A research on the possibilities to improve the existing situation and to guide the future development of Gedaref town

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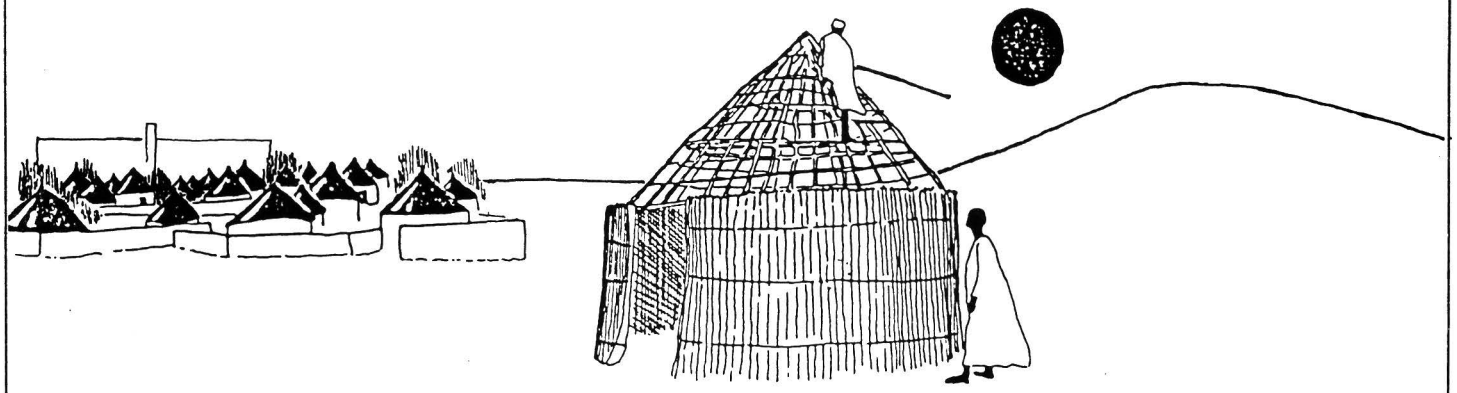
GEDAREF PLANNING STUDIES



part one survey of the town

University of Technology Eindhoven
The Netherlands

GEDAREF PLANNING STUDIES

part one survey of the town

A RESEARCH ON THE POSSIBILITIES TO IMPROVE THE EXISTING SITUATION AND TO GUIDE THE FUTURE DEVELOPMENT OF GEDAREF TOWN.

LUC VROLIJKS

EELCO HOOFTMAN

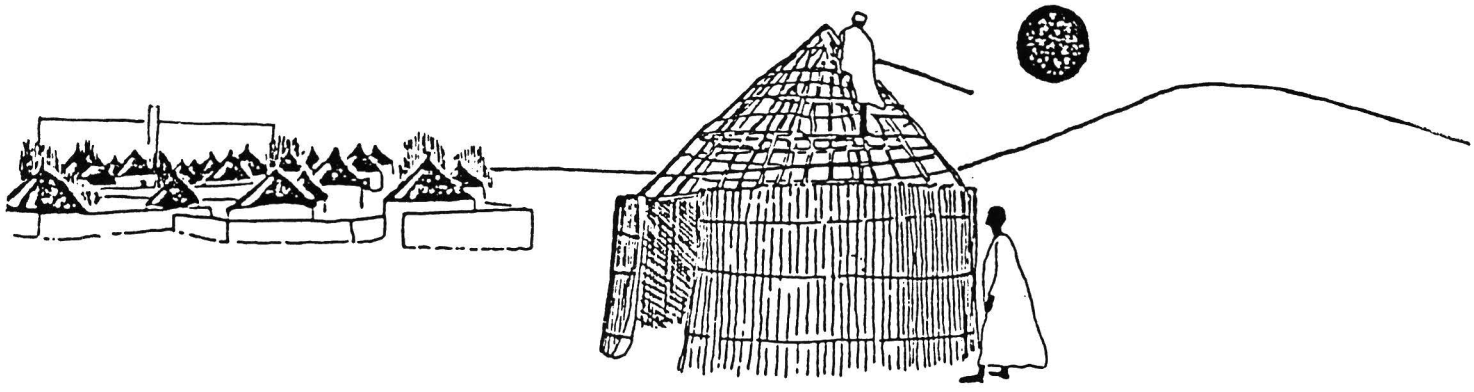
PETER TRAGO

WITH CONTRIBUTIONS OF

HANS FRANSEN

MAARTEN KOOL

Eindhoven, the Netherlands, July 1986



DUTCH UNIVERSITY TEAM '85/'86

LUC VROLIJKS

EELCO HOOFTMAN

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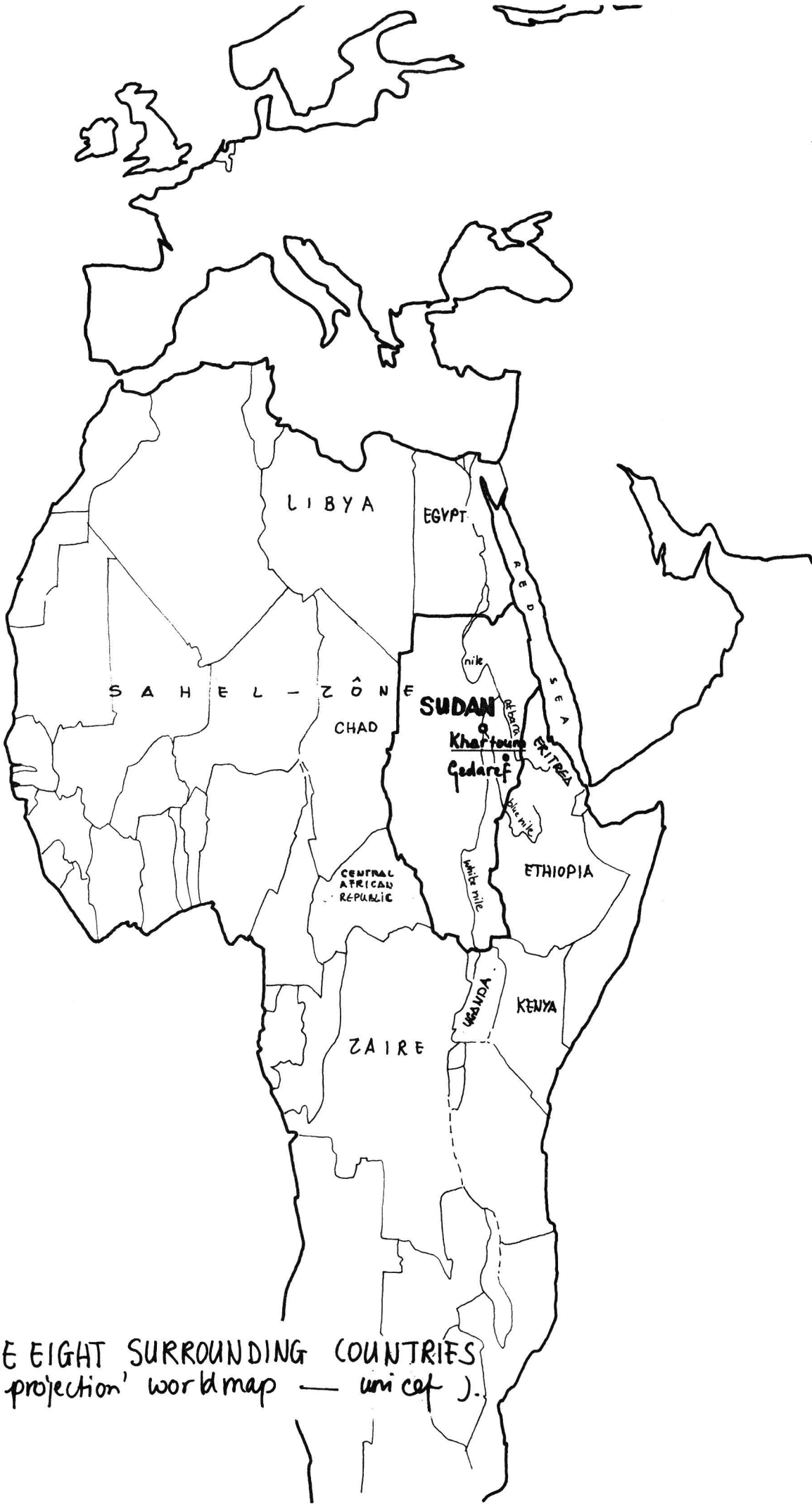

SUDAN WITH THE EIGHT SURROUNDING COUNTRIES
(from a 'peters-projection' worldmap — unicef).

GEDAREF neighbourhoods of Gedaref

Dutch University Team 1985

CONTENT

PART 1

PREFACE

This report forms, together with part two, the result of a three month research in Gedaref, the Sudan. The research was carried out during the period September to December 1985. For this report part I, information is used that was gathered by the six team members. Their individual findings form part II of this study: Sector research.
The aim of this report (part I) is to present an analysis of Gedaref in which all studied aspects are integrated and to present recommendations which are concluded from this analysis. The report is focused on an analysis of the existing situation, rather than on research in future tendencies.
Due to the limited time and manpower not all subjects which are important for the development of Gedaref were topic of research. We hope that the coming student teams will be able to fill these gaps. In particular we herby think of research on economic aspects, social aspects, the regional context and the planning of new extensions.

During our stay many people in the Sudan have welcomed us with great hospitality. Their assistance helped us to find the information needed and through their hospitality we learned a lot about life in the Sudan and Gedaref in particular. Authorities have supported us in many ways and guided us through the unknown fields of governmental organisation. In particular we owe thanks to:
Mr. Ereibi, Mr. Osman and Mr. Baroudi from the Gedaref Town Council, who supported and guided our research. Also many practical matters could be arranged thanks to them,
Mr. El Karim, Mr. Muktar, Mr. Beshir and Mrs. Awatif from the Gedaref Planning Office, who have given us the opportunity to get to know Gedaref and to discuss with them problems of the town and development possibilities.
Furthermore we would like to thank,
Mr. Laz and Mr. Shingria from the Ministry of Housing resp. Kassala and Khartoum,
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Mr. Mubarak from the National Electricity Coorporation (Gedaref Department),
Mr. Kalefulla and Mr. Ibrahim from the Gedaref National Water Coorperation,
Mr. Moffit and Mr. Grant from James M. Montgomery, Consultance Engineers,

Mrs. Vihe Feixas from UNHCR, F.O. Gedaref,
Mr. Hettinga from KADA, Kassala and
Mr. EL Din and Mr. Mubarak from the University of Khartoum.
Lectures from several Dutch Universities helped us in the project. We mention here,
Mr. P. Beekman (projectleader, T.U. Eindhoven), Mr. B. Janssen (T.U. Eindhoven), Mrs. I. Ducchart (U.A. Wageningen), Mr. J. Post (U. of Amsterdam) and Mr. K. van Zwieten (T.U. Delft)

Hopefully, this document can contribute to the development of Gedaref and the planning of this development by the local authorities.

Eelco Hooftman
Peter Trago
Luc Vrolijks

Teammembers:
Eelco hooftman, U.A. Wageningen
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Maarten Kool, U.of Amsterdam
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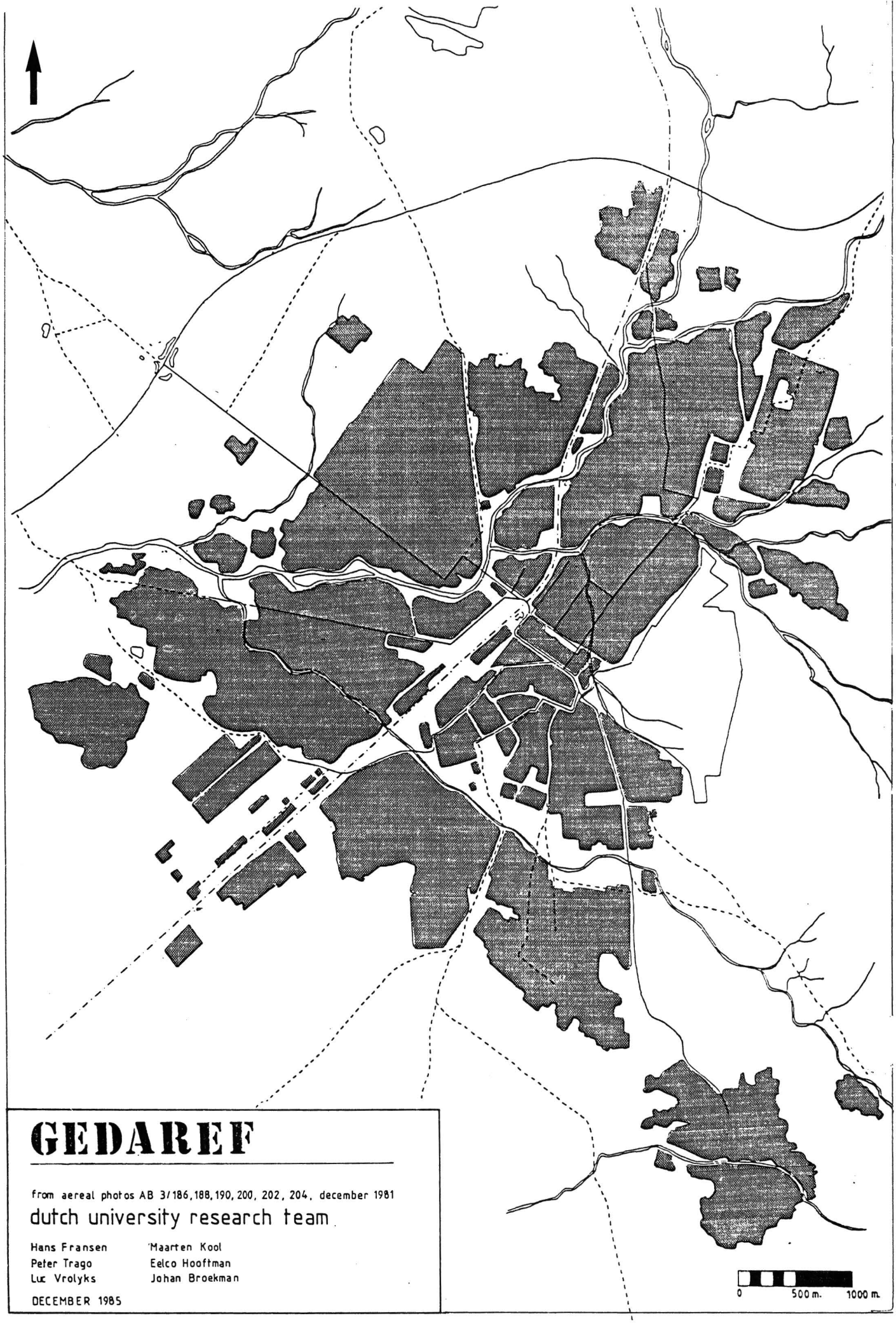
Eindhoven, the Netherlands, July 1986.


GEDAREF
from aereal photos AB 3/186,188,190,200, 202, 204, december 1981
dutch university research team
Hans Fransen
Peter Trago
Luc Vrolyks
Maarten Kool
Eelco Hooftman
Johan Broekman
DECEMBER 1985
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500 m.
1000 m.

Chapter 1: INTRODUCTION

This report is the result of a study carried out by six Dutch students in Gedaref (Sudan) during the period September-December 1985. The task of the group was to carry out studies that could be used for an urban development plan and project proposals for Gedaref. The report consists of two parts: planning studies and sector research, each of which is concluded with a set of recommendations and project proposals. The aim of this report is to provide a tool to the local government that can contribute to the future development of Gedaref.

Gedaref is a town in Eastern Sudan with a population of 150,000 to 180,000 people. The town is the centre of a rainfed, mechanised agricultural area, one of the most important food producing districts in Sudan. Main crops are sorghum (dura) and sesame. Extreme droughts and the influx of refugees from Ethiopia have recently caused enormous problems in food supply, health care and other services. The population of Gedaref has doubled during the last ten years, which has caused a degradation of the urban environment and a lack of services.

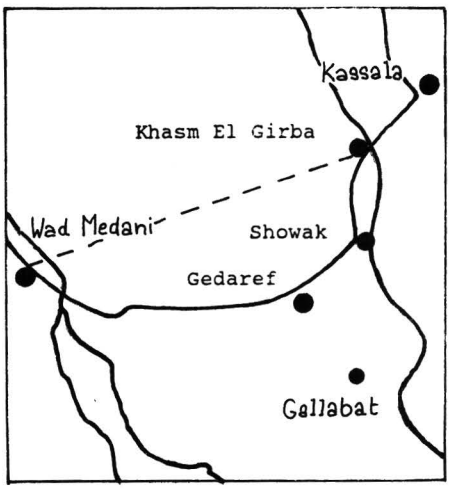


Fig. 1.1 Region

The studies described in this report were carried out on request of the local government. In a December 1983 letter, the senior Executive Officer of Gedaref municipality, Mr. A.O. Ereibi, asked for support in making a development plan for Gedaref town.

After the visit of Mr. P. Beekman, lecturer at the Eindhoven University of Technology, in October 1984, it was decided to set up a long term project at the university with Mr. P. Beekman as project leader. The objectives of the study were to be the development of Gedaref and the implementation of short-term projects. Sending a team of students to carry out inventory studies was seen as a first step in this project. This step will be followed by further detailed studies carried out under the supervision of the university. The implementation of the future projects will be undertaken by others with assistance from the university. Some project proposals have been worked out and presented to donor organisations. The next group of students is due to leave for Gedaref in October 1986.

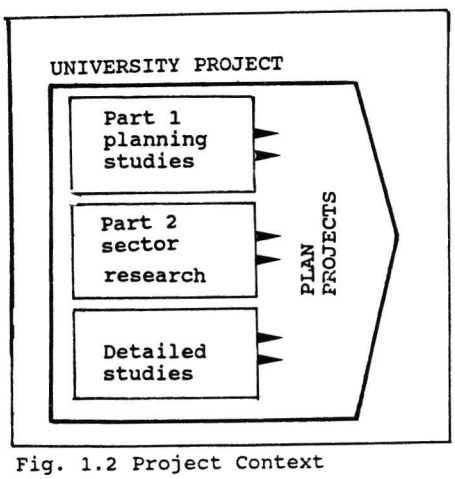


Fig. 1.2 Project Context

The team that carried out the research in 1985 consisted of the following members:

Hans Fransen, Univ. of Technology, Eindhoven, Department of Town Planning

Peter Trago, idem
Luc Vrolijks, idem
Johan Broekman, Univ. of Technology, Delft, Dept. of Civil Engineering
Eelco Hooftman, Agricultural Univ. Wageningen, Dept. of Landscape Architecture
Maarten Kool, Univ. of Amsterdam, Planning

The first task of the team was to carry out studies to be used for the design and policy making of a development plan for Gedaref. Studies were also to be carried out to provide information for project proposals. The local government as well as the project organisation put much emphasis on information needed to solve urgent problems. As a consequence of this, the study focuses on an analysis of existing problems.
Although the report makes recommendations for future developments, these are largely based on the existing situation rather than on an analysis of long-term future trends. Future trends have therefore received less attention than their importance merits. Here we mention population growth, development of agriculture, the ecological and economic systems in Gedaref.
The research period in Gedaref was split into two parts. In the first period a broad overview of the town was made by means of interviews, observations etc.. In the second part of the projects, six individual researches were carried out in different sectors. This research is presented in part 2 of the report. Part 1 of the report concentrates on an integration of the various aspects that were the subjects of research. Analysis of the existing situation, and recommendations, form the body of this part of the report.
In chapter 2 of part one, the planning approach is discussed. Several aspects that play a role in the realisation of the development are described. Some strategies for the local government to realise projects are also discussed. In chapter 3 four aspects of the present situation are described: physical structure, social aspects, economic aspects and government. The chapter is concluded with a description of the main problems of Gedaref.
Chapter 4 is looks forward; future tendencies are mentioned and analysed where possible. The consequences of the present rapid population growth are described from several aspects.

Chapter 5 can be seen as a conclusion of the analyses in chapters 3 and 4. Recommendations are given for long term developments and short term projects. An integrated picture of the development options is discussed. The chapter focuses on the physical structure of the town.

This report is the result of the first in a serie of studies and is largely based on an analysis of the existing situation. As such it does not aim at providing 'final solutions' to the problems of Gedaref. First aim of the study is to relate different sectors to each other and to provide an integrated description of the problems. Thus, problems that are at first experienced as isolated, can be evaluated in the framework of the development of the town. This document provides a basis for discussions between departments of the local and other governments, on actions in Gedaref. The detailed recommendations in chapter 5 are meant to stimulate the discussion and to direct the discussion to central problems in the town.
In chapter 2 it is indicated that there are more strategies available to the local government to guide the growth of the town, than are used now. Not all strategies are directly available to the local government, but they are possibilities that can be developed. The strategies, indicated in chapter 2, combined with the project proposals of chapter 5, aim at starting up a process of integrated planning, rather than to give isolated, final solutions.
The considerations that have led to the recommendations in chapter 5 are given in detail in part 2 of the study. This report (part 1) focuses on conclusions that have an impact on the physical planning of the town, while in part 2 also measures are indicated that only indirectly influence the urban planning.

Part two of the report presents the sector research and gives recommendations for improvements in the sectors concerned. The subjects that are discussed in part 2 of the study are: Housing (chapter 2), Land Use (chapter 3), Electricity (4), Transport (5), Garbage Collection (6), Sanitation (7), Seasonal Rivers (8), Green environment (9), Water Supply (10) and the Towncentre (11).
Added to this report is a map of Gedaref 1:10,000 which was made from aereal pictures (december 1981), and a plan 1:10,000 with development options.

Chapter 2: PLANNING APPROACH.

Introduction.

In most African countries, the high population growth rate and migration to the cities has led to an increasing population pressure on the towns. To guide this change in the society instruments had to be developed. Town planning as well as regional and national planning systems were incorporated to guide the urbanisation process. For Sudan and especially Gedaref, the increasing population caused problems for the functioning of the town.

In some decades, Gedaref has changed from a conglomeration of villages to a town with 150,000 to 180,000 inhabitants. Yet the town is still a mixture of urban and rural elements. Reasons for the fast growth of the town have to be found in the surrounding agriculture, and a large part of the population originates in rural areas in all parts of the Sudan.

The large concentration of people necessitates the availability of public utilities, schools and other facilities. Disfunctioning of the town is first experienced in the lack of these facilities. This malfunctioning is in fact caused by a gap between the size and functions of the town on the one hand and investments in required facilities on the other hand. To guide and stimulate improvements in this 'gap' can be seen as the 'aim of planning'.

Within the framework of national plans, the task of the local authorities is to identify key-problems in the town and to develop strategies to improve these. Beside the lack of intra-urban technical facilities, the degradation of natural resources (deforestation, desertification) and the lack of a diversified package of economic activities can be identified as key-problem areas. A development plan will indicate these problem areas and develop a strategy to improve these.

The study that forms the basis of this report, only covers a small part of the items that should be covered in a development plan. It provides an analysis of parts of the existing situation and can thus serve as a basis for further study for a development plan.

The local authorities only posess limited power to realise new developments. Financial means and the lack of manpower limit the possibilities of the local government to guide the development of the town.

Because of this limited implementation capaci-

ty, the local authorities will have to direct their power also towards stimulating other actors to implement projects. Thus, improvements can be realised with less government investments.
In a town like Gedaref, growing fast and under unfavourable conditions, a flexible planning approach is needed to make guiding of the explosive development possible. An urban development plan provides a tool to the local government to monitor these changes and stimulate the desired developments of the town. In this chapter important aspects of a flexible planning approach in Gedaref are described. The description provides a framework for the analysis and recommendations of this report.

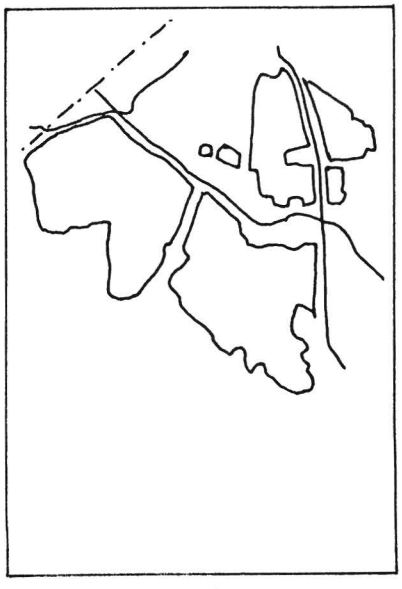
Flexibility.
The explosive development of Gedaref can only be guided with a plan that can react to changing circumstances. As this plan is related to the development of the town, it must fit in the existing political, social and economic context. A flexible plan indicates broad measures for long term development and more detailed measures for short term developments. The implementation of these short term measures influences the long term development of the town.

Actors.
The local government is only one of the actors that play a part in the development of the town; others also influence this development. The national and regional governments with their laws, approval of plans, and sometimes direct influence on the implementation of projects, also play a part. Merchants and merchant organisations also affect the development of the town: the decision whether or not to invest in new industrial or commercial activities in Gedaref affects employment possibilities and the physical structure of the main market area. Neighbourhood organisations can play a role in the development of the town by organising garbage collection, building health centres or by putting political pressure on the local government to realise certain public facilities. Other influencers in the town can be religious organisations, development aid organisations, individuals, social organisations, farmers' organisations, etc.
The development of Gedaref is directed by the interaction between the above mentioned participants and the physical structure of the town.

The latter consists of the natural terrain with man made structures built on it.
The local government has to work with a minimum of political tools. Measures taken by the government should therefore stimulate others to implement projects that benefit development. A policy of stimulating developments is expected to be more effective than a restrictive policy of prohibiting certain developments. To achieve this, it is necessary to take the existing social, economic and political situation as a starting point for planning. Improvements have to be implemented step by step after careful analysis of the existing situation.

Levels.
In the system of the town different levels can be distinguished:
- the town in its regional context (agricultural scemes, regional highway, forestation areas, distribution of population etc.)
- the town itself with its khors, industrial and residential areas, market areas, main roads, hospital etc.
- the quarters of the town with their health facilities, box routes, intermediate schools etc.
- the neighbourhoods within the quarters in which for example public standposts, elementary schools and public spaces are important

town level


quarter:Gedaref-South

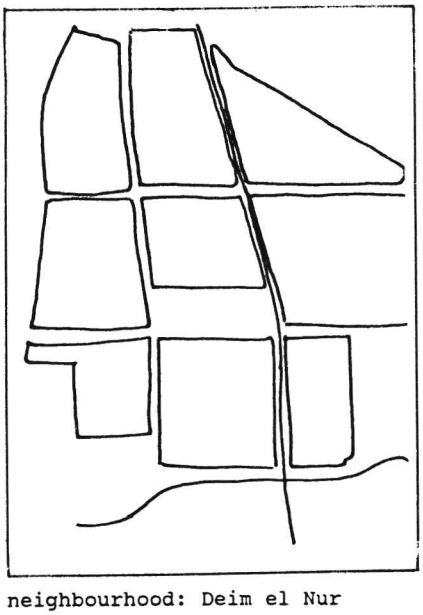

neighbourhood: Deim el Nur

Fig. 2.1 Scale level

A development plan will mainly focus on the town as a whole and can thus be used as a framework for detailed planning in quarters and neighbourhoods. On the other hand, developments

within a specific neighbourhood also determine the development of the town. The interaction between the levels should be studied in the development plan. The development plan should be based on research in neighbourhoods as well as on other levels.

Priority.

A long-term development plan is necessary, but many of the problems of Gedaref can benefit from short term projects that fit in, and stimulate, the overall development. These short term projects will have to be coordinated so that the implementation of one project will not hinder the development of another. In this way, priorities can be assigned according to the urgency of the problem, and to what extent each short term project fits into the long term development.

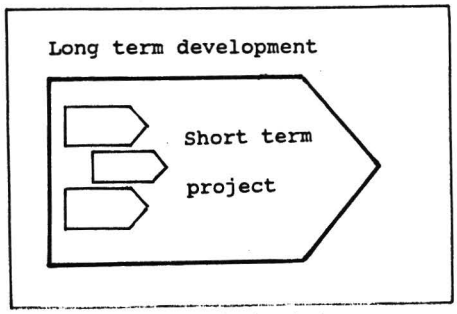


Fig. 2.2 Long and short term

Sectors.

The development plan must not be limited to the problems and progress of one department only, but must aim at integrating the sectors that form the local government. The plan can therefore be used as a framework for detailed sector plans. Guidelines are given for these plans. How detailed these guidelines are depends on the nature of developments and problems in that particular sector. The development plan is, inter alia, based on an integration of sector research and has to be translated into 'action plans' in these sectors.
The implementation of the plan has to be coordinated by a government body. The choice of the Planning Office as the coordinating body seems obvious. They will coordinate activities that are carried out in other departments and that are related to the development plan. To fullfill the role of coordinator it is important that the Planning Office get information from other departments on their plans and intentions

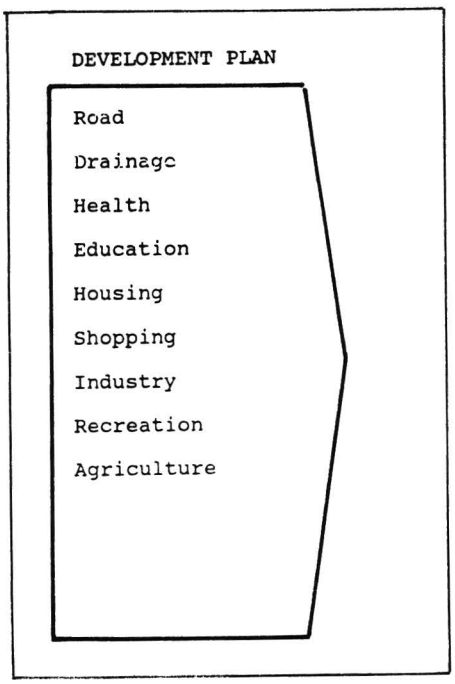


Fig. 2.3 Sectors

Development Options

A coherent development plan has to be based on a vision on what role the town may play in the national and regional context in the future. This vision should be based on a realistic analysis of the possibilities for development of the town as a whole and of specific functions of the town. For example, possibilities for the development of the trade sector or the industrial sector must be considered.

Strategy.

Measures mentioned in any town development plan are based on realistic prospects of attaining a goal. Different strategies can be used to bring about the proposed improvements. The choice of strategies depends on the nature of the measures. Strategies involving actors other than the local authorities can simplify execution. In general, a correct choice of strategy (or combination of strategies) will maximise the implementation potential of the development plan.

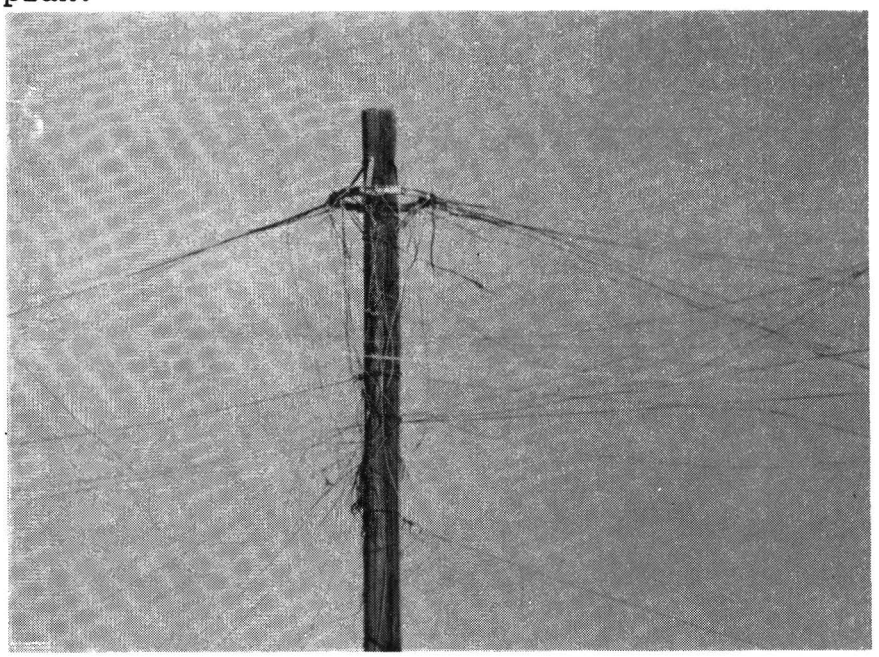


Fig. 2.4 What strategy?

Six strategies are indicated here:

1. Direct action by local government.

The strategy will be used for the tasks that are under direct responsibility of the local government. Execution of the tasks requires efficient government organisation and clearly defined responsibilities for the different departments. The government will need sufficient funds (hard currency if necessary) and local support. Other government bodies can be involved in project realisation; absolute clarity as to financing and responsibility is then imperative.

2. Indirect action by local government.

The government has some power to stimulate or hinder developments by granting permits or imposing taxes on certain activities. The actual work is then being performed by others, but the government has an instrument to guide developments.

3. Involvement of neighbourhood organisations.

This strategy can be used for projects on the neighbourhood level with direct benefits fo local population. Some conditions have to be made on this strategy:
- participation of neighbourhood organisation in how to execute the project,
- the government takes care of the availabilit of materials,
- clear project organisation is required,
- neighbourhoods have to be organised.

4. Use of socio-economic processes.
This indirect strategy can be used to stimulate gradual changes. Some desired developments cannot be realised by individual projects but require all sorts of participation from different actors. An indirect strategy will, in those cases, be useful. The essence of the strategy is that the government does not use its power to restrict but to make alternatives for development more attractive. Instruments like land use policies, permits and taxes can be used. The strategy may make changes possible with relatively little government interferance. Detailed knowledge of economic processes and legal possibilities is necessary to select the right stimulating measures.

5. Involvement of other local actors.
Local businessmen and organisations, clubs, women's organisations and political parties can also be involved in town development. Direct benefit or agreement with the ideas of the project executors is then necessary. Financial support and labour are aspects that can be supported by these organisations.

6. Stimulate involvement of foreign aid organisations. For some well defined projects it may be possible to interest foreign aid agencies to play an active role in the implementation. There is a wide variety of these agencies but a common condition on receiving aid is that projects must benefit the population of the town directly. Preparation of project proposals with the how and why of the projects is necessary to obtain funds. An active role of the government and related organisations is necessary. It can be important to combine foreign aid with government related activities.

CHAPTER 3: EXISTING SITUATION.

3.1. Physical structure of Gedaref Town.

Gedaref Town is located on a slope of the Gedaref Ridge and is surrounded by a number of hills from North to East to South, creating a cresent like figure which faces and slopes to the West. The rainwater from this cresent finds its way westwards through a number of seasonal rivers (Khors) that run through the town.

Fig. 3.2 Physical location of Gedaref

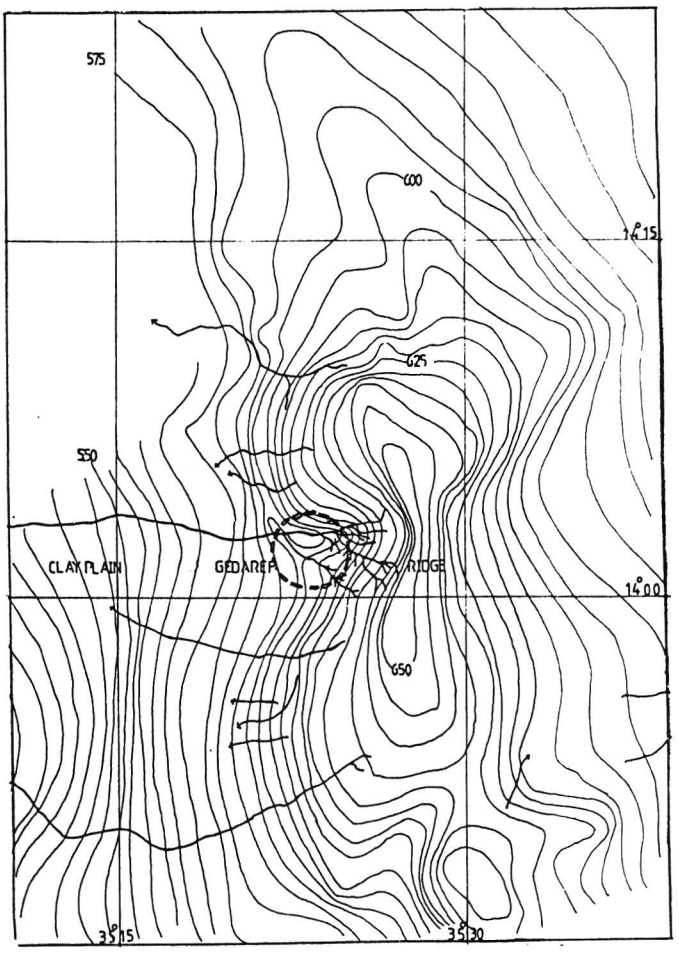


Fig. 3.1 Contour map Gedaref area

This natural drainage pattern is largely dendritic. The Khors cut their courses deep into the clay of Gedaref Town, sometimes down to the rock underlying the clay, and experience both drought and brief but intense downpours. Shallow hand-dug wells (10-20 m. deep) constructed in the volcanic rock are common along the river beds of the Khors. Originally, these wells were the only source of water for Gedaref. Groundwater at the depth of 180-225 metres can be found in the Nubian Sandstone formation at Abu Naga 16 km. distance South-West of Gedaref. Topography within the town can be described as mild

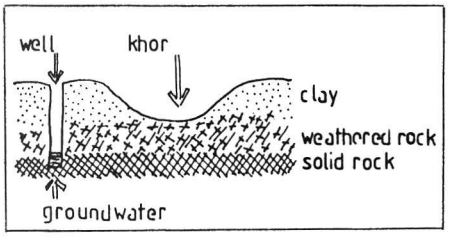


Fig. 3.3 Cross section soil

with gentle hills increasing in elevation towards the North-East. Ground surface elevations within the town range from approximately 590 to 625 meters above sea level. On the top of the hills solid rock outcrops and weathered rocks of varying sizes are found with patches of thin superficial clayish soils. The relatively flat areas consist of clay. The depth of the clays, varying from place to place, is generally about four meters, followed by 4.5 meters weathered rocks, then solid rocks. Average annual rainfall in Gedaref is 579 mm., average number of rainy days p.a. is 50. Between the wet summer month of June to September approximately 90 percent of the total annual rainfall is recorded. Much of this rainfall occurs in short duration, high intensity storms.
The presence of the Khors, the gentle hills, the condition of the soil and the absence of groundcover dominate the site conditions of Gedaref Town. During the rainy season the waterlogged clays become very sticky and the Khors discharge large amounts of rainwater, which sometimes causes heavy flooding. The Khors form physical barriers which are difficult to cross. The soil condition is not very suitable for the construction of roads, and permanent buildings need expensive foundations.

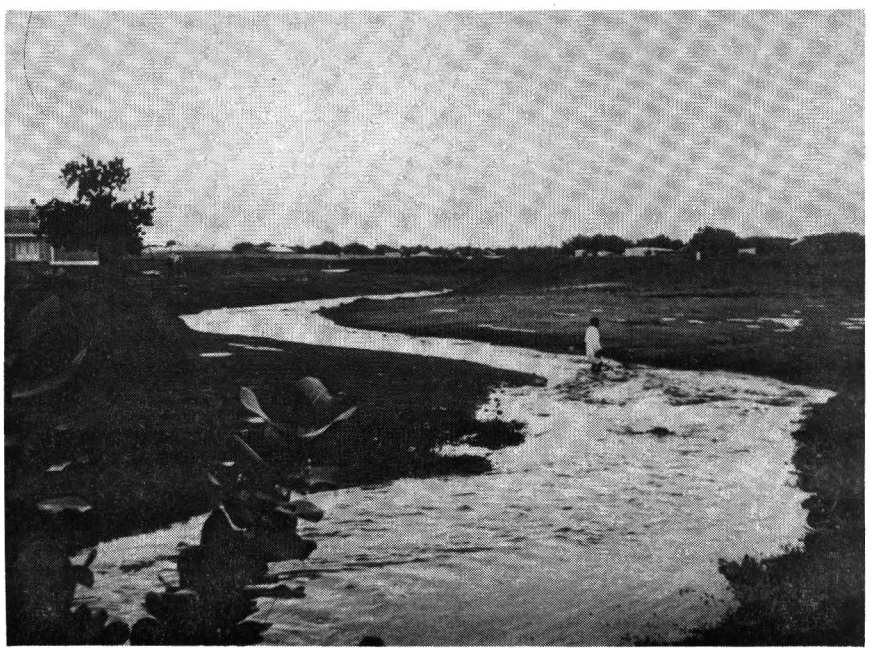


Fig. 3.4 Small khor after one hour rain

Historical growth of Gedaref.
Originally Gedaref was a gathering of villages,

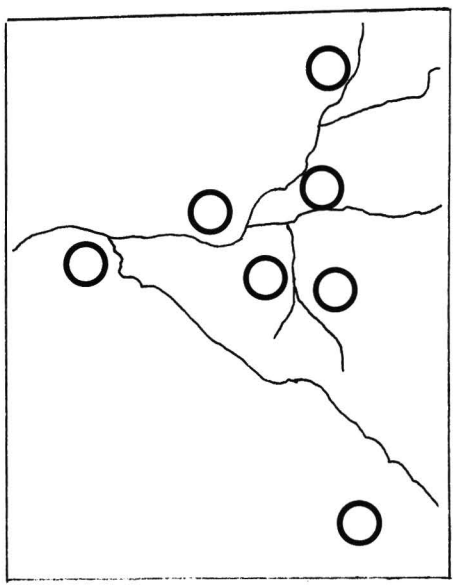


Fig. 3.5 First settlements

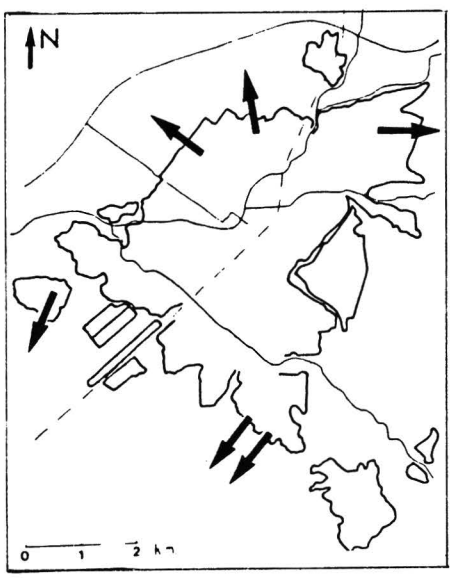


Fig. 3.6 Existing urban areas and directions of new extensions

founded by different tribes in the nineteenth century, built on the higher lands between the Khors. During the British colonial period the Gedaref settlements expanded around the military fort and administrative centre, both located on a hill. The conglomeration of villages grew into a small town. The rapid expansion of mechanised dry-farming since World War II in the Gedaref District created agricultural and commercial prosperity, which, in turn gave rise to a high rate of immigration into Gedaref Town. In 1957 Gedaref had 17,852 inhabitants and today the population is estimated at 150,000 to 180,000. According to this growth, Gedaref Town has a strong outward expansion. During last 15 years the area covered by the town has more than doubled.

At this time the Gedaref Municipal Territory covers about 10,880 ha. of land including the villages Abayo, Al Sharef and El Malik. A rough estimate of land-use is;

- Waste land	4,840 ha.
- Agriculture	3,440 ha.
- Residential	2,080 ha.
- Commerce, industry, railway, etc.	276 ha.
- Khors	244 ha.

Recent growth is towards the North, North-East and South-West. The expansion of the town is not only in an outward direction, but also in an inward direction. This means that densities in existing neighbourhoods are growing. Nowadays even the lower areas, sometimes directly located along the Khors, are being used for housing.

There are two main reasons for the strong horizontal expansion of the town. The clay texture of the ground necessitates expensive foundations for the construction of permanent multistoried buildings, leaving huts (ghottias) as the only alternative. Secondly, virtually all land is owned by the government. This has made it possible for public authorities to allocate land to site schemes at a price that low income groups can afford. However, because of rather rather large plot-sizes the resulting population density is too low to justify infrastructural works.

Also important is that residental areas are divided into classes (first, second, third and fourth classes). Most of these class divisions took place in 1970.

Besides the allocation of plots and the division in classes most of the growth of Gedaref is unplanned. In 1981 the Gedaref District Council decided on the design and execution of

an extensive Replanning Program. This program consists of the replanning of all unplanned neighbourhoods and the location of some new extensions.

Physical structure of the town.

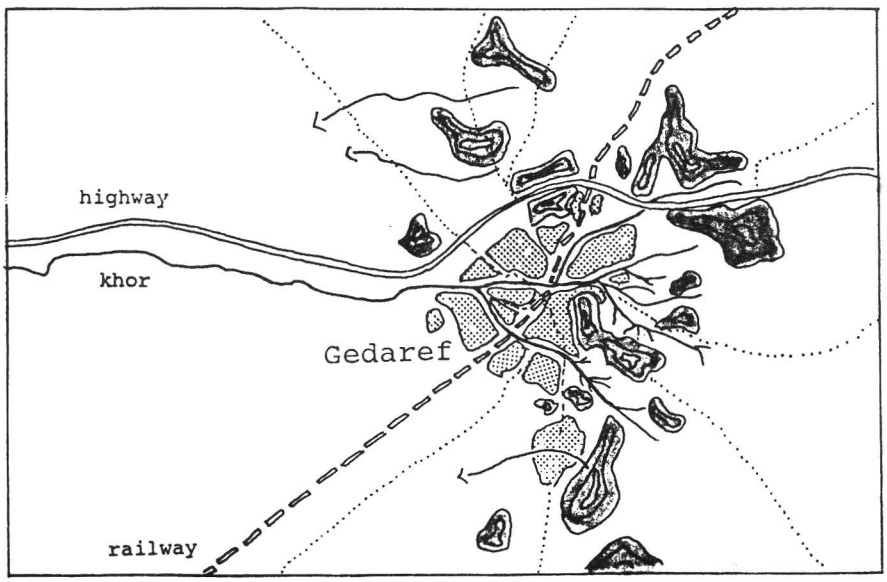


Fig. 3.7 Location of Gedaref

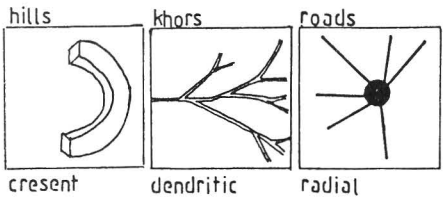


Fig. 3.8 Main physical structures

Gedaref is characterised by its strong horizontal expansion on the gently undulating slope of the Gedaref Ridge. The crescent like shape of the hills around Gedaref and the dendritic pattern of the Khors have determined the structure of the town. Most of the different neighbourhoods are segregated from each other due to bad accessibility because of the Khors. The general East-West direction of the main Khors forms a big barrier in the North-South connections within the town, especially Khor Abu Fargha with width up to 40 metres, depth up to 4 metres and a high man-made embankment. There are only a few bridges. The railway line also forms a barrier dividing the town into a North and a South part. Only two railway crossings break through this barrier. The railway line is about 20m. wide, and people use it as a foot path. Another physical obstacle is the Military Hill which has blocked the expansion of the town towards the East. Because of this, the town could not develop radially around the old centre and has grown more into the other directions.

Within the town the network of main roads has a radial structure with the town centre as focal point. This radial pattern of main roads conflicts with the physical East-West obstacles

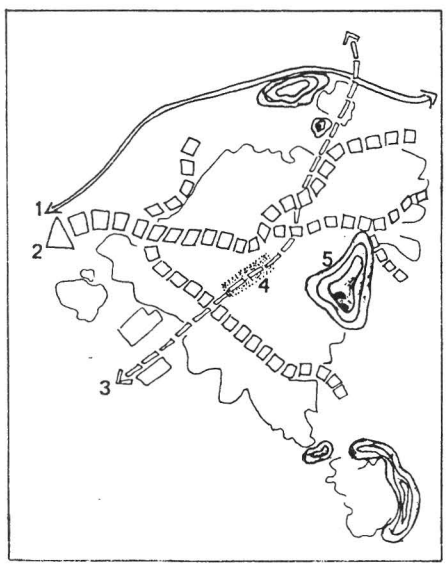


Fig. 3.9 Main barriers
(1)highway (2)khors (3) railway
(4) railway area (5) military hill

of Khors and railway. The town has only one main acces road from the highway.

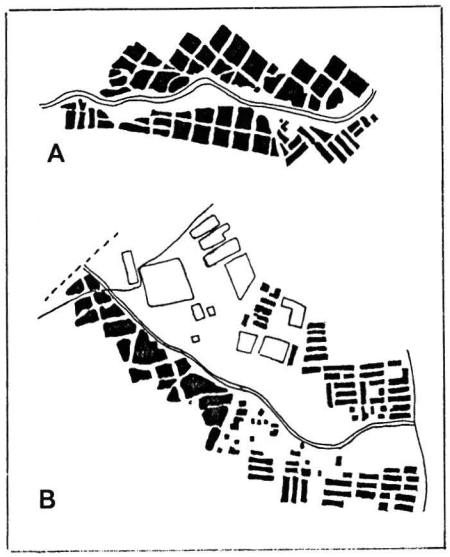


Fig. 3.10 Division of the town into sectors by the khors
(a) khor Abu Farga (b) khor Magadeem

Fig. 3.11 Embankement along khor Abu Farga

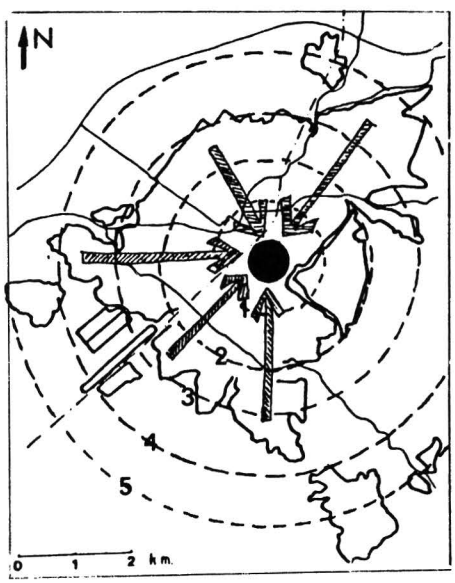


Fig. 3.12 Centralisation

The town is also characterised by the existence of one single centre containing nearly all the urban facilities. Although commercial and public facilities also extend along some main access roads, there is no hierarchy of subcentres within Gedaref. Because of this strong centralization, the old town centre is overcongested, and the supply of daily needs raises problems in some neighbourhoods. The strong horizontal expansion of the town means lengthening the lines of communication to the centre, especially problematic because walking is the most important mode of transportation. Around the commercial and administrative town centre the widespread neighbourhoods are built. Close to the town centre we find the first and second class neighbourhoods, which consist mostly of houses of concrete and brick. Further away the lower class neighbourhoods are located with higher population densities, smaller plot sizes and grass-roofed huts. On the edges of the town the fourth class neighbourhoods are located: spontaneous settlements with a rather low density. Because of the strong horizontal expansion of the town it is difficult to provide the town with public utilities.
Besides the central area, the military area and the widespread neighbourhoods, another distinctive place is the Agro-Industrial area with the very important regional cropmarket on

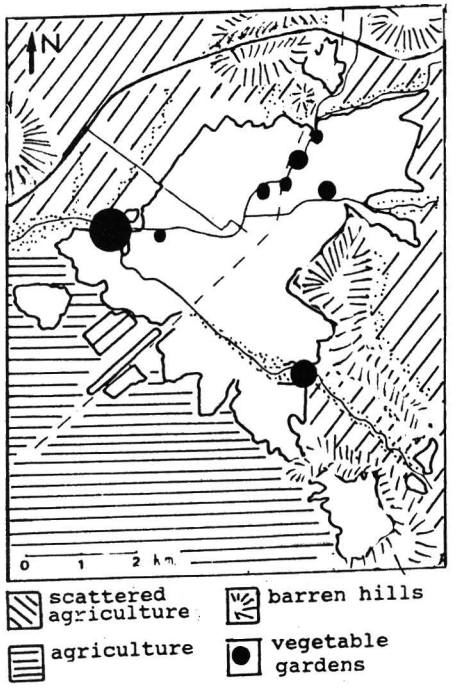


Fig. 3.13 Land use around Gedaref

the South-West edge of the town. This complex was located near the railway to have good access to rail transport. Nowadays however, all transport is done by heavy truck. As there is no direct connection with the highway, all the trucks have to pass through the town centre. The Khartoum-Port Sudan highway, passing Gedaref in the North, influences the structure of the town. We can already see the development of a road service centre on the crossing to Gedaref. Also new extensions are planned along the main access road from the highway to Gedaref. The highway itself can be a physical obstacle for the expansion of Gedaref to the North.
Within the town there are still many areas with barren land without any specific use, especially areas prone to flooding. Alongside the Khors there are wells with vegetable gardens at several places. Open spaces in the town are often used as football fields. Most of the land around Gedaref is cultivated by small farmers who live in the town.
Some landmarks and important points of orientation in Gedaref are the 40 m. high grain silos on the South-West edge of the town, the Military Hill with the yellow plastered buildings on the East, the flat topped Tawawa Hill north of the town, the different mosque and the radio antenna in the centre of the town.

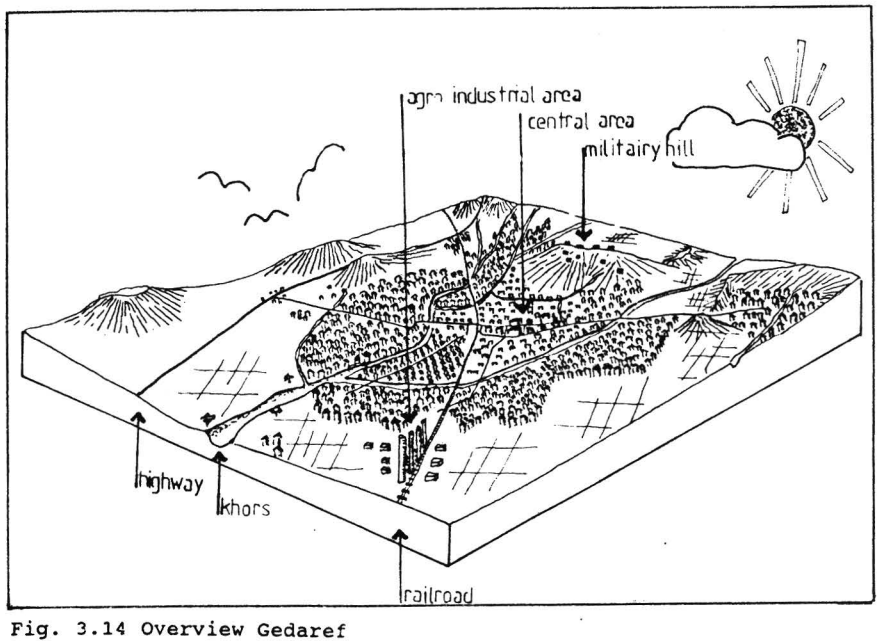


Fig. 3.14 Overview Gedaref

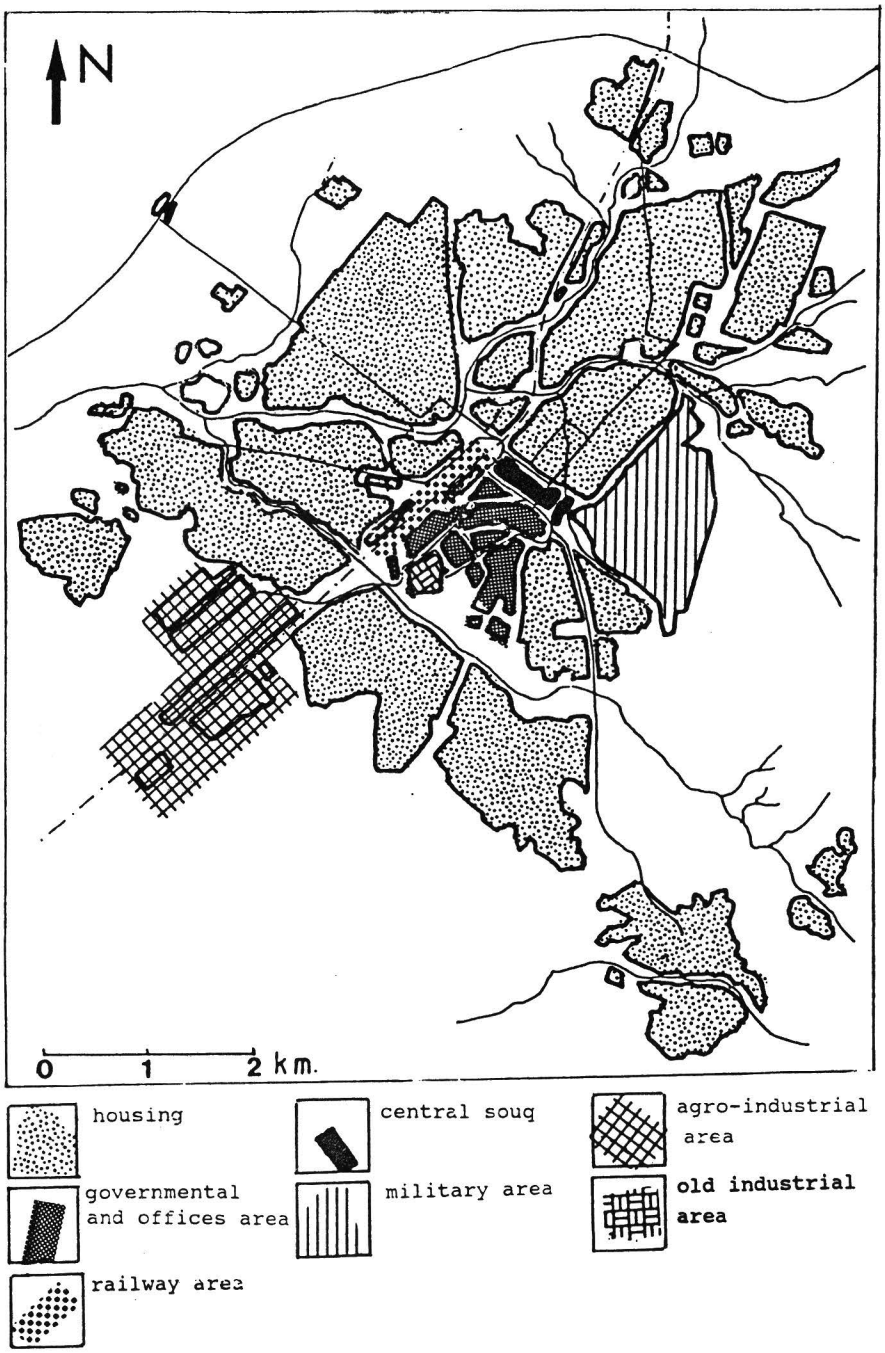


Fig. 3.15 Land use Gedaref

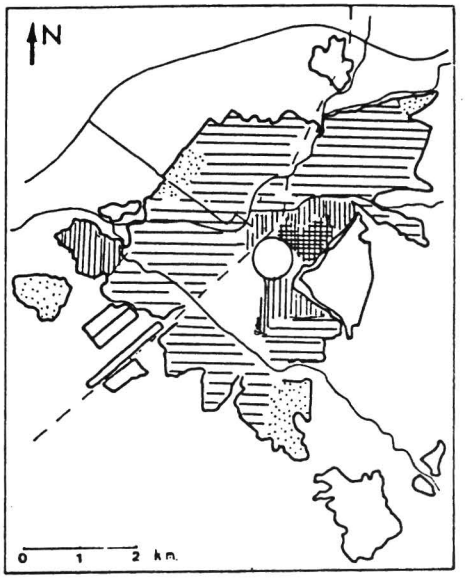


Fig. 3.16 Class division of neighbourhoods

Residental areas.

Residental areas are divided in four classes. The class of a neighbourhoud is largely determined by the economic status of its inhabitants. The residential area comprises about 30 neighbourhoods, of which three are first class and four are second class.

Each class has its official standards concerning services, building materials and plotsizes. The fourth class gives plot owners only a temporary status, and no services are provided. After some time a fourth class neighbourhood may be upgraded to third class level. A third class area should have roads, drainage, water and electricity supply, and one main asphalt road to the town centre. In addition a second class neighbourhood should have asphalted roads, covered drainage and public sewage systems. First class neighbourhoods also have trees and paved footpaths. In practice, not one neighbourhood receives the services it should.

In third and fourth class neighbourhoods no construction standards are met, inhabitants build their own houses and make gradual improvements. In first and second class neighbourhoods, houses should be made from permanent materials like concrete and brick.

Plotsizes of third class neighbourhoods should be 400 m2, of second class neighbourhoods, 500 m2 and of first class neighbourhoods, 600 m2 or more.

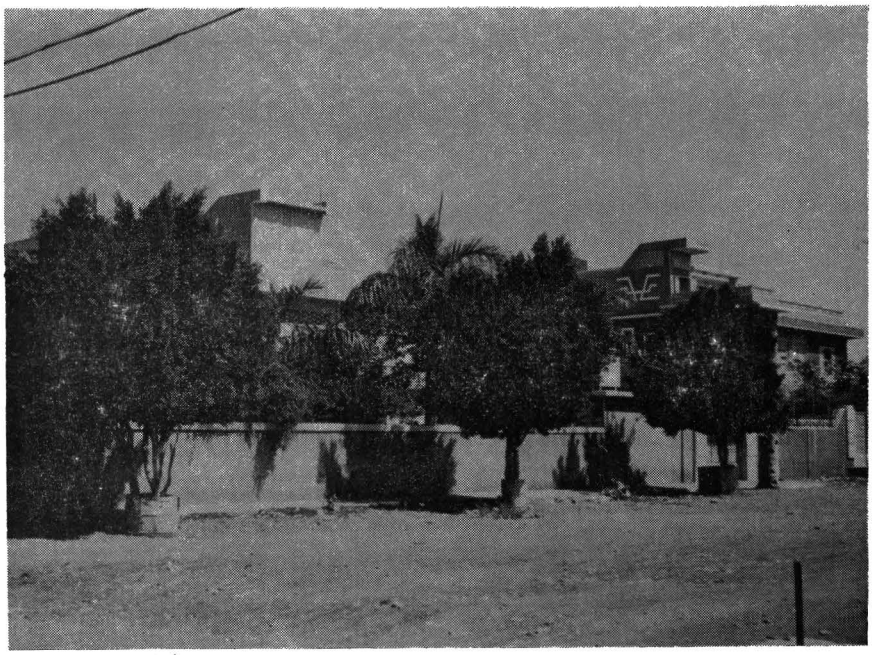


Fig. 3.17 First class neighbourhood

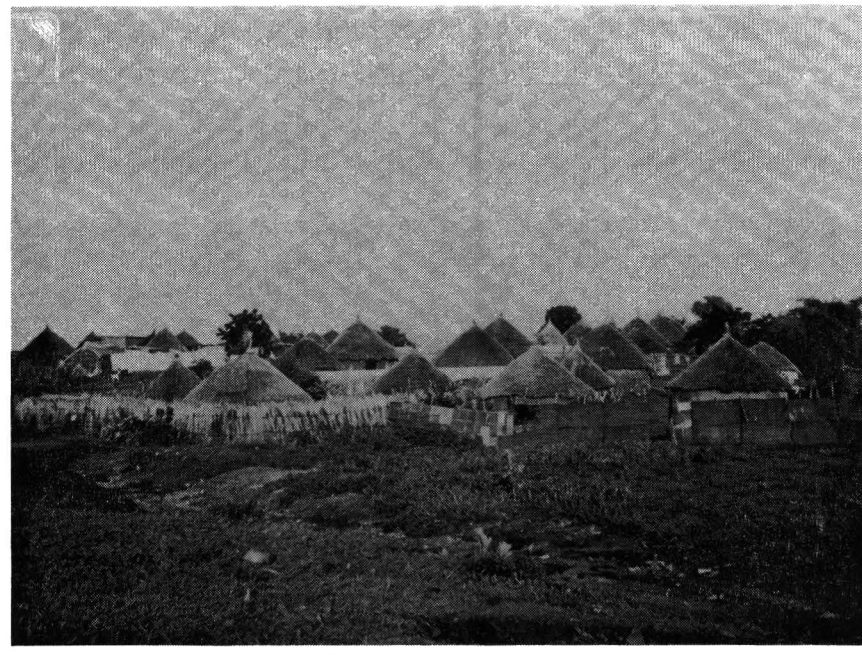
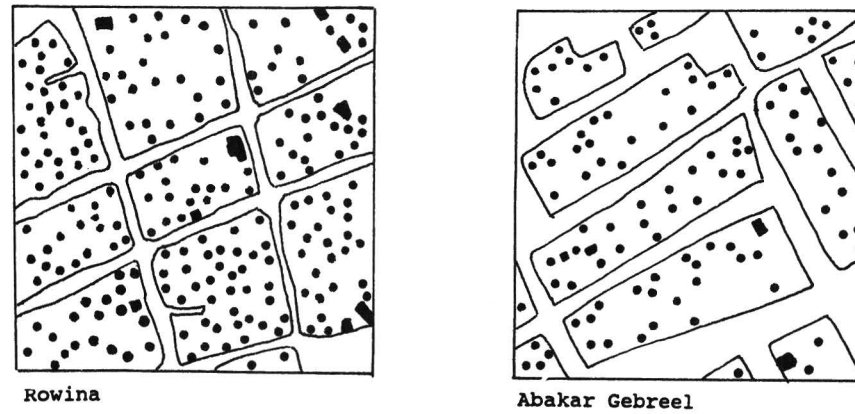


Fig. 3.18 Third class neighbourhood

The first and second class neighbourhoods are mostly located around the centre with the best access to all public and commercial activities. At present there is an uneven distribution of the population with high residential densities contrasting with large empty plots nearby. The average density is about 80 inhabitants per hectare. The average size of a household is about 7 to 8 persons. Population densities and household sizes are increasing because the building activities can not keep pace with the population growth.



Rowina Abakar Gebreel

Fig. 3.19 Different population densities

Most of the land is given out in leasehold by the government. Prices for freehold land in first class areas run very high (over SL 200,000 for a plot of 500 m2). Also leasehold

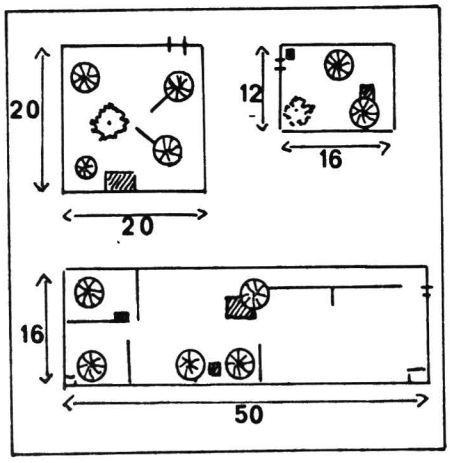


Fig. 3.20 different plots

land has market value. This value depends on what is built on the plot, on the availability of water and electricity and the distance to the centre. Prices range from SL 2000 in the outskirts to SL 100.000 close to the centre.

Characteristic of Gedaref is the high percentage of ghottias and other huts, built from natural building materials (wood, grass, straw and mud). These ghottias are the only low-cost housing form which doesn't need a foundation and is resistant to the heavy rains. The individual compounds consist of several ghottias, each with a special function, like huts for women, men and guests. Within the compound the owner will place a hut according to demand. A lot of the domestic activities take place in the open air. Domestic privacy is of great importance to the Sudanese way of life. This necessitates high perimeter fences around the compounds. The fences are made from dura straw, sometimes from old oil drums or corrugated iron sheets. Only the neighbourhoods around the town centre consist mostly of multi-storey houses of concrete and brick.

Fig. 3.21 Plot with gottia and fence

In general there is a big contrast between publicly and privately owned land. Trees are mostly found only within the individual compounds. Besides the lack of vegetation, the public spaces are characterised by scattered

garbage, no drainage system and unpaved streets.
The central places within a neighbourhood are often formed by buildings like a Mosque, school or health centre. All neighbourhoods have one or two large mosques and several small ones. Each neighbourhood has a boys' and girls' elementary school. Some neighbourhoods have a health centre, sometimes a gift of an inhabitant of the neighbourhood. At some junctions and squares one may find shops or a small market. Some neighbourhoods have public standposts.
The older neighbourhoods often consist of people of the same tribal origin who then form an organisational structure of local leadership. In many cases the older neighbourhoods have developed along the lines of rural villages. Most of these neighbourhoods have irregular patterns with clustered compounds. These pattern were often the result of old pedestrain routes, small streambeds and social structures which are based on strong family and tribal ties. Individual plots inside clustered compounds are not necessarily connected directly to recognizable streets. Sometimes it is difficult to distinguish between private, semiprivate and public space. As these neighbourhoods grow larger and become more densely populated, these rural structures become inappropriate. For example the lack of sanitation facilities conflicts with the living environment, thatch roofed cause fire hazards, public space is reduced, plots located along the Khors are prone to flooding.

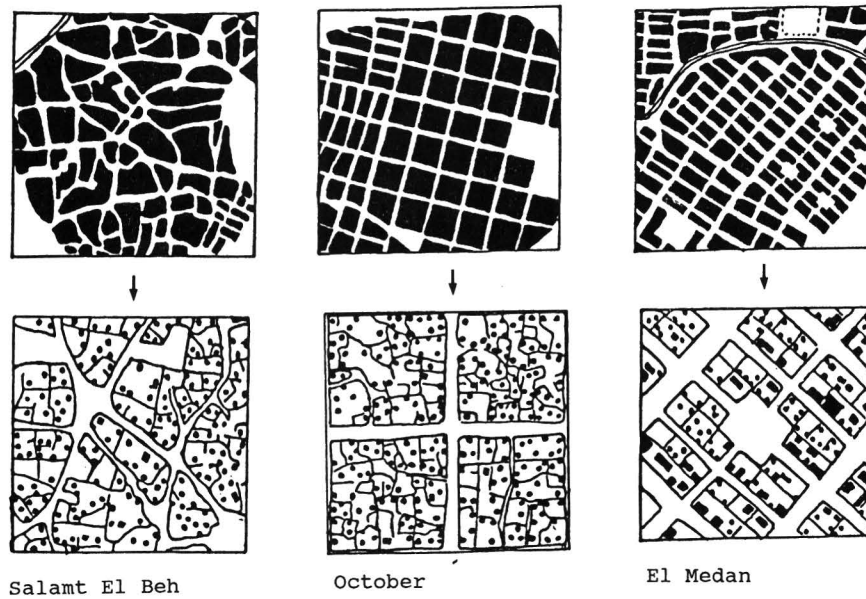


Fig. 3.22 The plot lay-out of three different neighbourhoods

Fig. 3.23 Small street in unplanned area

Through the replanning a grid pattern of streets has been introduced in many neighbourhoods. Within the grids that contain 9 to 12 plots, plotownership is not always been regulated gridwise. Streets in these replanned areas are rather wide (15 - 30 metres), also to act as fire breaks, and very long. This grid pattern results in a rather monotonous urban pattern.
The new replanning program also shows a rigid grid lay-out imposed on the existing urban structure, although later plans show more variation with space allocated for open areas, schools, mosques and social activities.

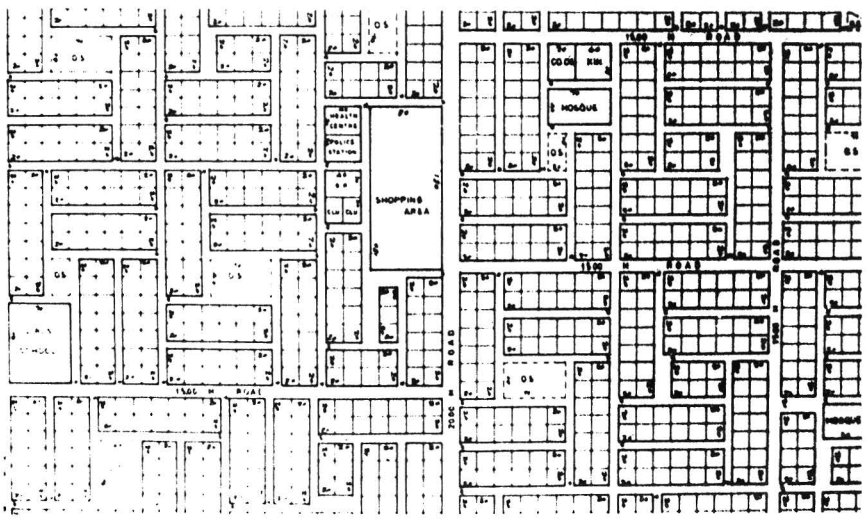


Fig. 3.24 Design of neighbourhood replanning

The aim of the program is twofold: to legalise and regulate the plot ownership in order to decrease densities on the plots, and to provide for the basic needs of the people through supply of water, electricity, education, healthcare and recreation facilities. Most of the proposed services however are not provided, due to lack of means.

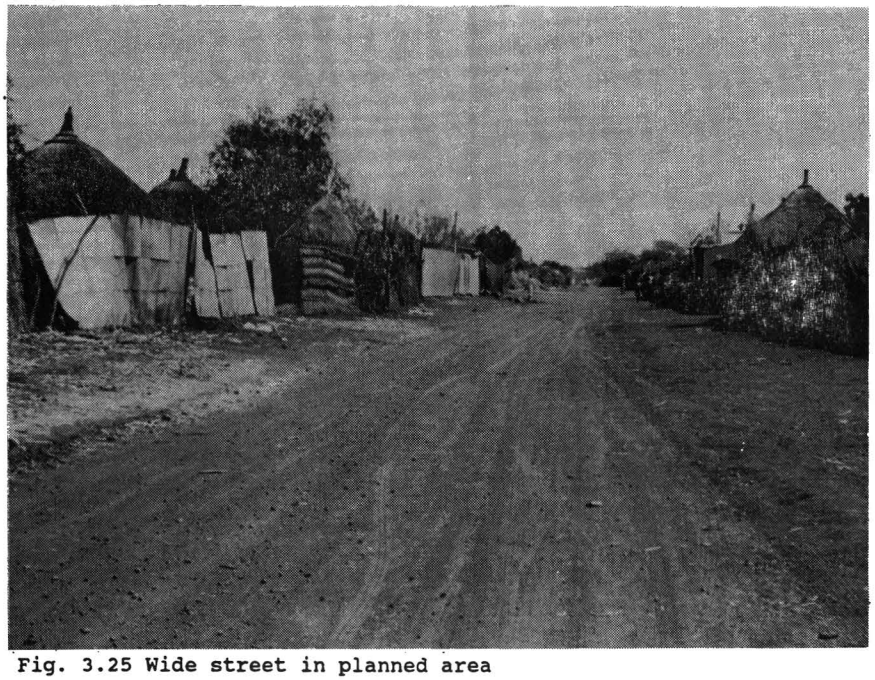


Fig. 3.25 Wide street in planned area

As a result of the rigid new lay-out most of the people have to move to a new plot. People who have to move to the new extensions often stay in their old neighbourhood, because the new extensions have no facilities at all and because of the ties with their families and the increased distance to the town centre.

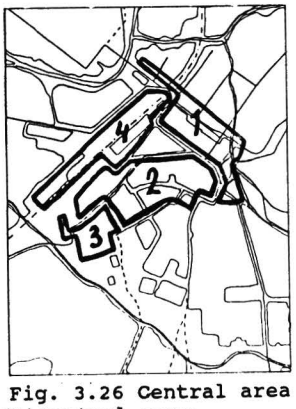


Fig. 3.26 Central area
(1) central souq
(2) governmental and office area
(3) old industrial area
(4) railway area

The central area consists of the main market area (central souq), the governmental and housing area Mozafeen, the light industrial area and the railway area. The main market area, which dates from colonial times, is also grid-like. Around this area we find shops, restaurants, hotels, banks, Mosques, the hospital and petrol-stations. Areas are also used for bus- and box-terminals, different market places, streetvendors and open space. Because of the strong centralisation of activities in Gedaref the souq is overcrowded. Circulation on the souq is often problematic due to the number of people, vehicles and vendors, and also because of the narrowness and bad pavement of the passages. The drainage system is very poor, causing many problems during the rainy season.

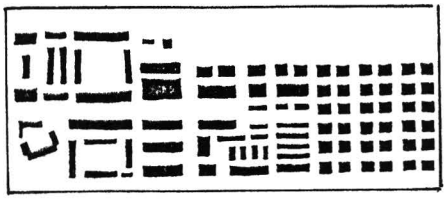


Fig. 3.27 Lay-out central souq

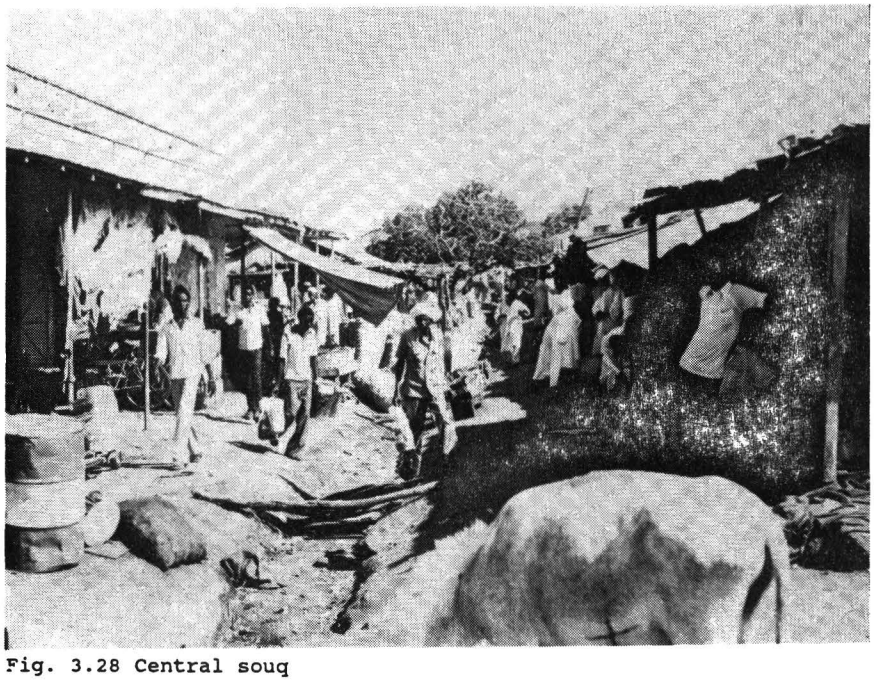


Fig. 3.28 Central souq

The structure of the governmental office and housing area Mozafeen, also dates from the colonial period and is built on a higher part of the town. It has an irregular street pattern with wide streets and large plots. In contrast with the overcrowded souq, this area has ineffective land-use. The railway area consists of some buildings, a shunting yard and a rail-workers housing scheme. Most of the land is unused. The area is owned by the the National Railway Company.

Fig. 3.29 Main access road to Central Area

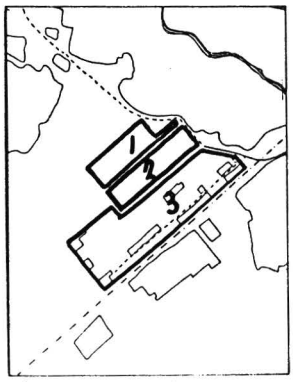


Fig. 3.30 Agro-industrial area
(1) New industial area
(2) Cropmarket
(3) Storage area

The old industrial area consists of shops, workshops and stores organised in a rather chaotic way. The only structures are the four large blocks of stone buildings composed of several units. No surface is paved. At one corner of this area the large gasoline storage area of Gedaref is located.
At the South-West edge of the town, the agro-industrial area is located. Most of this area is used for storage of grains, two small factories and some office buildings. The important regional cropmarket is also located here. Enough land is available for futher extension of functions, but the area has nearly no facilities like water and electricity for industries.

Infrastucture and public facilities.
Gedaref is connected with some regional infrastuctures like the Khartoum - Port Sudan highway, the railway, a waterpipe connection with Showak (70 Km North-East of Gedaref) at the Atbara River, the Abu Naga well-field and the electricity transmission line from the Khasm El Girba dam.
Because of the rapid growth of Gedaref most of the existing infrastructure has become inadequate, overburden or lacking at all. Only in the towncentre and adjoining neighbourhoods this situation is some better. Towards the edge of the town the infrastructure gets worse. Improvement of public facilities like water-supply, electricity supply and good access-roads is one of the purposes of replanning. The implementation of the proposed improvements is hindered by the fact that the local government does not have the means. The condition of the present public utilities is already bad because the lack of finance and materials.

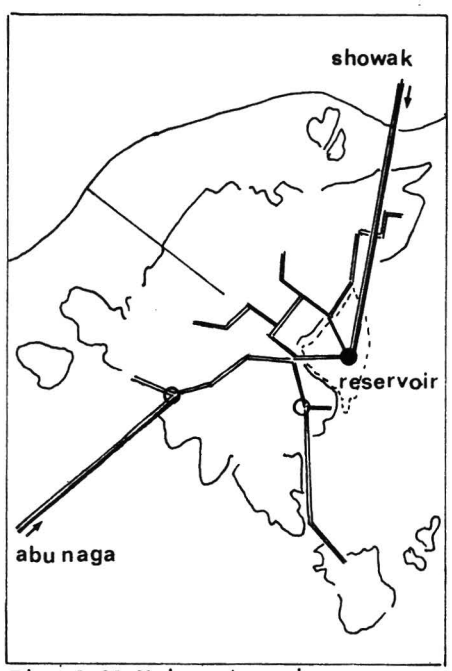


Fig. 3.31 Main water pipes

Clean water is the most critical utility for every human settlement. The most striking problem in Gedaref is the shortage of drinking water. The two main water resources are groundwater from Abu Naga and surface water from the Atbara River. This water is brought by pipelines to the main reservoir at the military hill to Gedaref. From there it is distributed through a fairly extensive, but incomplete distribution system. The distribution net is fed by gravity flow and undersized lines and low pressure cause very little water do reach the end of the network. Waterlines leak or break frequently. The 30% of the inhabitants directly connected to the network live around

the centre of the town. All the other inhabitants have to get their water by other means, e.g. public standposts and watervendors. This water is much more expensive than directly piped water and is a major demand on the household budgets of poor families. Hand dug wells are also still used for drinking watersupply. Every year at the end of the dry season the watersupply sets worse and worse. The waterproject of US-AID solves the most critical problems of water delivery to Gedaref at this moment, but severe problems still have to be solved. Within ten years a new main pipe will be necessary and as distribution within Gedaref is not part of this projekt, it remains a critical problem.

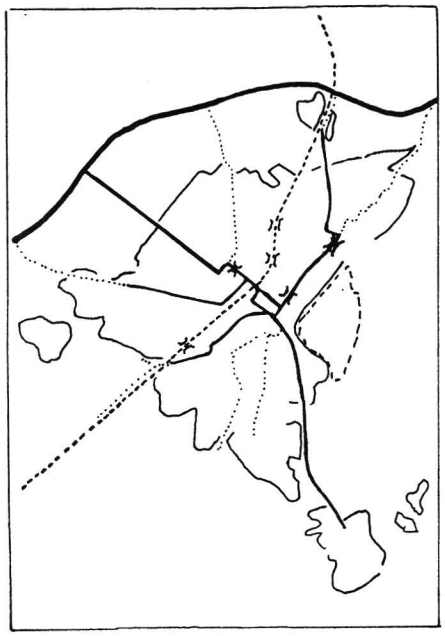


Fig. 3.32 Main roads

The road system of Gedaref is not sufficient to serve the basic needs of urban activities. The accessibility of vital functions of the town is hindered by bottlenecks in the system. Especially the road quality and the riverbed crossings form a problem. Except for some major roads, most of the roads are unpaved. There are two types of Khor crossings; bridges over the khors and the so called 'Irish bridges' through the Khors. The existing bridges (except one new bridge) are old and cannot cope with the increased number and weight of new trucks.
Rapid flow of the waterstreams causes undermining of the bridges and irish bridges. Some bridges are already damaged. The Irish bridges

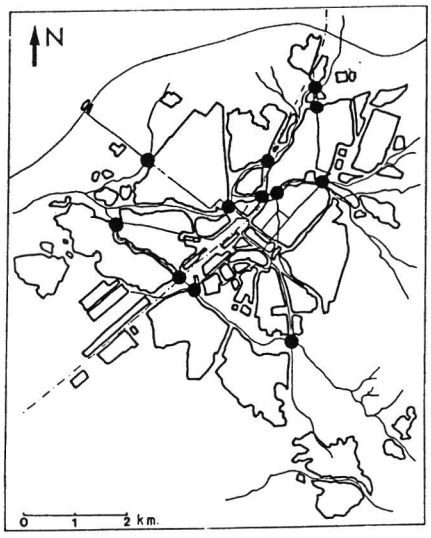


Fig. 3.33
Bottlenecks of Khor crossings

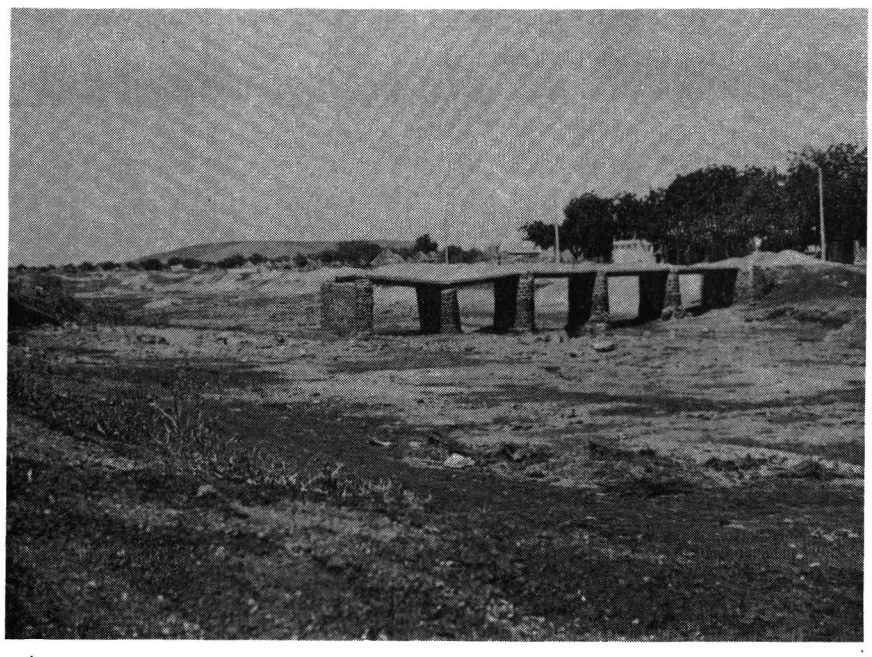


Fig. 3.34 Destroyed bridge

bridges cause bottlenecks in the system, especially in the rainy season.
The most important means of transport to and from Gedaref is heavy trucks and busses. Within Gedaref people mostly use public transport by means of pick-ups (boxes) or just walk. Private cars, motorcycles and bicycles are relatively scarce. A large part of the motorised traffic consists of good transport to and from the towncentre and the cropmarket. Donkeycarts are still used frequently. As the roadsystem is concentrated at the center of the town, this part is congested.
The frequency of the railway is low (2 trains a week) and the train is only used for transport between Khartoum and Port Sudan.

Electricity is only supplied to the central souq, the surrounding neighbourhoods and the light industrial area. The system is not reliable. The capacity of the electricity system is not sufficient for Gedaref. In neighbourhoods, many privately-run generators supply some electricity. There are plans to make a connection with the national electricity network (Blue Nile Grid).
Other than the natural East-West drainage system of the Khors there is no man-made drainage system in Gedaref. The water has to find its own way out. There is much surface runoff along the streets. Most streets have no drains.

Fig. 3.35 Surface run-off into khor

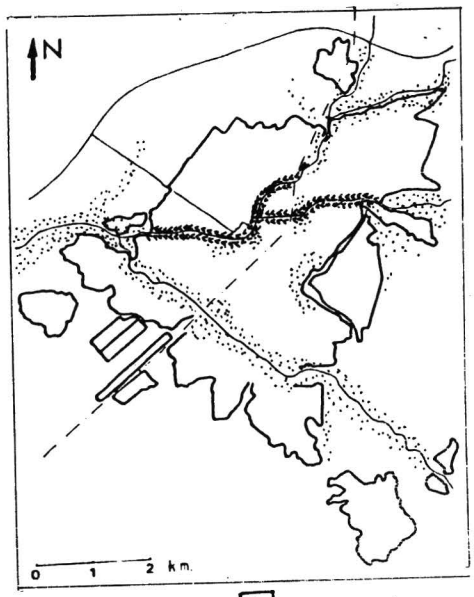


Fig. 3.36 Embankement along khors

Severe flooding of the Khors is an annual event and usually causes heavy damage to areas along the channels. Devastating floods swept the town in 1973 and 1982. This last incident stimulated some work on flood-protection. In 1983 the Khors Abu Fargha was deepened, using the soil for protective embankment. Still many areas are affected by flooding.

The garbage collectionsystem of Gedaref is very insufficient. It consists of 28 garbage containers and 4 container trucks. Two official and some unofficial dumping sites are in use to dump and burn the collected garbage. Because at least 175 containers are needed, people chose their own dumping location on places like Khorborders, dead-end streets and even public space in the neighbourhoods.
Gedaref has no sewage system, due to the shortage of water. Different toilet-systems used in Gedaref are bucket-latrines, pit-latrines and septic tanks. The soil condition in Gedaref is not suitable for the realisation of cheap pit-latrines. Most people of the lower class only have a provisional facility on their plot or no facility at all. As no public toilet facilities exist, these people use the public land (Khorbeds, waste lands) to defecate.

Fig. 3.37 Pollution near central souq

3.2 Social aspects.

The national context.

The population of the Sudan comprises 22 million persons and includes a wide variety of ethnic groups. Traditionally the northern part of the Sudan, including the Eastern Region, was inhabited by nomadic tribes. In the past decades a large number of nomads were settled, more or less permanently in urban and semi-urban areas and rural settlements. The following reasons for this rural-urban migration may be identified. In the long term the character of agriculture has changed from small scale traditional agriculture to the large scale mechanized agriculture on schemes. This, limited the space for nomadic movement and diminished economic opportunity for small scale farming diminished. Through this process traditional farmers and nomads lost their land and were forced to labour on the mechanized schemes and find opportunities in agricultural centres like Gedaref.
On the shorter term, recent droughts and desertification have forced nomads to settle near population centres. Nomadic tribes settle in the vicinity of population centres, rather than in these centres, in order to maintain their nomadic lifestyle and also to have access to urban services.
In the past 20 years the Eastern region has taken in 700,000 Ethiopian refugees. Most refugees who entered the Sudan before 1975 were of rural origin and Moslem conviction. Most of these refugees have assimilated into the Sudanese society. The majority of refugees, that entered the Sudan recently, are partly of urban origin and many are Christian. Assimilation of this group of refugees is very troublesome. First it is a very large group that sees its stay in Sudan as temporary. Secondly, the Christian belief of the refugees causes problems in the Islamic society of the Eastern Region and thirdly the foreign relief aid has resulted in a standard of services in the refugee settlements and camps that is not attainable for the Sudanese themselves. Of these 700,000 refugees about half are living in refugeecamps and settlements near international relief agencies. The other half is trying to earn a living in urban centres.

It may be concluded that, through the absorption of refugees and the rural-urban migration, the urban centre of Gedaref has become the

major concentration of population in its region with all problems connected to this.

Gedaref Town.
Gedaref has a total population of 150,000 to 180,000 inhabitants. The population fluctuates seasonally through the seasonal labour-demand of the mechanized farming.
The population growth, as observed since 1972, is estimated at 6 to 7 percent of which 3 to 4 percent is natural growth. The following figures will show this enormous growth.

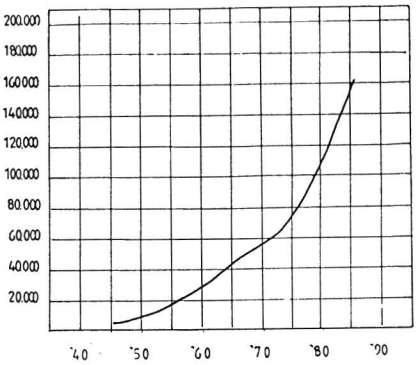


Fig. 3.38 Population growth

Source	Population of Gedaref Town.
Census 1957	17,852
Survey 1964/65	45,491
Census 1973	66,465
Estimated 1985	150,000-180,000

The population is very young; about 50% of the population is 20 years and younger. There is a slight surplus of males. In Gedaref many people from different nations have settled. The 1973 figures show already the variety of nationalities and this continues to increase:

Nationality	Population	Percentage
Sudanese	59,121	88,9
Ethiopian	1,995	3,0
Nigerian	4,682	7,0
Chadian	161	0,2
Other African countries	211	0,2
Yemini	201	0,3
Others	93	
TOTAL	66,463	100

Source: Census of 1973.

At this moment an unknown number of Ethiopian refugees is living in Gedaref. Concentrations may be found in the neighbourhoods of Deim el Nur, Karary and El Thawra. Integration of the refugees into the Sudanees community seems to proceed slowly. Tawawa and Um Gulja are semi-urban refugee-settlements situated West of Gedaref. An estimated 40,000 Tigrayan and Amhara refugees have settled in these settlements. Foreign relief aid is concentrated in these centres.
The unit of society is, by tradition, the family. Family-ties are very close and highly

appreciated; for instance the settlement of a family in a particular place may be motivated by the presence of relatives. Most families live on plots. When a son or daughter gets married they will settle on the plot of the parents or on a plot close by. The head of the family is often the main income earner and finds his employment in agriculture or agriculture-related sectors. In many cases the head of the family is assisted by his children with his work.
A family may have one or more plots of land. Plots vary in size and shape according to the neighbourhood they are situated in (class of neighbourhood, legal or illegal settlement).

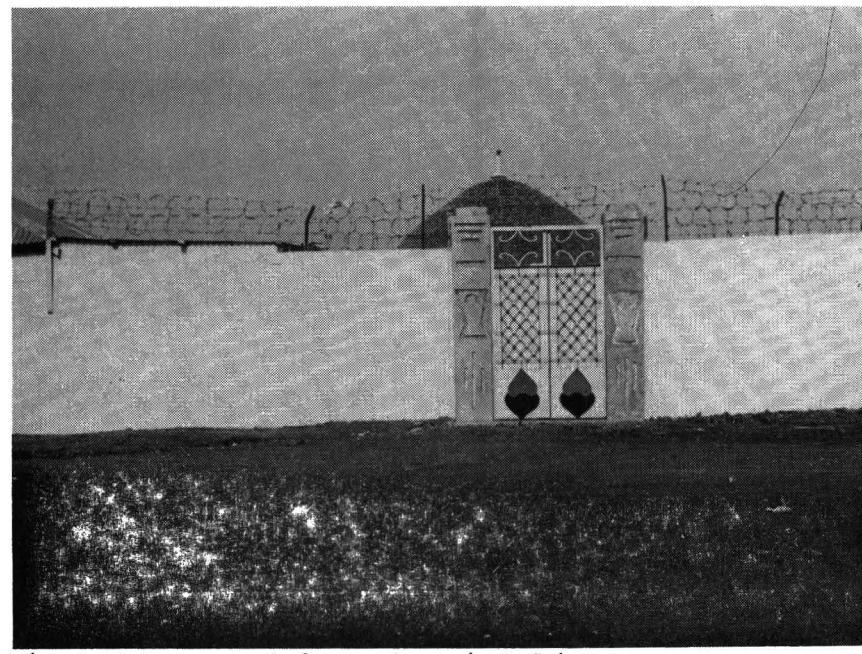


Fig. 3.39 A permanent fence of corrigated iron

Plots are fenced and, provided there is enough space, there will be areas reserved for men, guests and women; normally the kitchen area for the latter. Movement of women outside the plot is limited.
Ownership of the plots is highly valuated, although rental of plots is common and for many owners a source of additional income. There is a shortage of plots of land fit for housing, i.e. with reasonable access to public services and not prone to flooding. Population densities on the plots are high in general, but show some variation. Neighbourhoods near the centre of the town have higher densities, up to 4 families per plot of 400 m2. The average household consists of 6-8 persons. The average density is estimated at 80 inhabitants per hectare.

Among the people there is a desire for replanning as this governmental operation leads to a regulation of ownership and can be used as a argument for the removal of family or relitives non grata. It is also seen as the first step towards the provision of public services.
The people in the older neighbourhoods often originate in the same tribe, and are then organized in neighbourhood societies with a shiek as traditional leader. The efficiency of these organisations varies and as the traditional ties within a neighbourhood are declining, the organisation is liable to change.
It must be noted, that the position of women is also undergoing change. Under pressure of the economic situation women have been forced to take up an occupation. Most women that work find employment in the informal sector as vendor or in handicrafts. The average income of a household in Gedaref ranges between SL 2000,= and SL 4000,= per year. It must be mentioned though, that the distribution of income is unequal. There are some very rich people in Gedaref, and a large group of poor people living in the fourth class neighbourhoods and the unregistered new extensions.

Fig. 3.40 A combine in a neighbourhood

The rapid expansion of mechanized dry farming since World War II in the Gedaref District created economical prosperity. As the agricultural centre of the Eastern Region, Gedaref is the major distribution centre of labour for the

mechanised agricultural schemes. All labour for these schemes is recruited in Gedaref. Therefore prospective labourers, from all parts of the Sudan, come to Gedaref in order to find employment. Some of these labourers stay in Gedaref for an extend period to find successive jobs and only return home after the harvest. The major sectors of employment in Gedaref in 1973 give an idea of the distribution of labour within the town. Of course the figures are backdated: e.q. the 200,000 to 300,000 seasonal wage-workers at the mechanized farming schemes of today not included.

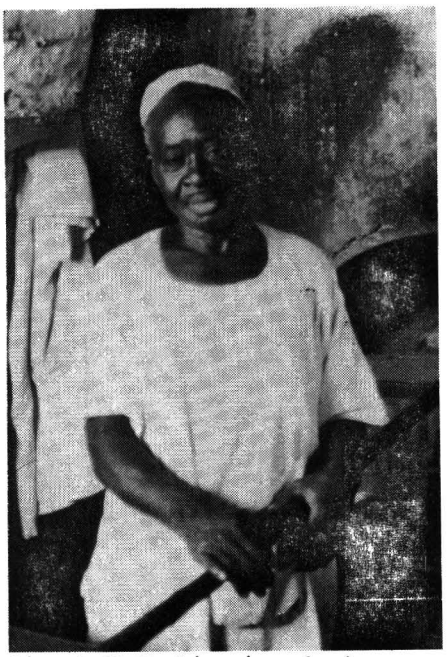


Fig. 3.41 Working in a backery

Sector	Economically active population.	
1. Agriculture and Forestry	5,211	25.0
2. Mining & Quarrying	31	0.2
3. Manufacturing	2,514	12.1
4. Electricity, Gas & Water	276	1.3
5. Construction	833	4.0
6. Wholesale retail trade, Restaurants and Hotels	3,631	17.4
7. Transport, Storage & Communication	1,931	9.3
8. Financing, Insurance, Etc.	259	1.2
9. Community, Social and Personal Services	5,590	26.8
10. Others	550	2.6
TOTAL economic active population	20,826	100.0

Source: Census 1973.

As for the education of the population two groups may be distinguished. The older generation has, in general, received no education or only a few years of education through the Koran-school. The younger generations are receiving more and better education. In the past decade a public education system has been set up. As a result about 75% of the children receive primary education. Education is considered to be very important by many people as it increases job-opportunities. Secondary education is limited to 30% to 40% of those that receive primary education. After secondary school some of the students can go to one of the universities of Khartoum. But the insufficient education level of the secondary schools and the necessary financial contribution often constitute an insurmountable barrier. The scarcity of jobs for educated people in the Sudan make it difficult for students to

find a place in society after graduation. Many young, skilled and higher educated people find work in the Gulf States where they can earn 5 - 10 times as much as in the Sudan.

The health of the majority of the population is not optimal. Several factors are involved. There is qualitative undernourishment. The nourishment situation is particulary critical during the droughts. A large part of the population depends on external aid, to varying extents. People are prone to waterborne diseases as the quality of drinking water is often very low. Sanitation in the low class areas is unhealthy. Working conditions on the mechanized schemes are bad. On top of this, the health facilities to cope with disease and illness are limited.

The accessibility of public services is also limited for the largest part of the population. Only 30% of the population of Gedaref is served by piped water. The other part of the population has to buy its water from watervendors (donkeymen). Water from a watervendor is, depending on availability, 25 to 100 times as expensive as from a private connection. On top of that, water from watervendors is of worse quality than from the watersystem. In general, those with less income have to pay more for a watersupply of lesser quality.
The situation is not much different for the electricity supply. Only 15% of the population is connected to the electricitynetwork. The network is not extended throughout Gedaref but is concentrated around the centre. There is only a very limited supply of hardware and initial costs for a connection are very high. Although electricity may be regarded as luxury, regular supply of electricity to health centres, schools and social clubs is desirable, but in practice often absent. In most neighbourhoods the electricity network is supplemented by an informal network of small privately-run generators. Use of such a system depends largely on the economic position of the neighbourhoods inhabitants.

Recreational facilities are also limited. At the moment the main facilities consist of waste land used as football fields and the social clubs. The official football fields are very limited in number and the contribution of social clubs, as little as it may be, is too costly many people. In general, access to

formal recreation is reserved for a small part of the population. The commercial centres also serve as a recreational facilities.
The level of public and commercial services also differs. Only schools and, where present, health facilities are used to their full extent by neighboorhood inhabitants. Other services are obtained in the town centre.

Dynamics.
Most of the activity in Gedaref takes place during the early morning with a break between nine and ten o'clock for breakfast. Everyday there is a large influx of people from outside the town who disappear in the evening. The central souq with the daily foodmarket is very crowded. Offices are open until about two o'clock. During the afternoon the town seems deserted, because of the heat most people stay in their homes. Late afternoon streetlife starts again, people gathering together, children playing foodball, teahouses and restaurants are visited. After nine o'clock in the evening the streets are empty again.

The time of the year is very important for what actually happens within the town. Most striking is the large influx of seasonal workers at the beginning and end of harvest time. The town therefore experiences a unique pulsative increase of population. Seasonal workers are mostly contracted by the farmers at the central souq. During this time of year many people from outside the town sleep at public places in the open air. At the end of harvest time busy activity takes place at the regional crop-market, causing an intensive traffic of heavy trucks to and from this area. After harvest time most of the building activities take place because of the availability of dura and straw. At the end of the dry season the general situation in the town gets worse. People run out of money, because there is no agricultural activity. Moreover the watersupply gets worse, prices of food and water rise, fodder for animals gets scarce, the crime rate rises, etc.
At the end of May, the rainy season starts. Transportation is very difficult, the town becomes isolated from its hinterland and activities within the neighbourhoods or at the market areas are hindered, because of the bad drainage situation and the weakness of the wet clay.

In relation to the steady growth of the popu-

lation there have become some other changes over the years. Especially successive dry years have had and will always have a great impact on Gedaref. This causes a great influx of drought refugees. Drought also means no harvest and as a result less employment, less economic activity and higher food prices. During the years of drought there is also less building activity. Another fluctuation is for example the political situation. The Ethiopian/Eritrean conflict, resulted in a flow of about 30,000 refugees to Gedaref in the last years, most of them settling in the Tawawa refugeecamp.

It may be concluded, that the climate has a great impact on life in Gedaref. It not only influences the division of the days and the years, but also the trends over the years. The activities caused by the seasonal agriculture are a good example. Towards the end of the dry season and especially after some dry years, live is hard for most people in Gedaref. Through the year especially the poorer part of the population has to faces problems like underemployment, bad working conditions on the fields, overburdened public facilities, and a high inflation rate. Notwithstanding this diffucult situation, the town is growing fast. It will probably double the next ten to fifteen years, with all the problems involved.

3.3 Economic aspects.

National framework.

The economy of the Sudan basically depends on agriculture. Around 85 percent of the population gets a living from agriculture. Agriculture forms more than 40 percent of the Gross National Product (GNP). Other economic activities are e.g. trade and finance (21% GNP), public administration and defence (13% GNP) and manufacturing (9% GNP) (1970 - 1977). Sudan is one of the poorest countries in Africa in terms of per capita income. It has a huge balance of payments deficits, and a mounting backlog of debt. During Nimeiris rule, agricultural production and services have suffered rapid deterioration, manufacturing production has been levelled down by foreign currency constraints, imports have reached a level more than twice the country's capacity to export and an unprecedented immigration of skilled and semi-skilled workers and professionals to neighbouring Arab states had occurred.

The severity of Sudan's economic crisis is seen in the fact that the annual growth rate of exports was negative (-5.7%) during the period 1970-1980, while that for imports was increasing at 3.5 % annually. By 1980 the balance of trade deficit stood at the equivalent of over a billion US dollars. There is a steady deterioration of the balance of payments:

year	73/74	74/75	75/76	76/77	77/78	78/79	79/80	80/81	81/82
deficit	-30.5	-160.5	-107.6	-15.1	-42.8	-77.9	-133.8	-182.9	-310.6

(Bank of Sudan, Annual Report #20,21 and 22)

This together with an unfavourable world market situation during the 1970's made Sudan's external outstanding debt amount to US$ 6.3 billion by december 1982.

Some causes for the deterioration of the economic situation are the poor performance of the agricultural sector, combined with a lack of foreign exchange, inadequate physical and institutional infrastructure and an acute shortage of financial and human recources.

The poor performance of exports in the 1970's was mainly caused by the declining physical output of all major exports from the irrigated modern sector of agriculture. There was also a stagnation of traditional rainfed agriculture. Investment in agriculture has been essentially in the mechanised rainfed sector, and also in

some irrigated schemes (Rahad and Suhi). Outputs have been strongly influenced by the droughts.

Industrial investment has been limited and industrial production has remained virtually stagnant over the last years. Most factories operate far below their capacity. Causes are demand problems, lack of fuel, electricity shortages and cuts, unavailability of imported raw materials and spare parts and shortage of foreign exchange in general. All these not only affect the level of production but also the investments.

Within the picture of overall stagnation there is one index that shows great buoyancy: that of prices. The Sudan has witnessed in the last few years extreme high rates of inflation. Faced with the crisis the government resigned itself to the dictates of the IMF and the World Bank. By the end of 1982 the Sudanese pound was devaluated by 31 % and subsidies on essential consumer goods and agricultural inputs had been removed. It is not certain whether the IMF is capable of bringing a halt to the process of rapid deterioration of the economy, or, alternatively, whether its proposals will further deepen the crisis. It is not yet clear what the policy of the newly elected government (April 1986) will be.

As for human recources, a large number of people have emigrated to Saudi Arabia to find employment and generally better payment. This number is estimated between 1.1 and 1.6 million. These numbers must be seen in relation to a total population of approximately 18 million, a labour force of around 5.58 million, and an urban labour force of little more than one million. A serious "brain-drain" of professional and skilled workers.

The Sudanese Government and the public sector corporations are major urban employers, even though they do not account for the majority of urban workers. Being the largest employers they set the tune for organized private sector employment as well as the general basis for working conditions. Thus it is signifcant that within the public sector the pay structure is not determined by market supply and demand forces but institutionally. Until some years ago a system of guaranteed employment for graduates operated. This has led to a top-heavy administrative structure and substantial, disguised underemployment in Government and in some public sector corporations.

Wages are usually determined in companies by

"collective agreements" between representatives of the workers and of the management. Most factories pay more money for unskilled labour than the goverment does. The influence of trade unions has been significant (e.g. representatives in town-councils).

Gedaref area

During the last 20 years Gedaref has become the most important area in the Sudan where high profits in agriculture can be made. The introduction of mechanised farming in the area in 1945 was a turning point for many traders, who started investing in this type of agriculture.

Fig. 3.42 Women on the cropmarket shifting rests

The first mechanized farming schemes were operated by share-croppers. They were started for the purpose of producing food for British army units stationed in East Africa in the latter years of the Second World War. From then a rapid expansion of the area under rain-fed mechanized farming took place. The private sector was encouraged by the state to get engaged in mechanized farming and many merchants and notables were attracted in view of substantial profits. Through the Mechanized Farming Corporation the Government gave substantial assistance at every stage of agricultural operations. The state constructed roads, made available research results and gave free advice in agricultural techniques. Finally, it offered loans, through the state-owned Agricul-

tural Bank to finance operations. In 1975 the World Bank and IDA provided loans for further expansion of private farmery. Although the state invested in mechanized farming, private farming dominates.

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state schemes	private schemes
3%	97%

The Government was unable to cope with the expanding demand for more land to exploit. Thousands of feddans outside the areas allocated by the Government are cultivated. Figures for the 1985/'86 are an expected 2,000,000 feddans unplanned and 1,500,000 feddans planned cultivated land in the Gedaref area. (National total: 4,474,000 planned; 3,100,000 unplanned (SudanNow Vol.10,F10)).

On investgations carried out in the Gedaref area, mechanized farming was found (F.B. Mahoud, 1984) to be more profitable than other forms of agricultural production. The net profit from a single scheme (1,000 feddans) was estimated to be L$ 2,260 per annum in 1967 and L$ 7,200 in 1976. In Gedaref, the private investors who cultivated outside the planned area or owned more than one scheme, were estimated to be no fewer than 10. These mostly cultivated areas of 1,000 to 5,000 feddans each while two of them exploited areas of as much as 10,000 feddans each. Private investors include next to traders civil servants, former civil servants and pensioned army officers.

Recruitment of seasonal labourers is generally carried out by growers associations, one of the main tasks of such associations. Also self-recruiting labourers assemble in major towns near schemes, like Gedaref, where they are contracted and employed by recruiters, who then truck them out to the schemes. Workforce is supplied by immigrants like Hausa's from West-Africa and peasants and pastoralists who have been facing seriou problems of declining productivity. This makes them dependent on markets in general and wage labour markets in particular. Also Eritrean and Ethiopian refugees in and around agricultural schemes form permanent pools of wage labour.

Last years dura prices have been very high because of the drought, only after the 1985 season with an abundant rainfall prices fell down and the Government had to intervene and establish a minimum price. In Gedaref the most important cropmarket of Sudan is located. At

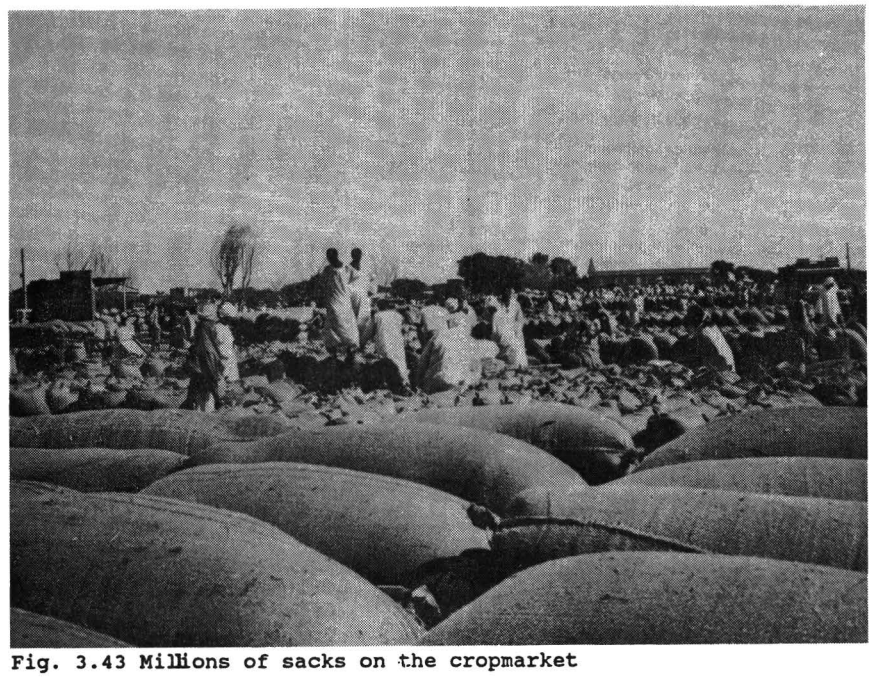


Fig. 3.43 Millions of sacks on the cropmarket

auction starting with the official minimum price dura and sesami is sold. Tax is paid on each sac and half this money goes to the administration of Gedaref town as an important source of income. Cropmarket administration is also responsible for prevention of illegal selling of crops which regularly happens.
Limiting factors for the agricultural production are on short term problems with fuel supply, supply of spare parts and seeds. On the long term environmental degradation, especially soil condition will decrease crop production.

Gedaref Town
During the last 20 years, Gedaref has become the most important area in the Sudan for private agricultural capital accumulation. As the leading area in the country for mechanized farming, Gedaref also aquired importance as a commercial centre. The accumulation of private capital is expressed in the large and increasing number of banks in Gedaref; the commercial activities and big and luxureus houses.

A sharp contrast forms the obvious insufficient means of public insitutions and services, the extended residential areas where seasonal labourers, small subsistence farmers and others live under very modest conditions.

Next to agricultural and commercial activities there are some small industrial activities in

Gedaref. A sweet factory, a groundnutoil factory and an ice factory next to a large number of workshops. Development of an industry is blocked by the inadequate water and electricity supply and other means of infrastructure. But also investment is discouraged by the instability of prices, problematic fundfinding, high prices (e.g. building materials) and other causes at national level.
The only expanding category of urban economy in Sudan is the area where the increase in demand is so great that operations are profitable in spite of supply constraints; such as construction, transport, hotels and restaurants and other services. Especially with the money that private people have aquired in agriculture or through working in the Gulf states these categories offer oppertunities for development of the town.Investments however are untill now inadequately encouraged.

Infrastructure will have to be provided by local government. As mentioned before, local government has very limited means to carry out her tasks. Its sources of income are rent from housing, storehouses, licences and a share of the cropmarket tax. Only most urgent maintenance works can be carried out.
Working conditions for government employees are very poor. Offices and equipment are often old and in poor condition. Salaries are low compared to salaries paid in agriculture and private enterprises. This forces employees to provide their families with an extra income through informal activities. A large number of people get their income through informal activities. This ranges from women who sell homemade products to military personnel that exploit a piece of cultivated land.

Prices for urban land have developed although almost all land is government owned and given out in lease-hold. The value of the land depends on what is built on the plot, availability of water and electricity and distance to the towncentre. Prices for a plot vary between L$ 2,000 and L$ 100,000. Prices for plots in the market area (shops) go even higher.Selling publicly owned land could provide an important source of income. Gedaref town, however would not profit from this since all revenues of this character are flowing to the national treasury.

Centre of economic activities is the central market area with bank located at its periphere.

Basically commercial activities take place in this area.
Activities like wholesale, repairshops, maintenance of lorries and agricultural equipment are located in the old industrial area.
A new centre for car and lorry maintenance is developing at the entrance of the town, along the Khartoum- Port Sudan road.
The new industrial area houses the two factories Gedaref has and is mainly used for storage of agricultural products.

Next to the central market, 9 small commercial subcentres exist in the neighbourhoods. In the neighbourhoods itself one may find several shops, bakeries and other activities often in the informal sector where people make a living by making mats, baskets and other things. Often seasonal labourers open a shop or sell goods with money they have saved during the harvest season to have an income through the rest of the year.

The economic climate of Gedaref is untill now very much fluctuating with the annual agricultural outcome and very dependent of the national economic situation and policies.

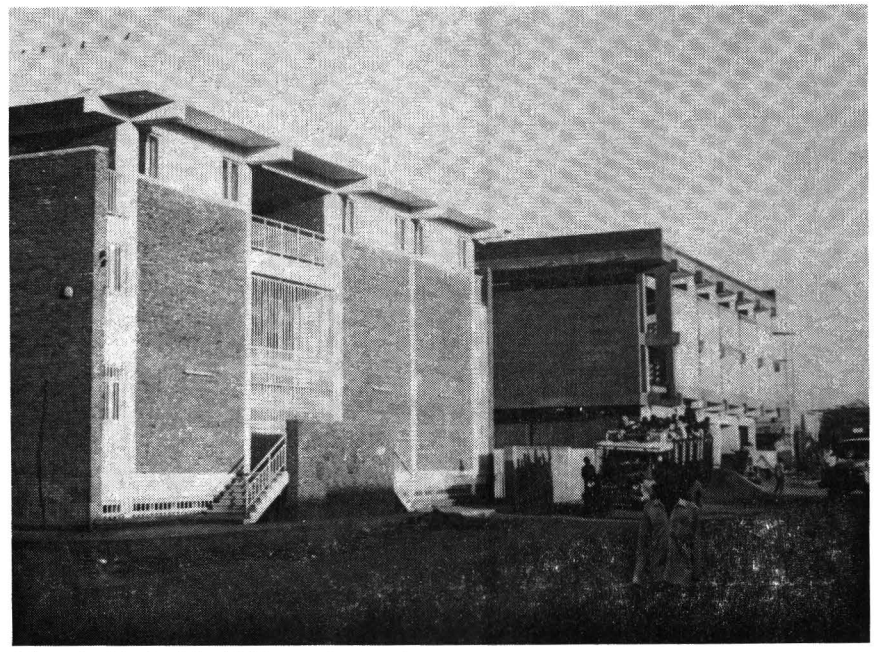


Fig. 3.44 Bankbuildings Central Souq

3.4 Government.

The national organisation.

The government of the Sudan is organized at 4 levels: the national level, a regional level, a provincial level and a district level. The Each level has its own responisibilities and budget.The local governments have to remit a part of their revenues to the central government in Khartoum. The central government budgets these funds and channels them back either directly or through the regional level, to the local government.
The provincial level of government has only recently been introduced as part of an attempt to decentralise government administration. However, this decentralisation faces problems. The flow of governmental funds has not been decentralised, as a consequence lower governmental levels have limited possibilities for budgetting. Another problem of the decentralisation is, that parts of the government are not (yet) decentralised. The Departments of Planning, Electricity and Water, Police, Public Housing and Works, Survey and the Landoffice are directly responcible to their respective ministries at national level. All these departments at local level are in fact the local representitives of the ministries. These local departments however are in some cases dependant on the local government concerning housing and working-stock. An entire different situation exists in the case of the water and electricity and water departments. Recently these have been reshaped into public coorporations, with branche offices at local level. In this situation it is difficult to define clear responsibilities and tasks between the departments on the several levels. All this, together with the a general lack of funds and shortage of experienced personel, makes the government of the Sudan hard to conceive.

Gedaref Town.

Gedaref Town is located in the Eastern Region, with the regional government stated in Kassala Town. The Eastern Region is divided into the Red Sea Province and Kassala Province. In Kassala Province the Gedaref (or Southern) District is located. As a result of the recent decentralisation, the Gedaref District Council as well as the government of Kassala Province are stated in Gedaref Town.
The local government of Gedaref Town consists of the Municipality, the Municiple Offices and

the Departments of the Central Government.
Before April 1985 the municipality consisted of the Gedaref District Town Council, with 33 elected representatives from neighborhoods, 4 members appionted by the governer and 6 representatives of the Trade Unions. The Town Council was responsible for the local policy and adviced the departments. Formaly there were 4 municiple departments responsible to the Town Council: Health Office, Building Office, Education Office and Municiple Administration Office. The local departments responsible to the central government are: Departments of Planning, Public Housing and Works, Electricity, Water, Police, Survey, Railway and the Landoffice. Furthermore there are the Labour Office and the Landregistration Office carrying out administrative tasks only.
After April 1985 this this structure has temporary been centralised because of the political situation in the Sudan. The Town Council was dissolved. That position was taken by the Executive Officers of the four Municiple Offices.
The sources of income of the municipality are the issue of licences, the collecting of taxes from the cropmarket and remittances from the central and regional government. The amount that is left for public spending, after deduction of overhead costs, is rather limited leaving little (financial) space for policy excecution. As we have seen, the organisation structure of the municipal offices and the local departments is different. In this situation it appears difficult to define clear responsibities and to coordinate the local policy definition and execution. And although the Town Council can direct the policies to health, education, building and administration, effectiveness in these fields is limited due to the shortage of funds. As a result the initiation and execution of policies seems to depend on the actions of individual governmental officials rather than on coherent government organisation.
The main policy that is in progress of execution is the replanning program. This program is started in 1981, aming to regulate plot-ownership, reducing densities and to improve the level of public utilities and services. It involves all unplanned neighbourhoods.

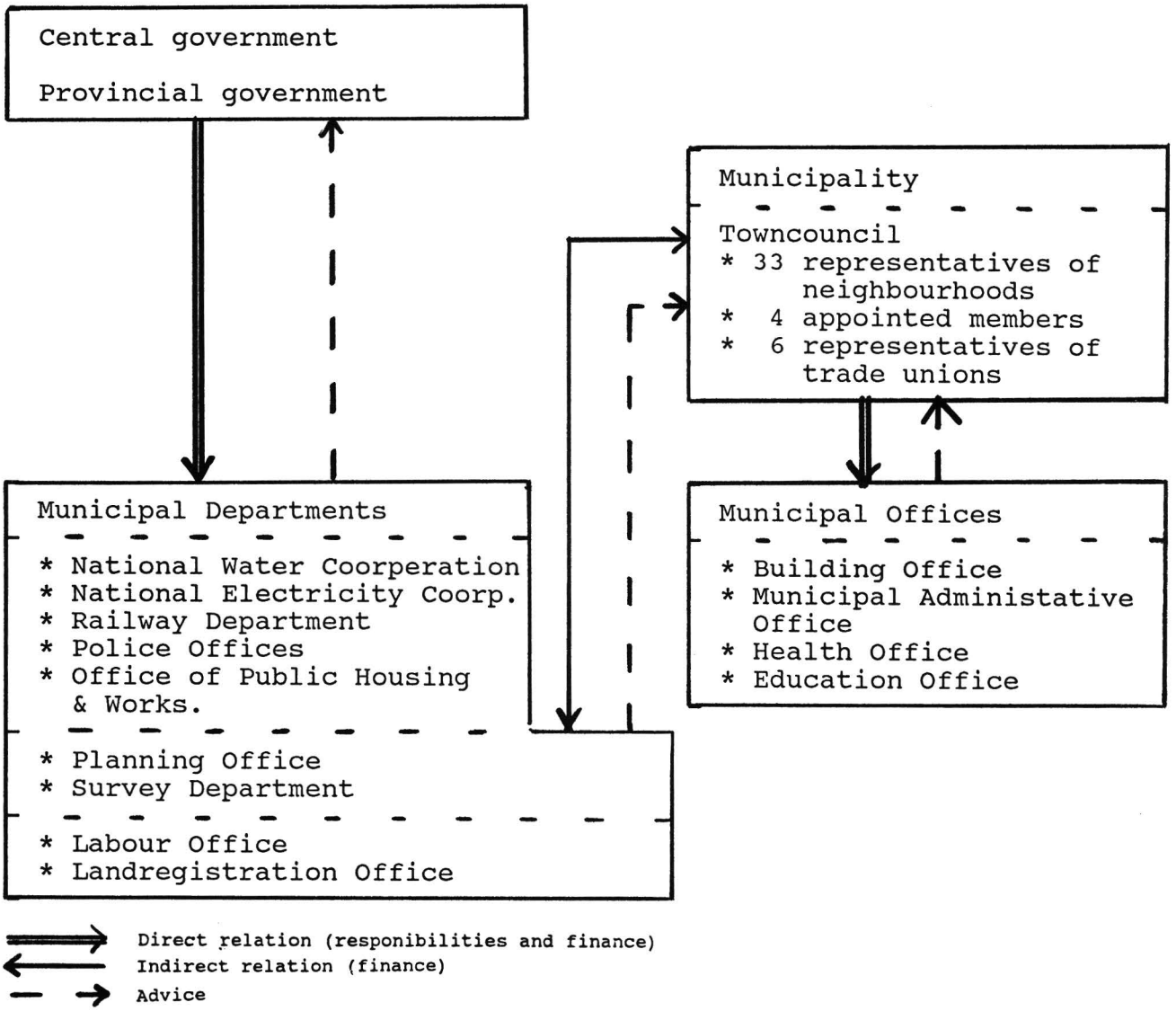


Fig. 3.45 Outline of finance and responsibilitie relations before April 1985

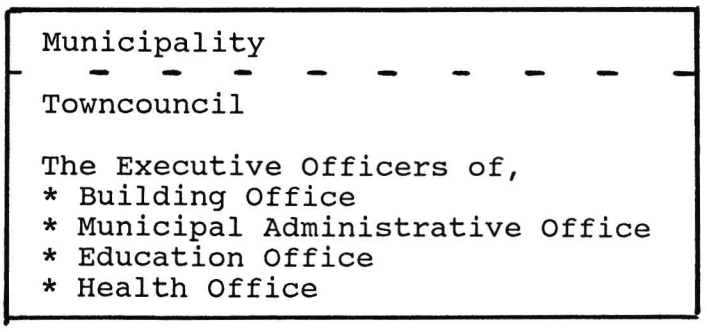


Fig. 3.46 New arrangement of Towncouncil after april 1985

3.5. NATURAL ENVIRONMENT.

In the Gedaref District occurs an area of bassalts from volcanic origin surrounded by Nubian Sandstones. The rocks of these geological formations are mostly covered by superficial deposits consisted of thick layers of heavy clays. Outcrops of the rock formations are only found in numerous isolated hills (jebels) and on the Gedaref-Gallabat Ridge. The elevations of the undulating plains on the Gedaref Ridge is 550 to 650 m. The flatter plains are gradually sloping away from the Ridge down to about 450 m near the Rahad and Atbara Rivers which respectively lie on the South-Western and North-Eastern boundaries of the district. Because of this the Gedaref area consist of two main physical features: the Gedaref Ridge and the clay plain. The Ridge constitutes the major waterdivide between the rivers Atbara and Rahad drainage system, which lies within the Eastern part of the Nile basin. Numerous seasonal streams have been formed and radiate from the Ridge. Groundwater is found to be under artesian and semi-artesian pressure locally. The Nubian Sandstone is a source of this groundwater (150 to 250 m below surface) which

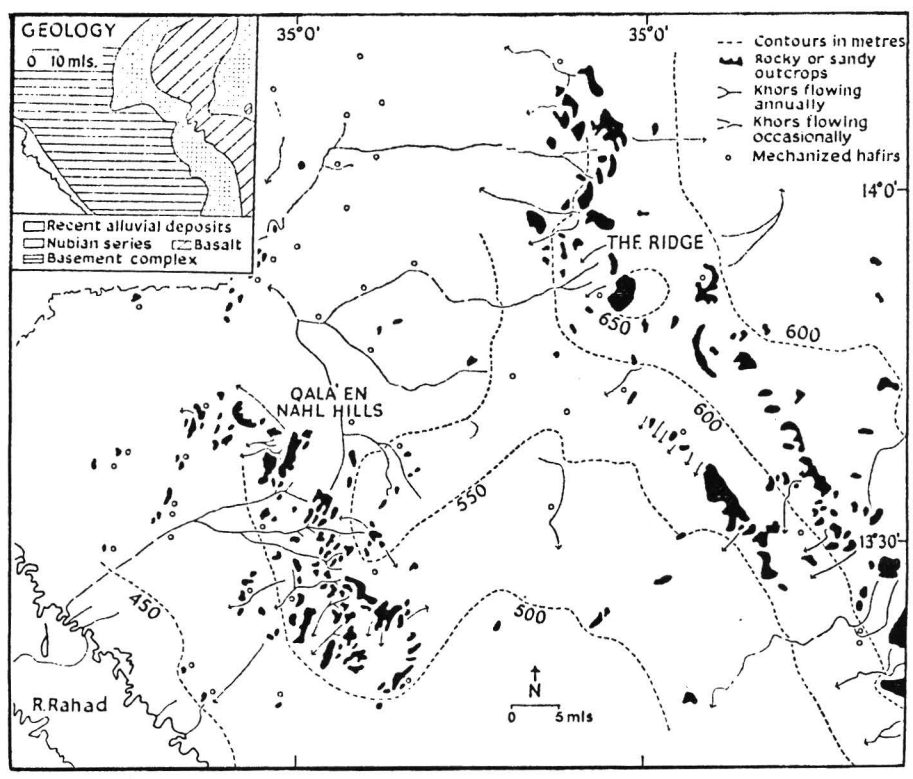


Fig. 3.47 Main physical structure of Gedaref Region
Source: Anne Graham 1964

has recently tapped by bores. Groundwater also occurs in weathered, jointed and fractured basalts, mainly under free watertable conditions (3 to 20 m deep). Recharge mainly comes from water seeping through the seasonal watercources (because of their permeability). The clay plains yield no soil subsurface watersupplies. These so called "black coton" soils are impervious to the downward movement of rainwater for more than a few feet but the water-holding capacity of the soil is very high. The soils are very hard when dry and very sticky and plastic when wet. The clay plains provide a soil which is remarkably uniform as well as being exceptionally fertile. Its heavy texture, however restricts the range of crops which can be grown and the soils are difficult to cultivate. The soils on the ridge are less suited for agriculture as they are to dry and shallow.

The climate of Gedaref District is semi-arid. Average annual rainfall ranges from 400 to 750mm (Gedaref town 579mm) which occurs almost all in the period of May to October. Rainfall decreases from South to North. Total rainfall is very variable, sometimes there are very dry or very wet years. The hottest period occurs in the months of March, April and May (40 C). Due to the coming of the rains, the temperature begins to drop down towards the end of May, reaching the annual lowest temperature in August (31 C). Due to the decrease in rainfall, the temperature rises again in the months of

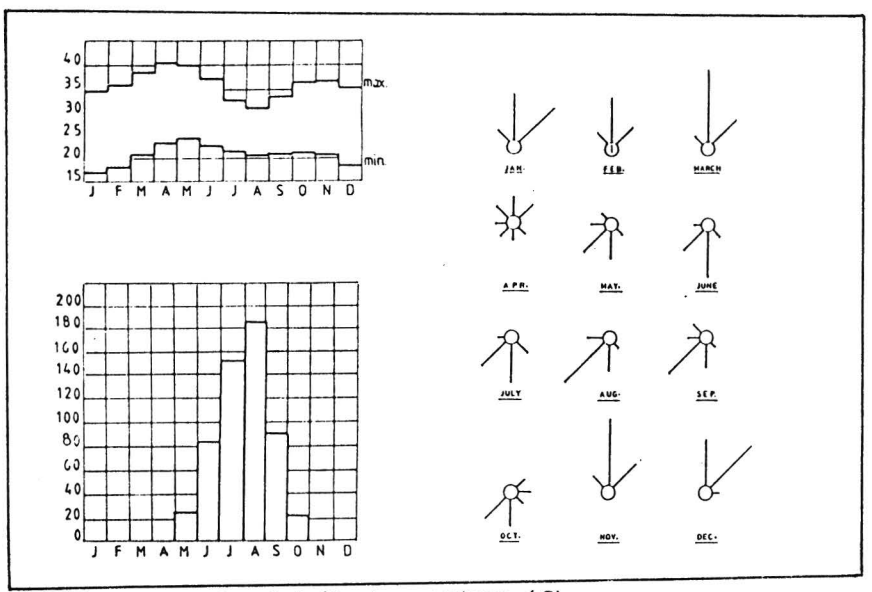


Fig. 3.48 (A) Gedaref daily temperature (C)
(B) Gedaref rainfall (m.m.)
(C) Gedaref winddirection
Source: Sudan Metrological Department.

September and October, only the start dropping with the coming of the winter where the temperature tend to be moderate (35 C). In the winter dry North-Eastern winds are blowing from the desert. In the summer the South-Eastern winds, loaded with moisture, causes the rainfall.
Because of the semi-arid environment the natural vegetation can be described as savanna land. This acacia grassland vegetation which covers the area varies according the rainfall. In the drier regions of the North it consists of short annual grasses with scattered thorn bushes which concentrate to form dense thickets along the meandering lines of seasonal watercources. Some common trees are Acacia mellifera (Kitr), Acacia nubica (La'ot), Balanites aegyptica (Heglic). Southwards there are tall perennial grasses with open decidious woodlands. Some common trees are Acacia fistula (Sofar), Acacia seyal (Tahl), Acacia senegal (Hashah) and Balanites aegyptica (Heglic).
Acacia senegal is an important tree because of its Arabic gum production. Acacia seyal is regularly cut for charcoal making. Balanites aegyptica is widespread because it is fire-resistant, hard to cut, does not produce a good quality of charcoal and has edible fruits which are collected and sold. Wood and perennial grasses are also collected for building material. In the Gedaref area much of the original vegetation has been replaced by crops or destroyed by livestock grazing.

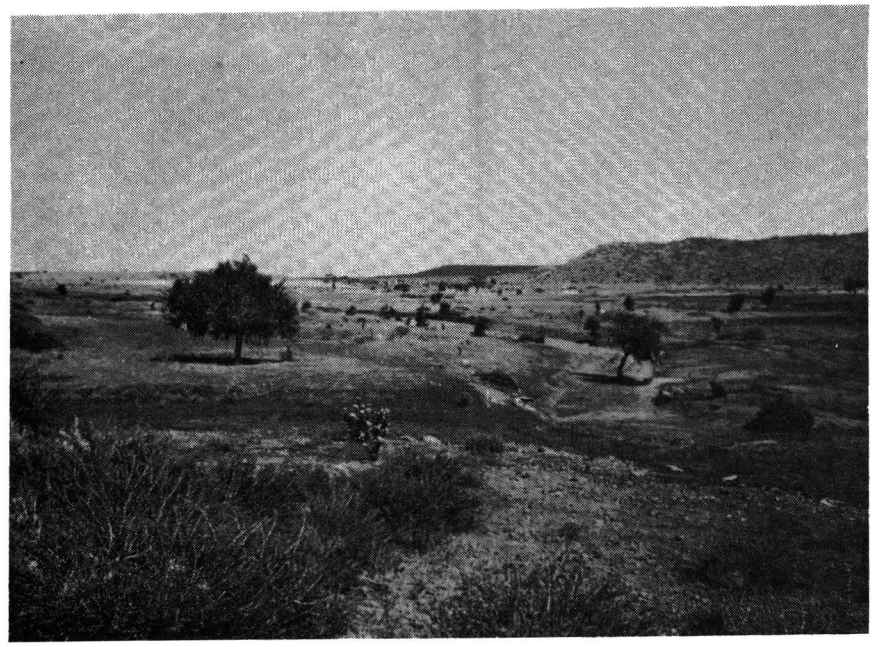


Fig. 3.48 Landscape of Gedaref Ridge

The wildlife once associated with savanna area have been removed or displaced to a large extent. Small mammals, snakes, insects, scorpions and small land birds are still common, as several types of scavenger birds. Disturbance of the ecosystemic balance led to a huge increase in the population of rats and birds which invade crops. The disappearance of some insect-eating birds result usually in infestation of crops by pest.

In Gedaref area the original settlement pattern reflects the distribution of watersupplies. Villages cluster tightly at the foot of the Gedaref Ridge, at the change from the rocky hills to the vast clay plains, because this is originally the only place where well-water was available. The low population density in the clay lands is attributed to scarcity of sources of water and the inaccessibility during the rainy season.
Although potentially available water limits the location of settlements, the detailed setting of villages is also a result of tribal, political and economical consideration.
Two methods of exploiting the potentially available water have also altered the human settlement pattern. First deep boreholes have been sunk in the rock of the Nubian Sandstone (like the Abu Nage Field near Gedaref town). Second is merely a modernisation of an old known technique to conservate water by excavating basins or "hafirs" in the clays in such a position that they are filled by surface run-off water. This last technique made some settlements in the plain possible.
In the first half on the century the construction of a railway and later on a road connection betweem Khartoum and Port Sudan (recently completed as an asphaltroad) accelerated the economic activities in Gedaref and the region. Some additional settlements sprang up along the road and railway, mostly due to immigrants.
Within Kassala Province there are three major urban growth poles: Gedaref, New Halfa and Kassala, each of them having their own hinterland with respect to economic and social services.
Gedaref is the main urban centre in the region. Some places of secondary importance are Fao Town, Quala En Nahal, Showak, Doka and El Hawata. Gedaref is connected with the villages and the farm schemes in the area through a network of dry season roads. However, these roads are inaccessible during the rainy season

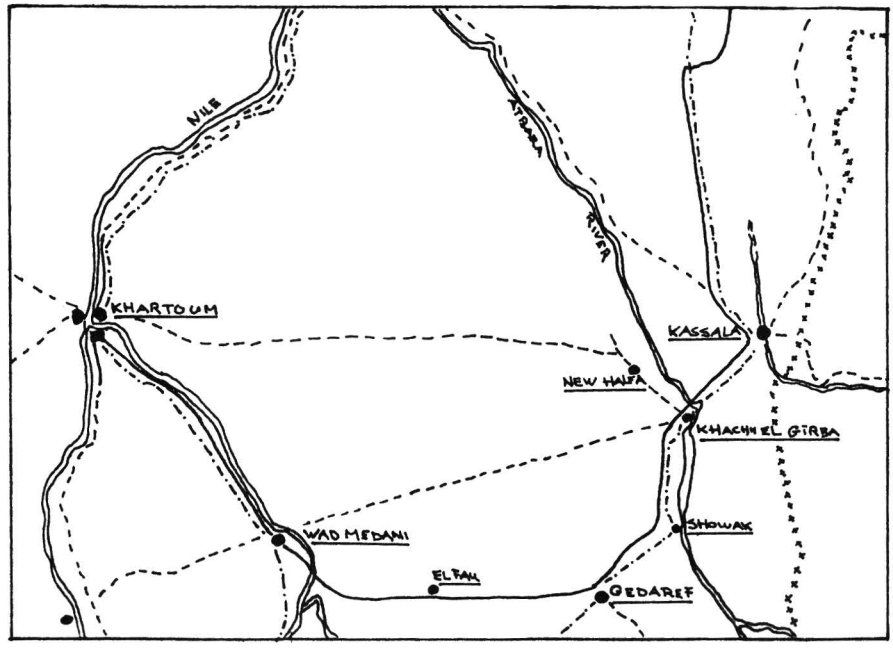


Fig. 3.49 Regional context (Source: D.H.V.)

due to the waterlodged sticky clays covering the surface area. During the rainy season parts of the region are isolated. Some major seasonal roads are : Gedaref to El Hawata through En Nahal and Gedaref to Gallabat (on Ethiopian border) through Doka.

Nearly everyone in the area obtain his basic livehood from agriculture. Dry farming is significant in areas recieving an annual rainfall over 500mm. The main crops are Dura and Sesame. Since Dura prefers a modest amount and Sesame a good deal of rain one of these crops is likely to be a succes whatever the rainfall. Dura is part of the daily food. Sesame can be used to make oil.

Growing season	No. of successive months	Percentage of occurence
July - October	4	37
July - September	3	27
June - September	4	26
June - October	5	8
June - November	6	3
Average	3.8	100

Fig. 3.50 Occurence of growing season
Source: van der Kevie, Buraymah

As a result of rainfall and evapotranspiration there is a "growing season" of 3 to 4 months. Crops are not usually planted until July. Sesame is harvested in September and Dura in December. Weeding is necessary about a month after planting. A traditional farmer can cope with about 10 feddans of land, but most holdings are smaller. Traditional farming practise alternated agriculture with long fallow periods to allow soil replenishment. Historically farming was accomplished with minimal clearing of Acacia. With increases in human population fallow periods have grown shorter.
The uneven distribution of water-supplies has produced an irregular pattern of land-use in the area of otherwise uniform physical charac-

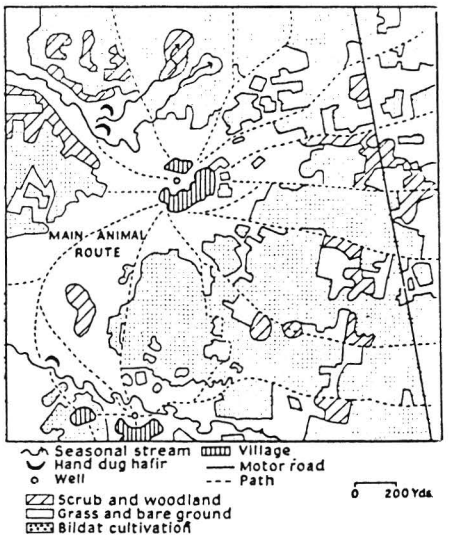


Fig. 3.51
Landuse around traditional vilage
Source: Anne Graham

teristics. Intensive used fields (bildat lands) extend outward from the village . This periphery of cultivated land seldom extends more than 5 miles beyond the village for this is about the distance a farmer can travel to daily work. An extensive system of agriculture called "Hariq" (a type of cultivation based on firing the old stand of grasses just prior to sowing) enabled parts of the waterless plain to be put in occasional cultivation.
Animal husbandery is also an important occupation found in the area. Most families in the villages have some stock at home. There are different types of grazing patterns, from local grazing around the villages throughout the year till nomadic herdsmen who travel most of the year with their herds. The nomads economy is very much dependent on the natural environment and sensitive to the wet and dry year-sequence. In the dry season there is a nomads movement from the Butana area to the Gedaref District. The clay plain provides an important grazing area.
The landuse has been radically altered with the introduction of machinery (especially tractors) for cultivation. This rapid expension of mechanized dry farming since World War II has resulted in large agricultural schemes with Dura and Sesame being the main crops. Gedaref District became one of the most important grain producing areas in the Sudan. The conviction that land (e.q. uninhabitable clay plains) was abundant did play a crucial role in establishing these schemes on extensive scale basis.
Thousand feddan holdings are rented to entrepreneurs on an annual basis for a nominal sum. The areal of mechanized farming uptil now is about 3 million feddan. Also in mechanised farming this is still done by hand, creating numerous seasonal jobs. The district receives about 200,000 to 300,000 seasonal wage-workers. The shortness of the agricultural season result in a considerable degree of rural unemployment during the rest of the year.
The original plan for mechanised farming assumed integration of contourploughing, rotation planting and windbreaks, but the institutional and regulatory infrastructure to back up such conservation measures are lacking. The Mechanized Farming Coorperation (a governmental organization) has been unable to check the spread of unplanned, unauthorized mechanized farming schemes. These schemes cover almost as much area as the planned schemes.
Scheme-unit holders must posses sufficient

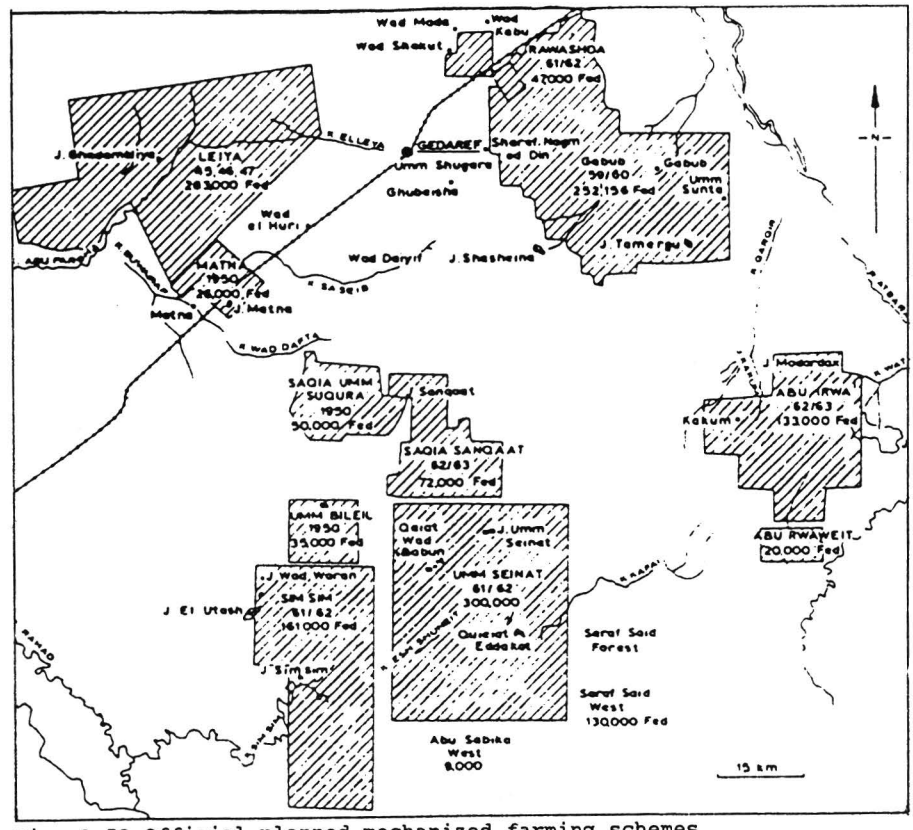


Fig. 3.52 Official planned mechanized farming schemes

capital, provide their own machinery and recruit their own labour force. They are mostly non-farmers (merchants, tribal chiefs, top civil servants, ex army officers), and are exclusively town-dwellers. Since the wealthier landowner can buy up other peoples licences, there is a tendency towards concentration of ownership. The schemes unit holders are primarily interested in quick return of their invested capital. The combination of the almost unlimited possibilities to cultivate land and the low rent does not encourage the owners to consider land as an investment. Profits coming from these schemes are often not re-invested to improve the natural resources or to add conservation practises, but rather used for investments in new land or transferred to other parts of the economy and to other regions of the Sudan. Lower yield is thought to be compensated for by a larger area undercrops. The conviction that land is abundant could have been responsible for the general lack of concern about maintaining productivity per feddan.

Over exploitation of parts of the agricultural area is becoming a major problem. The exhaustion of the soil is leading to a degredation of the natural environment and will destroy the economic basis of Gedaref Town.

The landscape of the schemes with its vast field, tree-less horizons and geometric grid of dirt acces roads contrasts sharply with the irregular, scattered plots and paths winding through the bush , which form the traditional agricultural scene. The development of the mechanised schemes has (had) important implications for the traditional agriculture. Many villages lost their harig-fields. When the schemes were established, cultivation has become more concentrated, less land is availible for the traditional scheme-rotation. Over cultivation and lower yield result. Not only have traditional farmers lost land, which they used to cultivate, but all have been faced with lower prices for their crops as a result of competition from the schemes. People also lost their holdings of gum arabic. The "Unregistrated Land Act" of 1970 stipulated that all unregistrated land belonged to the state. By this act traditional farmers and nomands lost their traditional right of land, because communal right on land-use is not registrered. This land could then be leased to investers. As a result many of the subsistence farmers became wage labourers and gave up their land. This change has brought great changes in the social structure of the region. In contrast to the huge expansion of agriculture, the spread of settlements into the plains has been more modest. But the mechanized farming has been responsible for the rapid growth of Gedaref Town. As new land was opened for cultivation, more people moved into the area attracted by the wage-work. Among them the displaced traditional farmers and nomands. This gave rise to a high rate of in-migration into Gedaref Town. Gedaref became the commercial and service centre for the agricultural sector in the district. It provides services as a regional cropmarket, industrial areas (repair of farming machinery), the agricultural banks, markets and commercial grain silos for storage.

3.6 Conclusions.

The steady movement of people from different places of the sudan to supply the necessary labour for the expansion of the agricultural schemes in the Gedaref district resulted, in combination with the high birth rate, in an enormous growth of the population of Gedaref Town. Overpopulation, in turn, causes urban proverty, underemployment during most of the year, and a shortage of urban services, such as watersupply, waste disposal, drainage facilities and transport facilities. These problems are compounded by inadequate shelter. The standard of living of the new urbanized population is very low; it approaches the poverty line. Most of the household budget is spent on food for daily living. Besides this mass urban poor we can find some very rich people in Gedaref, earning money on the mechanised farming and speculation with dura and sesame during period of hunger. The rapid growth of the population also causes change in traditional cultural patterns. Especially because the population of Gedaref nowadays consists of people from many tributary origin. As a result the social unity of neighbourhoods is declining and with that the traditional laedership of chiefs. Many people who live in Gedaref have a recent rural background. Their more rural way of live conflicts with the high densities of the central parts of Gedaref. Still public space is used for human waste disposal, causing problems with healthcare. The general way of housing consists of several grass roofed huts (gottias) on a plot of land with fences. The fact that people can be their own houses must be regarded as an advantage, but this way of housing causes strong horisontal expansion of the town and a high fire risk. Both problems also have to do with the clay structure of the siol, troubling the construction of pit-latrines and permanent housing. The strong dependence of the town on agriculture causes a vulnarable urban economy. The succession of some dry years, and especially exhaustion of the soil have disastrous effects on the economy of Gedaref Town. In general there is a lack of investment of private capital. Profits that are made through agricultural food trade are reinvested in other parts of the country or even abroad. Most of the taxes on agricultural products flow to the central government and can't be used for local governmental intervention.

The physical setting of Gedaref Town causes major constrains for the development of the town. The pressance of the Khors hinders the accessibility and urban growth within the town Frequent flooding has caused a lot a damage. Because of the waterlodged clays, the drainage condition of Gedaref is problematic. The condition of the soil is also not suitable for the construction of roads and permanent buildings need an expensive foundation. The use of fuel wood as the main source of energy, has a distructing impact on the environment. As the forests around Gedaref has been used, the fuel wood is becomming scarce and has to be brought to the town from far away. The expansion of the town, the high population pressure on the surrounding land and the exhaustion of the siol through the mechanised farming causes environmental degradation.

Due to the rapid expansion and the physical setting of the town, there is a lack of comprohensive urban structure. The town is spread out over a wide area sothat long distances have to be bridged to provide the town with public utilities like roads, waterpipe connections or a waste disposal system. Because of the strong centralisation of commercial activities in Gedaref, the main souq with its limited space is overcrowded. The radial pattern of the main roads leading to the centre conflicts with the East-West pattern of the Khors. Although some neighbourhoods are overpopulated, there is still ineffecient landuse in other parts of the town. The spacial organisation is not always optimal, for example the railway area and military area in the centre of the town, the location of the old industrial area, the absence of small market areas in some neighbourhoods or the spatial distribution of public standposts. Plotsizes and the strict division of residential areas in four classes can sometimes be regarded as discutable. Although most of the land is owned by the government, leaseholds are sometimes sold at high prices. The output of these open auctions however flow to the central government.
The functioning of the local government and the implementation of physical planning is hindered by confusion of adnministrative organisation and responsibilities. The confusion about decentralisation measures of the central government contributes to this. An example is

the approval of plans by local and regional departments and commitees.
The main objective of the replanning program are the improvement of the urban structure and the legalisation of landtenure. It is also seen as the first step in the provision of public standservices as water and electricity. A replanning plan is already made for most of the neighbourhoods, but most of Gedaref is still unplanned. Indeed physical planning must be regarded as a difficult task. Growth and change are processes which can be influenced only partly by physical planing. Moreover the limited data makes forecasting of future events difficult and is a constrain for the planning of the development of Gedaref. Most important problem seems the lack of financial means: the local government has to deal with a limited budget and the majority of the inhabitants are very poor. The lack of material and skilled manpower makes the situation even worse.
The execution of plans is confrontated with problems in term of finance and organisation. The replanning program illustrates this; no capital is available for basic infrastructure although the implementation of public facilities was an important aim of this project.

Summary of main problems.

Public utilities	- Shortage of watersupply(lack of resources, capacity and distribution network). - Bottlenecks in existing main road system and inadequacy of this system. - Poor quality of neighbourhood roads. - Lack of waste disposal and sanitation facilities. - Inadequate floodprotection. - Lack of drainage facilities. - Shortage and unreliability of electricity supply.
Urban structure	- Strong horizontal expansion of the town. - Use of unsuitable land for housing and other activities inside the town. - Inefficient land-use and spatial distribution of activities. - Spatial segregation due to physical obstacles(e.g. khors). - Strong centralisation of activities in the central souq area. - Bad access to cropmarket and industrial areas.
Environment	- Exhaustion of natural resources(agricultural practices, deforestoration and overgrazing). - Expansion of the town on arable land. - Pollution of public land inside the town.
Economy	- Vulnerable urban economy(dependency on agriculture). - Underemployment. - Standard of living often under poverty line. - Lack of investments.
Population	- Rapid growth of population(natural growth and immigration). - Population changes due to influx and outflux of seasonal labourers throughout the year. - Mixed population with different cultural values. - Bad access to services for large parts of the population(health care, education and public utilities).
Housing	- Overcrowding of plots. - Cost of permanent buildings.
Government	- Lack of means(financial, material and skilled labour). - Inadequate administrative organisation. - Unclear definition of responsibilities. - Local government depands strongly on the central goverement for funds and permissions.

Chapter 4: FUTURE DEVELOPMENTS

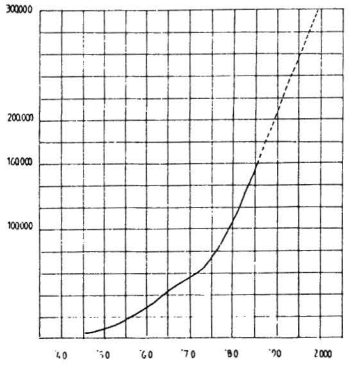


Fig. 4.1 Extrapolation of population growth

Introduction

The forecasting of future events of Gedaref Town is very difficult due to limited data and uncertainty about the economical and political situation. For making a development plan, however, it is indispensible to have a reliable indication of what is likely to happen over the next five to ten years. Examples are increase in future population, consumption of water, and future patterns of traffic movement and economic growth. In this chapter we attempt a global picture of the developments which have the greatest impact on Gedaref.

The population growth will dominate the future development of Gedaref. With the existing growth rate, the population will double every 10 to 15 years. This would mean an expansion of the residential area by about 100 hectars every year and increase the demands on the infrastructure and public services.

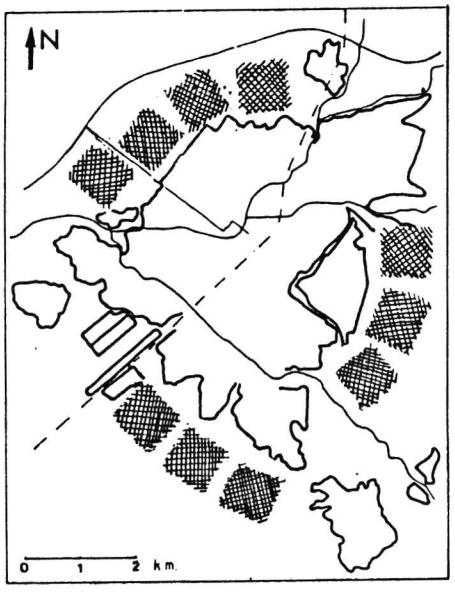
Altogether, an increasing pressure on the whole urban system seems inevitable. The implementation of primary infrastructure is the only way for the local government to guide development. A well defined structure of unpaved roads and reserved public spaces are tasks that can be carried out with the limited means of the local government.

External help for the local government will be needed to face the consequences of this population explosion in aspects such as water supply, health care and employment.

Description

Gedaref will develop its position as commercial and service centre for the agricultural sector in the district. It will also become the administrative centre of the Gedaref Province. The Khartoum - Port Sudan highway will increase the economic opportunities of the town. Gedaref will remain the main urban centre of the region and will grow more rapidly than any other village in the area. Only rural development, like improvement of the rural water supply, improvements in access, services and support of small farmers, which is highly recommended, can spread some of the population to the other villages in the area and slow down the growth of Gedaref.

The annual growth of the population of Gedaref is about 6 to 8%, of which 3 to 4% is natural growth. About 50% of the population is under the age of 21. If we make an extrapolation of



Area of 100 hectare

Fig. 4.2 Area of extension needed untill 1995

these figures, this means that. By the year 2000 the population will exceed 300,000 inhabitants. For the government it is very difficult to restrict this population growth. Due to the lack of all kinds of resources (like water) it can be stated that this size of population will cause great problems. A decline in quality of the urban environment is to be expected, at least without external help.
Over the next ten years, the growth of the population means that about 1000 hectare will be needed for new residential areas (100 ha/-year). For the coming years a strong horizontal expansion of the town is expected - this is also the result of the ongoing replanning program. It can be expected that, as long as the new extensions are not provided with basic services like piped water and good access roads, densities in the existing neighbourhoods will rise. This may cause social tension and serious health problems. The increase of population will result in more third and fourth class neighbourhoods.
Without a reconstruction plan for the market area, this place will become even more overcrowded and small shops will disappear due to high prices of leases. Extension of grain-storage capacity and light industry based on agricultural products or services, are expected in the agro-industrial area. Improvement in the accessability of this area and the provision of water and electricity are the only way to stimulate investment of private capital in new industrial activities in this area.
In the highway service centre some new economic activities will develop like repairshops, restaurants and probably a petrol station. Due to the expansion of the town the agriculture on the edge of the town will become more marginal. Because of uncertainty as to the right to land, small farmers will not invest to improve soil fertility or make other long term improvements. As a result, the land will be even more threatened by erosion. Extension of vegetable gardens will become more profitable because of the intensive land use and the high price of vegetables.

Due to the young population of Gedaref the situation of underemployment will continue, or even get worse. Employment opportunities in the agricultural sector will not rise with the growth of population because of more mechanisation of the agriculture and exhaustion of the soil. The many refugees of Tawawa provide cheap

labour for the agricultural schemes. Employment in the administrative and service sector will increase but on a relatively small scale. Most people will therefore, also in the future, depend on the informal sector. Due to the ecology of the Gedaref area, prices for building materials and fuel wood will increase rapidly. The general standard of living will not increase.

The most striking problem, now and for the next 10 years is the shortage of drinking-water. The growth of the population will necessitate the expansion of the resource capaci ties. The standard of 50 l. per person a day (W.H.O.) seems out of reach. The Abu Naga wellfield cannot be expanded forever. A second pipeline from Showak to Gedaref must be constructed, or new sites for resources near Gedaref have to be found. Another main reservoir must be built, for example on the hill near El Malik. The distribution network must be extended in order to provide water to the increasing population of Gedaref.
In general it can be stated that the water supply is the most crucial factor in the growth and development of Gedaref.

The number of trucks and private cars will increase in the near future. With the expansion of the town, the network of boxes will expand. Especially in the centre of town, this will cause traffic congestion and parking problems. More motorised traffic will conflict with pedestrian use of the main roads.

The health situation is much influenced by the provision of water. If the watersupply cannot increase with the growing population, serious health problems are to be expected. Expansion of the health service centres and especially health education, can improve the health situation. It is to be expected that in replanned areas (where land tenure is legalised) people will be more willing to invest in improvements of the health situation, by building latrines or contributing to the garbage collection. In the centre of the town, due to overcrowding and lack of sanitation facilities, the health situation will get worse.

Without planned development, growth of the town will be in a West, South-West and North-East direction. Because of the horizontal expansion of the town, it is difficult to provide public

utilities. The mainroads to the centre will become more important. More commercial sub-centres are to be expected in neighbourhoods that have bad connections to the town centre. Gradually the building techniques will change and more houses will be built of permanent materials like corrugated iron and brick. More multistorey buildings are to be expected. The division between residential classes will then become more apparent. With these permanent structures a plan is needed. The locations of the railway and military areas will become very problematic.

From statistical distribution figures it can be stated that serious floodings like 1973 (871 m3/sec.) have a recurrence interval of 25 years. The discharge of 1,000 m3/sec. has a 50 year interval period. In the near future it will only be possible to remodel the khor cross sections to handle 500 m3/sec. (recurrence interval 5 years). This means that the local authorities and the population of neighbourhoods along the Khors should be concerned with flooding. The efficiency of flood protection works depends on their continued maintenance.

As we saw in the years 1983/1984, drought can have an enormous influence on Gedaref. Gedaref is especilly 'drought sensitive' because it is an agricultural town. A drought seems to occur about every 10 years. With a growing population and no governmental measures like food-storage and provisions for 'drought refugees' this may cause a catastrophe in the future.

The growth of Gedaref needs a more adequate administrative structure, an increase of the town budget and more skilled manpower. If not forthcoming, the design and especially the execution of plans, will be very difficult in the near future. The new physical and urban planning law (1985) will have consequences for the planning of Gedaref. Whether the democratic system of elected representatives from neighbourhoods will continue to be part of the political decision process, is uncertain. However to achieve more neighbourhood participation, it is desired that this situation continue. People will then be able to identify with proposed change, and chances of success will increase. The decision to make Gedaref the headquarters of Gedaref Province should be expressed by the allocation of financial resources and relocation of administrative offices from Kassala to

Gedaref.

Conclusion

The major problem of Gedaref in the next decade will be the population growth. Given the limited possibilities to prevent this growth, the problem becomes how to regulate this growth so that living conditions can be improved. The other problems derive from this situation. The most important derived problems are the water supply, the vulnerable economic position of Gedaref, and the lack of infrastructure and services.

Regulation of land use and the implementation of infrastructure projects are tools for the government to regulate the growth. Using these tools, we must realise that a townplanning decision and the implementation of a project is a choise which blocks certain development options and stimulates others. Thinking on the longer term, this means that the implementation of a project not only contributes to the solving of an existing problem, but also gives direction to the future development of the town.

Chapter 5: DEVELOPMENT OPTIONS.

Introduction.

In this chapter development options short term projects and long term developments are indicated. This list will not be exhaustive because of the short research period. The economic system of the town, for example, has not been a specific topic of research. The development options in this part of the report concentrate on townplanning aspects.
In chapter 5.1 the recommended development options are integrated in what must be seen as a first step for the future land use of Gedaref. The map that goes with this chapter intends to visualise the consequenses of the development options. The text in 5.1 describes the land-use of the functions that form the town. Chapter 5.2 describes the most important development options concerning the physical structure and organisation of Gedaref while chapter 5.3 indicates short term projects that are 'first steps' in the development of the town.

5.1 Vision.

Map "Future developments" shows the land-use consequenses of the development options presented in this chapter. Some uncertainties remain in the development options. In the following the functions distinguished in the plan are discussed.

A. Housing.

The possibilities of the government to influence the population growth and densities are limited. Although actions in these directions are usefull and necessary, expansion of the town seems inevitable. The total surface used for housing is now 2000 ha. In the next decade this will have to increase with approx. 1000 ha. Extension of the housing area will have to take place in two steps.
The first step is based on the existing replanning program. The development of one new housing area (Sadaga) and the extension of existing neighboorhoods where possible form this first step (see fig. 5.1).
The next step will be the development of one new, large housing area. There are several options but from analysis the area east of the military area now seems most feasible. Further research will be necessary before a final choise can be made on the location of one large area with good possibilities for connecting

Fig. 5.1 Step 1: new housing areas

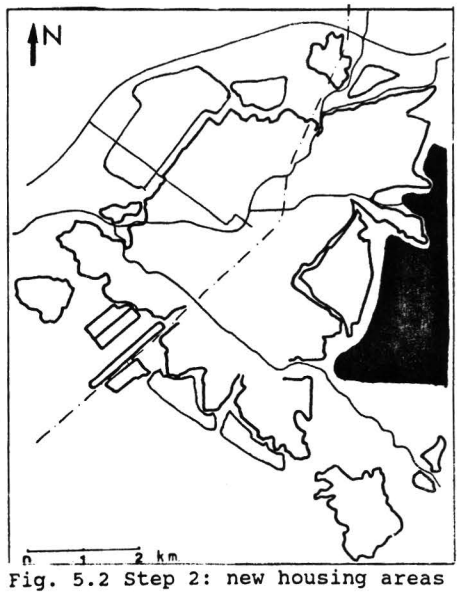


Fig. 5.2 Step 2: new housing areas

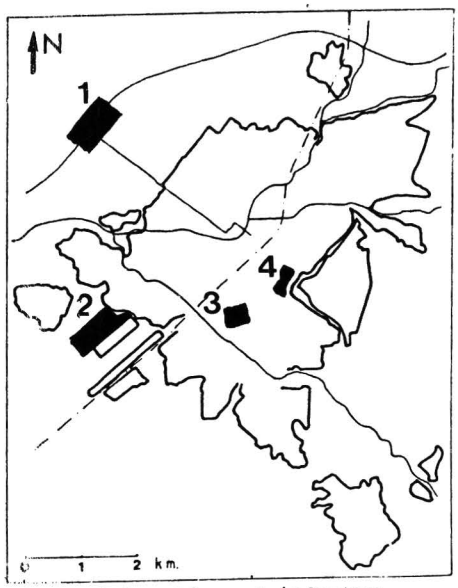


Fig. 5.3 Location of industry
1. highway service centre
2. new industrial area
3. old industrial area
4. central souq

B. Industry.
Industrial activities that are related to transport, such as car repair, will be transferred to the highway service centre, where space is reserved for other industrial developments as well. The old industrial area can then be used for craftwork. The location of industrial activities at the new industrial area must be stimulated by improvement of the infrastructure and administrative support. A small extension has been reserved for future developments. On map 5.3 the areas for industrial activities are indicated. Besides these areas, a lot of the craftwork will remain in the neighbourhoods as this is not considered to be a problem.

C. Commercial activities.
Commercial activities are now concentrated in the main market area, causing overcrowding. Easing the pressure in the main market area will have multiple benefits:
1. Activities that are not directly commercial, such as craftwork and offices, will be relocated mainly to the old industrial area.
2. Development of subcentres: in newly developed neighbourhoods, land will be reserved for shops (daily needs). A policy of licenses can stimulate the development of these areas.
3. Extension of the main market area: despite the two first measures, extension of the market area will be necessary to deal with the population growth and the regional functions of Gedaref. Extension can take place by giving licenses for shops and improving infrastruc-

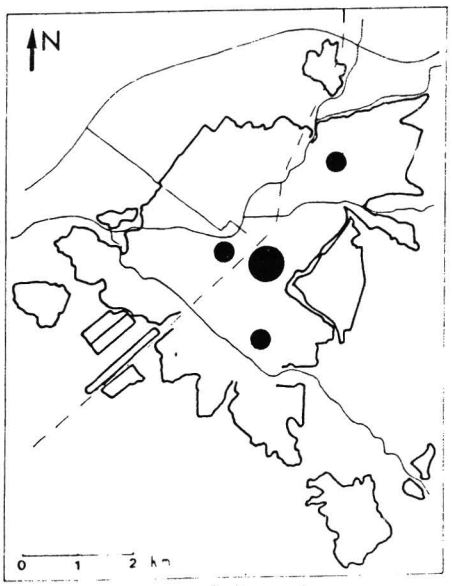


Fig. 5.4 Commercial centres

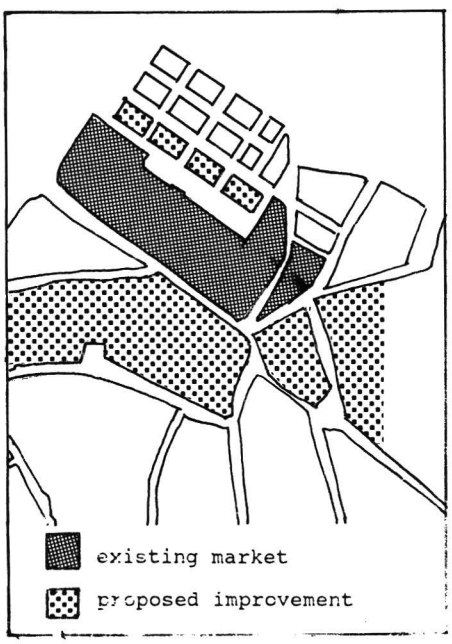


Fig. 5.5 Extension main market area

ture. Four areas are reserved for commercial functions (see map):
- a part of Mozafeen is planned for commercial development (in combination with government officesnned for commercial development (in combination with government offices)
- the first block of Deim Hamad
- the South-East part of main market area (by canalisation of the Khors)
- after relocation of the militairy camp, which is advised, the western part of this area can be used for commercial activities.

D. Cropmarket.
The sorghum trade is an important income generating activity for both the inhabitants and the government. The government will have to stabilize the function of Gedaref as centre of the mechanized farming area in Gedaref District. The existing area, now used for storage, cropmarket and offices, will be extended so that all grain storage can be in this location. Concentration of storage in one area will lead to reduction of pressure on the main market and a stronger position of trade facilities. Infrastructure will be needed to improve the connections with the region.

E. Government.
Part of Mozafeen is reserved for government offices. Even with the location of the provincial government, this area will be large enough, if land is used efficiently. Relocation of government housing is recommended to make place for commercial activities and government offices.

F. Agriculture.
The extensive sorghum agriculture on the edge of the town will remain an important income generating activity for the inhabitants of Gedaref and the land use will be maintained as such. Intensive land use by irrigated vegetable gardens is recommended to improve and stabilise the food situation of Gedaref. Three areas are suitable for this development and some initiatives have already been taken in these locations. Water will be available from existing wells and the construction of new ones near the Khor beds. The three areas indicated on the map will be reserved for irrigated horticulture

G. Recreation.
In the neighbourhoods some small locations

Fig. 5.6 Irrigated horticulture

should be reserved for recreation. Several small locations will be used more efficiently than one large location. Some of the recreation on the town level can be in a zone near the Khors. This zone can also serve as a fire and flood protection zone. Recreation in the centre of the town can be made possible by upgrading of the area: planting trees, changing of function from storage to horeca activities. Recreation was not a specific research item, so more detailed studies will be needed to make a plan for this aspect.

H. Infrastructure.
The development of infrastructure is lagging behind due to the tumultuous growth of Gedaref during the last decade, and the lack of financial means. It can be expected that this growth will continue in the next ten years. Large and capital-intensive measures will be needed to make the necessary continuing growth of the infrastructure possible. Watersupply, electricity, drainage and road construction are key-factors in the development of Gedaref.
Infrastructure is not only a need of the growing population and economy, it can also be an instrument used by the local government to guide developments. In fact, it is one of the few instruments the government possesses. The developments described above in the sections on housing, industry, etc. depend on the existence of proper infrastructure. Developments in the water supply, electricity supply and the road system are described here.

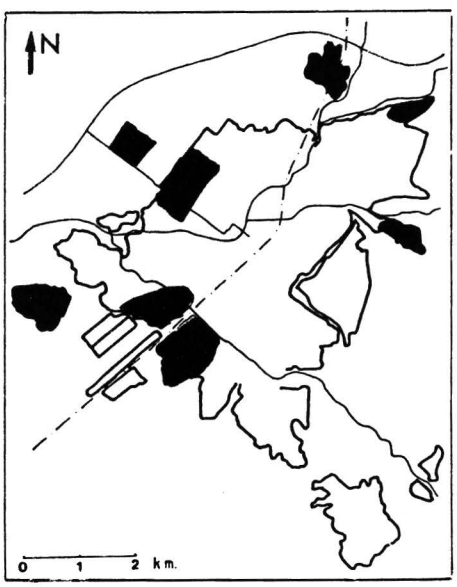


Fig. 5.7 Bad watersupply in neighbourhoods

1. Water-supply.
The increase of the supply and storage capacity is essential under the circumstances of continuing population growth. The existing capacity of the main pipes will be insufficient for the water-supply of the whole town.
The first step in the development of the water-supply system must be the improvement of the watersupply in existing neighbourhoods by means of the construction of public standposts. Neighbourhoods that have the worst service have the highest priority (Abakar Gebreel, El Gineina, Salamt El Beh, El Malik, El Thawra, Dar Es Salam). The next step in the improvement will be the increase of supply capacity and connection of the network to the new extensions plus extension of the networks inside the neighbourhoods. Extension of the network will have to be combined with increase of the storage capacity. Technical feasibility of a sto-

rage tank near El Malik plus increase of the capacity of the existing storage will have to be examined in detail. The combination of these options would provide a more network-structured water supply system, which makes provision of drinking water to all neighbourhoods feasible. In this option the provision of the new extensions is technically feasible.

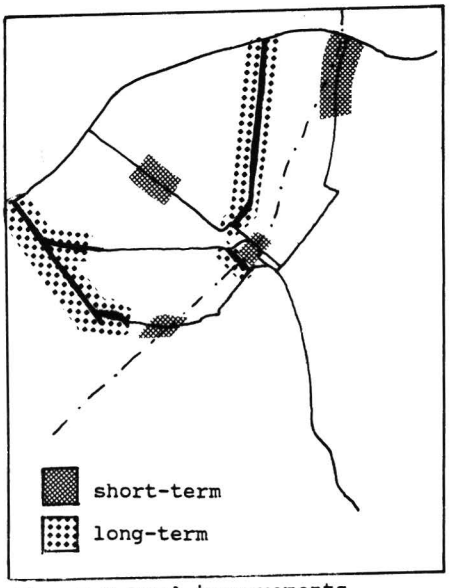


Fig. 5.8 Road improvements

2. Roads.
Improvement of the main road system consists of two features: alleviate bottlenecks in the existing system, and extend the system. In both options we recommend to concentrate activities on the improvement of the accessibility of vital economic functions i.e. main market area, cropmarket and industrial area. Access to neighbourhoods has second proirity. For the development of Gedaref the relation of commerce and industry with the region is more important than their relation with the neighbourhoods.

3. Electricity.
Supply capacity and main transformer capacity have to be increased before extension of the network is usefull. After these two projects have been implemented, the connection of existing and new industrial areas to the electrical network has the highest priority.

5.2 LONG TERM DEVELOPMENT OPTIONS

Long term Options are indicated on three levels: town level, neighbourhood level and regional level. Emphasis is put on the options on the town level. Recommendat

on the regional level are only stated if they a strong impact on the town.

5.2.1 Town level

1. The choice of locations for new extensions

Description
The location of new extensions of the town has to be based on an analysis of criteria that are tested on all possible locations. Thus, the bes

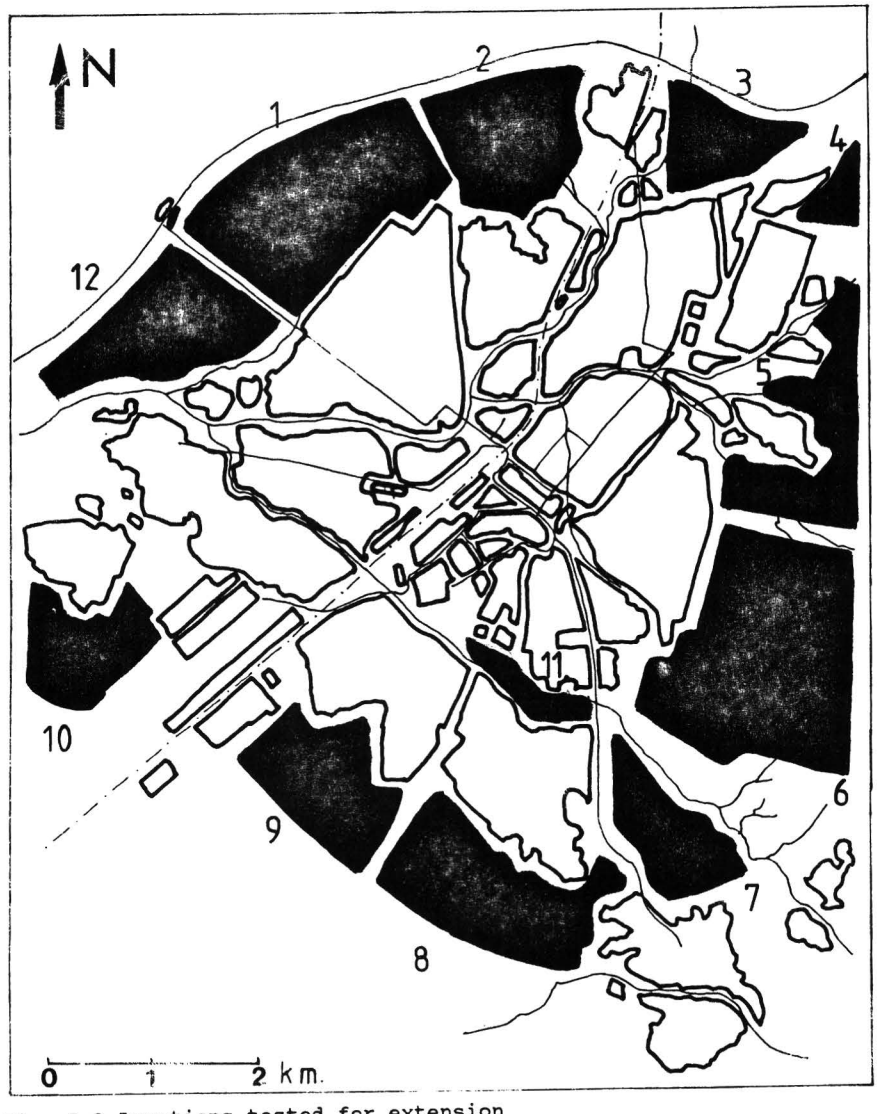


Fig. 5.9 Locations tested for extension

suited locations will be chosen. Not all criteria are of the same importance, but an overview of the test of criteria will give an indication of the suitable areas. Important information is still missing on some of the characteristics: drainage possibilities, danger of flooding,

legal situation and soil condition are not always clear.

Suitability for housing is not the only factor that directs the choise of new locations. Some locations may be very suitable for the development of other functions:area 7 and 11 border khor magadeem with good possibilities for constructing wells for irrigation. Area 7, now used as a small farming area, can be developed as a garden area. Area 11, waste land, can also be developed as a garden area; danger of flooding is then not such a big problem anymore. The south border of area 12 is already used as a garden area; further development of this function is possible. Development of area 10 as a housing area may hinder the development of the industrial area or the crop market.

		1	2	3	4	5	6	7	8	9	10	11	12
PHYSICAL CONDITIONS	slopes	+	--	+	+	+	+	+	+	+	+	+	+
	soil condition	+-	-	+-	+-	?	?	+	+	+	+	+-	-
	drainage	?	?	?	?	?	?	+-	?	?	?	?	?
	danger of flooding	+	?	?	?	?	+-	+	+	+	+	-	-
PRESENT USE	socio-economic value	+	+	+-	+-	+-	+-	-	-	-	-	+-	+
	legal problems	++	+	?	?	?	?	+	+	+	+	?	+
STRUCTURE OF THE TOWN	distance to town centre	-	--	-	-	+-	+-	+	-	-	--	++	-
	distance to working areas	+-	-	-	-	-	-	-	-	+	+	+	+-
	distance to replanning areas	-	+	+	+-	+	-	-	+	+	+-	+-	-
INFRA -STRUCTURE	distance to mainroad	+	-	+-	-	-	+-	+	-	-	-	+	+-
	water supply	-	-	+-	-	+	+	-	-	+-	-	+	-
	electricity	+-	-	+	+-	+	+	+-	+-	+-	-	+	-

++ = very positive + = positive +- = neutral - = negative -- = very negative

Fig. 5.10 Suitability for housing

For short term development, other aspects are important. Physical conditions are important for both situations. For the short term development the present value and the legal situation as well as the distance to replanning areas are extra important criteria. For the long term development the cost of infrastructure and the structure of the town are very important criteria.
From the information now available we may draw some cautious conclusions:
- For short term development, areas that border replanning areas (2,3,8,9) and areas already under development (1 and partially 12) are suitable.

- If drainage is adequate, development of the town in an eastern direction (5,6) is desirable in long term (also con sidering possible relocation of the military area).
- Area 7, 11, and parts of 10 and 12 should b reserved for the development of other functions.

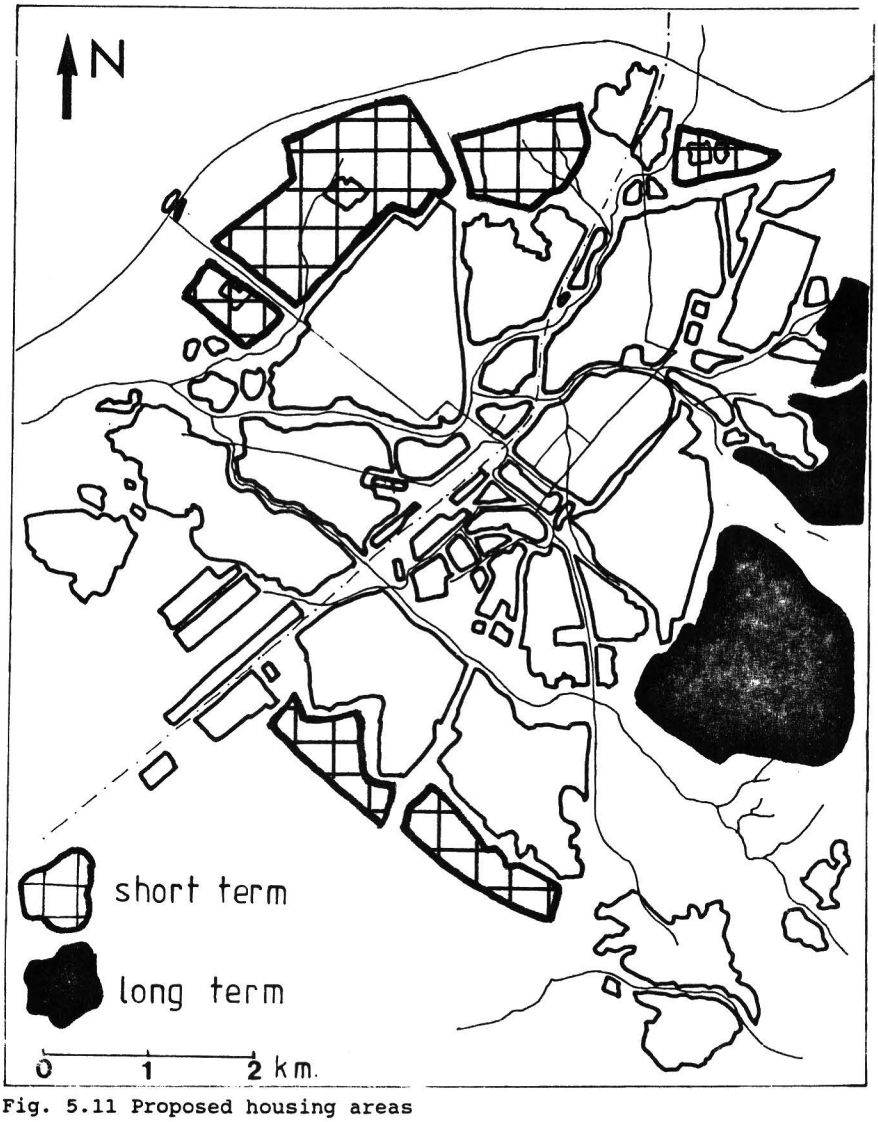


Fig. 5.11 Proposed housing areas

Background

In chapter 4 it was stated that a population-growth of 6% per year must be considered realistic. This lead to doubling of the population in less than 13 years. Partially this population growth can be regulated by a better land use inside Gedaref, but the development of new extensions will be necessary. Some over-populated areas of Gedaref will be replanned and therefore demand more space.

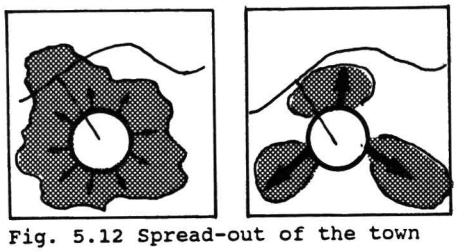


Fig. 5.12 Spread-out of the town

A big growth of the area necessary for housing will be needed in the next decade. The choise of new settlement areas by the local government will stimulate the desired development and prevent 'spread-out' in all directions. It is than necessary to provide plots to 'newcomers' and to provide new extensions with some basic infrastructure. The area now used for housing in Gedaref is approximately 2,000 ha.. In the next 10 years another 1,000 ha. will be needed to meet the demand for housing.

Strategy

The existing land law provides a good starting point for an active land policy for the local government: almost all land is owned by the government. Although legal possibilities are available, the choise of locations should try to avoid disturbance of income generating activities. Many small farmers for example depend strongly on the small piece of land that they cultivate.

Land leases should be given by the land office. A part of these leases will be given to people from replanning areas, but also a part should be given to newcomers to prevent spontaneous settlement and thus take away the necessity of replanning these areas later.

To make new areas attractive, especially overflow areas for replanning, some basic infrastructure should be provided. For the implementation of new infrastructure the local government will partially have to depend on the availability of external funds. In the planning and realisation of new extensions, the realisation of infrastructure forms an important aspect.

2. Extension of main road infrastructure

Description

The existing road system of Gedaref is strongly directed to the central district. In the future this area will remain the most important, and traffic attracting, area. Some other areas, however, will gain importance: new industrial area, crop market area, highway service centre and Mozafeen. Extension of the road network is concentrated on these areas. Besides, improvement of the traffic structure of the market area is needed.

In the first phase of the extension of the network, four measures are suggested:

1. A new road from cropmarket and new industrial area to the north to provide a connection

of these two areas to the Khartoum-Port Sudan highway.
2. A third, new, railway crossing near El Danagla, to provide a better north-south connection to the town.
3. Restructuring of the traffic in the town-centre to prevent constraints.

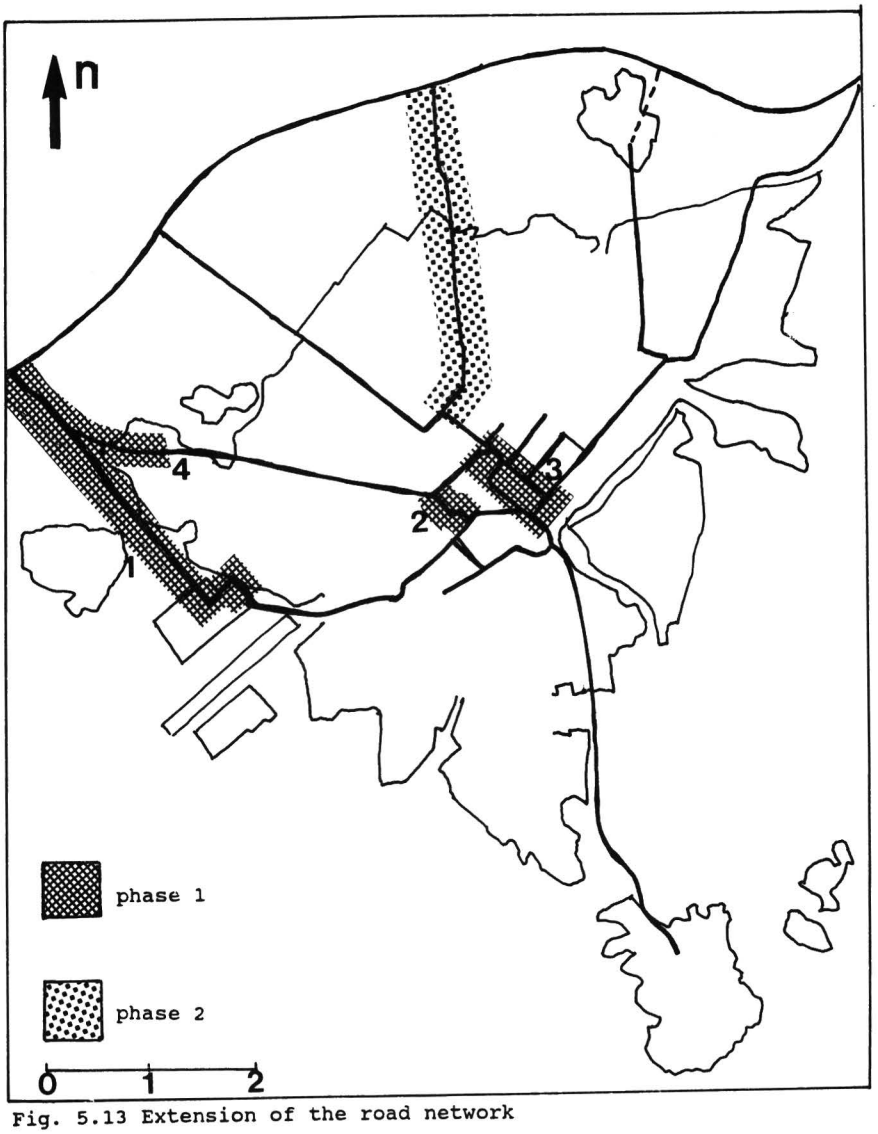


Fig. 5.13 Extension of the road network

4. Connection of the road through october to the highway to provide an extra connection of the town to the highway.

In the second phase of extension of the network two measures will be taken that result in the construction of some new roads:
1. Increase of the number of connections to the highway
2. Connection of newly developed extensions to

the roadnetwork (depends on the selection of new neighbourhoods).

Background

The fast growth of Gedaref in the recent past has caused an arrears of infrastructure that has to be made up. Some short term projects are indicated to achieve this. For the future extension of Gedaref, increase of the number of roads is necessary, to prevent constraints.
The construction of roads and other infrastructure can be used to stimulate certain developments. When a new extension has good infrastructure it will be more popular than when it does not have the basic infrastructure. The road to the new industrial area and the cropmarket is meant to stimulate these two functions. Besides, it can prevent constraints that are caused by heavy traffic in the towncentre.
A plan for reconstruction of the roads in the towncentre has to be combined with the planning of other changes in this area. An integral plan for the central district with functional zoning, physical structure and infrastructure has to be made as a sequel to this report.

Strategy

Improvement of the connection of the cropmarket to the highway is a matter of regional or even national concern. For construction of this road the local government can direct to the regional and national government for assistance. Investors in Gedaref may be interested in improvements of roads for economic development and willing to the contribute to the realisation. The local government will have to reserve some capital to construct new roads and bridges.

3. Improvement of water supply

Description
Limited extension of the water distribution system is possible with the same supply system. These extensions can be realised on short term. On the long term, however, radical and capital intensive measures are needed to improve the water supply system. The storage capacity will have to be increased and more water has to be pumped to Gedaref to meet increased demand.

Fig. 5.14 Locations for new water storage

- Increase of storage
Essentially there are two possible locations for a new storage tank:
  - on the same location as the existing tank
  - in the hills east of El Malik

Technical feasibility of these locations has to be studied in detail but some planning aspects can be mentioned here. Realisation of a new storage near El Malik will improve posibilities for watersupply to the North-West and the North-East of the town (thanks to a reduction of pressure losses).It can also be mentioned that extension of Gedaref to the east of the military hill gives good possibilities for water supply when the storage on the military hill is increased.
Both options for extension of the supply capacity will be very costly. The needed storage capacity strongly depends on the population growth. When this population growth can be limited, the existing storage capacity will be enough for some more time.

Increase of supply capacity
There are three ways of extending the supply capacity:
a. Increase of the supply capacity at Showak plus a new transport pipe from Showak to Gedaref
b. Increase of pumping capacity at the Abu Naga well field
c. Development of a new well field.

Increase of the supply capacity at Showak is not problematic: some more deepwells can be drilled or deepwell intake can be combined with surface-intake. The transport of water to Gedaref, however, is problematic because the maximun capacity of the existing pipeline is almost reached. Than, a second pipeline will have to be constructed, which is costly because of the large distance (70 km.).
Whether it is possible or not to increase the

capacity of the Abu Naga well field is not clear because it is not known how fast the refill of that aquifer goes. It is possible that the maximun extraction is already reached. More detailed data is needed for conclusions on this possibility.
Development of a new well field is usually more expensive then increasing the capacity of an existing field. Advantage is the diversification: it will make the system less vulnerable. A possibility for a new wellfield is the Umm Golja aquifer 10 km. west of Gedaref. Detailed feasibility studies will be needed.

Fig. 5.15 Public tap

Background

Water- demand is a strange phenomena; it not only depends on the number of people that need water but also on availability, price, distance to the tap etc. When the population increases the waterdemand will also increase. This will make improvements in the supply-system necessary on relatively short term. If the population growth can be limited, implementation of these improvements will be easier.
Extension of the distribution system will increase the waterdemand (improvement of availability, reduction of prices). Partially this can be prevented by another pricing structure and the introduction of valving schemes, but an increase of demand will be inevitable. Despite this, extension of the network is considered necessary to provide a more equal waterdistribution.
Changes in the water network can be a tool for the local government to guide the development of the town. New extensions can be made attractive and industrial developments can be made possible. Even the choise of the location of the storage tank has planning implications.

Strategy

Improvement of the retribution factor should provide a better financial position to the Water Corporation. If this is enough to realise big projects as described above, is doubtfull. Other funds will have to be found for these projects. Possibilities for this are international aid organisations, national and provincial government funds and local private funds.

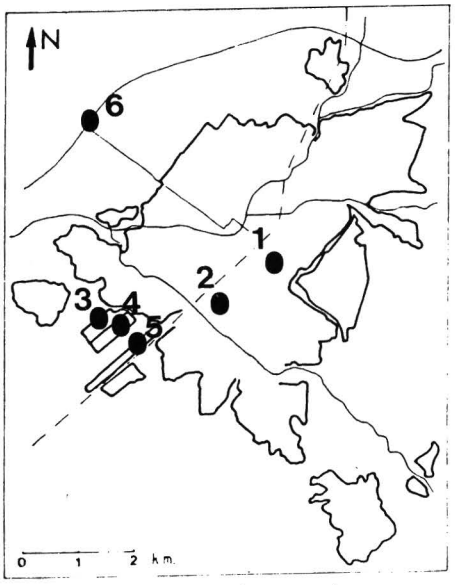


Fig. 5.16 Large urban centres

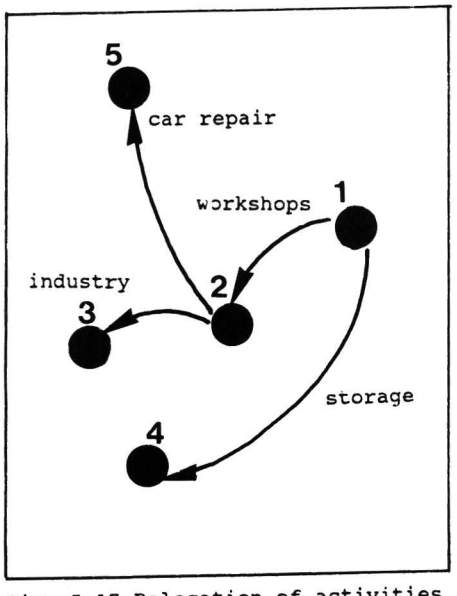


Fig. 5.17 Relocation of activities

1. Central souq
2. Old industrial area
3. New industrial area
4. Sorghum storage
5. Highway servicecentre

4.The location of commercial and industrial activities.

Description.

In Gedaref several centres of commercial activities are located throughout the town. The large urban centres now extisting are the central area (1), the old industrial area (2), the new industrial area (3) with nearby the cropmarket (4) and the storage area (5) , wheras the highway centre Sadaga (6) is still in the first stage of development. The population of Gedaref Town is now doubling every 10 -15 years. A growth of commercial activities will take place. The town is expanding in the direction of the highway and will later probably expand behind the military area. In the new extensions centres must be located to provide the daily needs of the inhabitants. Conflicts of the existing centres with the growing residential areas will increase. The location of the different commercial activities concentrated at the centres must be reconsidered, with the growth of Gedaref and the changes of society in mind. At governmental level, the replanning of commercial centres can be seen as an instrument to guide the development of Gedaref.

The pressure on the main market area is already a problem and will increase in the future. Possibilities to relieve this pressure are horizontal and vertical expansion and relocation of certain activities to other commercial or industrial centres. Conflicts between the existing centres and the changing structure of the town can be relieved partly by relocation of certain functions. At the old industrial area (with fuel storage) more and more activities related to the repair of cars, trucks and mechanised farming machinery are located. The extension of activities conflict with the surrounding governmental area and residential areas. As the licences of most workshops will end within two years, a possibility arises to consider the relocation of these workshops, creating places for more towncentre and government related activities. In principle the repair activities could be transferred to the highway service centre. The new industrial area is meant to attract the investments in large(r) scale industrial activities. But industrial activities still hardly exist in Gedaref. The cropmarket is a still growing seasonal trade centre for the regional crops and the administrative centre of crop-

tax-control. The construction of necessary infrastructure for these two areas (paved roads, electricity supply, storage room) faces difficulties because long term investments are needed. This situation hinders the development of the industrial area. The area around the highway crossing near Sadaga has potentials as a service-centre. Already small scale activities are located (repair shops, restaurants) and a governmental plan to reserve areas for a fuelstation and motel have been made. In some neighbourhoods the supply of daily needs appears to be a problem. Possiblities here could be the concentration of the neighbourhood activities at its subcentre, or even the concentration of several subcentres to a centre large enough to deal with the daily needs.

Fig. 5.18 Secondary shopping centre

Altogether a gradual shift of functions of commercial and industrial centres is proposed. The town centre will mainly be used as shopping centre. The old industrial area for craftwork and the highway service centre for car related workshops and small scale industry. The crop-market, storage area and new industrial area keep their functions for crop-trade, storage of crops and new industrial developments. The concentration of little centres and the location of new centres must be studied more in detail before a plan can be made.

Background.

Gedaref has an agricultural background. With the introduction of large scale agriculture,

the commercial activities developed. Beside these commercial centres the importance of small scale activities must not be forgotten. The self-reliance of small farmers e.g., must be taken care of as a relatively important contribution to the livehood of the inhabitants of lower class neighbourhoods.
For development of Gedaref as a town, it is necessary to broaden the economic basis. The rapid growth of Gedaref and the changes in the society cause problems in the functioning of the centre and the relation with their surrounding. The population is now doubling every 10-15 years. As the distance of new extensions to the main souq increases with the growth of the town, the supply of daily needs in every neighbourhood becomes more and more important. Changes in society ask for different (higher standard of) technical infrastructure as water-supply, paved roads and electricity supply for all centres.
Together with the replanning of residential areas a reconsideration of the existing commercial and industrial centres and the development of new centres is necessary now. A detailed plan is necessary, because many actors and interests are involved in extension, concentration and relocation of economic activities

Strategy.
The government will meet complex problems with the policy of relocation. Therefore the option of extension of the central of the main market area is very important. A detailed policy plan is needed with;
1. A detailed conversion plan of the plots of the extension area of the central area, with some building regulations (e.g. the new shops must be provided with verendas to give room to the numerous mobile activities).
2. A plan of the functions at the existing centres that have to be relocated and the place they will have to go to.
3. A plan of the new commercial centres located in the new extensions.
In general a stimulating policy has the highest priority. Possibilities to use the output of open auction of some plots of the central area must be examined and (if necessary) discussed with the central government. The plots of the relocated functions at the old industrial area can serve as an alternative for the workshops from the central area. To offer the storageroom holders from the main market area an attractive alternative, a licence for a new activity at

the main market area can be provided. The relocation of repair related workshops can be forced by giving the new licences a new location: the highway service centre.

5. Replanning of the location of military activities

Fig. 5.19 Location of military area

Description

The military area is now located on a piece of land adjecent to the souq area. Expansion of the market and other functions of the central district is needed. A solution to this would be the replanning of (part of) the military area for this purpose. Once the military area formed, together with the market area, the most important part of Gedaref. Since the growth of the economic function and the decline of the military function of Gedaref (border town) there is no need for the militaries to have their station in the centre of Gedaref.
The military functions can be displaced to a location outside Gedaref. Research for location of the military area still has to be carried out, but a location near the highway could be favourable for strategic purposes. The western part of the military hill will be used for commercial functions, while the rest of the area will be developed as housing area. Soil conditions and drainage are suitable for these functions. The change of functions can be realised in two phases: first the western (commercial) part and then the eastern part. Change of function of the military area will improve the physical structure of the town and the spread of functions.

Background

The market area is overcrowded while in the areas around the market area (railway area, government area and military area) land is used in a very inefficient way. Removal of these funktions or optimalisation of the land use in these areas is than a possibility to decrease the pressure on the main market area.
Negociations will have to be held with the military authorities but, considering the absence of strategic importance and the availability of funds, it must be possible to find solutions on this matter.

Strategy
After removal of the military area, the land will be sold in open auction. This for the commercial land as well as for the residential land. The money that comes from this auction will have to be used to construct a new military camp and to construct basic infrastructure. Considering the prices that are now paid for a plot in the market area, this should be enough but more detailed research into the price structure is needed.
Negociations with the national, regional and military authorities will have to take place to realise the transaction. The local government can play an initiating role in this.

6. Change of function railway area

Fig. 5.20 Location of railway area

Description
The railway districts now consists of a large shunting-yard, some buildings now out of use or used as permanet storage, a lot of wasteland and two small neighbourhoods. The railway, as it functions now, has lost its importance for Gedaref. The transport function has been taken over by road transport. The north-east part of the railway district borders the main market area. To improve the funktioning of this market area it is suggested that some of the semi-permanent funktions of this area are shifted to the northern part of the railway district. A central busterminal could be developed there.
When in the future, after improvements, the importance of the railway would increase, it can be considered to construct a new goods station near the cropmarket with a small passenger station in the towncentre. The existing physical structure is not suitable to handle large amounts of freight, so that improvements are necessary anyway.

Background
The market area is overcrowded while in the areas surrounding this area (railway district, military area and Mozafeen) land is used in an ineffective way. Removal of these functions or optimalisation of land use coulde decrease the pressure on the main market area.
In the case of the railway area only semi-permanent change of function is suggested so that development of a goods station in the towncentre in the future remains possible. Only relatively little capital will be needed for this change of function. Therefore it is possible to use the land as public space, for

example for a bus-station. The physical measures that have to be taken for this change of function are not so radical; it is the permission that is decisive.

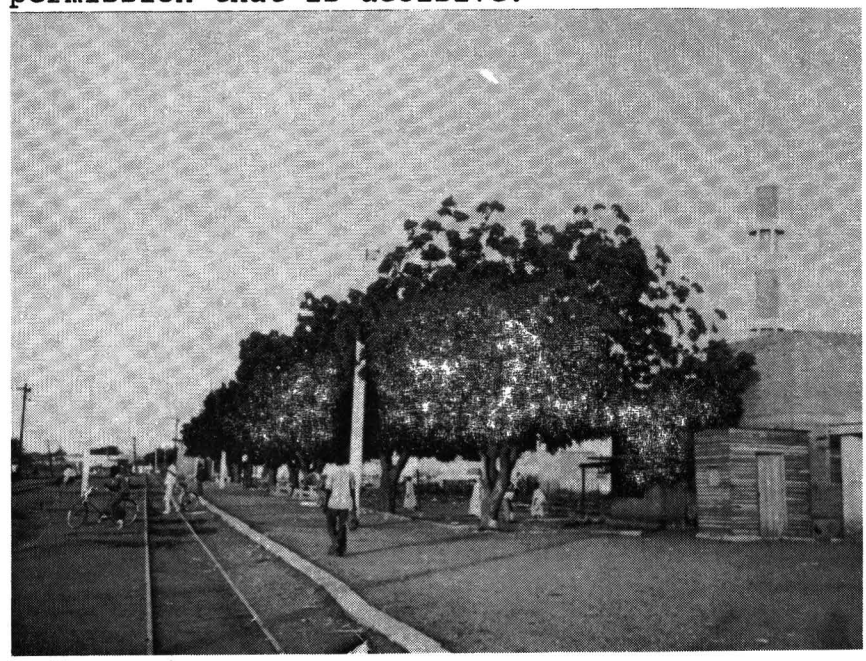


Fig. 5.21 Railway near station

Strategy

The first and most important thing that has to be arranged is the permission of the railway authorities to use the northern part of the railway district for semi-permanent functions. The local government should play an active role in obtaining this permission. This permission should not have radical financial consequences for the local government. Some improvements of the surface and the drainage will be needed. These improvements can be carried out with local budget or with help from bus companies.

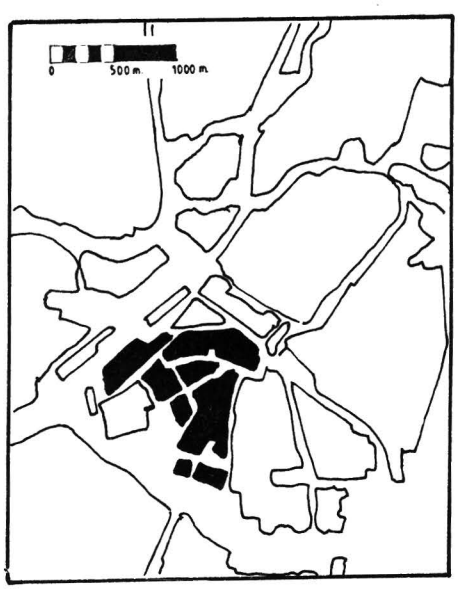


Fig. 5.22 El Mozafeen

7. Optimalisation land use Mozafeen

Description

Land use in El Mozafeen, an area adjecent to the market area, is now very inefficient. The ratio built land/unbuilt land is very low, there are many open spaces without a special function and houses for government employees are constructed on large plots. This is in sharp contrast with the overcrowded market area.

All government departments have a number of plots which are sometimes used as offices and sometimes as (often extensive) housing.

Relocation of housing areas and opening of

Mozafeen for commercial offices will lead to a more efficient land use and will decrease the pressure on the market area. A plan for Mozafeen has to be developed in close cooperation with the government departments that are now located in the area. In that plan, some of the open spaces can be developed for commercial functions.
It is recommended that Mozafeen area will in the future change function and become an area mainly for offices, commercial as well as governmental. Recent developments show that there is an urgent need for office space in the vincinity of the market area. Mozafeen can be used for this function. Basic infrastructure is available in most of the area.

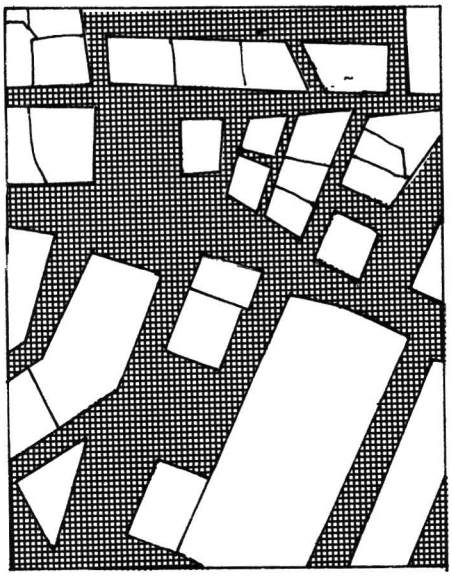


Fig. 5.23 Part of El Mozafeen (1:5,000)

Background
Mozafeen is a first class area which was built in the colonial period on a higher piece of land of about 60 ha. It has an irregularly structured road plan with wide streets and large plots. In the area we find the Town Hall, Building and Construction department, Prison, Police and some other departments. The departments each have a number of plots but they do not have to pay leases for these plots. On the north side of Mozafeen we already see some commercial developments such as banks.

Strategy
Relocation of government housing can be financed by selling land for commercial functions in open auction. This process has to be organised in close cooperation with the departments concerned. A physical plan, to be conceived by the Town Planning Office, can than serve as a starting point.
Formally it is now impossible to use money from an open auction for improvement of infrastructure and relocation of housing areas. Therefore discussions with the national government should be opened to achieve permission in this specific case. Most organisations involved are government organisations, which all benifit from this development, so that a permission appears realistic.

8. Food production around Gedaref

Description
Extension of vegetable gardens around and within Gedaref is recommended. This asks for the digging of more wells and improvement of the system of groundwater recharge of these

wells, which recharge is accomplished by the khors.

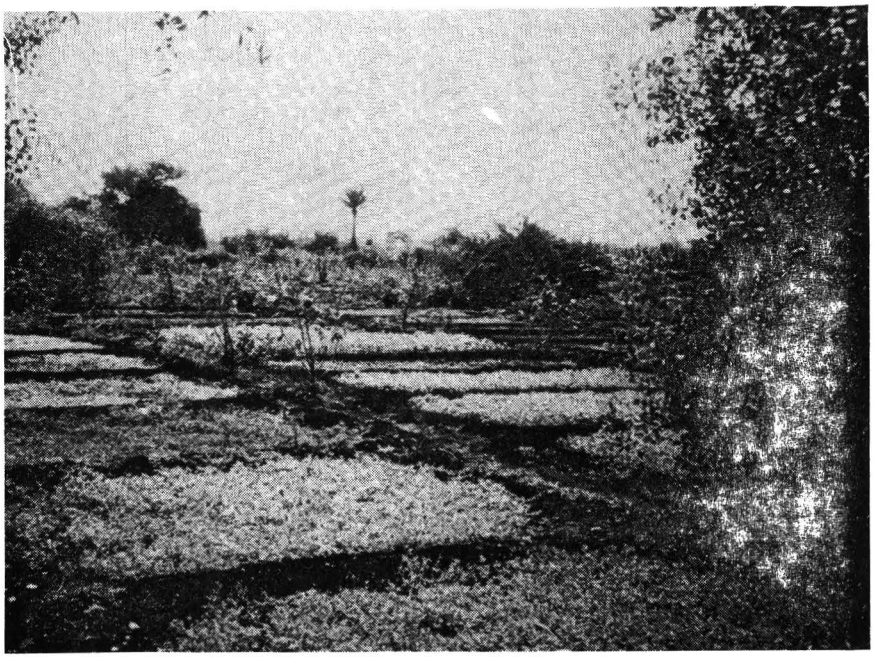


Fig. 5.24 Vegetable garden

Development of systems making use of the surface water of the khors, by building small dams and reservoirs in the contributaries of the khors, has to be investigated.
Improvement of the productivity of small fields of agriculture has to take place by promoting systems of production that are adapted to ecological conditions. Possibilities are mixed cropping, recycling of organic materials, the introduction of new crops like sunflower and soya beans, use of animal manure, rotation of dura with leguminous crops.

Background
Most of the land around Gedaref is cultivated by small farmers who live in Gedaref town. The relatively marginal economic importance of maintaining and increasing the capacity of these lands does not deminish the importance for the people who are earning their livehood from these lands. Because of expansion of the town, arable land is replaced by residential areas. The location of agricultural fields near the town gives some special opportunities for more intensive ways of cultivation. Gedaref should be more self sufficient in the supply of food.

Strategy
Official leases for small farmers to cultivate the land are necessary to enable the farmers to invest in long term improvements. Digging of wells and construction of small dams and reservoirs should be done by public authorities. Information to small farmers about ecology based production techniques should be organised with active participation of the regional minister of agriculture and farming cooperations.

5.2.2 Regional level

1. Forestry around Gedaref

Description
Possible location for forestry around Gedaref are:
- forest reserves along upstream parts of the khors
- forest reserves along floodplains of the khors
- shelterbelts along agricultural fields and Gedaref town
- tree planting within Gedaref town

Some highly recommended tree species are Eucaliptus camaldulensis (Ban), Acacia senegal (hashab), Acacia seyal (Falh), Cajanus cajan (Adis), Sesbania sesban (Sena). As many others, these species have a potential woodproduction of 10-15 m3/ha./yr. As supply of water is essential for the realisation of treeplanting, the greenbelts are recommended in the vincinity of the khors. Because the realisation of greenbelts takes much longer than the realisation of urban areas, it is suggested to start as soon as possible.

Background
The main reasons for forestry around Gedaref are:
- The role of forestry in the improvement of the physical environment (watershed-protection, reclaim of wasteland, soil improvement, erosion control) and in sustaining agricultural productivity (nitrogen fixation, windbreak).
- The reliance of the great majority of the population on fuel wood.
- The role of trees in the improvement of the urban environment, e.g. provision of shade and shelter.

Usually these benifits are produced in one or more combinations.

Strategy
The establishment of local tree nurseries will be required. Active participation of the Gedaref Forestry Department and Regional Ministry of Agriculture should also take place as well as the participation of citizens and farmers in the planting and maintenance of trees and shrubs. Uncontrolled woodgathering has to be prevented. Coordination of donor organisations appears essential, especially Sudan Care. Some other organisations, given the interest Sudan recieves in the field of forestry, could be F.A.O., World Bank, Netherlands, U.S.Aid. Commercial exploitation of tree plantations by individuals must be stimulated.

5.2.3 Neighbourhood level

1. Choise of replanning strategy

Description
The replanning strategy of an individual neighbourhood should be based on an analysis of that particular neighbourhood. Problems in the neighbourhoods differ so, that one uniform replanning strategy will not be able to cope with the problems. Four factors that are considered important for the choise of strategy vary throughout Gedaref:

- There are big differences in densities between the neighbourhoods.
- The level of services is different in the neighbourhoods. Neighbourhoods like Dar es Salam, Abakar Gebreel and Salamt el Beh hardly have any services, while neighbourhoods like El Sofi, Rowina West and El Matar are equipped with water and sometimes electricity.
- For some neighbourhoods, like Salamt el Beh and Gamhuria North extensions can be made near the existing neighbourhood, while neighbourhoods like Rowina are enclosed by housing.
- Differences in income between the neighbourhoods are important for the possibilities of people to rebuild houses.

More detailed research and problemdefinition is necessary in the neighbourhoods to define the proper replanning strategy for that particular neighbourhood.

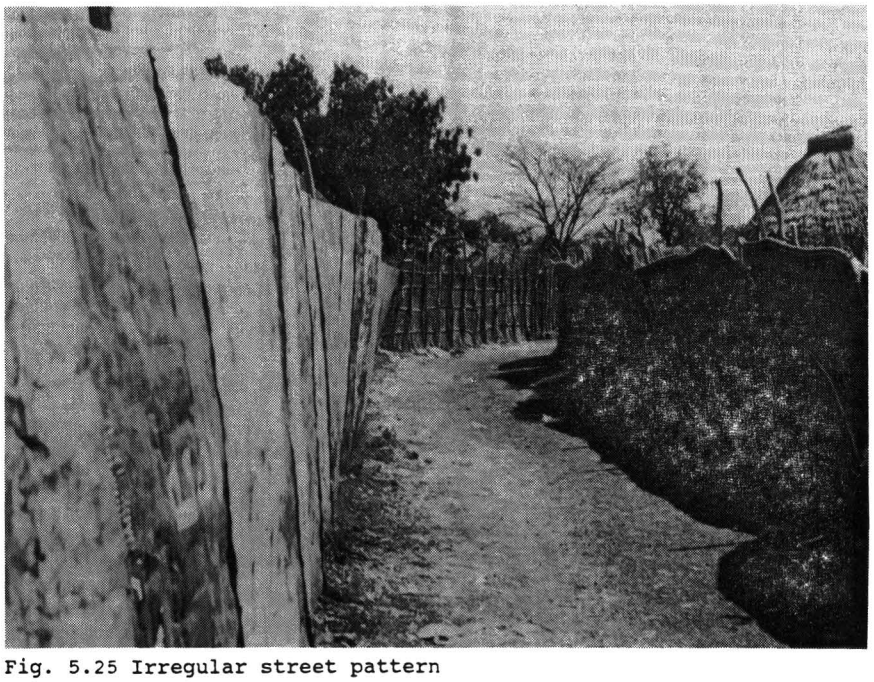


Fig. 5.25 Irregular street pattern

Background

In 1981 and 1982 the Gedaref Town Council decided upon the design and execution of an extensive replanning program, this under the explicit pressure of the neighbourhood representatives in the Town Council. The program consisted of the replanning of all not legally planned neighbourhoods. The aim of the program is on the one hand to legalize and regulate plot ownership in order to decrease densities, and on the other hand to provide basic services such as water, electricity, education and health facilities.

The method of planning is the same for all neighbourhoods. This is based on the assumption that occurring problems are the same for all neighbourhoods.

Before replanning most neighbourhoods have an irregular structure. This structure often originates from old pedestrian routes or small streambeds that drain the water in the direction of the khors. Irregulary shaped plots of different sizes, where people settled with their families often many years ago. In these neighbourhoods it is sometimes difficult to observe the distinction between private, semi-private and public space.

Replanning rather rigorously imposes a grid structure on the existing urban structure. Plots of 20 by 20 m. are leased to inhabitants according to certain selection criteria. Some people get plots in the extension area which is

sometimes located far away. Reallocation of plots leads to many disputes, many of which are only decided upon before the Magistrates Court.

Strategy
Cooperation with neighbourhood organisations and detailed research in the neighbourhoods will lead to a more appropriate replanning strategy. Because this strategy will be more fit for that particular neighbourhood, it will be easier to implement the replanning program. Cooperation with the National Water Corporation and National Electricity Corporation will fasten the actual implementation of services.

2. Optimalisation of land use

Description
To minimize the spread out of the town and the cost of infrastructure the land use in the neighbourhoods should be organised as efficient as possible. The existing building method, however, limits the possibilities to decrease plot sizes and sizes of streets (fire hazard). Although building in gotteias must be taken as a starting point, some changes in land use can improve the efficiency.
Now a uniform plot size of 400 m2 is used in the replanning program. Although this is said to be a national policy, in other towns in Sudan smaller sizes are used for new extensions; hence there are no legal objections against smaller plots. In some neighbourhoods in Gedaref plots are devided and parts are rented, of which we may conclude that there is a market for smaller, cheaper plots. Especially in neighbourhoods that have to be replanned because of high densities and where extensions will be far away, it must be considered to decrease plotsizes.
Landuse in new extensions can be optimized by introducing a variety of plotsizes, decreasing the sizes of public squares and by introducing smaller streets. Additional measures to prevent fire hazard may be necessary.

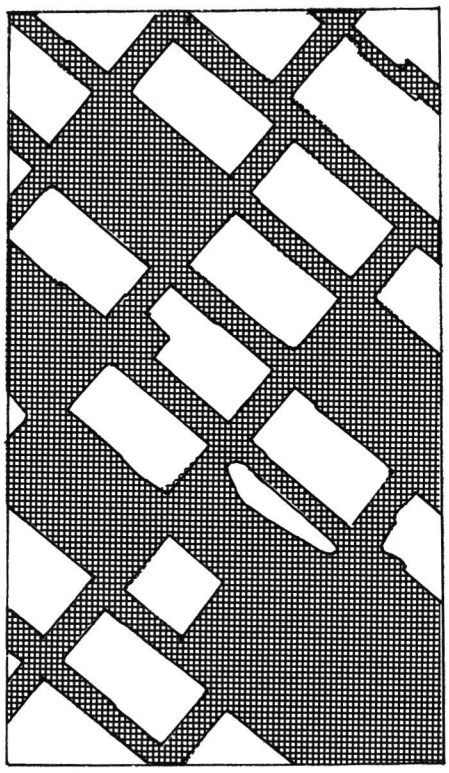


Fig. 5.26 Part of Kerfis (1:5,000)

Background
The population growth of Gedaref during the recent past exeeded 6% per year. Extrapolated in the future this leads to a doubling of the population during the next 13 years. The local government has a very limited capacity to deminish this growth so that efforts of this government should be focused on regulation of this growth.

A wide spread-out of the town in all directions will be the consequence of unplanned growth. To regulate this new extensions will have to be located before spontaneous settlement has taken place. Beside this regulation limiting of plot-sizes and efficient use of public land will restrain uncontrolled spread out. Thus, the distance to the towncentre and working areas as well as the cost of main infrastructure can be limited.
The cost of infrastructure on neighbourhood-level depends directly on the size and the shape of the plots. Smaller plots will lead to a more compact neighbourhood and thus to a decrease of the cost of infrastructure. Narrow but deeper plots will lead to a reduction of street length and thus to a reduction of the cost of infrastructure.

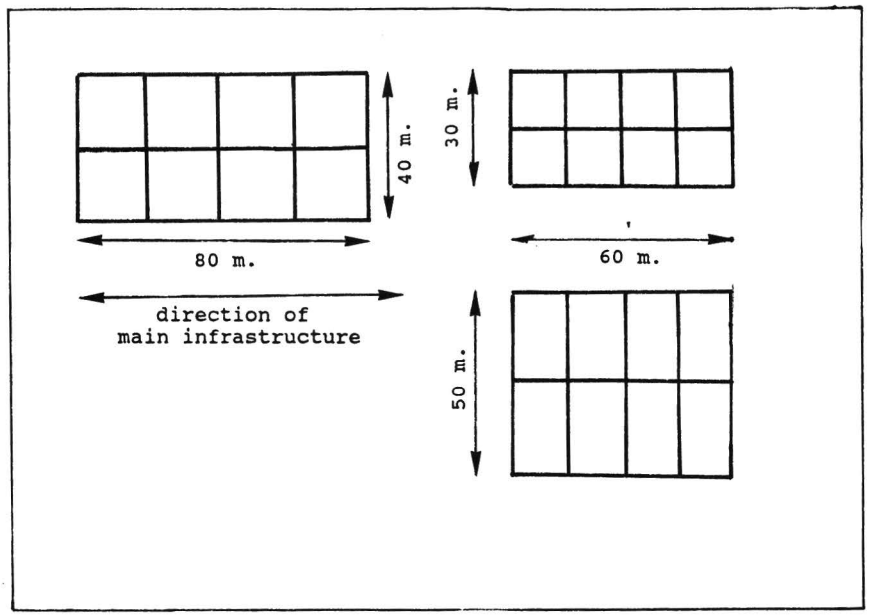


Fig. 5.27 Efficiency of infrastructure related to plotsizes

Strategy
In some cases in the replanning of neighbourhoods the question to the inhabitants will in fact be whether they want smaller plots or a plot in a new extension, which can be far away. A model on how to decide on this has to be developed in close cooperation with the neighbourhoodorganisation concerned.
Plans for new extensions are drawn up by the Town Planning Office. Changes in this layout should therefore not be so problematic.

5.3 Short term projects

The functioning of the town is now hindered by a number of factors that need improvement on short term. The projects that are described here should be seen as a first step for the realisation of desired long term developments.

1. Watersupply

The most important acute problem is drinking water supply. To improve the watersupply-situation big changes in the system will be needed on long term. On the short term some improvements and small extensions of the system can provide a more equal distribution of drinking water.
Essence of the project is to bring water to more neighbourhoods through the introduction of public standposts which will be combined with the introduction of a valving scheme to assure equal distribution.
Neighbourhoods that suffer most from the lack of water are: Abakar Gebreel (1), El Gineina (2), Salamt el Beh (3), El Malik (4), El Thawra (5) and Dar es Salam (6) (see map). Introduction of public standposts in these neighbourhoods has priority. In the neighbourhoods Abakar Gebreel and Salamt el Beh improvements will be easier because of the proximity of a waterpipe that can be used to make a connection.
The introduction of a valving scheme will make it possible to block the watersupply to certain neighbourhoods in favour of other neighbourhoods. Most valves will be placed in the town centre.
Further details will be discussed in chapter 3 of the second part of this report. Some more detailed research will be needed.

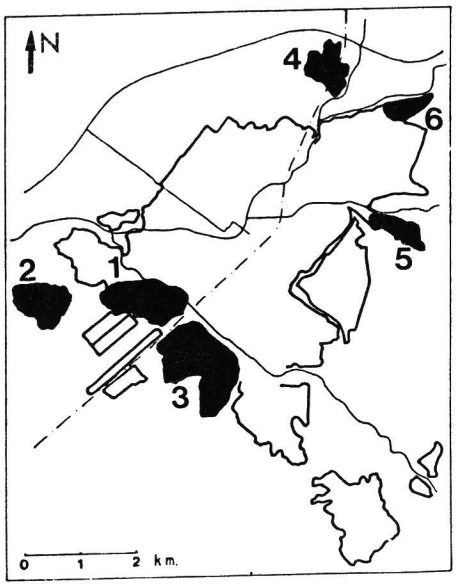


Fig. 5.28 Neighbourhoods with bad water-supply

2. Khor improvements

Improvement of some of the riverbeds is necessary to prevent calamities in the near future. On the map is indicated where improvements are urgent.

1. Khor Magadeem runs through the neighbourhoods October and Abakar Gebreel through a narrow streambed. To prevent regular flooding the streambed will have to be deepened. On short term widening of the streambed is problematic because of the proximity of houses.

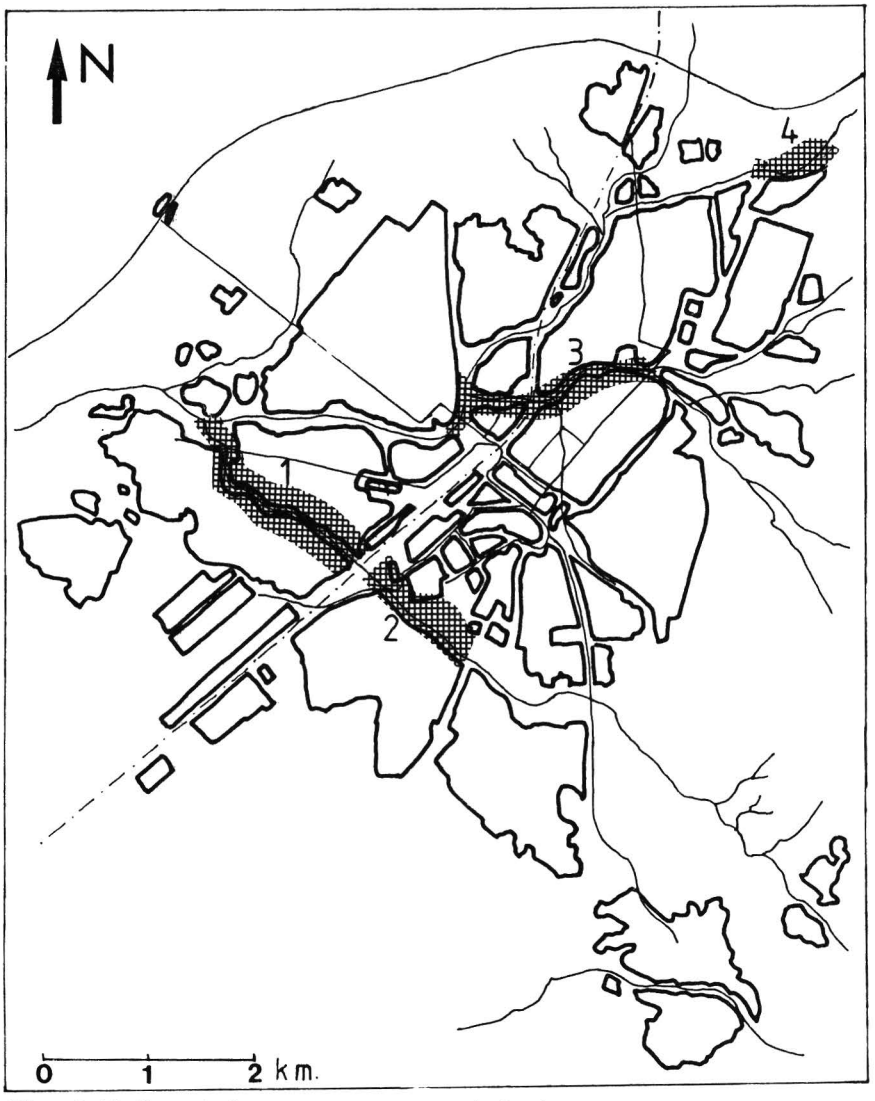


Fig. 5.29 Urgent improvements natural drainage

2. Near Salamt el Beh the same khor causes flooding of the areas in the proximity of the khor. Because most plots are empty here, the construction of an embankment on the south side of the khor is possible.
3. The situation between Gamhuria South and El Nasr is, in spite of the high embankment, problematic because of the succeeding of bridges and the meeting of khor Abu Farga at 90 degrees. Consolidation of the earthen embankment and further deepening of the profile will increase the discharge capacity. Further it is necessary to improve the stream profile at the 'khor-joining', to prevent blocking of one stream by the other stream.

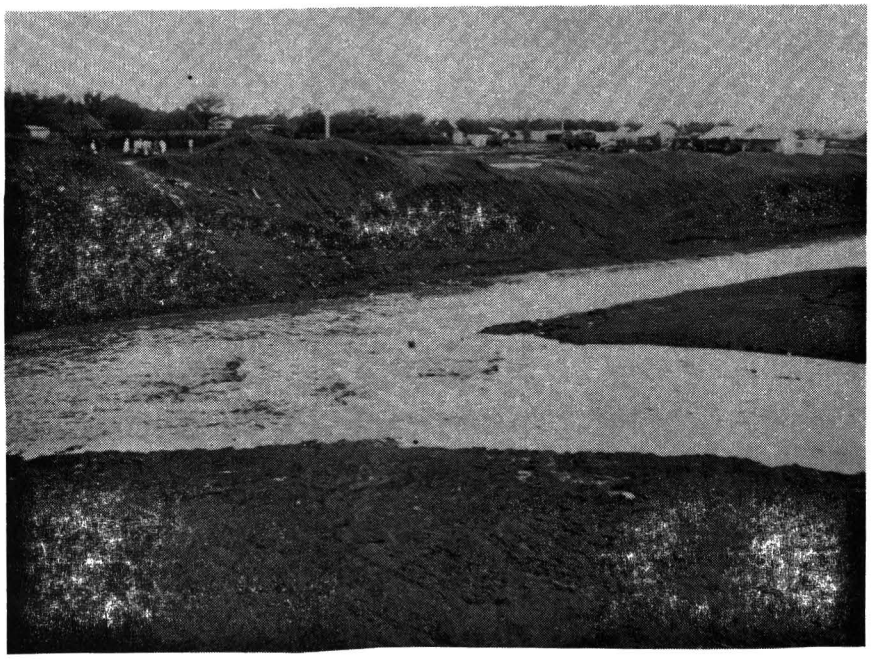


Fig. 5.30 Khor joining

4. To prevent further calamities and land loss riverbankprotection is needed at Dar es Salam. The protection will consist of an earthen embankment in the outward bend of the khor, combined with lining of the slope.

3. Garbage collection

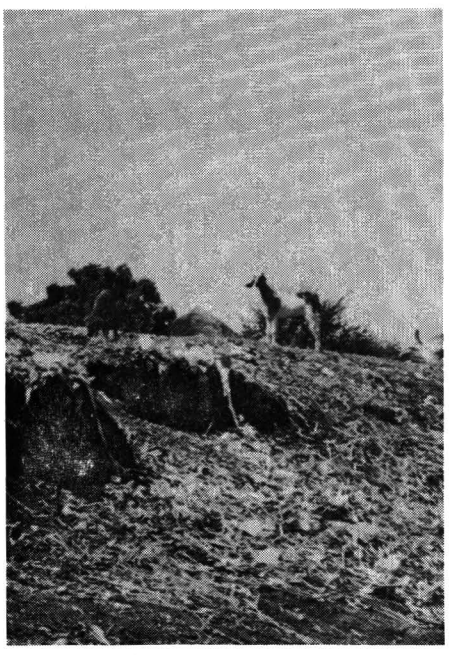


Fig. 5.31 Garbage

On two different scale levels actions have to be taken to improve the garbage collection and thus prevent pollution and the spread of diseases.
In all neighbourhoods small garbage collection points have to be constructed. Neighbourhood organisations should be involved in the choise of locations and the locations must have good access for trucks.
Partially the collection points will be containers and partially simple open constructions. Increase of the number of containers to 120 (now 28) can be realised without needing extra lorries.
Beside the construction of collection points, the 'garbage collection organisation' will have to be improved in order to clean open dumps and for regular cleaning of collection points. A mechanical shovel (loader) and tractor are necessary for this task. More personnel will also be needed.

4. Transport

To improve the access to Gedaref as well as to facilitate transport inside Gedaref three types of measures will be needed on short term:

1. Maintenance of existing structures: The erosion due to the heavy rainfall in Gedaref makes it necessary to put a lot of effort in maintenance. The weak surface on which roads are constructed cause holes in the roads, which is worsened by the high percentage of heavy traffic. Bridges, irish bridges and roads therefore need a lot of maintenance. It is advisable to make a yearly maintenance program for these structures and to reserve a considerable part of the 'road budget' for maintenance. Thus, much bigger expenses in the near future can be prevented.

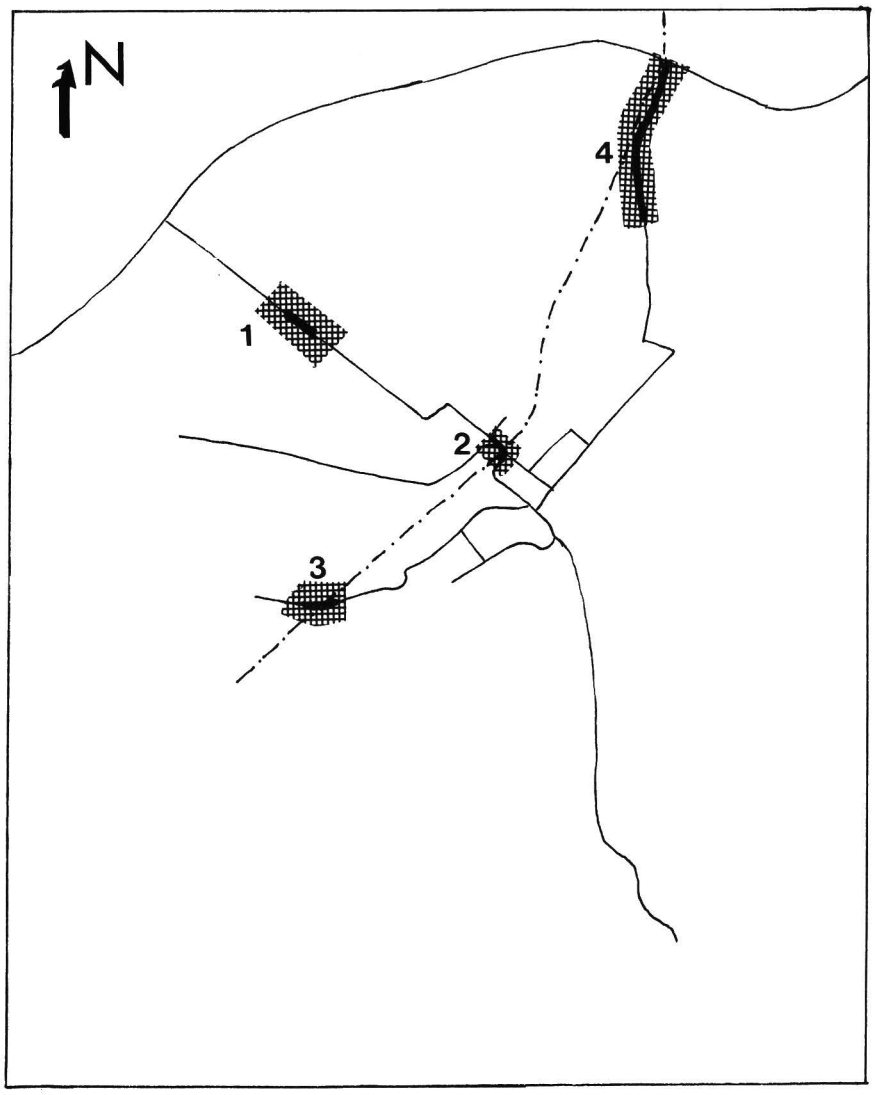


Fig. 5.32 Bottlenecks in the mainroad system

2. Improvement of bottlenecks in the mainroad system: On the longer term it is necessary to extend the main road system. On short term, however, improvements can be reached by taking away constraints in the existing road system. Thus the access to the town and the vital economic functions of the town can be improved. First priority is given to the construction of a bridge near Kerfis (see map) to improve the access to the town. Furthermore, reconstruction of railway crossings and improvement of the North-East access to the town are advised on short term. Detailed descriptions of these projects can be found in part 2 of this report (chapter 5).

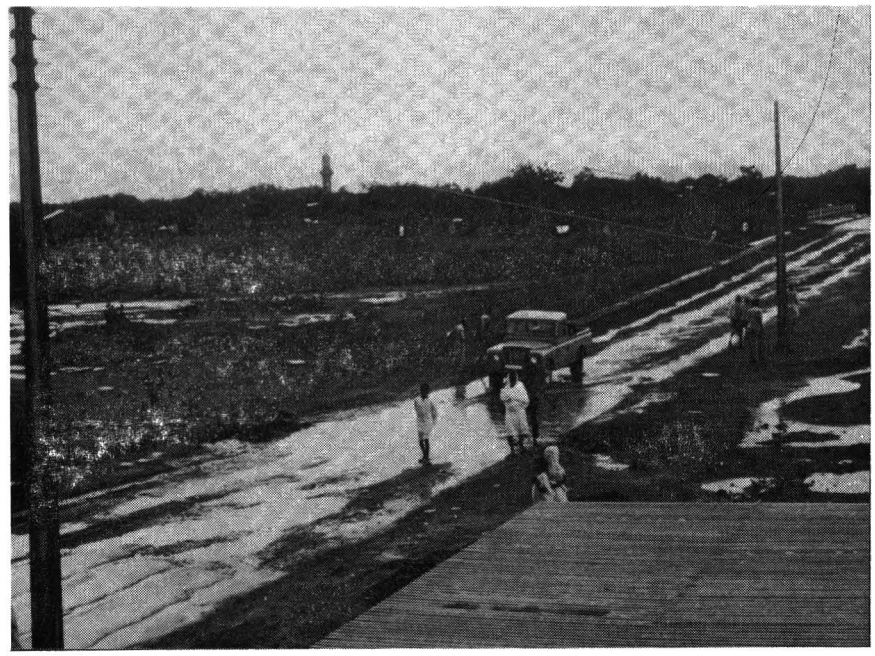


Fig. 5.33 North-West accessroad after short rainfall

3. Improvement of routes to neighbourhoods: Beside the mainroadsystem there is an important secondary road system which provides access to the neighbourhoods. These roads are used by the public transport (boxes). Compared with the mainroadsystem, here the whole route is usually of bad quality. Improvement of the system can therefore, even on short term, not limit itself to the reconstruction of bottlenecks but has to be directed to the improvement of complete routes. The routes should be improved neighbourhood by neighbourhood. Metalling of roads, improvement of irish bridges, and improvement of drainage along the roads will be the most important topics.
Because of the very bad access to this neighbourhood the road to Dar es Salam will be the

first to improve. The most important neighbourhood routes are indicated on the map. For more detailed information see part 2 chapter 5 of this report.

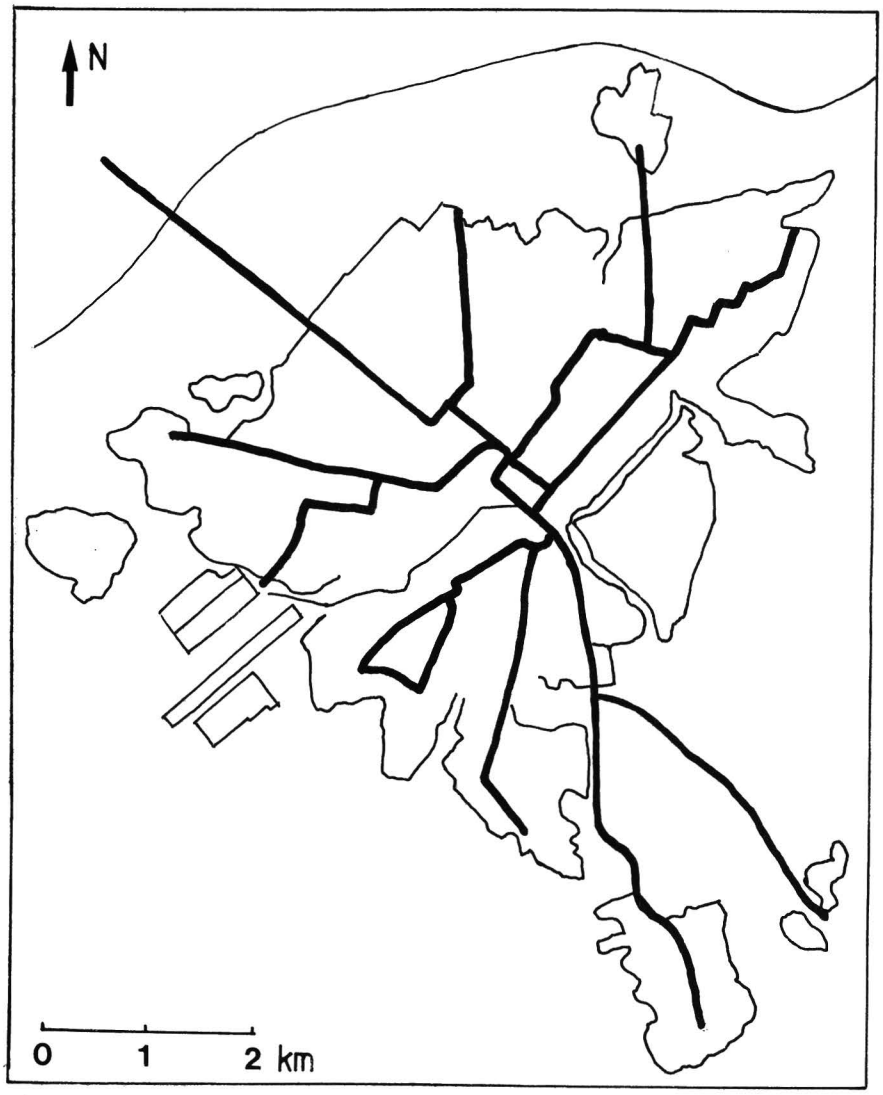


Fig. 5.34 Neighbourhood accessroutes

5. Improvement of physical structure main market

The main market area is now in fact overcrowded. All functions concentrate on one small piece of land. On the long term shift of functions and an extension of the market area will deminish the pressure on the existing area. Nowadays however, the intensive use of the market area imposes heavy demands on the physical structures of the area. Improvements are therefore needed on short term. Three types of projects are indicated here to improve the functioning of this critical area:

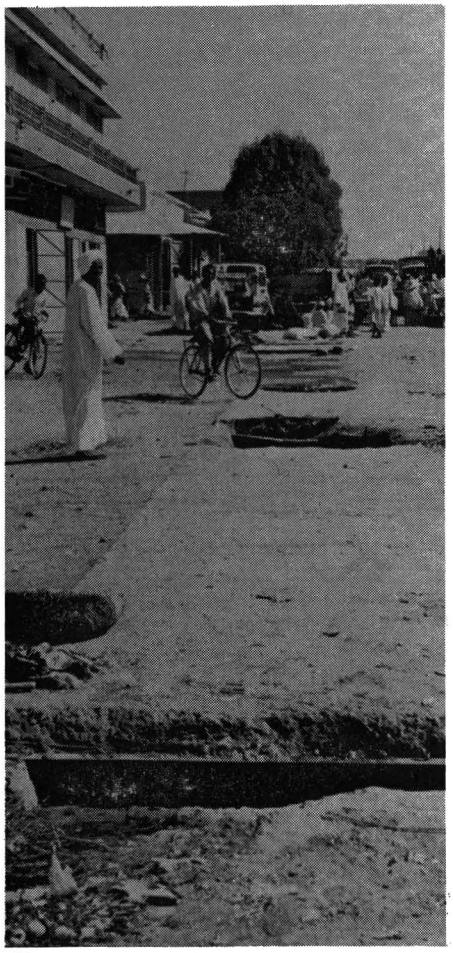


Fig. 5.35 Primary drain main market area

Fig. 5.36 Main market area

1. Improvement of the existing drainage system: the main system drains from S-E to N-W. this system has a limited capacity, it ends abrubtly near the station and is heavily polluted. The channels that lead to the main channel are often not lined, and their capacity is to small.
A better connection from the main market drain to khor Abu Farga is needed as well as extension of the capacity of the secondary drains. A better garbage collection system should prevent pollution of the drains.

Fig. 5.37 Drainage market area

Some water is drained to the South-East side of the market area. Her we cannot speak of drainage channels, but only of surface run-off. In combination with the canalisation of this khor, this system has to be improved.

2. Canalisation of the khor on the S-E part of market area: The south-east part of the market area is now in fact a riverbed. In the dry season this area is used as a grain market but hardly any permanent buildings are erected there. Although the area is part of the market area it cannot be used efficiently because of the regulary flooding. By canalisation or even covering of the khor, the area can be used in a more effective way. Thus another valuable piece of land can be used for market functions. More detailed research will be needed to calculate profiles and determine construction methods.

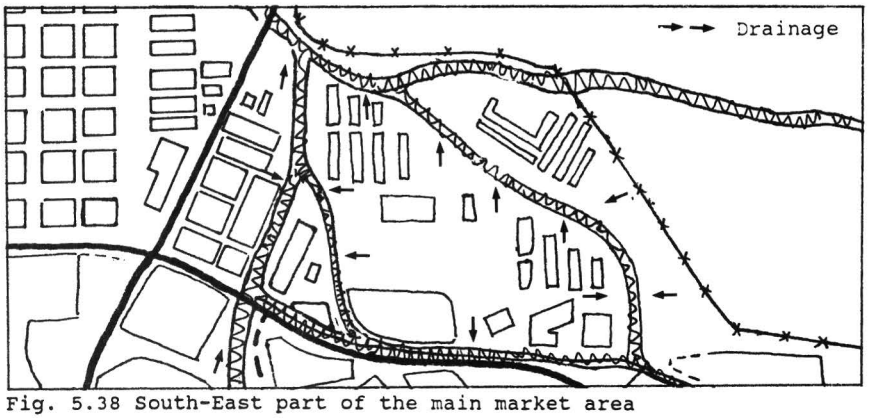


Fig. 5.38 South-East part of the main market area

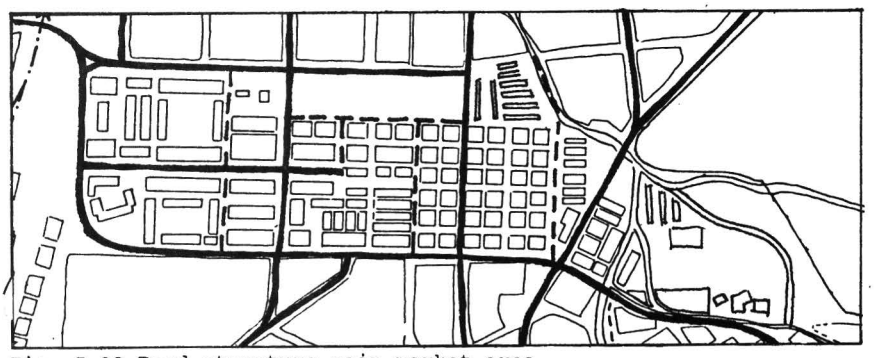


Fig. 5.39 Road structure main market area

3. road improvements and landfill: most roads in the market area are of clay, which makes the market area already inaccessible after a small amount of rain. It is necessary to metal the most important routes (see map) to provide permanent access to most of the area. Some landfill will be needed to facilitate surface water run-off. To plan this, detailed levelling will be necessary.

6. Improvement of electricity supply

Extension of the electricity network is useless unless two projects are carried out. Because extension of the network is considered necessary to stimulate industrial developments, these projects should be realised on short term:

1. Connection of the Gedaref electricity network to the national net (Gezira grid). This (large) project will improve and secure the supply of electricity so that industries can rely more on the availability of electricity. Detailed studies have been carried out by the National Electricity Corporation so that implementation can start quickly.
2. Increase of the capacity of the main transformer. The existing transformer is now used at its full capacity (2mW). Replacement of this transformer by two new transformers of 5 mW each has been studied by a Finnish development agency and is technically feasible.

After execution of these projects, the connection of the new industrial area and the highway service centre with a 16kV line are urgent.

Implementation of short term projects

It can not be expected that on short term the possibilities of the local government to implement projects will increase very much. Therefore the existing 'implementation capacity' of the local government should be taken as a starting point. The choise of strategy must be based on this conclusion.

Most projects require a lot of material support. The government will therefore have to rely on the support of local organisations that benifit from the improvements (e.g. market area) or on external finance. This can be national or regional governments or development agencies. Efforts will have to be taken by the local government to obtain these funds.

SELECTED LITERATURE.

Abdelgalil, H. (1983), Technical report on Khor Abu Fargha Gedaref, ..

El Agraa, O. and A.M. Ahmed, (1979) Human settlements in arab countries, Khartoum University Press, Khartoum, the Sudan.

Caminos H., R. Goedhert (1978), Urbanisation Primer, Massachusetts, MIT press, U.S.A.

Elkhier, S.E.O., M.Y.A. Mafiez, et al, (1981) Gedaref structure plan, University of Khartoum Press, Khartoum, 1981

ETMA-program, G.D. El Tayed (1983), Environmental monitoring baseline and trend analysis report, part II: Gedaref District, Institute of Environmetal Studies, University of Khartoum, Khartoum, the Sudan

D.H.V. consulting engineers (1979) Kassala Urban and Adjecent Area Development Projekt Part 1, 2 and 3, Amersfoort, the Netherlands

Dutch University Team I (1986), Gedaref Planning Studies part II: sector surveys, Technical University of Eindhoven, Eindhoven, the Netherlands.

Dutch University Team I (1985), Provisional Report to inform the Gedaref Towncouncil ..., Gedaref, the Sudan

Dutch University Team I (1985), Survey Report,Gedaref, the Sudan.

Fouad, N.I. (1978), The problem of desertification in the Republic of the Sudan with special reference to Darfur Province, University of Khartoum, Khartoum, the Sudan

Kivie, van der (....), Exploratory soil survey of Kassala Province, Buraymah

Montgomery Consulting Engineers inc. (1983), Feasibility study improvement water supply Gedaref, ...

Post, J. (1985), The future development of Kassala's town centre, Free University of Amsterdam, Amsterdam, the Netherlands.

Post, J. (1985), Ruimtelijke integratie of se-

gregatie van urbane vluchtelingen, Free University of Amsterdam, Amsterdam, the Netherlands

Kheir, ' O.M. (1980), The hydrology of the Gedaref Basin, ...

Tewlik, M. (1977), A pilot project for the Khors, Eastern Sudan, Ekistics May 1977, ..

UNESCO (1984), The management of human settlements in hot dry climates, Khartoum, the Sudan