effects of grazing patterns.

The Civil Engineering Department of the University of Khartoum is also active in the development of water harvesting schemes, and could be instrumental in the design and monitoring of new systems in the area.

5.4.2 Construction and experimentation

Diversion schemes which are under construction should be completed as soon as possible. It seems that these systems are simpler in concept than in operation and there remain many unknowns. Not least there are no infiltration measurements to show how long water spreading needs to feed each plot, nor any run-off data to show the probablility of such flows occuring. Thus physical parameters of the water harvesting system are, mostly of necessity, poorly defined, and this is combined with a degree of caution over social aspects. Preparations of people appear to have been better than those made at the government scheme at Odrus, where little or no use has been made of the water spreading and silt accumulation. There still remains some uncertainty how the water spreading will work, and how people who have contributed their labour will react if water is insufficient to reach their plots in the first couple of years. These unknowns and the system's tolerance of them needs to be observed for two

years at least so that necessary adjustments can be made. After that efforts can be more easily put into new schemes.

The only other area where major construction efforts might be concentrated is the main dam at Erkawit. The project has considered this before but the scale of works was beyond the budget available. The dam was built as the lowest in a series in the early part of the century, and many of the others have failed, and the project has re-built some of them. This lowest dam is, however a key part of the system. It has caused the build up of some 15 metres of silt, and accompanying groundwater storage. The wide area of flat land so formed is one of the main areas of cultivation in Erkawit, and the loss of the dam would cause gullying far back up the valley, and might even affect some of the soil conservation works which have been done. The Project Engineer calculates that some 50,000 Sudanese pounds would be needed for labour and materials, but that the work is well within the capability of the teams trained on the project.

If funds could be made available for this work, the project would need to ensure close co-operation with local and regional government departments. The government has previously carried out repairs to the right side of the dam, and then ran out of funds. Before outside funds are sought, it should be ascertained whether government funding has been found, and how the NRWC /Soil Conservation could best be involved. Implementation of this project should not be further delayed, as the dam is now in a critical state.

With the plans to slow down on construction, the project has the chance to expand on its own experimentation as well as to encourage that of the research teams. In particular there should be some opportunity to follow up certain problems which remain unsolved. A significant one is the quality of water from hafirs, and measures to improve their storage. If individual small scale schemes are to be promoted during this next phase it will be possible to try various forms of filter (eg.a sloping intake pipe which can be de-silted, passing into a chamber full of sand

through which water passes upwards and is collected off the top for domestic use. The sand should be accessible for replacement when clogged, and the amount of through-flow will not need to be enormous if it is only for drinking and washing).

Other problems still needing investigation include energy dispersion below dams and the relative merits of weirs and spillways with such variable flows. There has to be an element of trial and error where so little is known of flood flows and much can be learnt from seeing the first installations in operation. So far most problem has occurred where the apron was made smooth, so that little energy was dissipated before the water ran onto the khor bed. Scouring and undercutting were therefore bad, and the Engineer is proposing to install cusps (half well rings) to break up the flow. Gabions set at different heights and fringing a stilling basin might be an easier solution and one with less danger of blocking with driftwood. The choice of confined spillway or open weir for diversion schemes and for sand dams may also need to be re-assessed once they have come into operation.

5.4.3 Consultants inputs

During the early part of the construction, the project could have gained from opportunities to discuss problems with the Consultant. Now the project has gained much experience from the successes and failures which have been encountered, and the need for a Consultant is not quite as great. However there are still problems to be solved, as outlined above, and it would benefit the project to have a consultant to call upon as necessary.

Budgets should allow for some Consultant's time, office based, to consider problems presented by the Engineer, and to assess the effects of the designs which were proposed. One visit per year of two weeks should be allowed for the same purpose. As a separate issue, funding should be considered for a further study after about twelve months, to investigate new sites proposed by the project and to carry out a more integrated study of one or two whole catchments which show most potential and also have some

ABOVE: Sorghum residue after harvest.

BELOW: Area where conditions have become too poor for agriculture. Photos: H.C. Svads

demand for more water supplies. Consideration should also be given to involvment of the Department of Civil Engineering Khartoum University, who are working on water harvesting scheemes, and who could be involved in the future to supply relevant expertise and continuety. A regional water resource study is needed, but should not be contemplated unless the project devolves to government level, rather than NGO.

5.4.4 Liaison with government

At present the project is an NGO project, and as such suffers from some of the prejudices which sometimes attach to them. Strenuous efforts have been made at some times and to some organisations to involve them and ask their advice. At regional level, however liaison has not been good recently and this has led to some barriers being built up. The result is that the experience of the project is being lost to other organisations working in the same field, and vice versa. As an NGO , the Red Crescent does have misgivings about its capacity and capability to continue with schemes such as those so far constructed. It is more suitable that regional and local government departments, with specialists in the appropriate fields, should be more involved to help provide long-term continuity, even if there may be some short term disadvantages.

6. AGRICULTURAL RESOURCES

6.1 Introduction

The Sinkat district has marginal agricultural resources, the most important activities being pastoralism and sorghum (Sorghum vulgare) cultivation. The climate reflects this situation characterized by very low rainfall, its distribution and reliability as described in chapter 2. Sometimes the rain appears in heavy showers during short periods causing serious erosion damages on pastoral and cultivated land because there is very little vegetation left to keep the water behind.

The evaluation team experienced the situation described above when visiting the area and has looked upon the agricultural projects proposed by NORCROSS against this background in addition to oral and written reports since 1986.

6.2 Preliminary Studies

When NORCROSS decided to continue its assistance in Sinkat area from relief to development aid it must have been a handicap to base the programme on more or less its own ideas, since an overall government plan for the area does not exist. Furthermore NORCROSS experienced the data and statistics available to be scarce, old and not always reliable. Therefore it was very important that NORCROSS spend some time to collect as much information as possible from the area as guidance for its program of work. A feasibility study was done from 16.1. - 19.3. 1986.

6.2.1 Feasibility study

According to the Red Cross principles the target group for any intervention shall be "the poorest of the poor". The feasibility study, however addresses the initial program to people being in a position to participate in NORCROSS support. This project policy was to be reflected in the early stages while the intention was to include appropriate projects later for the poorest based on the experience so gained. Taking into consideration the marginal conditions for agricultural production in the project area the evaluation team supports such an idea because it is very important for NORCROSS to succeed in its activities through local people that have resources enabling them to take active part in the program. These people can later on act as good examples to the rest of the population on how agricultural projects with appropriate technology can function.

6.2.2 Project proposal

The feasibility study points out the following agricultural proposals:

- Sorghum production
- Horticulture introduction
- Forestry and nursery rehabilitation

Sorghum production has for a long time been a very important crop in Sudan, including the Sinkat district. The crop is very well adapted to the climatic and soil conditions in many parts of the country, being drought resistant by its well-branched root system that very efficiently extracts moisture from the surrounding substratum. The efficient root system makes the yield of grain relatively high on poor soils without using fertilizer. The yield will, however increase with better rain or irrigation and the application of fertilizer.

While some crop damage is due to disease, the largest losses are due to pests. The sorghum crop can sometimes be completely destroyed by pests like stem borers (Sesamia spp.) which tunnel and finally kill the stem, and locusts (Shistocerca gregaria) which eat most of the plant. The project area has experienced both pests, in 1986 the stem borer, and the locusts attacked both in 1987 and 1988 leaving the farmers behind with no grain to harvest. In chapter 6.3.1.5 further comments will be made to these problems.

The NORCROSS sorghum project proposal includes distribution of seed, demonstration plots including cropping pattern and variety testing, and extension work with the objectives to improve yields and secure a sustainable grain production. The projects are regarded as very relevant to the Sinkat district situation and should be given high priority.

Horticultural introduction

The agricultural crop production in the project area is to a large extent dominated by sorghum. Very few other kinds of crops are grown. This makes production very vulnerable in that when sorghum production fails as happened in 1986, 1987 and 1988 a food shortage will arise. In addition monoculture often makes the diet incomplete leading to malnutrition. The NORCROSS feasibility study is aware of the situation and proposes projects on vegetable production similar to what the government has introduced in Erkawit. Production is to be based on irrigation and the program includes the following components:

- Extension work with guidance, demonstrations, seed distribution, etc. to cooperatives and individuals in the Sinkat district.
- Practical work with the farmers in Erkawit including a variety of activities, too many to mention here. However, they are regarded as relevant and important to the area but very ambitious.

Forestry and nursery rehabilitation

Travelling around in the Sinkat district the impression is a landscape with little or no vegetation left. In some areas, like the hillsides in Erkawit and the wadis, however, some trees and bushes are growing. The feasibility study gives a list of names of trees growing in the area. There are different reasons for the degradation of the vegetation. Here are mentioned:

- Fuelwood including charcoal burning.
- Building materials
- Clearing land for cultivation
- Fodder production
- Drought

It has been noticed that the cutting for all these purposes mentioned has expanded, in particular the charcoal burning, despite governmental rules and regulations for the use of vegetation.

The government and local authorities are very concerned about the situation but they need support. The NORCROSS feasibility study has recommended a project on rehabilitation of the Sinkat nursery, to be able to produce 100.000 seedlings annually, which is much more than they have produced in the past. The NORCROSS project is highly supported by the evaluation team.

6.3 The Actual Situation

6.3.1 Sorghum production

6.3.1.1 Seed distribution

Since 1985 several NGO's have distributed seed of sorghum to the farmers in the Red Sea Hills province. The distribution continued in 1986 and 1987 from a plan proposed by Sinkat RC and NORCROSS. Each year a quantity of 18 tons of seed was distributed from the variety Telamoy reaching an area of approx. 7.500 feddan a year. In 1988 no sorghum seed distribution was done due to weather improvement and the fact that farmers did purchase the seed and planted without any outside support. This shows the farmers willingness, initiative, interest and responsibility in doing the sorghum production themselves when the situation improves. Some seed, however were distributed in 1988 in cooperation with the Range Management and Pasture Administration. The seed in question were Chloris, Cauchrus, Pionen and Digitoria, the latter also distributed in 1987 with good germination. A random survey done by the Range Management and Pasture Administration trying to see the effect of last years grass seed distribution impact on the primary production in affected areas has yet not been published. The evaluation team, however, stresses the need for such information since pastoralism is a crucial agricultural activity for the Beja even though the grazing vegetation has become very sparse due to the drought. Any attempt to improve the carrying capacity of the grazing land will benefit the people in Sinkat district. NORCROSS is therefore advised to continue and strengthen its assistance in this field.

6.3.1.2 Cropping patterns

The cultivation of sorghum has for a long time been done traditionally with low productivity as a result. In an attempt to improve the outcome of the production NORCROSS is engaged in extension work in the following areas:

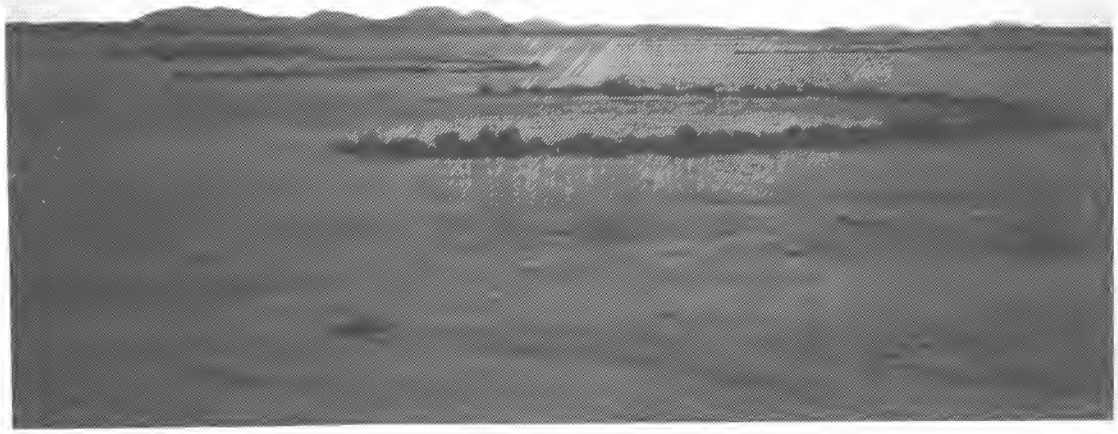
- cleaning of fields prior to planting (prevention stem borer attack)
- improve planting technique (spacing, seed per station)
- intercropping (beans, millet)
- planting time (diversity over time and area)

The evaluation team agrees these projects are very important and relevant to the actual situation in the NORCROSS area. Any improvement in one or some of the cropping patterns listed will have a positive effect on the yield of grain. This was clearly demonstrated after the stemborer attack in 1986 when NORCROSS advised all farmers to uproot and burn the remaining plants before the next planting took place. No stemborer attack has appeared since.

For the same reason we also agree to the statement in the feasibility study, paragraph 2.1.4 Hybrids, which gives low priority to introducing new hybrid varieties to the project area. However, NORCROSS should be aware of the ongoing plant breeding program in sorghum many places in the world with the objective to improve both the quantity as well as the quality of new varieties. For this reason a testing program should be introduced, but under safe guidance from NORCROSS.

6.3.1.3 Water harvesting

The sorghum production in the project area is limited to rainfed cultivation. In an attempt to minimize the risk for a crop failure due to rain shortage, NORCROSS initiated some trials in 1988 where microcatchments were implemented on slopes where sorghum used to be grown. The catchment were made by stones 15-20 meters wide and permeable to slow down the water and increase the



ABOVE: Water catchments for durra production.

BELOW: Garden plot on outskirts of Sinkat.
Various fruit trees, vegetables and methods
of cultivation. Photos: H.C. Svads

infiltration. The farmers in Marfidoy area took part and were given seed to plant in the catchment area. The project reports of a visible effect of the catchment on the vegetative growth of the sorghum plants. Unfortunately the locust attack destroyed the sorghum resulting in no measurement of grain yield. From other semi-desert areas in Africa (Mali, Niger, Chad) it has been reported that similar water catchment arrangements have improved the growing conditions for agricultural crops like sorghum.

6.3.1.4 Sorghum irrigation scheme in Beramfe

In Beramfe another type of irrigation scheme using a diversion dam is under construction. The water in the Beramfe khor is to be spread out using 0.75 meter high silt bundings. The bundings close to the diversion will be reinforced with stones. The system is designed partly with traditional spillways, partly with a system where the water spills around the wings of the bundings. As the water passes through the system, an area of 14 ha is irrigated. It is estimated that the scheme will provide sorghum grain for 15-20 families after a crop yield of 360kg per feddan. The evaluation team visited the project when it still was under construction. Therefore it is too early to judge the future of the scheme. The project is more complicated than the water harvesting project described, but the area in question is also a more difficult area due to the higher velocity of the water flow and then the need for stronger water control measures.

6.3.1.5 Sorghum irrigation expansion in Hashtribab

The diversion scheme planned at Hashtribab is estimated to provide 595 feddans of cultivable land. This will benefit 485 people, (410 local farmers, 75 from Sinkat town and Gebeit) or approx. 97 families. The scheme will thus be considerably larger than the one at Biramfe, making the development of a diversion system for irrigation purposes more complex.

Before such a system can be implemented, it is important to determine the agricultural potential of the area. A soils study

is needed to be tied in with a water availability study in order to determine what types of additional inputs might be necessary to ensure reasonably good production without pressuring the environment. Since agricultural potential can differ widely within the target area, land tenure issues must also be carefully addressed before such a large diversion scheme can be implemented.

6.3.1.6 Crop protection

The NORCROSS project has to a large extent experienced the pest problems affecting the sorghum crop. In 1986 the stem borer attack destroyed the crop by tunnelling and finally killing the stem. In 1987 and 1988 the Red Sea Hills area was invaded by swarms of desert locust. The Government Locust Control did spray in the area, but the action was far from sufficient to prevent the plants from a total disaster.

As explained in section 6.3.1.2 Cropping patterns, a preventative method of pest control is to destroy the remaining plant tissues like roots and stalks by burning. An immediate action in the case of an attack is the spraying of the plants. However, this exercise may be out of the question taking the Beja's resources under consideration. At present the only locust control measures used involve extensive resources over short periods; the fight against the locust is regarded a Government Locust Control responsibility. An early warning system has been established in Sudan. They cooperate with neighboring countries in the attempt to give advice about the development of locust attacks. To some extent the control is functioning, but not sufficient enough to prevent an attack on a specific area. Instead of being ahead of the locust situation at any one time, they often are behind resulting in little spraying effect and a crops disaster.

In a meeting with the Sinkat district plant protection officer, the evaluation team was told that from next year a branch of the Government Locust Control will be stationed in Port Sudan enabling them to reach the Red Sea Hills area much more quickly

than before. From this it can be concluded that the farmers in the Sinkat area may see sorghum crop production as less risky.

The government extension service seems to have extensive experience in crop protection methods in the area and thus represents a valuable resource to the project. The extension service has had good success using minimal chemical inputs, and is involved in a national campaign to control rodent problems. The cooperation already existing between the project's agricultural advisor and the extension service should be continued and strengthen where possible.

6.3.2 Horticulture introduction

NORCROSS has experienced a growing interest in horticultural production in the area and has started some extension programs in this field. Farmers are being trained in the cultivation of tomatoes, cucumbers, watermelon etc. at demonstration plots like the one we visited in Helayat and on the outskirts of Sinkat, the latter also includes fruit trees like guava and lemon trees. In both places NORCROSS has also introduced tree species of different kinds. The horticulture plots are irrigated regularly from water brought from wells nearby. People living close to the project are responsible for the watering.

The results so far are promising. The number of people who have received vegetable seeds and advice from NORCROSS in 1988 was 127 which must be regarded as very good. However, one should bear in mind that horticulture is a new production system to the people in Sinkat district meaning that an introduction period is needed including close attention to species and varieties, cropping patterns, plant protection, harvesting and storing methods. For the sake of interest it will be important to keep records on production results.

LEFT: Misquite tree

BELOW: Water catchments, with misquite trees planted at each apex protected from browsing by a pyramid of stones.

Photos: H.C. Svads and S. Sutton

6.3.3 Forestry and nurseries

Last years improvement in the climate which resulted in a good rainy season has had a positive impact on the trees and bushes which seem to be recovering from the previous drought. At the same time a dramatic increase in charcoal demand has put pressure on the wood resources. Since the idea of planting trees to prevent deforestation is not very widespread in the project area, the NORCROSS extension work on forestry is very important.

6.3.3.1 Forestry

The program so far has established some demonstration plots where people in the area can come and see and hear about the project. In these plots NORCROSS is testing different tree species and varieties, irrigation methods related to the stage of establishment, and physical protection methods for young trees being browsed by goats. It is important that the results of these tests are clear before introducing new trees and establishing new methods to the local farmers. However, one tree species which seems to be well adapted to the soils and climatical conditions in the area is Misquite (Prosopis chilensis). The species is drought resistant, fast growing, fixes nitrogen and can provide a good production of firewood. It was introduced by planting in Erkowit, Gebeit el Ashrab and Sinkat town 10-15 years ago. The trees show good growth.

In 1988 NORCROSS established woodlots of Misquite in six areas with approx. 400 seedlings in each. The survival percentage was 59 after two months of growth which is considered acceptable for the area. NORCROSS will continue the planting program in 1989.
The evaluation team is very much in favor of this exercise.
In addition NORCROSS has distributed tree seedlings of different kind to people who have shown interest. More than 4400 seedlings have been distributed this way. The successful introduction of fruit trees like guava and lemon will promote good relation between the project and local people leading to a broader understanding of the problems and possibilities of tree planting.

In attempting to establish Misquite, the project has introduced several methods of seedling protection. The team observed the use of brick structures, stone pyramids and branches to protect the seedlings from browsers. Fences were also used, mostly in conjunction with branches surrounding the seedlings. The stone pyramids combined with water catchments seemed particularly effective in promoting growth and deterring browsers, at least until the trees reached the top of the structure. Fencing would then be necessary to ensure their survival.

It should be noted that the construction of such structures is very labor intensive, and their success on a larger scale will be totally dependent on the willingness of the local population to divert their labor to such activities. Since forestry is a long-term investment, it is critical that the local people fully understand the need for erosion control and vegetation regeneration. Extension is therefore critical.

6.3.3.2 Nurseries

The establishment of nurseries to raise forest and fruit trees for the project area is regarded as a must. NORCROSS is supporting two nurseries in the Gebeit Boy's School and the Erkawit Girl's School with the idea of establishing tree planting as a daily activity in the schools and to produce seedlings for the project. They are also encourraged to sell the trees to their parents to promote tree-planting in the town areas. Each school has a teacher with agricultural knowledge. NORCROSS supports the nurseries with instruction and equipment the first year and will guarantee to buy the unsold seedlings. So far the people have not shown great interest in buying trees. It is suggested that more information is needed for the use of trees.

At the NORCROSS camp in Sinkat a nursery has also been established recently. In its first production 500 Misquite, 1380 Saysaban and 72 Acacia were grown.

ABOVE: Swift water flow minutes after the onset of a small rain shower.

BELOW: Gully erosion in Erkawit. Photos: S. Sutton

6.3.4 Soil erosion control

The yearly rainfall in the area is very little and one should think that the small amount will not cause soil erosion problems. But like most arid and semi-arid areas, the Sinkat district experiences massive erosion because the little rain often appears in heavy showers during a short period and there is hardly any vegetation or other hindrance left to slow down the speedy movement of water. This situation allows poor water penetration but rather heavy surface run-off after rains, leaving no possibilities for vegetation to establish.

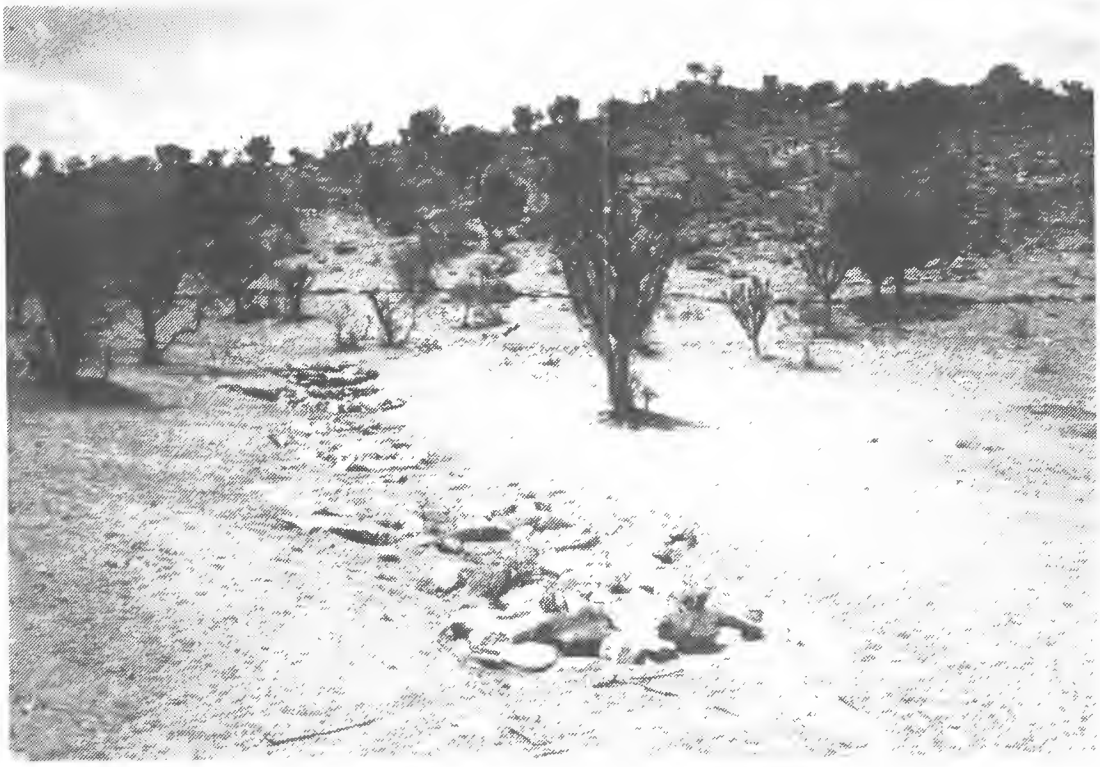
In the NORCROSS project erosion control is regarded as important. Two projects will be mentioned here, but other projects related to the water sector also have erosion control effects. The two projects in question are both in the Erkawit area where soil erosion is very severe in some places due to a longer rainy period and steep hillside topography.

6.3.4.1 Contour lines

At one place contour lines of 6500 meters were established and planted with Acacia, Saysaban and Misquite. The seedlings were protected by stone pyramids built around the plants. So far the system has not been tested properly to judge its efficiency, but it is believed that maintenance of the contours will be necessary after the rains.

6.3.4.2 Gully control

In another place the evaluation team experienced heavy damage on pasture fields from erosion gullies due to sparse vegetation cover and heavy surface run-off. In the beginning stones were filled into the gullies and covered with a soil layer. It was difficult, however, to establish new grass vegetation on top of the stones because the water penetrated easily down the soil and stony layers. To improve gully erosion control NORCROSS decided to build a number of checkdams. They are permeable but reduce the



ABOVE: Attempt to control and prevent gully erosion in Erkawit through contouring, gully-filling, and small stone check dams.

BELOW: Main Khor in Erkawit. Erosion damage to dam will have drastic consequences to agriculture in Erkawit if not repaired. Photos: H.C. Svads

speed and amount of water and work as sand/silt traps. The checkdam system has proved to work well and layers of sand and silt were observed behind the dams where the germination of grass and tree species took place.

NORCROSS intends to continue the erosion control program both with contouring and gully control projects. It should be noted that checkdams in the gullies itself do not reduce the runoff from the area unless infiltration in the ground increases. The water will always find its way out and create new gullies. Contouring and gully control should therefore be seen as a continuous solution.

6.4 Future Plans in the Agriculture Sector

The feasibility study from 1986 outlines several projects in a future plan. The evaluation team, however, stresses the importance of NORCROSS first of all concentrating its efforts on projects already initiated. Additional projects should only be initiated after considering the need for such investigations, the benefit to the target group and the capacity of NORCROSS. In the following sections, some activities that ought to be considered in coming years in addition to those already in effect are listed.

6.4.1 Carrying capacity of the land as a grazing area

Traditionally the Beja people are animal keepers using the grazing land for pasture. During the drought period of 1984-85 many animals died from starvation. Now since the climate has changed for the better and vegetation is being reestablished, the Beja can see the possibilities of improving their animal production again by restocking their herds. Observations done recently in the area, however, indicate that the livestock is increasing faster than the regrowth of vegetation. This is a serious situation and specialists in livestock and pasture management indicate ways to improve it by:

- intensive rationing of water, i.e. catchment dams, lining of reservoirs, etc.
- reseeding of deteriorated areas by use of tractors, aircraft and manually
- intensive cultivation of forage crops

The specialists are also in favor of carrying out a carrying capacity survey of the grazing areas in the region to be able to estimate how many animals one can feed without destroying the vegetation. The evaluation team very much support the proposal in the feasibility study to start a registration of the carrying capacity of the land now. The study has to be carried out over time so that any changes in climatical conditions influencing the development of vegetation is taken care of. In a study like this both national and foreign agricultural/botany students could take part under professional leadership in cooperation with range management and soil specialists.

In addition to the survey of the land carrying capacity study NORCROSS is also advised to establish demonstration plots with the objective to test grass and legume species for grazing purposes suitable under the climatical and soil conditions in the project area. The genetic plant materials to be tested should first of all be local species and varieties. It is, however, also advisable to contact international agricultural research centers to get additional seed of grass and leguminous that might be of interest to test.

6.4.2 Forestry expansion

In the feasibility study the forestry program outlines several projects which have already been implemented. In the same study six additional projects are proposed started, out of which the first two are already in operation:

- extension work and demonstration
- establishment of test plantations including different species.

The four other projects should first be taken into account from the time NORCROSS has the capacity to expand its activities. The

projects are regarded relevant but in the order of priority as listed in the feasibility study.

6.4.3 Horticultural expansion

As stated in the feasibility study the development of the cultivation of horticulture is dependent on the availability of water for irrigation. Referring to the list of vegetables presented in the study compared to what the evaluation team observed, there should be room for additional observation/-research regarding species and varieties in combination with cultivation methods. The same applies to fruit trees. A horticultural production based on irrigation throughout the year is mainly for settled areas. For the pastoralists this production will only apply in the rainy season.

6.4.4 Seed distribution

The necessity to continue the distribution of seed in the Project area seems to be less important in the future as long as the climatic conditions for agricultural production improves. In fact there was no distribution of sorghum seed in 1988. Under such circumstances support may create aid addition and undermine the economic common sense of the farmers.

6.4.5 Water harvesting

It is recommended to look into any system that may improve water harvesting and slow down the run off. The few systems we were shown like the one in Baharotay, were very good examples of how the cropping situation can change for the better by using simple methods for water catchment. It was also interesting to notice how the same farmer had succeeded in establishing the tree species Misquite along the lines dividing the plots. The evaluation team encourages NORCROSS to continue these activities in the future since the systems are both water-holding and erosion controlling. When introducing such system in an area it

will be important to make proper plans so that everybody involved will benefit from it.

6.4.6 Soil erosion control

It is proposed that the promising results obtained in erosion control in Erkawit should be extended to other areas where soil erosion is a problem. This will include more local people engaged as supervisors and workers which hopefully will have some educational effects by creating an understanding of why erosion control is essential. NORCROSS staff should assist in design and quality control. Careful siting is essential.

6.4.7 Extension and training

The project has for some time experienced the peoples need to be informed and guided in their agricultural production. This is a very positive sign and feedback to the project people involved encourage them to continue their good attitude to fulfill the objectives. In addition to the target group the Project should also address its information and knowhow to other categories of people like teachers, public health workers, district agricultural extension officers etc. It should be from these people the pastoralists should be taught about the tree value as fodder resources.

Further education and training for the project staff at all levels would also be a wise investment in the project. For the field officers this could take the form of short courses offered locally. For the more advanced staff including the agricultural advisor, further study in Africa or abroad in topics dealing with resource management and development would be highly recommended.

T E R M S O F R E F E R E N C E

Evaluation of the

NORWEGIAN RED CROSS - SUDAN RED CRESCENT SOCIETY's

integrated rural development project in
Sinkat District, Red Sea Hills, Sudan

0. ANTECEDENTS

During the drought in the Sahel region 1984 - 86 the LRCS - League of Red Cross and Red Crescent Societies - carried out an extensive relief operation. A field delegation was established in the Sinkat town aiming at supporting vulnerable groups among the Beja-tribes in the district. NORCROSS supported the relief operations financially as well as with delegates.

Reports from the operations soon brought forward the question of rehabilitation and development work among the bejas when the drought situation ended.

NORCROSS accepted the challenge and following prefeasibility studies on waterpotentials, agriculture and social anthropology made an agreement with the SCR (Sudan Red Crescent) and the LRCS to start a development programme in the Sinkat district.

The intervention was based on the Red Cross Principles and in conformity with the NORCROSS working philosophy and Plan of action as outlined by the Board of Representatives.

The SSE-Unit within the Ministry of Development Cooperation was approached for financial support of the programme.

Originally the programme was designed for a duration of 3 years with an economical frame of NOK 15 mill. of which NORCROSS funds NOK 6 mill.

April 17 1986 the programme was approved by the SSE-Unit.

1. Objectives

The overall objective of the programme, as outlined in our first application for funding in December 1985, was to: "Establish the means of subsistence for up to 250 000 beja-nomads following a prolonged periode of drought. Furthermore, prepare both the population and the environment for coping with climate changes in the future."

The idea of the programme being the development of a number of small scale projects with emphasize on:

- improved householding of water
- vegetablegardening
- planting of woodlots close to settlement
- improved livestock management
- improved general healthsituation
- give room for the continuation of a semi-nomadic way of life.

In its first stage the more practical targets would be:

- By means of engagement in the development projects, scale down the relief aid at a rate corresponding to the improved degree of self reliance. Total termination of the relief aid is foreseen in 1988.

- Support the local population in their efforts towards a more differentiated means of subsistence, and improvement of the present agricultural and pastoral practices.

- In order to allow the traditional cultural values to remain, adjust the development projects according to the priorities presented by the local population. The bejas themselves are supposed to implement the projects.

2. PROGRAMME DEVELOPMENT AND ACTUAL SITUATION

2.1 Pre-studies

Prior to the start-up of the development activities and as a means for detailed planning, several prestudies in the fields of social anthropology, hydrogeology and agriculture was carried out. The reports from the studies follows as appendixes to the T.O.R.

The conclusions from these reports made it clear that the programme area was marginal in terms of resources in any respect of the word.

Groundwaterreserves were scarce, of poor quality and depleting. The annual rainfall combined with restricted areas for cultivation reduces the possibilities for agricultural development. Complicated ownership to land, fodder and water underlines the need for careful intervention. The beja-culture shows a great flexibility, hence, our approach must reflect this.

The discussions with local authorities both governmental and tribal reveiled priorities to improved water- and foodsupplies.

The programme plans incorporated these priorities, and the decision to start implementation was taken, well aware that the humanitarian aspect counted heavily compared to the development potential.

Finally, prior to starting, an agreement with the Sudanese Red Crescent Society (SRC) and the League was signed.

Practical projectwork started, parallel to the Leagues relief operations in March 1986.

2.2 Actual Situation

Based on practical experience and in accordance with our strategy, the programme activities have been adjusted to the local needs, conditions and demands. All in agreement with the SCS and the Liague. The scaling down on search for groundwater has been replaced by schemes for surface water harvesting and storage.

Practical agricultural work has been replaced by testplots and intensified extensionwork. The project staff does not any longer ask the Bejas what they want only, but add: "that you can do yourself."

The interventions in the programme area by UNICEF (water), Universities of Khartoum and Bergen, British Red Cross Society (women) also have influenced upon our activities.

Finally, it has taken time to build up the nessessary level of confidence in order to engage all the involved parties in project discussions and participation on equal terms.

The programme runs behind schedule in some areas of implementation, but there are clear reasons and explanations for this delay. As a consequence of the same, spending of the available funds also is lower than anticipated.

Regarding the present programme activities we refer to the annual report for 1988 following as an appendix to the T.O.R.

3. THE PURPOSE OF THE EVALUATION

Since the programme is approaching what was originally scheduled the termination, it is of general interest to have an external evaluation carried out. All parties involved feel this is important.

Needless to say, the evaluation, with its observations, corrections and hopefully recommendations, will serve as a guidance on how to proceed with the programme.

From a technical, economical, sociological, humanitarian and developmental point of view it is of interest to know:

- What has been done right?
- What has been done wrong?
- What might have been done differently?
- What impact the programme has had?
- How has the programme been received in the Sudan, nationally and locally?
- How has the programme involved and influenced upon the target group
- To what extent has the objectives been fulfilled?
- To what extent are funds spent justified?
- Where and how to go further?

Or in short: Regarded as a development programme, what are the effects registered by all parties concerned - and to which extent does the programme relate to the overall strategies for development?

4. ISSUES OF SPECIAL INTEREST

The topics mentioned below are to be regarded as indications. The team shall feel free to extend or diminish the list. Furthermore, the team will set their own priorities, all in relation to the economic frame and the time set out for the evaluation.

4.1 Strategy

Within the context of the Red Cross Principles, the concept "Prevention better than cure" and the official Norwegian policy on development cooperation, has the strategy of the programme been appropriate?

Within the same context has the programme led to any unforeseen consequences, positive or negative?

4.2 Approach

What may be said about the way in which NORCROSS has developed the programme from an idea to actual implementation of concrete projects.

4.3 Objectives and results

In view of the objectives outlined do the actual projects meet real demands in the area?

Are the objectives relevant and realistic? Do the project activities lead to expected results?

What limitations and difficulties have the implementation of the project been subject to?

4.4 Activities

What may be said about the suitability of the different projectactivities generally and specially? Are they relevant and/or adequate in relation to expectations, the objectives outlined and defined plans?

What are the relation between the outputs and the inputs in the different project activities, the timeaspect taken into consideration?

Whenever applicable what may be said about the "cost - benefit" ratio in the different projects?

4.5 Organization and administration

The programme is based on a signed agreement between the SRC - NORCROSS - LRSC. The SRC formally representing the programme towards the Sudanese authorities. The roles and tasks of the

different parties are outlined in the agreement.

At NORCROSS H.Q. level the programme is administrated by a project coordinator, who also have the same role in other programmes.

In the field the programme is administrated and implemented by a staff of three:

- Coordinator - administration, economy, expatriate
- Technical Supervisor - implementation and extension-expatriate
- Agricultural Supervisor - implementation and extension-local

In addition several locals are employed for different tasks, jobs and duties. The SRC and LRCS under different kinds of services and advice. What may be said about the organization as such?

What may be said about the performance of the partners?

4.6 Sustainability

Talking about sustainable development in a marginal area like the Sinkat district, where sometimes the question is: "How to survive", may seem contradictory. However, some of the project activities are aimed at improving the level of sustainability. Fortunately, some of the projects may, if found feasible, be implemented (repeated) in the area - or elsewhere.

Finally, some of the project activities aim at building competence and skills, among the participants.

The question remains whether the bejas through the programme, will cope better if, or when a new drought strikes. Has it added to their "flexibility"?

Or will some have come in a position from where they may have a real chance of success if they wanted to start another way of living elsewhere in the Sudan?

4.7 Involvement of targetgroups

Although the number of expatriates in the programme is restricted, quite a few of the skilled employees are persons coming from outside the beja-tribe. To some extent it seems fair to say that very few bejas available possessed the skills acquired to make the project operational. Fortunately, there are significant exceptions.

In order to train beja tribesmen a system of trainees or apprentices has been adopted.

In some projects the bejas themselves are the main actors.

The support to the development of the SRC is one of the objectives of the programme.

Who among the target groups are benefitting from the programme? What roles do they play in the activities? What are the impacts of the programme on the population in the area looking at gender, age and class where possible?

4.8 Nationalisation

As the programme in its implementation of some of the projects is behind the original timeschedule, the question of transferring authority and responsibility to the Sudanese, so far has been given little attention. In some fields however, such transfer may be appropriate.

Indications on which fields seem most suitable for handing over, and how such transfer should be successfully implemented, are of great interest and value.

5. METHODS OF WORK

Within the frames of the evaluation, and related to the professional capacities of the members, the team shall be free to choose their method of work.

6. THE EVALUATION TEAM

Selected for this evaluation are:

Mr. Henning Svads, Msc. agriculture, Norwegian, Director NORAGRIC. Teamleader.

Dr. Sally Sutton, Hydrogeologist, Consultant. British.

Mr. Abdul Ghaffar M. Ahmed, socio-economist, Sudanese.

Mrs. Ingrid L.P. Nyborg, (Paid by NORAGRIC). Observer, assistant. US-citizen.

7. TIME SCHEDULE

March	- Introduction meetings - Preparations
April 10 - 11	- Preparation and discussion Oslo
April 12 - 25	- Field studies in the Sudan
May 26th	- Draft report
June 15th	- Final report

8. REPORTS

Prior to the departure from the Sudan, the team is expected to present a brief summary of its findings, and present their main conclusions and recommendations in a meeting where representatives from the parties invlolved are present i.e. SRC, LRCS, NORCROSS and NORAD.

The verbal and written reporting shall be in English. A summary of the final report will be translated into Arabic.

The final report shall contain the common views of the team. The team members, however, are free to express their specific views in their own name. Furthermore, if found suitable, technical reports elaborating on specific issues may be presented as appendixes to the final report. The appendixes will then be included in the Table of Contents.

9. ECONOMY

The budget figure approved by the SSE-Unit of DUH for the evaluation is NOK 250.000,-. The teamleader shall discuss the details of the budget with NORCROSS, H.Q.-staff prior to the field studies.

Oslo, 17.03.89

Frithjof Frederiksen
Head of International Department

Appendix 2

SOCIAL ORGANIZATION OF THE PROJECT

1 SOME ELEMENTS OF SOCIAL ORGANIZATION OF THE PROJECT TARGET GROUP

The Hadandawa, like the rest of Beja have a highly developed sense of territory, with a great cultural and emotional attachment to land. All land is divided up between lineages, which are grouped into sections. There is not, normally, a strict control over land as an economic resource i.e. those who do not belong to a certain division owning the land can use the area for grazing provided that they ask the permission of lineage members who own it when they meet them. Digging of wells in dry riverbeds (khors) that traverse the land is the right of the members of the lineage that own the particular section of the territory. No outsider is allowed to have such a right. However, members from other lineages may be given permission to cultivate a plot of land provided that they acknowledge the right of the owners through giving them a certain proportion of the harvest known as "godab:.

In order to keep strict supervision over their land the Hadandawa lineages scatter their dwellings all over their territory so that no outsider can come and settle permanently in the area without being noticed. Such an arrangement leads to the spread of tents all over the territory in small numbers. Even those kin who put their tents in a neighbourhood seem to maintain a distance between each other. The explanation for such a physical layout of tents is mainly but not only related to the above land tenure issue. It is also related to the fact that each tent which is inhabited by a family unit makes an effort, in such a marginal area, to keep a distance from other units in order to allow a chance for its small animals to graze. In addition to this certain aspects of the social values of the Hadandawa reinforces this spread of tents and strengthens the attitude of being a

part. One of these aspects is the social value of avoidance between a man and his in-laws, especially a bridegroom and his mother-in-law. A Hadandawa man does his best to avoid coming in contact with his mother-in-law. Some claim that they have never seen their mothers-in-law after they got married. In order for a man to visit his wife at night while she is still in the settlement of his in-laws the wife's tent is put to the side maintaining a good distance from those of her mother and other relatives. This distance decreases when a man moves with his wife to his parents settlement. Yet even there, the environmental setting (grass cover) and the number of animals that each family owns decides the distance between the tent of the new comer and that of his parents. The distance between tents varies from a few hundred meters to a few miles. It is very common in most of the Hadandawa land to have one's next door neighbour, who may at the same time be a father or a married brother, two miles away.

This residential aspect has its impact on the social relations of production. The elementary family, which is the basic production and consumption unit among the Hadandawa seems all the time to be operating on its own. Very limited cooperation on an extended family or lineage bases in daily activities can be observed. Women's cooperation in the Hadandawa society, which is an extremely male dominated one, does not seem to exist. Women have virtually no conspicuous role in public life, though their role in family decisions is not easily seen by outsiders. The extent of their involvement in productive activities is generally low but varies across the province. In the project area women rarely do agricultural work, herd only sheep and goats, and are excluded by custom from milking. In some areas they carry (but very rarely draw) water, and do not generally collect fire wood. They are responsible for maintaining the household and preparing food. Due to the highly held values of honour and shame women do not wander far from their tents and hence find themselves within the boundaries of their domestic domain.

The male activities are herding in general and cultivation during the rainy season. Digging wells is one of their main

occupation during the dry season. All these activities draw men away from the family domestic domain and bring them to a public domain which is male dominated since cultivated land, grazing areas and riverbeds where wells can be dug are all lineage property and are found close to each other. It is here in this public domain that we can note some collectivity of action among the Hadandawa. Digging a well is an activity that requires hard laborious work that no one person or even two can do. Others have to join and help; after all they always come later when the well is finished to make use of it even though it may not be in their lineage territory. Also during agricultural activities a man might call upon close neighbours and relatives to help with certain tasks.

The Hadandawa used to organize two types of collective labour known as "koban" and "tawiya". In both cases a person invites relevant people to join in the required activity while providing them with a drink or some food. The "koban" involves people from a wider area who may not be lineage members and the task involved may be for example helping to dig a well. The "Tawiya" is a system of organizing collective activities among close relatives in the neighbourhood. Both systems have lost their frequency in recent years since nobody seems to be able to provide the customary hospitality expected due to lack of resources, nor embark on an activity that require more than the family labour. This is not to say that the element of collectivity has disappeared completely. Men still call upon their relatives or neighbours for help, especially in digging wells, but are not in a position to offer much by way of hospitality.

The Hadandawa were administratively part of the Beja native administration system. On the local community level, (i.e. villages or pastoralist camps) the Hadandawa politics is based on equality among male household heads, striving for consensus and the influence of shaykhs. Beyond this level it also connects with, and is affected by larger tribal structures, which have been reinforced by colonial rule, the politics of the local government system that was in place (1971-85) and the national

politics. When the native administration system was abolished during the early 1970s the Hadandawa, like other groups in the region and the country as a whole were affected. However, the traditional leadership did not loose its legitamacy during this period and continued to run the affairs of local communities without seeking the consent of the government authority. Realizing that it is almost impossible for it to reach the Hadandawa the government reinstated the Hadandawa Nazir as part of a move to restablish native administration among rural populations in the country as a whole.

In settling local issues on a camp or a village level a council (mejlis) is normally called to discuss the matter. Any male may attend, but generally only household heads of the land-owning lineage, or parties to the dispute can speak. The only exception here is the attendance of others who may have relevant information, or outsiders famed for their mediating skills or religious knowledge. Each lineage has its shaykh who is first among equals in such a meeting and there may be a few influential men that community members refer to as "mandub" and may be granted a status very close to that of the shaykh. Shaykhship, and influence in general may be acquired by birth, but is gained also by hospitality and mastery of traditional political oratory. Literacy and the holding of minor government posts such as a paramedical position may now give younger men the chance of influence at the village level.

Above the shaykhs comes the Omdas and on the top of the hierarchy of this political structure is the Nazir.

2 THE FLEXIBILITY OF THE ADAPTATION SYSTEM OF THE TARGET POPULATION

Given the fact that the Sinkat district is a marginal area that does not allow for many activities other than pastoralism and limited cultivation in some strip of lands which are watered by flush flood during the rainy season, living in these areas has

meant that the Hadandawa have acquired a great deal of knowledge of their environment. They have over hundreds of years been utilizing this indigenous technical and environmental knowledge to make a desired type of life, by their own standard, and to ensure survival in bad times. This means that they have known how to make their values, traditions and systems of organization of social relation, that may seem to an outsider to be very rigid indeed, flexible enough to allow for adjustment as needed. For example the land tenure system defines exactly where each lineage has its territory and gives the lineage a right of control on this land. Yet it is a system flexible enough to say that people are allowed to utilize this asset as long as they ask permission from any member of the owning lineage whom they meet while trespassing and grazing their animals. They can even use it for long periods (i.e. cultivation) as long as they recognize the ownership of the lineage concerned and offer a symbolic rent "godab" which may or may not be taken by the owners. When it comes to trees on this land it is only the actual owners who are allowed to cut these trees for use or sale as firewood or made into charcoal. Yet here again for certain inferior types of trees such as "ushar" and "tundob" they can be used by even non-territory owners.

Wells can only be dug by the land's original owners who as already indicated above may ask for the help of others in the process of digging. However, when it comes to making use of the well (i.e. watering humans or animals) everybody in the neighbourhood or passing through is allowed to use such a well.

With reference to residence it is noted that due to certain customs and values a reasonable distance is maintained between tents of different kin. However, when starting a seasonal migration in search of grazing grounds these distances may be considerably shortened for some periods due to the availability of grazing. When the Hadandawa were forced to leave their lineage territorial lands during the last drought (1984/85) and join the small urban centres or come to settle by the Port Sudan-Khartoum Highway this custom of residential arrangement

was not observed. However, once families went back to their territorial areas the custom was immediately revived.

The daily activities of both males and females, grown-ups and children, in the Hadandawa local communities are well defined. The major activities for men, on their lineage territory, are herding and cultivation during the rainy season. Wood cutting for making charcoal is a well known activity in the past few decades. However, when asked the Hadandawa would say that it is an activity that only the very poor would engaged themselves in. Those who own animals would look down upon such an activity. Yet, when drought circumstance led many people to loose their animals, charcoal making became the major activity for income generation in the area and the surplus gains from it, whenever they exist, are used in restocking.

Througout their history the Hadandawa have used a system of flexible migration of different kind to release the pressure on their environment. The seasonal migration which is a major feature of their pastoral system depended in its length on the verbal information passed by various individuals within or passing through different settlements. This migration in the case of the Hadandawa of the Sinkat District can be either south towards the Gash Delta or south-east towards Tokar Delta during the dry season. This might be followed by a migration east or north-east towards the coast by some groups during the winter time. Groups can change their direction according to the available information at a given time and no fixed routes are known for each group nor a permanent choice between the different directions is made.

Labour migration to small urban centres and to Port Sudan started to become a major activity since 1931 when the Beja, in general, were recruited to replace the expelled Yemeni stevedores. Many young men leave their lineage territorial lands after the cultivation season and go to Port Sudan. They leave their wives, children and animals with their close kin while

they are away. Though such a migration starts as temporary and seasonal in some cases it may turn into a permanent one.

Migration to schemes such as Tokar and Gash are part of the seasonal migration of the Hadandawa of the Sinkat District. Settlement on schemes such as Gash was only undertaken by the inhabitant of the southern Hadandawa land since 1920. Some members of these same groups had, in the early 1970s, accepted the offer to go to the Suki and the New Helfa schemes further south to take tenancies there.

The 1984/85 drought allowed adaptation of a new form of migration from the drought stricken areas to small urban centres and places along the Port Sudan-Khartoum Highway. In this case families migrated leaving their few surviving animals with kin who stayed behind. It has been emphasised by a number of informants during the field trip, that some of those who moved to the small urban centres or along the highway have given the small number of animals left to them to some young men of their relatives who drove these animals outside the drought stricken region. They moved south with these animals to more hospitable areas such as New Halfa schemes, an area which seems traditionally to have been a back-up to the Hadandawa eco-system. This in a way may explain the sudden increase of animal population in the Sinkat District even when taking into consideration the restocking strategy undertaken by some NGOs working in the area.

The above examples point to the fact that the Hadandawa are economically highly adaptable and have tried to survive in a harsh environment through utilizing various subsistance means. They have systems of organization of social relations, values customs and an emotional attachment to land which makes the observer at first think of their culture as very rigid in its attitude towards change. However, a close investigation of the reaction of the various elements of this culture to change shows a marked degree of flexibility. It is the understanding of how this flexibility may come about that can help in bringing development and change to the so far neglected area.

3 DISASTER AND RECOVERY

3.1 Famine in the Beja History

Neither famine nor famine relief are new features in the Hadandawa history. The available literature from the past hundred years or so shows that it is possible to trace periods of famine in the whole Beja territory. It is not surprising since the Beja live in a physically marginal environment with very low rainfall (50 - 250 mm north-south). Famines and bad years were reported by historians and British colonial administration but the famine drama in terms of human and livestock losses and the Beja ways of coping with famine is not reported in detail.

Two prolonged periods of famine where the Beja survival was at stake are to be noted (1890-94 and 1947-49). These periods have been preceded by decades of insecurity (wars), consecutive rainfall failures, crop failure and low livestock prices. The same factors seem to underlay the recent famine (1984) except for the fact that the insecurity or war element is not physically there. But the war in the neighbouring territory must have had its impact by putting pressure on the Beja ecosystem.

There were some references to bad years following the famine of 1894 mainly during the 1920s and 1930s. These bad years were caused by poor rains, crop failure and camel disease outbreaks and their serious impact was on Beja of the north rather than those of the south i.e. the Hadandawa. In 1928 hundred of tons of sorghum were distributed as famine relief to mine workers and others in Gebeit mine area.

Though some other bad years were reported (1936, 1939) the second major period of famine reported was 1947-49. According to British colonial administrators a decade of poor rainfall, poor animal health, low sorghum yields, sharp rise in grain prices and low livestock prices characterised the 1947- 49 famine. The impact of this famine was widespread and the Hadandawa were

greatly affected. During the period of this famine it is estimated that half the camels and two third of all other animals in the area died. Human life suffered due to lack of milk. This necessitated some famine relief work to save lives and over 3000 tons of grain were distributed.

Due to the drought situation in their traditional grazing area during this period the Hadandawa's and other herds had concentrated around the Gash and Tokar delta schemes. Trespassing over cultivated fields became a major source of conflict between pastoralists and cultivators in both schemes and animal theft become very common. The period 1947- 49 was widely reported as a crisis period; however it is not known how many human or animals died from starvation.

The condition of the area during the early post- independence period remains obsecure since no data is available. Local authorities reported serious famine conditions among the Beja in the late 1960s and early 1970s. As many as 20000 persons moved from the Hills to Port-Sudan. The Rural Council has concerned itself with the distribution of food supplies in the region since 1968. The local authority has been engaged in distributing food and medicine for about five years. In the summer of 1973 over 5000 tons of grain costing about LS.10000 were distributed in the northern part of the region. In the financial year 1972-73 the provincial authority raised over LS.70 000 to buy extra grain in the region.

The colonial and post-independence planners thought the only permanent solution to the Beja pastoral system and economic difficulties was to move most of them to the more productive, uninhabited rain belt areas such as south Gedaref and Gash and to some extent Tokar delta. Pastoralist were perceived as difficult to administer and the best way of reaching them (mainly to collect taxes) was through their tribal leaders and tribal consensus rule. The government had plans to support the Beja in four areas. These were: continued relief assistance to badly hit areas; pasture improvement by damming khors in selected

areas; introducing alternative means of subsistance such as fisheries and mining; and finally encouraging Beja migration to government sponsored schemes elsewhere. Needless to say the relief effort has saved many Beja lives but the fisheries project were unpalatable to the pastoral Beja. The pasture improvement projects were hard to realize. They were imposed on them by planners whose main concern was nomad settlement and seemed unaware of the positive Beja environmental perceptions and needs. Many of the Beja who were integrated to government schemes saw some reinvestment of farm proceeds on livestock as reliable means of subsistance.

Like the other serious famines before, the recent one was a result of a series of bad years with a complete failure of summer rains in 1984. It was at its height just prior to its discovery by Western agencies in autumn 1984. It was estimated to have affected approximately 350 000 people. After the failure of the rains the Hadandawa were affected by the death of livestock, the failure of harvests, a steep rise in prices of grain elsewhere in the Sudan and a disasterous fall in animal prices. As a result some of them moved to squatter camps on the Khartoum-Port-Sudan Highway and around Sinkat and other small urban centres in the area. Malnutrition rates and levels in all the camps were very high and it was clear that camp dwellers were only a fraction of the famine victims still in their communities in the hills. International agencies started relief operations and delegates of LRCS were stationed in Sinkat among other places. In February 1985 the World Food Programme started distributing a general ration to between 300 and 400 rural delivery points every month and later every 45 days. It is this major concerted effort together with the Hadandawa, and other Beja people, historical experience and ability to devise strategies for survival in their marginal environment that made them pass the critical point and start a process of recovery. The climatic situation, which seems to come in cycles, have started to improve.

Appendix 3

MEASUREMENTS TAKEN DURING EVALUATION VISIT, April 17-21, 1989

Hashteribab	Well downstream of dam 2.25 m to water TD 8.6 m After first rainfall of the season
Aqaba sand dam	1.65 m to water from well rim, TD 4.85 m Well water level 60 cm above that in dam pool
Ayshaf (unmodified, downstream) well.	6.0 m to water, from log ca. 1.5 m BGL. TD 6.4 m EC 317 microSiemens
Helayat	Rain gauge 10 cm of water in 22 cm dia cylinder, 5" gauge Main (downstream) well (013?) 12.75 m to water TD 15.60 m EC 880 microSiemens
Biramfe	UNICEF well 3.75 m to water EC 617 microSiemens
Biramfe	New well, main wadi 1.25 m to water from top of 5th ring Well sanding up
Erkawit	Well 114 (Between two Palestinian wells 10.2 m to water TD 15.20 m EC 1280 microSiemens
	Well 108? Right hand trib, tomato and pomegranate garden (.0 m to water EC 1620 microSiemens
	Project well, Harresab 17.4 m to water TD 17.8 m EC 1778 microSiemens
Khor O'Neill/ Halgeit	Scoophole 1 km upstream of sand dam, Halgeit, in main Khor O'Neill 0.5 m to water EC 1678 microSiemens
	Sand dam Halgeit, well 7.2 m to water TD 8.40 m EC 1678 microSiemens. Little rain recently, but undercutting of apron from last year's rains
	Scoophole 500 m downstream in Khor O'Neill 1.8 m to water EC 1717 microSiemens
	Scoophole 1.1 km downstream from confluence in Khor O'Neill <0.5 m to water, EC 2060-2550 in pools
	At Irish crossing of road in main Erkawit khor, water flowing at surface Flowing water EC 6010 microSiemens Ponded water by road embankment EC 4500 microSiemens.

Comments. All measurements with Aqualytic conductivity meter, with automatic temperature compensation. Measurements done in the field.

Appendix 4

TRAVEL REPORT

Evaluation of the NORWEGIAN RED CROSS -SUDAN RED CRESCENT SOCIETY'S Integrated Rural Development Project (IRDP)

SINKAT DISTRICT, RED SEA HILL PROVINCE, SUDAN

12 - 25 APRIL, 1989

Team Members: Henning Svads, Agriculturalist, Team Leader
Dr. Sally Sutton, Hydro-geologist
Dr. Abdel Ghaffar M.Ahmed, Social Anthropologist
Ingrid Nyborg, Rural Development, Observer

Prior to departure from Oslo, meetings were held with Bjørn Stang, NORCROSS, to brief the team on the project. Project documents were also made available.

Wed 12/4 Arrive Khartoum (evening)

Thu 13/4 Meetings:

- Dan Prewitt, Director, League of the Red Cross/Red Crescent Societies
- Arne Dahlfelt, Area Representative, NORAD/SUDAN

Evening:

- Team meeting discussing terms of reference and distribution of tasks.

Fre 14/4 Sabbath

Sat 15/4 Meetings:

- Ibrahim Mohamed Osman, Secretary General, Sudanese Red Crescent/ Khartoum
- Dr. Mamoun Daoud El Khalifa, Director, Institute of Environmental Studies
- Department of Geography, University of Khartoum
- Department of Anthropology, University of Khartoum. Students met: Ingunn, Viebekke...

Sun 16/4 Travel permits for Sinkat received 13:00.
Departed Khartoum by car 13:45
Arrived Kassala 00:45 (17/4)

Mon 17/4 Departed Kassala 7:45
Arrived Sinkat 13:45
Drove around town area looking at wells and general layout.

Tue 18/4 Abdel Ghaffar and Svads to Port Sudan.

Meetings:

- Mohammed Bedawi, Agricultural Supervisor (recovering from a back injury in Port Sudan)

- Mohammed Ahmed Ohassen, Provincial Director, Sudanese Red Crescent Society, Red Sea Province

Sutton and Nyborg to Sinkat.

Meetings:

- El Bagir Adlan, Sinkat Officer, Rural Water Corporation

- Amna Osman, Project Leader
Hashim Saleh, Research Officer
Sudanese Red Crescent Women's Programme, Red Sea Hills

Field Visits:

* Sinkat Girls School, Plant a Tree Programme
* Microcatchments for durra cultivation (11101)
* Mesquite trees, no protection (11202 - Forestry Other)
* Mesquite trees protected in stone pyramids
* Mequite trees, fenced (very small area)
* Hashtribab; infiltration trenches, drove along khor, examined checkdam. Rained a bit.

Wed 19/4 Field visits by entire team.

* Demonstration Fields, Forestry (11201)
* Hashtribab, checkdam and well (10102)

* Agaba/Wadal Testdam (10103)
* Well Rehabilitation (10300) - Hilayet, 2 wells, one rehabilitated, one left as it was
* Horticulture Extension (11104) - Hilayet Center, Boy's School w/garden. Previously Dept. of Agriculture site.
* Government Hafir in middle of Khor, put there without consulting local farmers
* Biramfe (10101):
  Charcoal burning of dead tree
  Well rehabilitation in Biramfe Main Khor
  Biramfe catchments
  Checkdam (10201)
  Omda and some community representatives

On way back to Sinkat we met with rain, hail and flooding of the road and khors. The erosion was tremendous.

Evening:

- Meeting at NORCROSS with team and nine members of the Sudanese Red Crescent/ Sinkat Branch.

Thu 20/4 Abdel Ghaffar and Sutton to Port Sudan for meetings.

Svads and Nyborg in Sinkat area.

Meetings:

- Horticulture Department; Ali Bakheid, Plant Protection Officer
- Mohamed Bedawi, Agricultural Supervisor, NORCROSS project
- District Commissioner, Sinkat
- District Health Inspector
- Hashim Saleh, Research Officer, Sudanese Red Crescent Women's Programme, Red Sea Hills.
- Saeed Awadalla, Assistant Project Officer, JNSP, Port Sudan

- Abdul Rahman Sadiq, Director NRWC, Port Sudan

- Said Dablub, Director, Soil Conservation, Port Sudan

- Mohamed Ahmed Ohassen, Provincial Director, Sudanese Red Crescent Society

Field Visits:

* Photos of NORCROSS compound and nursery
* Sinkat Girls School, Plant a Tree Programme
* Sinkat Boy's School, Garden
* Sinkat Boy's School 2 with bricks surrounding seedlings
* Mesquite Irrigation Test Plot (11201)
* Baharothey (not a direct project activity), innovative farmer with hafir

Fri 21/4 Field visit by entire team to Erkowit.

* Department of Agriculture Gardens/Plots
* Contourlines Erkowit (10200) planted with Mesquite - behind schools
* Gully Control, Phase I (see ealier reports), checkdams, contouring, and gully filling along the British checkdam system.
* Gully Control, Phase II (10200), extreme erosion, checkdams
* Well rehabilitation, small well next to tree-fenced garden of Mohammed Bedawi
* Halgiet Dam (10104), sub-surface dam
* meeting with school teachers of girls' & boys' schools

Evening meetings:

- Sutton with Sanders

- Svads with Nyborg

- Abdel Ghaffar with various local officials & member of the Constituent Assembly for the area, Ibrahim Issa

Sat 22/4 Departed Port Sudan 8:30 by charter flight.

Arrived Khartoum 10:45.

Meetings:

- Team with Roy Sanders and Bjørn Stang at NORAD to discuss organization.
- Short team meeting to discuss Sunday's presentation

Sun 23/4 Meetings:

- Team meeting for presentation preparation
- Presentation of preliminary observations in meeting held at NORAD. Those present:
  * Team
  * Roy Sanders, Technical Supervisor, NORCROSS project.
  * Arne Dahlfelt, Country Representative, NORAD
  * Dan Prewitt, Director, League of the Red Cross/ Red Crescent Societies
  * Ibrahim Mohamed Osman, Secretary General, Sudanese Red Crescent/ Khartoum
- Svads with Nyborg

Mon 24/4 Meetings:

- Dr. El Hag El Tayeb, Commissioner for Relief and Rehabilitation
- Fadlalla Elkhedir Elsayem, Dep. Director, Department of Meteorology
- Muatasim Khalil, Head of Rainfall Section, Department of Meteorology
- Team meeting to discuss format of final report.

Tue 25/4 Departed Khartoum 7:30
Arrived Oslo 21:20

In addition, meetings were held in Norway with former project coordinators Tore Svenning and Olav Løberg, as well as with Stein W. Bie, formerly of NORCROSS.

Appendix 5

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