ENVIRONMENTAL TRAINING & MANAGEMENT IN AFRICA (ETMA)

ENVIRONMENTAL MANAGEMENT IN THE SUDAN

LOWER RIVER ATBARA AREA

(NILE PROVINCE)

Final Report

By

Hassan A. Abdel Ati, (Ph. D.)

INSTITUTE OF ENVIRONMENTAL STUDIES
UNIVERSITY OF KHARTOUM
SUDAN

SEPTEMBER 1985

Prepared for :
The United States Agency
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ABSTRACT

ENVIRONMENTAL DEGRADATION IN THE LOWER RIVER ATBARA AREA (NILE PROVINCE)

Abstract:

The Lower Atbara refers to the area between Goz Ragab, on longitude 35° 30' East and latitude 16° 5' North, and the village of Al Magran at the junction of the River Atbara and the main Nile, just south of Atbara town. However, for the purpose of the study the name Lower Atbara is used to cover the triangle of Al Magran in the northwest, Ba'aluk in the southeast and Khor el Makabrab representing the southern limit of the area (Fig.1).

The reasons for this delimitation include:

1. The similar physical characteristics of the area in terms of climate, soil characteristics and natural vegetation.

2. Similar economic activities and land use systems along the river banks (east and west), and the complementary nature of the economic activities away from the river with those on the river banks which maintained in the past mainly the form of a "mixed" primary economy combining animal herding and rainfed cultivation in the northern Butana with irrigated agriculture on the river banks.

3. Perhaps the most important factor behind that delimitation was the similar signs and impact of environmental degradation that has been taking place in the area over the last two decades. The area has been subject to the dual effect of the Khashm el Girba Dam on the

riverine areas and that of rainfall deficiencies in the area away from the river since the early 1960's, which is taken as the base line.

4. Another major factor behind the selection of this area in particular is the fact that economic growth and development in Sudan has for the last 50 years or so been, and it seems that it will continue to be, heavily dependent on the expansion of irrigation systems and irrigated agriculture. Various studies conducted suggest that the expansion of irrigation networks and construction of dams in most of the arid countries has resulted in many adverse social, economic and ecological consequences that were not originally anticipated by planners.[1/] This means that by studying this area it is not only possible to anticipate the negative environmental and economic consequences of dam-based irrigation but also to throw some light on what could have been taking place, and may be unnoticed, in the different irrigated areas in Sudan.

However, the delimitation as it stands now falls into three administrative areas, namely Ed Damer Rural Council, Berber Rural Council and Seidon Rural Council. This fact, of course, could

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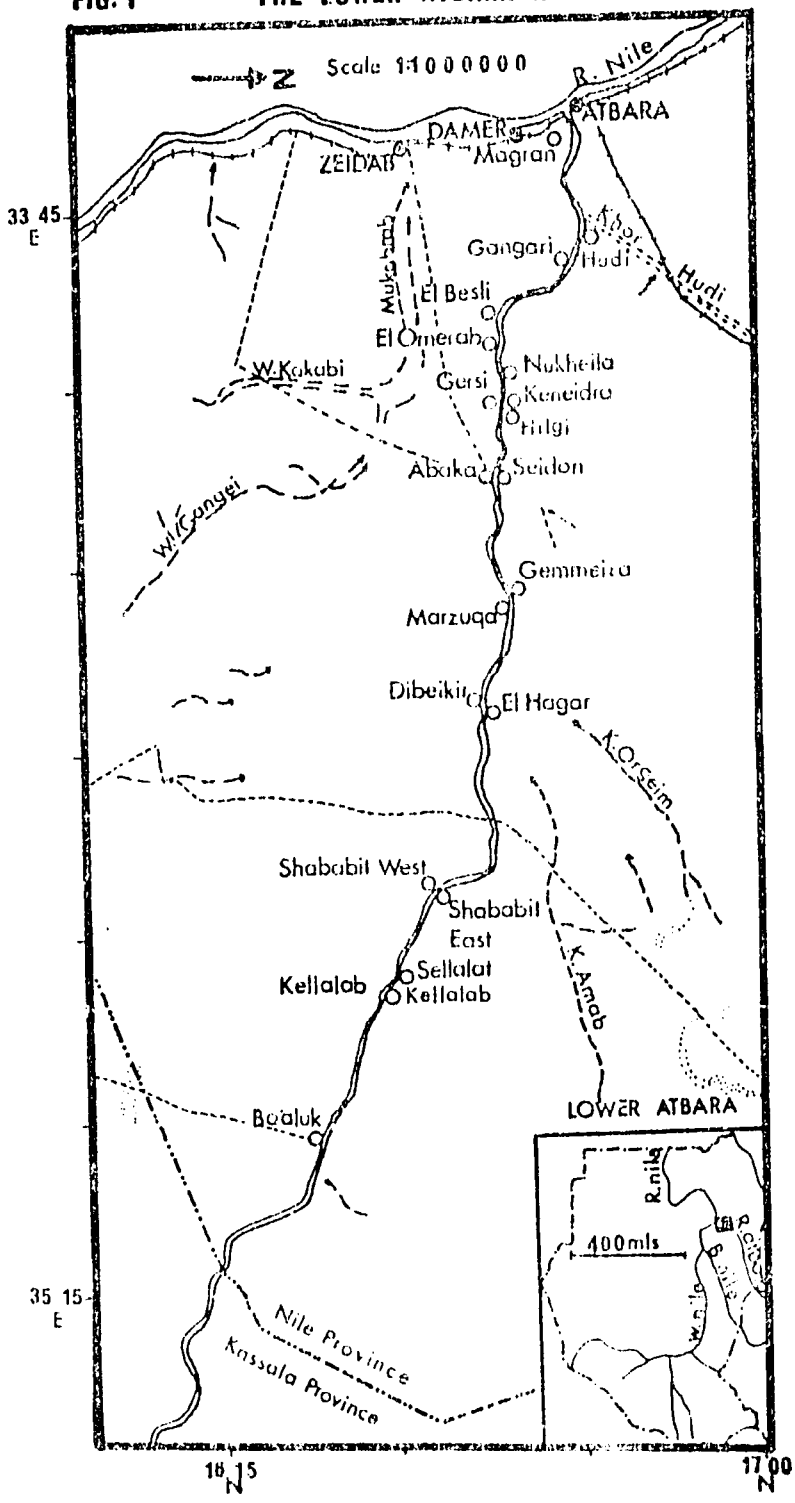
1/ See for example Farver, M.T. and Milton, J.P. (eds), The Careless Technology: Ecology and International Development, Doubleday & Co., New York, 1972.

FIG. 1 THE LOWER ATBARA AREA



have made it substantially difficult to collect the necessary statistical data if there had been an organized administrative system of data collection, but the lack of it made little difference, if any, resulting from ignoring these administrative boundaries. Furthermore, the recent changes (during the 1970's) of these administrative boundaries also contributed to that lack of systematized statistical data.

PART ONE

PART ONE

BASELINE REPORT

1. PHYSICAL GEOGRAPHY OF THE AREA

1. THE PHYSTICAL GEOGRAPHY OF THE AREA:

The area is characterized by an average total annual rainf-fall of under 75 mm, most of which is experienced in August and September. The climate is therefore of a desert type in which rainfall is negligible; its amount and duration depend on the direction and speed of the prevailing winds as well as on the temperature levels. The area is also well known as being one of the highest in all Sudan in the intensity of haboobs (dist storms) which reflect the dryness of the area, its lack of begetation cover and the disintegrated nature of its soil.

Alluvial and lacustrine soils cover most of the area, underlain mainly by the basement complex rocks except in the extreme northwest near the junction of the Atbara River with the main Nile. This northwest corner of the Butana plain forms a part of the Nubian sandstone series that dominates the whole of the northwestern part of Sudan. As for the northern Butana plain itself, it is generally flat with light clay soils of first class

fertility,[1] deteriorating gradually to the northwest although along the river Atbara even at its worst the soil fertility grade never falls below second class.[2] In his discription of the riverine soils in the Lower Atbara, Ayob considered them as a mixed product of the river silt accumulation, aeolian deposits and a high terrace wash down.[3] The vegetation cover is a semi-desert consisting of desert scrub, thorny acacia and seyal, and semi-desert and desert grasses and herbs. The density of these grasses varies according to the level of rainfall and the amount of water run-off.[4] However, it can safely be generalized that the density of vegetation decreases as we move south away from the River Atbara, but it starts to increase again towards the inner Butana. It also decreases on the river banks itself as we move to the northwest.

1/ This was one of the major factors behind the location of Khashm el Girba Scheme in its present place.

2/ See Hassan Dafalla, "The Nubian Exodus", Hurst and Co. London, 1975, p.107.

3/ See Ali Ayob, /Soil Investigation in Um Agaga, Shaaliya and Idrisab villages, "Unpublished report, Hudeiba Agr. Research Station, Ed Damer, 1970.

4/ See K.M. Barbour, The Republic of the Sudan, a regional geography. University of London Press, London, 1961, pp.65-67.

The River Atbara:

The Atbara River develops as a result of the rainfall in the Ethiopian Plateau north of Lake Tana, and as it enters Sudan near Gallabat it is joined by the Setit, the largest tributary, which occupies about $\frac{7}{10}$ of the river basin. The total length of the river is about 600 kms with an average width of one km, although it varies considerably and sometimes and in some places its width is doubled, depending on the amount of rainfall and the nature of the channel rock surface.

For most of its course in Sudan the River Atbara is well below the general level of the plain, and about one half of its course, especially in the upper regions, is bordered by the Karab or badlands as they are referred to by Hurst.[1]

The River Atbara used to contribute to the Nile waters some 12 milliard m^3 annually, 95% of which was between July and December. This represents about 13.4% of the Nile waters.[2] For the whole period of January-June the river used to be almost completely dry except for the few swamps and water pools that developed especially in the lower parts of the channel where the slope is relatively more gentle (See Fig.II).

1/ See Hurst, H.E., The Nile: a general account of the river and the utilization of its waters, Constable & Co., London, 1952, p.90.

2/ See Yahia Abdel Mageed, Nile Control for Agricultural Development in Sudan, in Shaw, D.J. (ed.) Agricultural Development in the Sudan, Proceedings of the 13th Annual Conference of the Philosophical Society of Sudan, Vol.2, Khartoum, 1966, pp. 318-9.

The seasonal nature of the river, the very steep slope in its upper course, the forestation of these upper parts and the high silt content of its water had all combined to form the basis for and shape the settled life on the lower reaches of the Atbara River.

The huge elevation difference between the Ethiopian plateau and the central plain of northern Sudan made the speed and velocity of the Atbara waters outstandingly high.[1] The flow, in addition to the relatively short distance crossed by the river and the alluvial nature of the soil, has contributed substantially to the strengthening of the erosive power of the river and its ability to uproot and drift falling trees from the Ethiopian plateau. As a result the concentration of silt in the river waters prior to construction of the Khashm el Girba dam was estimated to be 200 parts per million,[2] or 3 or more kg of silt per cubic meter of water,[3] and it is thus certainly the highest among all the Nile tributaries in the silt content of its waters.[4] The loss of the river

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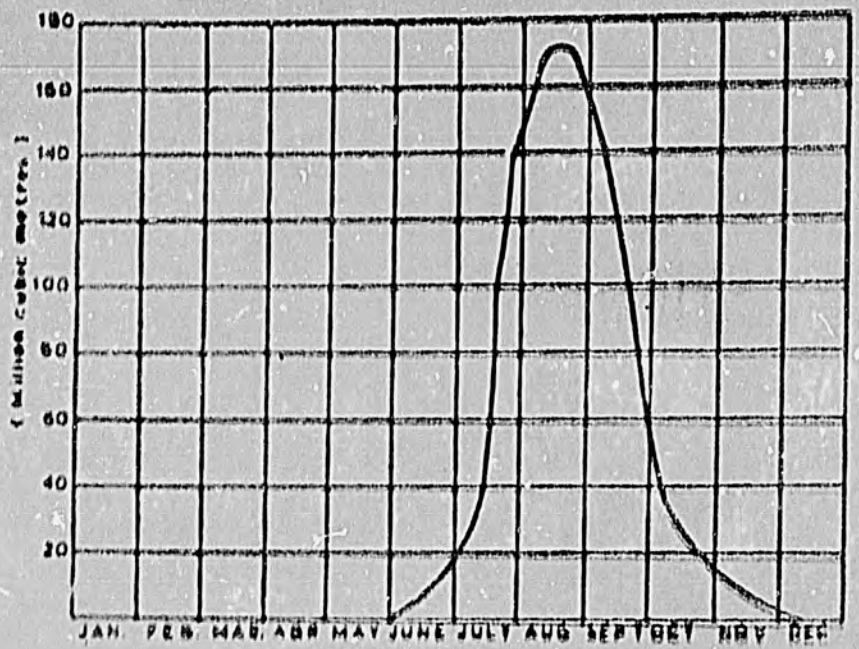
1/ It is estimated that the speed of the Atbara River during the flood time and prior to the erection of Khashm el Girba dam was about 40 kms per hour.

2/ See H.E. Hurst (1952) Op.cit., p.

3/ See Salah el Din El Shami, Studies on the Nile, The Anglo-Egyptian Library, Cairo, 1967 (in Arabic), p.164.

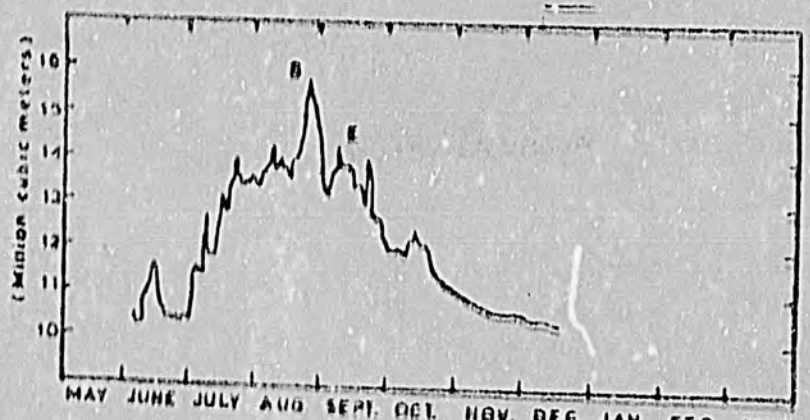
4/ See Mohammed Awad Mohammed, The Nile, Cairo, 1956, (in Arabic), p.294.

Fig(2 THE AVARAGE WATER DISCHARGE OF RIVER ATBARA (1913-1948)
(IN MILLION CUBIC METRES@)



After Shaml (1957)

(B) MONTHLY DISCHARGE OF THE RIVER ATBARA
(AT A. ELGINBA @@)



@@ After Hurst (1952)

waters principally through evaporation from the surface and percolation into its alluvial silt-bed.[1/]

The environmental condition that existed in the lower Atbara prior to the construction of the Khashm el Girba dam is largely responsible for the then prevalent economic activities and was hence reflected in the population structure and its mobility patterns. These conditions have allowed for, or may have imposed, an economic activity that, perhaps uniquely in Northern Sudan, continues throughout the year. This has taken the form of combining agriculture with animal husbandry and herding, both being supplemented by other minor activities such as fishing, wood collection and handicrafts. This latter activity was largely dependent on the extensive presence of the dom trees or the branching palm (Hyphaene thebaica) in the area which was the main source fof saaf (the dom leaves) from which hand-mattings such as broosh and baskets were made. In addition an important source of cash was the collection of the huge amount of wood that was annually brought by the river. This wood was sold as firewood or as a building material in the neighbouring towns of Ed Damer and Atbara. Fishing, largely associated with wood collection, was also practiced widely during the flood season.

However, the erection of Khashm el Girba dam in 1964 has considerably disrupted that pattern of life through the various ecological changes it

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1/ See K.M. Barbour (1961) Op.cit., p.119

caused in the area. These changes were clearly reflected in the forms of economic activities, land use patterns, and in the demographic structure of the population, all indicating the gradual loss of value of that environment.

Indicators of deterioration and the present trends in response to those changes are discussed below through a comparison between the conditions before and after the erection of the dam. First a general historical background about settlement in the area and the ethnic structure of the inhabitants is provided; it is followed by a brief description of the population characteristics. Secondly there is a description of the pre-dam economy of the area, heavily centred on the riverine land area. That is followed by a description and an analysis of the type and magnitude of environmental changes, a summary of their socio-economic consequences and the perception of them by the local population. Finally, on the basis of the comparison of the past with the present situation, a list of indicators of environmental degradation is, qualitatively, formulated. The report is concluded by raising a number of research issues and questions to be investigated and through empirical research to attempt to quantify those indicators to discover a means of reversing or checking that trend of degradation.

2. THE POPULATION OF THE LOWER ATBARA AREA

2. THE POPULATION OF THE LOWER ATBARA AREA:

No exact data can be given for the first settlements in the area, probably because of the mobility associated with the indigenous nomadic population, but there is some evidence that suggests the existence of a complete settled life during the late 18th early 19th century. In El Gubba village, there is the gubba tomb of Faki Abu Nagea'a, a religious man who is known to have migrated during the Funj Period (1650-1920). Another village, named Gerf el Buja, might also suggest that the Beja nomads of eastern Sudan may have reached this area in their continuous search for water and pastures; some of them might have settled in the area as cultivators.[1/]

2.1. The Ethnic Structure:

A large number of tribal groups depend totally or partially on the River Atbara and inhabit its banks. In the upper reaches of the river we find the Bisharin, Nifidab, Marahomab, Fadniya and Kamalab, while the Jaaliyin, especially Aliab, represent the majority of the population of the lower parts of the River Atbara. The Jaaliyin are believed to have moved to the area as established cultivators from the area east and west of the Nile near Ed Damer, most probably in the first half of the 19th century after

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1/ These views were formulated as a result of a series of conversations with inhabitants of the area over the last few years, especially Sayed Haj Ali Salih, the ex-Omda of the area, who expressed the same views in an unpublished and undated paper titled: "A Note on the History of the Lower Atbara" (in Arabic).

El Difterdar revenge expeditions that followed the murder of Ismail Pasha in 1821.[1]

2.2. The Demographic Characteristics:

The area under study is inhabited by about 80,000 people living in permanent villages on both sides of the river and some scattered camps on the western side of the river.

There is no detailed census nor are there very reliable statistics for the population of the area and the only enumerated figures available are those of the 1955/56 census that was based on the Omodiya as the smallest unit.[2] The 1973 census was based on the average number of household members and the number of houses in each village. Two other estimates for the population of the area were also made by the provincial authorities in 1969 and 1972, but no mention was made of the method or criteria on which these estimates were made. However these more recent sources suffer from the following:

1. being based on estimates and the lack of any clear statistical method that was applied to arrive at those figures.
2. the considerable variations and inconsistancies when their figures are compared.

1/ See H.A. Abdel Ati, The Impact of Khashm el Girba Dam on the Lower Atbara Area-Sudan, Unpublished M.Sc. Thesis, Centre for Development Studies, University of Wales (Swansea), 1979, p.13.

2/ This in fact suits most of our purpose here as the area under study roughly coincides with the boundaries of the ex-Omodiya of Al Magran. An Omodiya was an administrative unit consisting of two or more Sheikhships or villages under the authority of an Omda.

3. they seem to underestimate or ignore the significant variations between different villages, i.e., variations resulting from the combination of differences in the rates of in and out-migration and influence of location relative to a neighbouring town, if we assumed an equal rate of natural population increase.

Table 1 contains the figures given for six selected villages in the area, namely, Al Magran, Gangari, El Qubba, El Omerab, El Besli and Gersi (all on the western side of the river and indicates the huge differences between them.

Table 1

Total Population of six Selected Villages in the Lower Atbara Area in selected years 1/

Year	1955/56	1969	1972	1973	1978
The Population	5,869	12,300	15,200	6,899	10,550
average household number	5.4	n.a.	n.a.	5.6	10.6
annual growth rate (approx)	2.9%	7.8%	6.0%	1.5%	2.8%

1/ Notes on the table:

a) Sources, respectively, the 1955/56 Population Census of Sudan; E.I. El Sabooni, A Report on the Problem of Lower Atbara, Nile Province Headquarters, Ed Damer, 1969; Nile Province, A Memorandum on the Lower Atbara Area, Ed Damer, 1972; The 1973 Unpublished Census; and H.A. Abdel Ati (1979) Op.cit.

b) Annual growth rate is calculated on the basis of the 1955/56 Census figures.

On the basis of the 1978 sample, being the most recent, the following observations can be made:

a) that about 52.3% of the population is either under 15 years or over 45 years old and hence the community can be described as a young one in terms of age.

b) the average family size (i.e. all those living in the same household) is considerably high, exceeding 10.5 persons per household, although these ratios vary considerably between different villages, e.g., it is 7.2 persons in Al Magran while it is over 14 in El Qubba.

c) the economic dependency ratio is fairly reasonable (3.5 persons) when compared to the average household size, although again it varies between different villages, from a minimum of 2.6 persons in El Omerab to a maximum of 5.5 in El Qubba. However, these relatively low ratios of economic dependence that suggest high participation rates in fact might have obscured the high levels of unemployment. The reason for such assertion lies in the unclear definition of "income earner" or "the economically active", as it included all income earners no matter how long or short the period of their employment is.

Comparing the 1978 sample figures with those of the 1955/56 census we find that, although the annual growth rates are almost the same, the average household size has almost doubled. This indicates a high level of natural increase; it also suggests an intensive out-migration trend involving mostly the young males and probably small families a part of which might be left

with the wife or husband's parents. However, on the one hand, the exceptionally high growth rates of the 1969 and 1972 estimates seem to suggest a significant trend of migration into the riverine area; that may be a reflection of the natural hazards' effect on the local population of the southeastern parts of the area. The year 1968-69 witnessed the most extensive damage caused by the exceptionally high flooding of the river Atbara, and that damage caused some of the population to move further northwest along the river banks to settle in the lower Atbara. That also coincided with the beginning of the drought in the northern Butana when, for the first time in a fairly long period, rainfall deficiency was so great that it halted the rainfed cultivation and animal herding that used to be practiced both by the nomads of the northern Butana and some of the riverine population. This has also caused some of the originally nomadic groups of the Butana to move and start a settled or semi-settled life near the River Atbara. However, it must be noted that the occurence of these hazards, the resultant influx of population towards the area, and probably the political row[1/] it caused may have influenced the estimates of population made in 1969 and 1972 and hence the calculated growth rates.

On the other hand, the 1973 figure of growth rate (1.54) which is far below the national average also suggests an outward migration trend from the area,

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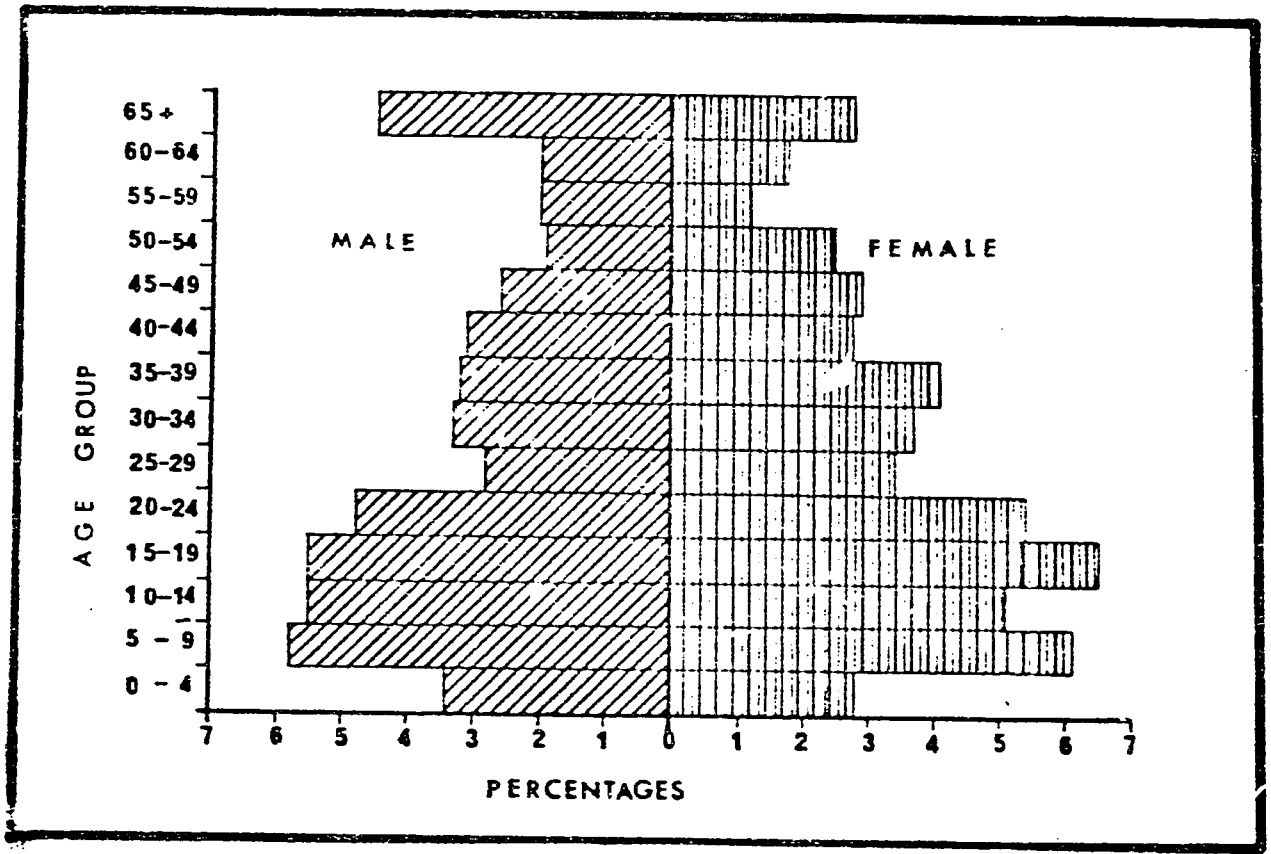
1/ During the 1969-72 period the area was visited by the President of the Republic and various ministers and the Provincial Authorities conducted these surveys in response to those problems.

but it is difficult to choose between it and the total population figure of the previous year, which is twice that of the 1973, and hence it is not easy to generalize.

With regard to the sex balance, the overall male/female ratio, according to the 1978 sample results, is fairly even, standing at 99.3%, but enormous variations are encountered for the different age groups (See Table 2). For those under 15 years of age, the male/female ration is 104.5% and 115.3% for those over 44 years old, but it is only 89.3% for the group of 15-44 years. The imbalance in this latter group, of course, indicates the migration of adult males, although the level of imbalance seems to have been kept down by the high ratio of population in the working age (47.7%) (See Fig. III).

The major destinations of these migrants are Ed Damer and Atbara towns, to which migration seems to be of a permanent nature and in addition to Khashm el Girba and the mechanized crop production schemes of the Gedaref area. Migration to these two latter areas seems to be temporary, either seasonally during cultivation periods or for only a few years.

FIG. 3 POPULATION PYRAMID OF LOWER ATBARA



Drawn by: A.Aziz Ahmed

Table 2

Lower Atbara Population: Age-Sex Structure, Education and Marital Status (*)

Age Group	Both Sexes (%)	M Total		Married		Education by age group (%)		Male/ Female Ratio	Broader Age Groups		
		Males	Females	Males	Females	Male	Female		Sub-total (%)	Education	Male/Female Ratio
0-4	6.2	6.7	5.6	-	-	-	-	117.8	6.2	-	-
5-9	11.7	11.4	12.0	-	-	60.0	68.8	93.8			
10-14	10.6	11.1	10.0	-	-	88.6	57.5	110.0	22.2	68.9	104.5
15-19	11.8	11.0	12.5	-	2.3	41.4	5.0	87.0			
20-24	10.1	9.7	10.5	2.1	5.4	9.1	2.4	91.7			
25-29	6.2	5.7	6.6	3.4	5.6	14.8	-	84.9			
30-34	6.8	6.4	7.1	4.5	6.8	3.9	-	89.5			
35-39	7.1	6.3	7.9	4.8	7.1	-	-	79.4			
40-44	5.8	6.1	5.5	5.8	4.8	2.1	-	109.1	47.7	7.5	89.3
45-49	5.5	5.2	5.8	5.0	[illegible]0	4.9	-	89.1			
50-54	4.3	3.8	4.9	3.4	2.9	3.3	-	76.9			
55-59	3.1	3.9	2.4	3.3	1.8	-	-	163.2			
60-64	3.8	4.0	3.6	3.0	2.1	-	-	110.4			
65 & over	7.2	8.8	5.5	7.3	2.1	-	-	159.1	23.9	0.8	115.3
Total	100.0	100.0	100.0	42.6	44.9	23	14.9	99.3	100.0	19.1	99.3

(*) Notes on the Table:

1) Source: H.A. Abdel Ati(1979), op.cit., p.18.

2) All figures are based on a 150-household-based sample survey conducted in 1978 covering six Sheikhships that form the ex-Omodiya of Al Nagran.

3. THE PROBLEM OF LOWER ATBARA: A HISTORICAL NOTE

3. THE PROBLEM OF LOWER ATBARA, A HISTORICAL NOTE:

As a result of the 1959 Nile Water Agreement between Egypt and Sudan that was followed by the construction of the Aswan High Dam, the inhabitants of Wadi-Halfa area (about 50,000) had to be evacuated. After a lengthy debate they were settled in the Khashm el Girba area in consideration of various factors the most important of which were the low population density in the area and the high fertility of the soil.[1] A dam was constructed on the River Atbara at Khashm el Girba village about 40 kms from the Ethiopian border and 350 kms from the Atbara-Nile junction, with a storage capacity of 1.3 milliard cubic metres, primarily to irrigate the 500,000 feddans-scheme that was established and to supply electricity (potentially 15 MW) to New Halfa, Kassala and Gedarif towns.[2]

No serious attempt has ever been made to assess or measure the effects the dam can make on the areas outside its immediate vicinity. As for the Lower Atbara, the most affected area along the Atbara river, it has never been a part of any evaluation of the Khashm el Girba Scheme either by the dam authorities or by the Central Government. With the completion of the dam in 1964, the ecological balance started to be disturbed causing enormous economic and social changes reaching the pressing levels from 1969 onwards; this elicited

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1/ See for example, Hassan Dafalla (1975) Op.cit., pp.134-5; also Ismail Hussein Abdalla, The Choice of Khashm el Girba Area for the Resettlement of the Halfawis, Sudan Notes and Records, Vol.51, 1970.

2/ See M. Sh. Osman and H.E. El Hag "Irrigation Practices and Development in the Sudan," Sudan Notes and Records, Vol.55, 1974, p.100.

some action by the provincial authorities, one of which was those surveys of 1969 and 1972.

3.1. The Traditional Economy of Lower Atbara:

Prior to the erection of Khashm el Girba Dam the economy was predominantly agricultural. Over 90% of the population depend on irrigated agriculture to make a living, though most of them supplemented their incomes by fishing and trading in the wood drifted by the river. The River Atbara was therefore the cornerstone for the local economy. Nevertheless, rain cultivation in the inner Butana was practiced, when climatic conditions allowed, together with animal herding that sometimes involved a partial mobility of households.

3.1.1. Agriculture:

Four types of cultivation were known in the area and these were:

a. gerf[1] cultivation on the annually flooded banks of the river;
b. karu[2] land cultivation immediately above the gerf land, mostly irrigated by sagia;[3]
c. magat[4] cultivation on the river bed when it dries up and develops small water pools; and
d. atmur[5] cultivation on the rainfed lands of the northern Butana.

1/ gerf (ar) the sloping land of the river bank or small pockets of silt land cultivated after the river flood waters subside.

2/ karu: land above the area annually flooded by the river (gerf).

3/ sagia: the ox-drawn water wheel.

4/ magat: refers to watermelon and cucumber cucumis on the river bed when it dries up.

5/ atmur: an area of sand dunes stabilized by a small clay content, cultivable in the rainy season.

Agriculture was typically subsistent and practiced on a family basis. The subsistent nature of the society seem to have been imposed by the seasonal nature of the River Atbara and the unreliability of rainfall in the area. In fact it seems that, with the then available technology, this subsistence level was not easy to maintain without the full utilizatcn of all agricultural potentials in the area; this may also be the reason for the drastic changes caused by the Khashm el Girba dam.

The year was divided into three agricultural seasons, seifi (summer), damira (flood) and shitwi (winter). In the seifi season (April to August) cultivation was restricted to the karu land, depended on sagia irrigation and involved the production of dukhn (bulrush millet) and some vegetables. In damira season (August-November) crops cultivated were mainly vegetables, dura (Sorghum Vulgare) and lubia (Dolichos lablab) on the gerf lands, the latter two to be cut green as animal fodder. During this season the cultivation was the easiest and the demand for labour was generally low. For this reason it represented the peak season for subsidiary activities such as fishing and floating wood collection. The shitwi season (November-March) was considered to be the most important season in terms of working hours, labour force employed and the crops grown. It also represented the second rotation of farming on the karu lands. Lubia (Dolichos lablab) and bersim (Lucerne) for animals, vegetables and horse beans for human food, and quite often for sale, were the major crops produced. In addition, wheat was also grown sometimes, when temperature levels were low and enough water was available for irrigation.

Magat cultivation of agur (cucumber cucumis) and watermelons, on the river bed, was usually carried out in March or April when the river develops into pools, to be harvested in June or July before the flood time, thus making use of the moisture content of the river bed soil.

Atmur or rainfed cultivation in the Butana was practiced in June, July or August depending on the time of rainfall. It used to involve only a part of the family (young males) who followed the herds during the dry season and then settled down with their herds after the start of the rainy season. Dura was the only crop grown for food while the straw was dried to feed animals during the summer season.

3.1.2. Nomadism and Animal Herding:

According to the 1955/56 census, the nomads and semi-nomads in the lower Atbara area accounted for about 4% of the total population of the area. The major differences between these two groups were:

a. the nomads were largely concentrated in the southeastern parts of the area around and south of Gersi Sheikhship, while the semi-nomads were scattered all over the area along the river channel;

b. the nomads used to concentrate on raising camels and sheep while the semi-nomads concentrated on sheep, goats and some cattle;

c. obviously the distance and duration of the nomads' mobility were both longer than those of the year in the Butana pastures and wadis, the nearest of which was khor el Makabrab (See map 1). Also sometimes nomads from the

central Butana used to move for far longer distances towards the Atbara river during dry seasons; they might even cross the river to the north.[1] The semi-nomads, on the other hand, who were mostly farmers, used to spend only two or three months away from the River Atbara and take shorter trips to Sih al Hagar, Wadi Umm Grain, Sararit and Wad Adar; and

d. while all the family is involved in the nomadic mobility, only some of the males were involved in the case of the semi-nomadic family.

Although the ratio of nomads and semi-nomads to the total population is very small, these groups used to own a very high proportion of the livestock then present in the area.[2] Sheep, cattle and camels, respectively, in terms of their numbers, were the main types raised by these groups. Goats were heavily concentrated on the riverine areas and largely associated with the settled population or with the resident part of the semi-nomadic family. Animals in fact played a very important role in the economic life of the settled population. The sagia, the gussabiya[3] and the wooden plouth, the technology that was used at the time, were all completely dependent on animal power (oxen). Donkeys were also used for threshing wheat. In addition to providing a source of food, these animals supplied manure and a means of transport.

1/ See M.E. Abu Sin, A Survey and Analysis of Population Mobility within Northern and Central Sudan, Unpublished Ph.D. Thesis, University of London (Bedford College), 1975, p.204.

2/ See H.A. Abdel Ati (1979) Op.cit., p.53.

3/ Gussabiya: an earth scoop made of iron and wood, used for leveling the land and making minor canals.

3.1.3. Fishing and Floating Wood Collection:

Although a very small proportion of the population depended entirely on these two activities to make a living, both formed an important source of pocket money for a considerable portion of the population. However, both of these activities suffered a number of problems such as:

1. being seasonal in their association with the river flood, the thing that made it difficult for the people to undertake them as basic activities;
2. the lack of transport and absence of local markets, which used to depress prices for wood and lead to huge losses of fish catch; and
3. the fishing activity, in addition to the primitive means used in it, had also faced the problems of competition from the main Nile fisheries where fish were better in quality and higher in quantity since they were caught from a much longer and perennial river

3.1.4. Handicrafts:

The dom trees that were predominant in the area provided the local population with a building material and a source for hand mattings. The stem of the dom tree was and is still extensively used for the roof support for houses in both urban and rural areas. The leaves of the dom tree or saaf was the main source for handicrafts such as brush (mattings), baskets and ropes. These handicrafts were largely carried out by women, and they represented one major contribution of females towards the household's economy. In fact this

activity to a large extent filled the slack season in the year as it was practiced during the late winter and early summer days. It must be noted that over 40% of the households were engaged in these activities.[1/]

In addition, some of the male members of the community used to make use of the clay soil of the river and the availability of firewood in the area to make water pots (Zeir) but again this was limited due to the difficulty of transport and the competition from the Nile areas.

In conclusion the main features of the traditional economy of the area can be summarized as follows:

1. It was basically a subsistent economy with a relatively high degree of self-sufficiency.
2. There were various alternatives for the individual though largely dependent on natural conditions. Animal husbandry, fishing, wood collection and handicrafts all were supplementary activities to irrigated and rainfed cultivation.
3. The availability of these alternatives left no, or a very short, slack season for the household and very small or no surplus labour force that could have otherwise migrated.
4. The practice of these various economic activities other than agriculture and the raising of large numbers of livestock, even among the totally settled population, seems to indicate some awareness on the part of the inhabitants about the marginality of their natural environment with which they learned to cope by straddling between these different activities.

1/ See H.A. Abdel Ati (1979) Op.cit., p.56.

4. ENVIRONMENTAL CHANGES IN THE AREA.

4. ENVIRONMENTAL CHANGES IN THE AREA:

It was mentioned previously that the Lower Atbara area falls into the semi-desert climate region, and the amount of rainfall decreases as one moves along the river from the southeast to the northwest. This gradual decline is indicated by the figures of rainfall averages in Atbara and Seidon contained in Table 3 below.

Table 3

Average Monthly Rainfall in Atbara and Seidon[1/]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Atbara	0.0	0.0	0.0	0.0	3	3	27	31	5	1	0.0	0.0
Seidon	0.0	0.0	0.0	0.0	1	6	25	41	8	3	1	0.0

Over the last two decades the amount of rainfall started to decline. If the meteorological records of rainfall in the Central Butana are taken as an indicator of that decline, we find that the minimum recorded for sixty years was in 1970 (298 mm as opposed to the annual average of 429 mm), although rain levels started to pick up again afterwards.[2/] It has also been reported that the area experienced the worst drought in its history between 1969 and 1973.[3/]

1/ Source: Abbasher E. El Amin, The Basin of the River Atbara in Sudan: A regional Study, Unpublished M.A. Thesis, Cairo University, 1976, p.99.

2/ See Ahmed Mohd. El Hassan, The environmental Consequences of Open Grazing in Central Butana-Sudan, IES Monograph Series, No.1, Khartoum, November, 1981, p.19.

3/ See Rapp, A., The Sudan, in A. Rapp and H. Hellden, Research on Environmental Monitoring Methods for Landuse Planning in African Drylands, London Univ., Geogr. Dept. Papers, No.42, 1979, p.47.

Two other changes, closely connected with the previous one, were also experienced in the area. These were:

1. a considerable increase in the intensity of desert encroachment in the area. The desert line has advanced southwards by about 100 kms. between 1958 and 1975,[1] thus covering all the area under study including the riverine lands (Fig. IV), and

2. the construction of the Khashm el Girba dam in 1964 which had its most significant effects on the riverine lands and the riverine population.

All these, of course, have combined to determine the quality of the environment and hence the type of economic activities practiced by the inhabitants of the area. In this section, emphasis has been made on the riverine lands and how they were influenced by the dam and the change in the "natural" conditions.

4.1. The Erosion of the River Channel:

Before the construction of Khashm el Girba dam, erosion on the river channel was mainly through the vertical cutting of the river bed itself, resulting in the clear low elevation of the river basin relative to its surrounding areas.[2] The pre-dam picture of the lower parts of river seems to have resembled a simplified form of the present situation in its upper parts, i.e., between Adarma and Gallabat where gullies

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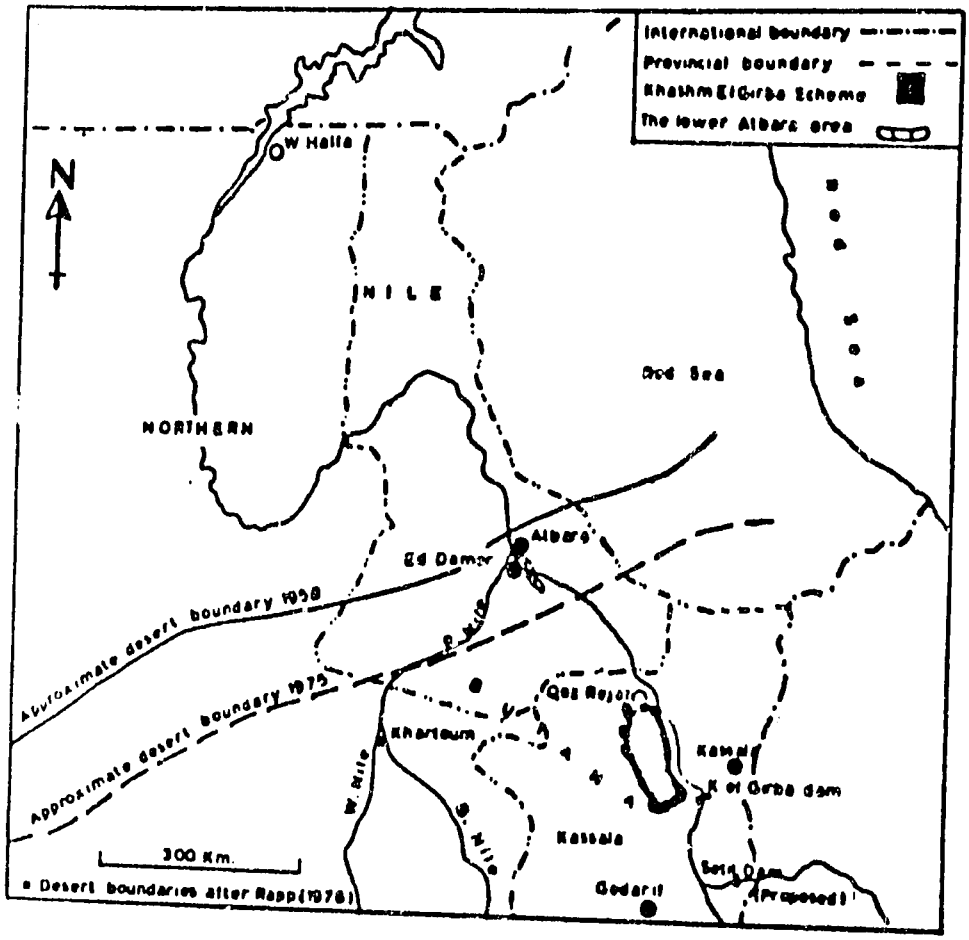
1/ See H.F. Lamprey, A Report on the Desert Encroachment Reconnaissance in Northern Sudan, Nairobi, 1975, cited in Erick Eckholm and Lester Brown, Spreading Deserts: The Hand of Man, World Watch Papers, No.13, August 1977, pp.9-10.

2/ See S. El Shami (1967) Op.cit., p.161.

Fig(4) THE SOUTHERN ADVANCE OF THE DESERT LINE 1958-75



have torn these kerrib land surfaces quite extensively. However, although the slope was generally steep (i.e., 1:400 between Khashm el Girba and the Atbara-Nile junction)[1] and hence the river speed was relatively high, it seems that the long distance crossed by the river and the heavy load of both coarse and dissolved materials it used to transport had helped to check its erosive power and restricted it to the river boundaries since the process was coupled with an equally high intensity of depositional activities in the lower parts of the channel. It is estimated that the River Atbara used to carry about 3 kilogrammes of dissolved and eroded materials per every cubic metre of water.[2]

At present the intensity of erosion below the dam site has increased considerably, as a result of the following:

a. the river current regains its strength as it passes the dam gates, a particularly large portion of the materials it carries from its upper course areas, that could have reduced its speed, are checked behind the dam (see section 4.4 below). This means that the lower parts of the river channel, instead of being subject to both erosion and deposition in a somehow balanced form, become largely subject to erosion.

b. the relatively short distance between the dam and the Atbara discharge area (about 400 kms), together with the relatively steep;[3] and

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1/ See M.A. Mohammed (1956) Op.cit., p.112.

2/ See S.El Shami (1967) Op.cit., p.164.

3/ The elevation difference is 5 metres between the town of Atbara (345 m) and Seidon (550 m) while the distance between them is about 50 kms.

c. the weak composition of the soil consisting of silt and clay that were originally deposited by the river itself.

The intensity of haddam (land sliding) has now considerably increased on both sides of the river, leading to the almost complete disappearance of the gerf lands, especially on the left bank of the river channel where the effect is more profound.[1] (See Fig.V).

4.2. Siltation:

The annual accumulation of silt behind the Khashm el Girba dam has a twofold effect on the lower Atbara. On the one hand it reduces the fertility levels of the riverine soils and on the other reduces the connectivity of its particles making it yet more vulnerable to both water and wind erosion.[2] The amount of sediments in the Khashm el Girba reservoir has risen from nil in 1964 to 0.46×10^9 M^3 in 1972/73, thus reducing the storage capacity from 1.3×10^9 M^3 to about 0.84×10^9 M^3 in the same season[3] and Thimm estimates it to be 0.80×10^9 M^3 in 1978.[4] The annual rate of sediment deposits' upstream advance was estimated in 1973 to be about 40×60^6 M^3,[5] that is approximately a horizontal expansion of about

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1/ See H.A. Abdel Ati (1979) Op.cit., pp.35-62 and 63.

2/ Ibid., p.36.

3/ Ministry of Irrigation (Sudan) R Report on the Sedimentation Problem of Khashm el Girba Reservoir, Khartoum, 1973, pp.4-7.

4/ See H.U. Thimm, Development Projects in Sudan: an analysis of their performance with implication for research and training in arid land management, U.N. University, 1979, p.16.

5/ See Sogreah, "A Preliminary Note on Experimental Flushing Operations of 1971 and Flushing Programmes of 1972", Ministry of Irrigation, Khartoum, 1972, p.4.

original river bed level. Furthermore Thimm estimates that about 50 million cubic metres of the River Atbara waters are annually lost as a result of this sedimentation problem in the reservoir.[1]

4.3. Fishing:

The adverse effects of irrigation dams on the downstream fish have been emphasized by various scholars and ecologists. The following are among the problems mentioned:

1. the hindrance of upstream and downstream movement of fish;
2. the obstruction of fish by turbines;
3. the alteration of the water regimen downstream by the dam that tends to deprive fish from making use of the seasonal shifts of water that are essential for feeding, spawning and breeding, since it leads to a drop in the nutrient level in the river waters;
4. the alteration of the natural level of sedimentation and water velocity, which also influences the nutrients and the dissolved oxygen levels and hence the productivity of fish; and
5. the changes in the salinity and chemical structure of the river waters, since the concentration of salt in water is known to cause the contamination of fish reserves.[2]

1/ See H.U. Thamm (1979) Op.cit., p.16.

2/ For an elaboration of these points see Dassmann, R.E., Milton, J.P., and Freemann, P.H., Ecological Principles for Economic Development, John Wiley & Sons Ltd, London, 1978, pp.191-197.

Of course most of these apply to the fisheries of the River Atbara, especially with regard to the high silt content of the water in the lower parts. However, as fishing was only practiced seasonally and provided a supplementary source of income, the economic impact of its disruption by the dam can only be seen as significant in association with the other aspects of the economy, particularly with regard to two things. First, the seasonality of the river and the blockage by the dam led to the drop in the lower parts so that when available fish were in most cases useful only as sardines as a result of the disruption of the breeding cycle. Secondly, the loss of other income sources, both agricultural and non-agricultural, denied those who practice fishing the capital necessary to conduct it, since the sardine industry, for example, requires an economic base far beyond the financial resources of the majority of these people.[1] This is probably why in 1978 it was found that only 0.7% of the Lower Atbara population relies on fishing as the major source of income.[2]

4.4. Deforestation:

It was mentioned previously that the River Atbara before the construction of Khashm el Girba used to drift a considerable amount of falling trees from its upper course areas in the Ethiopian highland forests. Sunt (Acacia albida), talh (A. seyal), tundub (Capparis decidua), Salam (A. Flora), haraz (A. albida), and Highleeg (Bilanites aegyptiaca) were the main types

1/ Sardine industry at present seems to be practiced largely by urban-based fishermen, mainly from Atbara town, fishing at the Atbara-Nile junction where they claim fishing is easier and fish are more abundant.

2/ See H.A. Abdel Ati, (1979), Op.cit., p.44.

of wood drifted by the river downstream. The natural vegetation of the Lower Atbara area itself consisted of dom trees (Hyphaene thebaica), tundub, sunt, talh, kittir (A. Mellifera) and laa'ut (A. nubica), in addition to the date palms that were concentrated along the river banks. Desert and semi-desert shrubs and grasses were also abundant in the area between Marzuqa and Atbara east and west of the river, decreasing in density towards the north and also east and west away from the river. These included tarfa (Tamarix ophylla). haskaneet (Cenchrus), nal (Cymbopogon nervatus), halfa (Demoslarpya cyrosuroidas) and tabas (Scrub).[1] All these had their economic value for the local population as firewood, building material and a source of cash. The construction of Khashm el Girba dam has not only halted the flow of wood downstream, but by so doing it caused extensive damage to the vegetation in the downstream area.

It is very difficult to estimate the volume of wood that was annually drifted by the River Atbara as it varied considerably from one year to another. At present it usually expands for 1-2 kilometres upstream from the dam on the full width of the reservoir, with the maximum accumulation occuring during the early days of the flood season (July-August).[2] This is important in two respects. First the accumulation of wood increases the rate of sedimentation in the reservoir. And Secondly, the removal operations of that wood require the complete closure of the dam in order to

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1/ For a more detailed description of vegetation, see A.E. El Amin (1976), Op.cit., pp.117-118.

2/ See Ministry of Irrigation Report on the Sedimentation Problem of Khashm el Girba Reservoir, Khartoum, 1973, p.23.

raise the water level to the maximum height (468 metres).[1] Thus, in addition to the checking of floating wood, the lower Atbara also suffers the restraint of both silt and irrigation water and hence the disruption of the agricultural cycle.

Denied the opportunity to collect floating wood, the inhabitants of the lower Atbara turned to surrounding areas, cutting trees for domestic uses and sometimes for commercial purposes. This is particularly true for the extreme lower parts, close to the urban areas (El Damer and Atbara) where the demand for wood is high, and here the acacia trees and even dom trees were almost cleared completely (See Fig.V).[2] In addition, a considerable number of the date palms on the river banks was lost as a result of the high intensity of haddam. Furthermore, the drought of the late 1960's early 1970's put more pressure on the vegetation cover as various nomadic groups from the northern Butana started to move towards the river and spend longer periods in its vicinity for water, while supporting their animals from this natural vegetation. It is well known that the combination of vegetation clearance by man and prolonged droughts is a prime cause of desertification.[3] Overgrazing is also accused of causing soil erosion and desertification in various parts of the semi-arid zone in Sudan.[4] All these factors seem to have contributed

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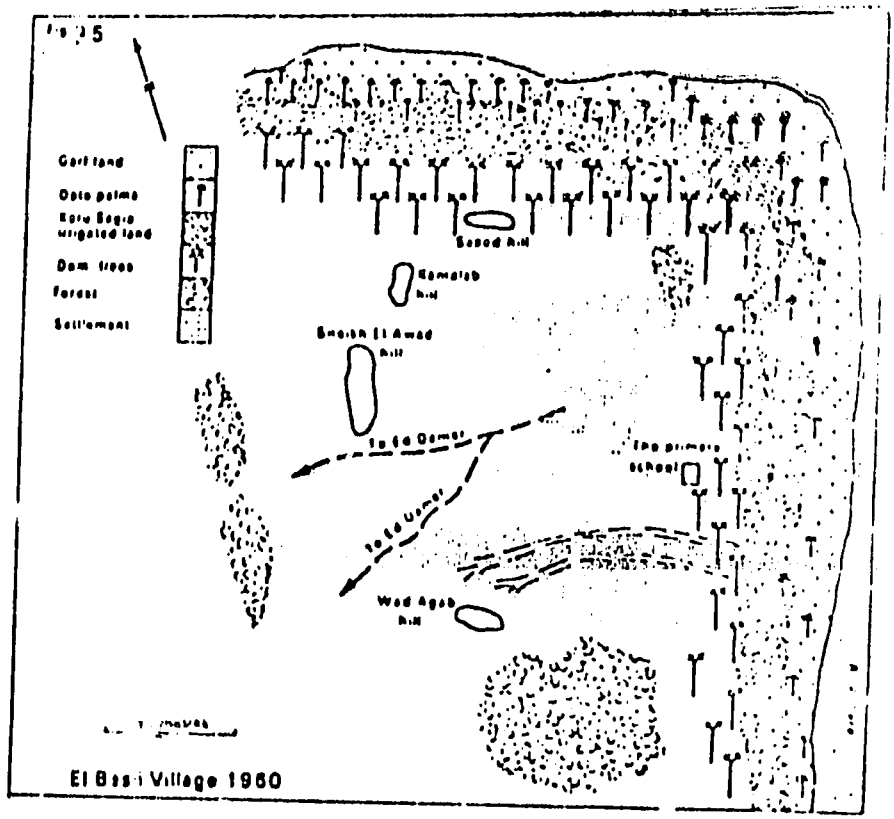
1/ Ibid., p.22.

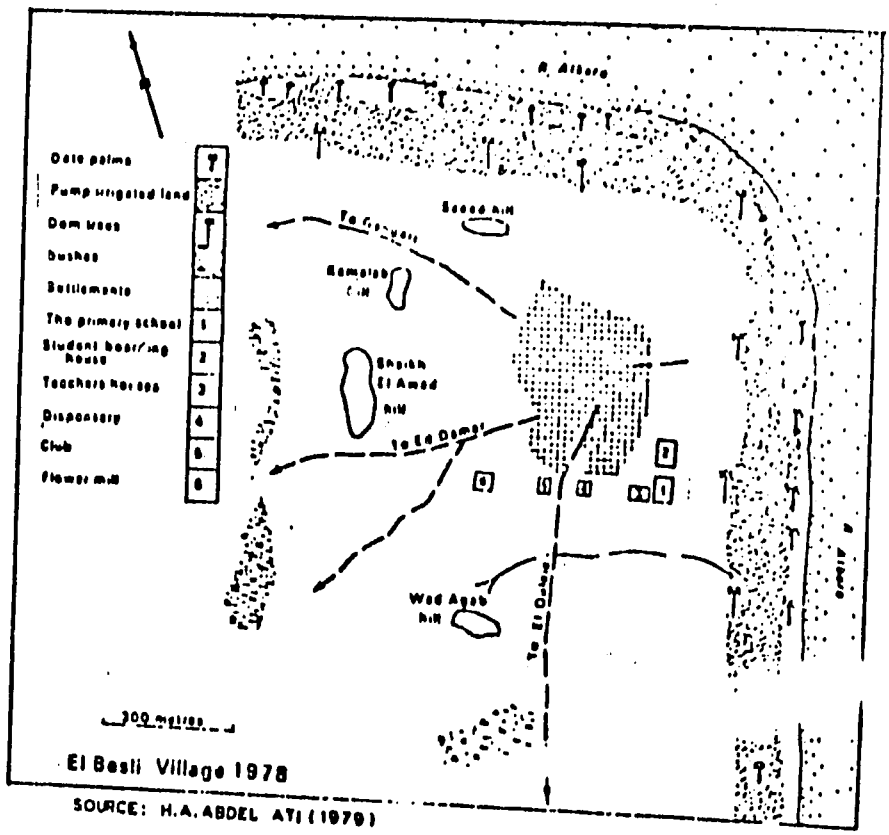
2/ The sketch map in fact indicates both the clearance of vegetation and the erosion of the gerf lands by the river.

3/ See A. Rapp, Sudan, in Rapp, Houreau and Lundholm (ed.), Can Desert Enchroachment Be Stopped ? Ecological Bulletin, No.24, Stockholm, 1976, p.

4/ See E. Eckholm and L.R. Brown, Spreading Deserts: The Hands of Man, World Watch Papers, No.13, August, 1977, pp.9-10.

to the southern advance of the desert line to cover all the lower Atbara area (See Fig. IV).





SOURCE: H.A. ABDEL ATI (1979)

5. THE IMPLICATIONS OF CHANGE ON THE ECONOMY OF THE AREA

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The marked drop in the amount of the river water passing downstream and the disruption of floating wood collection and fishing activities caused by the erection of Khashm el Girba dam on the one hand and the drought of the late 1960's on the other have combined to agitate and reshape the economy of the Lower Atbara. Here an attempt is made to assess the implications of those changes on the two pre-existing major economic activities, namely agriculture and livestock raising.

5.1. Agriculture:

Being the major economic activity, agriculture was the activity most affected by the erection of the dam and the environmental changes that occurred. The reduction of the river water, the loss of cultivable lands as a result of erosion of the river banks and the drop in rainfall levels in the atmur lands were the prime factors of change. The implications of this were enormous on all aspects of agriculture including land ownership, the crops and cropping systems employed, cultivation methods, and consequently, production relations.

As a result of the control measures over the River Atbara waters applied by the Khashm el Girba dam authorities, the "normal" flow of the river is restricted to three months (August-October), and by January or at most February, the river is completely dry when most of the water pools disappear. As a result of this and the variations in the time of opening the dam gates from one year to another on the one hand, and the high intensity of haddam on the other, both magat and gerf cultivation have ceased to exist.

The traditional irrigation system by *swagi* also had to be changed and replaced by diesel pump irrigation. This change was necessitated by:

a. the limited capacity of sagia.[1] This made it idle for over three quarters of the year, particularly with the high elevation of the land to be irrigated, caused by *haddam*;

b. the continuous changes in the river course that were difficult to cope with, by changing the location or site of the wooden wheel because of its bulky size and the special skills it requires in addition to the high costs involved;

c. the loss of the *gorf* and *atmur* lands that necessitated the use of more efficient irrigation machinery to allow the maximum use of the available land. Equally important, it seems, was the intention to use the area that had been occupied by fodder crops for the *sagia* bulls; and

d. probably, the reduction in the amount of wood and livestock in the area after the construction of the dam.

As a result of all these factors the number of farmers depending on *swagi* irrigation in the area started to decline, and they gradually turned to diesel pumps (See Table 4). But, in spite of the obvious economic advantages of this change, it had a more serious consequence stemming from the inability of the vast majority of producers to buy pumps. This led to the

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1/ On the main Nile the maximum capacity of the sagia was 5 feddans when the river is at its highest level but on average it rarely exceeds 2.5 feddans.

emergence of a landlord class, providing irrigation water to small farmers on a 50/50 share-cropping basis, for the first time in the area, thus altering the pre-existing sets of production relations.

Table 4

Methods of Irrigation in Lower Atbara before and after the K. el Girba Dam 1/

% of farming population	Methods of Irrigation			
	Flood	Sagia	Pump	Rain
Before the Dam (1964)	42	33	10	15
After the Dam (1978)	25	10	64	1
Difference (%)	-40.5	-69.7	+54.0	-93.3

1/Source: H.A. Abdel Ati (1979) Op.cit., p.61.

The second major change in agriculture was that related to the crops cultivated. The change has taken the following forms:

a. Most of the fodder crops like lubia (Dolocis lablab) and dura (Sorghum vulgare)1/ on the gerf lands, as well as dukhn and dura of the atmur lands disappeared, the former as a result of erosion, the latter as a result of rainfall deficiencies.

b. The drop in the moisture content of the river bed soils and the annual variations in the time and course on which the river flows led to a sharp drop in the intensity of magat cultivation.

c. The cultivation of fodder crops on the Karu land that was practiced by some farmers to feed domestic animals also gave way to dura and other food crops with a gradual decline in the numbers of animals raised. This in fact reflects the competition between man and animals for food.

1/ Dura was cultivated on the gerf lands to be cut green several times as animal fodder locally known as buttig.

d. The thirst-resistant and low-water demanding crops started to occupy proportionally large areas of the Karu lands. These include, for example lubia, the only fodder crop that is still grown on a relatively large scale, and groundnuts in some areas. Although the area under these crops is very small, its significance arises from the exhaustion of soil and the disintegration of its particles caused when harvesting groundnuts, for example. Both of these tend to reduce soil fertility and hence its productivity.

e. The agricultural cycle also underwent change as cultivation became restricted to the damira season and the early days of the winter. That means the disintegrated soil becomes subject to the strong north-easterly winds for most of the winter months. The evidence of this effect is the deposits of the riverine fine clay soil now found in the northern fringes of the Butana, east of Ed Damer.

In a survey conducted in 1978, food crops (dura, dukhn and vegetables) were grown as the major crops by about 91% of the farmers[1/] and occupied the largest proportion of the cultivated land. This implies that the decision regarding what to cultivate is largely influenced by the family food requirements and emphasizes the assertion made earlier about the competition between man and animal, which was obviously concluded in favour of the former. The problem of land shortage is further stressed by the decline of the Karu land fertility as a result of its continuous use and

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1/ For an elaboration see H.A. Abdel Ati (1979) Op.cit., pp.64-66.

the loss of all other means of fertilization (natural; traditional or artificial) that was caused by the blockage of the river silt, the sharp drop in the numbers of livestock in the area, and the poor financial conditions of the farmers.

Another important change experienced was that related to agricultural land ownership as it is shown in Table (5) below. It is clear from the table that the ratio of those who cultivate hired lands has increased substantially, although in terms of numbers land hirers are still far fewer than private holders. The reason for this contradiction is a statistical one that emerged from the negligible number of land hirers prior to the construction of the dam.

However, although private owners constitute the highest ratio among farmers, almost 15% of them lost their private lands over the first 15 years following the dam construction. Closely linked to this was the decrease in the size of cultivated plots from an average of 3.5 feddans in 1964 to 3.0 feddans in 1978. The reduction in farm size and intensity of private ownership can be explained, other than the loss of gerf and atmur lands, by natural population increase and the influence of inheritance (mainly of karu lands), or by the selling of land which could be caused by migration, the uneconomic size of the land or as settlement of debts. Both of these interrelated changes indicate the formation of two distinct social groups, an increasing group of small holders and land hirers and an emerging class of landlords.

Migration, loss of land and the in-migration of some nomads from the northern Butana to settle by the river banks, have also contributed to the presence of

Table 5

Land Ownership and size of plots before and after the Dam 1/

Percentage of farmers	Type of Ownership				Plot Size (in feddans)			
	Private land	Hired	Government (*)	Communal	Under 3	3-4.99	5-9.99	10 and over
Before the dam (1964)	69	24	4	3	64.7	15.3	12.7	7.3
After the dam (1978)	59.5	31.7	5.8	3	70.2	13.5	4.8	11.5
Degree of Change (%)	-13.8	+32.0	+45.0	0.0	+8.5	-11.8	-62.2	+57.5

1/ Source: Compiled from H.A. Abdel Ati(1978), op.cit., Tables VII and VIII, pp.62 and 63.

(*) Government lands refer to all unregistered lands that were used by local farmers, mostly situated away from the river around the various Khors and Mayaa't (water catchment areas) that used to develop in the northern Butana during rainy seasons.

wage labourers in the area. Again, although the ratio of farms entirely dependent on wage labourers is generally small (about 12%), it is almost double its percentage before the dam (7%). Another development in agriculture was the replacement of traditional tools and implements such as selluqa, gussabiya and the wooden plouth by more modern equipment such as tractors that increased gradually with the increase of landlords and private scheme owners. It can thus be said that the increase in the intensity of land hiring and renting, the use of wage labourers and the hiring of modern agricultural technology (pumps and tractors) all led to the breaking down of the "self-sufficiency" of the farm unit that in the past used to operate on its own land using family labour and privately owned agricultural equipment.

5.2. Livestock:

It was mentioned previously that the numbers of livestock were cut drastically over the last two decades. Under the pressure of droughts from the late 1960's onwards a large proportion of the Aliab and other nomadic groups that used to occupy the extreme northern parts of the Butana started to move southwards putting more pressure on the natural pastures around the wadis el Hawad and el Awataib. In fact the heavy concentration of indigenous and incoming tribal groups around the few water points in the vicinity of Um Sahdida and the concomitant overgrazing resulting from the imbalance of animal/land ratios has been accused of causing desertification in the area.[1/]

1/ The Northern Region, A Report on the Natural Resources and the Development of Nomads in Shendi Rural Council, Ed Damer, Jan. 1982, pp.13-16.

On the riverine lands animals gradually decreased, as mentioned previously, with the diminishing fodder production and with the decline of the demand for their power in agriculture. The ratio of settled population raising animals dropped from 84% in 1964 to 65% in 1978. Most significant, perhaps, was the drop in the average number of animals raised per household, as will be shown later. A large number of cattle died during the 1968-69 season when an epidemic disease, locally known as el Hud, hit the area. In fact about one third of the population surveyed in 1978 reported losing their herd during that season as a result of the disease, but the remaining two thirds blamed water shortages and poor pasture for that decline.[1] This seems to indicate that water shortage and pasture have influenced the nomadic and semi-nomadic populations that represent the largest proportion of animal owners.

In a report in 1969, el Sabooni mentioned that a total of 11,965 head of animals, representing about 93% of the animal wealth of Al Mogran Omodiya, were lost between 1964 and 1969.[2] From Table 6 below it is clear that the least affected among the Sheikhships was Gersi, which was basically a nomadic area and goats were the least hit among the raised animals. This, however, does not mean that the loss was not enormous as the loss ratio in Gersi area was 85.7%, and over 90% of goats were lost.

1/ See H.A. Abdel Ati (1978) Op.cit., pp.66-69.

2/ See I.A. El Sabooni, A Report on the Problem of the Lower Atbara, Nile Province Headquarters, Ed Damer, 1969, (in Arabic).

Table 6

Animals lost in the Omodiya of Al Magran 1964-69 1/

Sheikh-ship	Camels 1	Camels 2	Cattle 1	Cattle 2	Sheep 1	Sheep 2	Goats 1	Goats 2	% loss Ratio
Al Magran	88	-	206	1	618	7	755	48	96.6
El Gubba	22	3	89	10	845	78	969	26	93.9
Gangari	1	2	140	4	681	55	660	65	91.5
El Besli	19	1	174	10	744	23	689	81	92.9
El Omerab	5	-	154	1	786	-	645	35	97.7
Umm Sunta	10	-	7	-	567	27	1070	87	93.1
Gersi	59	2	46	-	706	52	1210	235	85.7
Al Magran Omodiya	204	8	816	26	4947	242	5998	577	93.5
Loss Ratio by Type	96.1%		96.8%		95.1%		90.4%		
1984	4		12		112		267		395
Loss Ratio	98.0%		98.5%		97.7%		95.6%		96.7

* (1) before the dam, (2) after the dam

** The 1984 figures are based on an assumption of a 5% annual loss rate based on the 1969 figures.

Although one doubts whether the loss was as big as that reported by El Sabooni, no evidence to disprove it is available. The drop in the number of nomads and semi-nomads is quite noticeable, and the productivity and quality of their animals has obviously been negatively influenced by the long distance and duration of their travel. Furthermore, in 1978, it was found that about 5% of the population does not raise any animals at all, which is quite strange by all standards for any rural community in Northern Sudan.

1/ Ibid., p.4.

In summary, however, the massive reduction in the number of livestock in the area as indicated above can be attributed to: (a) the epidemic of 1968-69, (b) the migration of nomads and semi-nomads southwards towards the inner Butana, (c) the large sales of animals by the settled population under the pressure of crop failures and the loss of other income sources, (d) the death incidence caused by the drought and (e) the fluctuating price of grain (dura) that is to be covered, at least partly, by the sales of livestock. For example, in 1983 the price of a sack of dura was between 50-60 Sudanese pounds and that of a sheep was in the same range. In 1984 dura price shot up to Ls. 150-180 while livestock prices remained at the same level and even declined over the last few months under the pressures of drought, higher grain prices and competition from the drought-hit livestock of Western Sudan.

The large scale of the drought's effect has also caused some conflicts between various tribal groups as, for example, those occurring around water points in the southern parts of Northern Butana and those between nomads and settled population close to the Atbara River. These latter occur as the inner Butana nomads are compelled, under drought conditions and the expansion of Khashm el Girba scheme, to drive their animals around the scheme from the extreme southeast to the extreame northwest of the Butana, i.e., the Lower Atbara.[1/] By so doing these nomads come into direct contact with the settled population for long periods

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1/ See M. Sh. Osman and M.E. El Hag (1974) Op.cit., p.100.

and frictions occur. The long dry seasons are known to be times of high animal sales, so the nomads prefer to stay close to the market, at Ed Damer, as long as possible. Since the River Nile is blocked by urban settlements and the deep and probably wet Butana is too far, those nomads find no alternative watering place to the River Atbara, thus going into conflicts with farmers, especially when crop damage occurs.

6. THE ECONOMIC SIGNIFICANCE OF ECOLOGICAL CHANGES IN THE LOWER ATBARA

6. THE ECONOMIC SIGNIFICANCE OF ECOLOGICAL CHANGES IN THE LOWER ATBARA:

An ecological change of the magnitude described above will obviously influence the overall socio-economic patterns existing in the area where that change takes place. In what follows, we are going to discuss the most important socio-economic changes experienced in the Lower Atbara area as a result of those ecological changes, namely the changes in economic activities, income levels and the demographic structures.

6.1. Occupational Changes:

The change of economic activities was a natural response to the changing environmental conditions that, as mentioned earlier, included the drop in rainfall levels and the shrinkage of arable lands that caused the drop in the number of livestock and owners as well as that of the farming population. Table 7 provides a summary of the occupational changes that occurred in the area between 1964 and 1978.

Table 7

Major Occupations in the Lower Atbara Area 1964 and 1978 1/

Type of E. Activity	% of Population Engaged 1964	1978
Agriculture	92.0	69.3
Nomadism & Animal Herding	2.0	0.7
Fishing	2.0	0.7
Wood Cutting & Collection	0.7	0.0
Commerce and Trade	0.0	4.0
Handicrafts	0.0	11.3
Wage Labour	3.3	14.0
All Activities	100.0	100.0

1/ Source: H.A. Abdel Ati (1978) Op.cit., p.78.
Note: These represent the economic activities considered "main" by the population and a large number might be practicing another secondary activity.

From the above table the following can be noticed:

a. Over half the population experienced a change of occupation;

b. there is a massive reduction (by about a third) in the farming population ratio;

c. handicrafts, only a subordinate activity or a source of extra-income in the pre-dam period, developed into being the major activity of over 11% of the population;[1/]

d. there is a substantial drop in the ratio of those practicing nomadism or animal herding as their major economic activity;

e. the presence of trade as a major economic activity in the area for the first time;[2/]

f. the enormous increase in the ratio of wage-labourers that was more than tripled. This is one of the most serious economic and social consequences of that change as it influences income distribution and reflects inequalities in land distribution and/or ownership.

1/ It might be interesting to note that during a visit in 1984, it was found that the Sa'af, the main raw material for handicrafts in the area is usually bought from Ed Damer urban market, for which it is supplied from the upper areas of the River Atbara.

2/ This doesn't mean the absence of trading altogether in the area, but it could have existed as a secondary job. However, this might be explained by the close location of the area to the urban markets of Ed Damer and Atbara, the subsistent nature of the local economy and, probably, the lack of any marketable surplus that could have encouraged the growth of shops and local markets.

6.2. Income Levels and Distribution:

The disappearance of certain economic activities in the Lower Atbara and the shrinkage of others have caused a real drop in output and hence in the level of incomes and the standards of living in the area. According to El Sabooni the per capita income decreased in the five years immediately following the construction of the Khashm el Girba dam to 49.7 Sudanese pounds in 1969, as opposed to 137.6 pounds before the dam.[1/] Without any regard to inflation, changes in crop prices or any other factor that could have influenced the per capita income level, the drop is substantially high (about 64%). Although these figures contradict the estimated total population in the same report and although no clear definition of income or how it was calculated is provided, the factors which make the results less reliable, a survey conducted in 1978 seems to confirm El Sabooni's findings, though in a far less significant way. It was found that:

a. 56% of the population in 1978 earned under 100 Sudanese pounds per year, as opposed to 51% in the same income bracket prior to 1964; and

b. the income of about 9% of the population has decreased (mostly from over 100 to under 100 pounds), in contrast to the increase in the ratio of those earning over 400 pounds (from 5.3% in 1964 to 8.7% in 1978).[2/]

1/ See I.A. El Sabooni (1969), Op.cit., Supplement 6 p.2.

2/ See H.A. Abdel Ati (1979) Op.cit., p.77.

The erosion of middle income groups usually indicates the rising inequality in the distribution of wealth. Such inequality is mostly induced in rural areas by the differential access to modern-sector facilities,[1/] which becomes more effective when the problems of economic growth are caused by environmental conditions rather than by any other factors. Access to the relatively modern technology, attained by some of the wealthier portion of the population (pump owners and landlords), and which resulted in further income disparities, was induced by the interplay of a number of factors, among which are:

a. The replacement of the traditional Sagia by the changing circumstances caused by El Girba dam.

b. The low incomes generated by the majority of farmers as a result of the shrinkage in cultivable lands and the decline in the non-agricultural income sources. This in fact made the dependence of small producers on pump owners inevitable as they cannot afford to buy their irrigation machinery.

c. The high intensity of land sales undertaken by small holders and migrants who were pressed by factors such as high operation costs, insufficient production, low incomes or the uneconomical size of the plot operated. This, in particular, contributed significantly to the emergence of some landlords who amalgamate a number of small plots to hire them on a share-crop basis.

1/ For an elaboration of this, see G.D. Coleman and F. Nixon, Economics of Change in Less Developed Countries, Phillip Allan Publishing Ltd., London, 1978; Also M.P. Todaro, Economics for a Developing World, Longman Group, London, 1979.

d. The policies adopted by the provincial authorities at the time in its attempt to rescue the area. The effort was largely one of a relief operation, but in some cases it involved the issuance of licenees and provision of financial support to some agricultural scheme owners.[1]

6.3. Demographic Changes:

From the previous discussion of the population characteristics it is clear that there is a high rate of outmigration from the area, imposed primarily by the environmental changes that occurred. Migration is indicated by the low rate of population growth as well as the imbalance between the two sexes among various age groups (See Section 2.2). Migration in the Lower Atbara involved two forms of human mobility; these are:

1. Migration involving only a part of the family, mostly the adult males, and these are directed to Khashm el Girba Scheme area, Ed Damer and Atbara towns, Khartoum and other urban centres as well as abroad. In this case migration is either seasonal or of a temporary nature.
2. The movement that involves all members of the household; this is represented by:
   a. The riverine population who lost their lands or their economic base in the Lower Atbara area for one reason or another and moved outside the area, mostly to Ed Damer town.[2] Here mobility is both geographical and occupational as it involves the change of economic activity.

1/ For an elaboration See H.A. Abdel Ati (1979), Op.cit., pp.80-82.

2/ Note: A very large proportion of the inhabitants of el Free' el Gadeed residential quarter in Ed Damer have their origins in the Lower Atbara.

b. The nomadic population that moved with its livestock southwards into the Butana in search for pastures and water.

The selectivity of migration in terms of age and sex has obviously had some implications in the area. Male migration has contributed to the decrease in the intensity of marriages, thus increasing the marriage age particularly for women. In fact in some villages economic conditions have deteriorated so much that marriages did not take place for a quite a number of years. In El Omerab Sheikhship for example, it was reported that no marriage had taken place over the first five years that followed the erection of Khashm El Girba dam.[1/] This sex selectivity of migrants also had a negative bearing on the economy as it led to a reduction in man-productivity and to the increase in the numbers of dependent and economically inactive people.

Furthermore the intensity of migration in some areas was so high that it led to the complete depopulation of those areas, such as the case of El Nateela and El Khalafallab villages.[2/]

6.4. The Perception of the Problem.[3/]

In the survey conducted in 1978, the farmers of the Lower Atbara were asked about the problems they faced at that time as well as those they used to experience prior to the construction of the Khashm el Girba dam. The results are summerized in Fig. VI below.

1/ I.A. El Sabooni (1969), Op.cit., p.16.

2/ Ibid, p.14. Also H.A. Abdel Ati (1979), Op.cit., p.21.

3/ All the information in this section was compiled from H.A. Abdel Ati (1979) Op.cit., pp.66-68, 91-94, and 96-100.

It shows a number of problems that can be described as persistent, including erosion of agricultural land, pests and disease, lack of capital and water shortages. But after the construction of the dam, some of those problems became more acute or were so considered by the farmers. Before the dam the spread of pests and disease was considered to be the major problem by over 70% of farmers, followed by land erosion (12%), poor market facilities (9%), lack of capital (7%), and shortage of irrigation water (5%). Although rats and sueid (smut) and asal (stickiness) disease, typical of dry sills and environments where they cause considerable crop damage, were widely spread in the area in 1978, they were rated second to the problem of water shortages which was considered to be the most important problem by about 55% of the farmers interviewed. Other problems emphasized included land erosion (25%), shortage of agricultural land (20%) and the lack of capital (12%). Furthermore, no respondent mentioned having no problem in 1978, as opposed to about $\frac{1}{10}$ of the population for the pre-dam period (See Fig. VI).

This change of attitude can be explained by the heavy dependence on irrigated agriculture on the riverine lands in the post-dam period when the atmur lands were lost as a result of the rainfall deficiencies. Shortage of water also implies the shrinkage of riverine cultivable lands and lack of capital, i.e., irrigation machinery. It also implies the loss of cash sources such as floating wood collection, fishing and magat cultivation that were rendered by the River Atbara before the erection of the Khashm el Girba dam.

Since the long-term effect of the dam in the area downstream to a large extent depends on the responses of the local community there, the people were also asked

about their feelings or attitudes towards the dam and to explain why they felt so. The result is shown in Fig. VII and can be summarized in the following:

a. 79% of the total farming population considered the dam to be harmful to their area both economically and ecologically, 9.50% considered it beneficial, 6.5% saw it as not effective either way, and the remaining 5% gave no opinions.

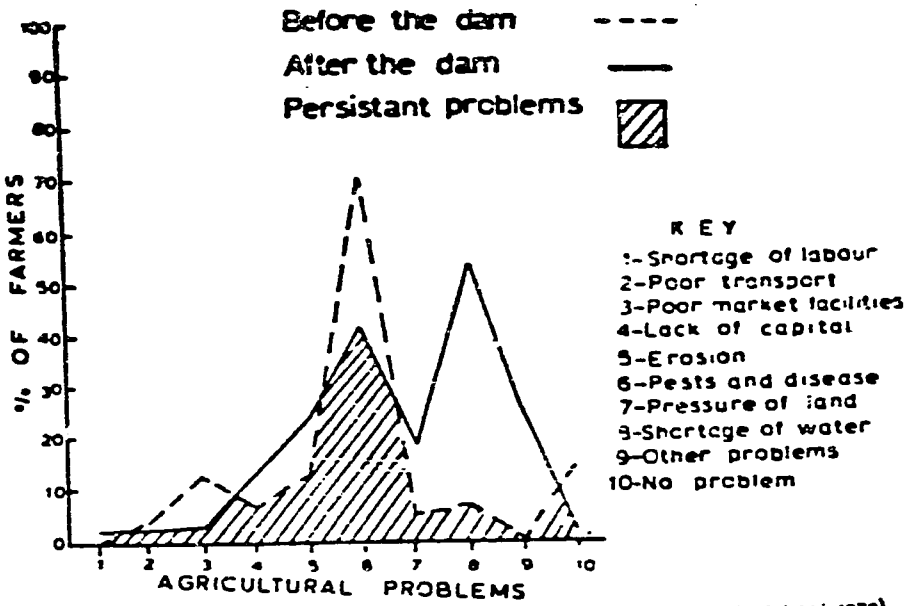
b. Those who viewed the dam to be beneficial attributed that to: higher incomes (4%), the introduction of new agricultural techniques into the area (3%) and the better marketing opportunities (2.5%).

c. Those who considered the dam harmful to the area accused it of having caused a drop in production (44%), a drop in income levels (23%), low marketing opportunities (5%), unemployment (3.5%) and other problems (3.5%).

However, slight differences existed when the views of farmers under 40 years of age were taken separately, although the general trend was the same. Among these younger farmers, the ratio of those who gave no opinion or viewed the dam as not effective is considerably higher when compared to the ratio of the total population, amounting to 20% and 11.9% respectively. All those who considered the dam to be beneficial (4.2%) attributed that to the better marketing opportunities then (1978) existing in the area. But similar to the total population, the ratio of those who viewed the dam as harmful was extremely high (64%), and their reasons for that were the drop in production (38.6%), drop in incomes (23.6%) and the lower market opportunities (1.7%) (See Fig. VII).

Fig(6) PROBLEMS OF AGRICULTURE BEFORE AND AFTER THE DAM

(FARMERS PECEPTION)



Source:H A. Abdel Ati (1979)

The major reason for the difference in the points of view between the elder and younger group seems to be the greater awareness of the former with the problems, as they were economically active before the construction of the dam and hence know better the scale of change. This in fact might be the reason why none of the population over 40 years gave "no idea" as an answer.

Ironically, perhaps, when asked about the things most needed for the development of their villages and the Lower Atbara area in general, the inhabitants' responses didn't quite match the problems they stressed previously. A list of ten selected services was given for each individual from which to choose and rate the four of them he feels feasible and necessary for the development of his village.[1/] Schools and agricultural cooperatives were the most needed and were rated first and second by 26% of the population, respectively, but water supply whose shortage was considered the most important problem (Fig. VI), and for which the Khashm el Girba dam was considered harmful (Fig. VII), came sixth in the rating (See Fig. VIII).

The increase in the intensity of migration, the development in the means of transport and the closer contact with the neighbouring urban centres seem to be the major reasons for the deviation of choice here from the problems stressed earlier. This is further emphasized by the enormous variations in the services rated first in the different Sheikhships, which again reflect the influence of contacts with the urban

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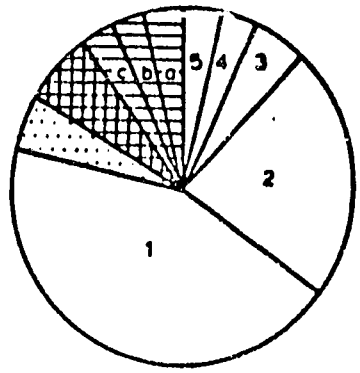
1/ The rating system was 4 points to the first one, 3 to the second, 2 to the third and one point to the fourth.

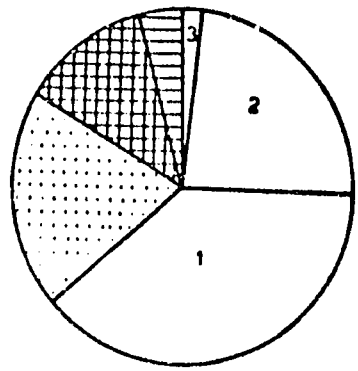
centres and urban attitudes. To illustrate this point let us compare the service priorities of the inhabitants of Al Magran, the nearest to Atbara and Ed Damer, with those of Gersi which is the most nomadic area and the remotest geographically from urban centres. For all Magran population electricity supply was the first priority followed, respectively, by schools, health centres, cooperative societies and water supply. This in fact not only reflects the assimilation by urban attitudes, but also indicates the greater involvement of the population in urban occupations and the abandonment of agriculture as a major economic activity. It might also indicate higher literacy levels, compared to the rest of the Lower Atbara area, made possible by that location. As for Gersi Sheikhship which is about 50 kms from Ed Damer, its inhabitants also rated schools and agricultural cooperatives as first and second, 28% and 26%, respectively, followed by health facilities (24%) and water supply (15%), but no mention was made of electricity (See Fig. VIII).

Fig(7)

(a) KHASHM EL GIRBA DAM AS PERCEIVED BY THE LOWER ATBRA POPULATION



(b) THE DAM AS PERCIVED BY THE POPULATION UNDER 40 YEARS OF AGE



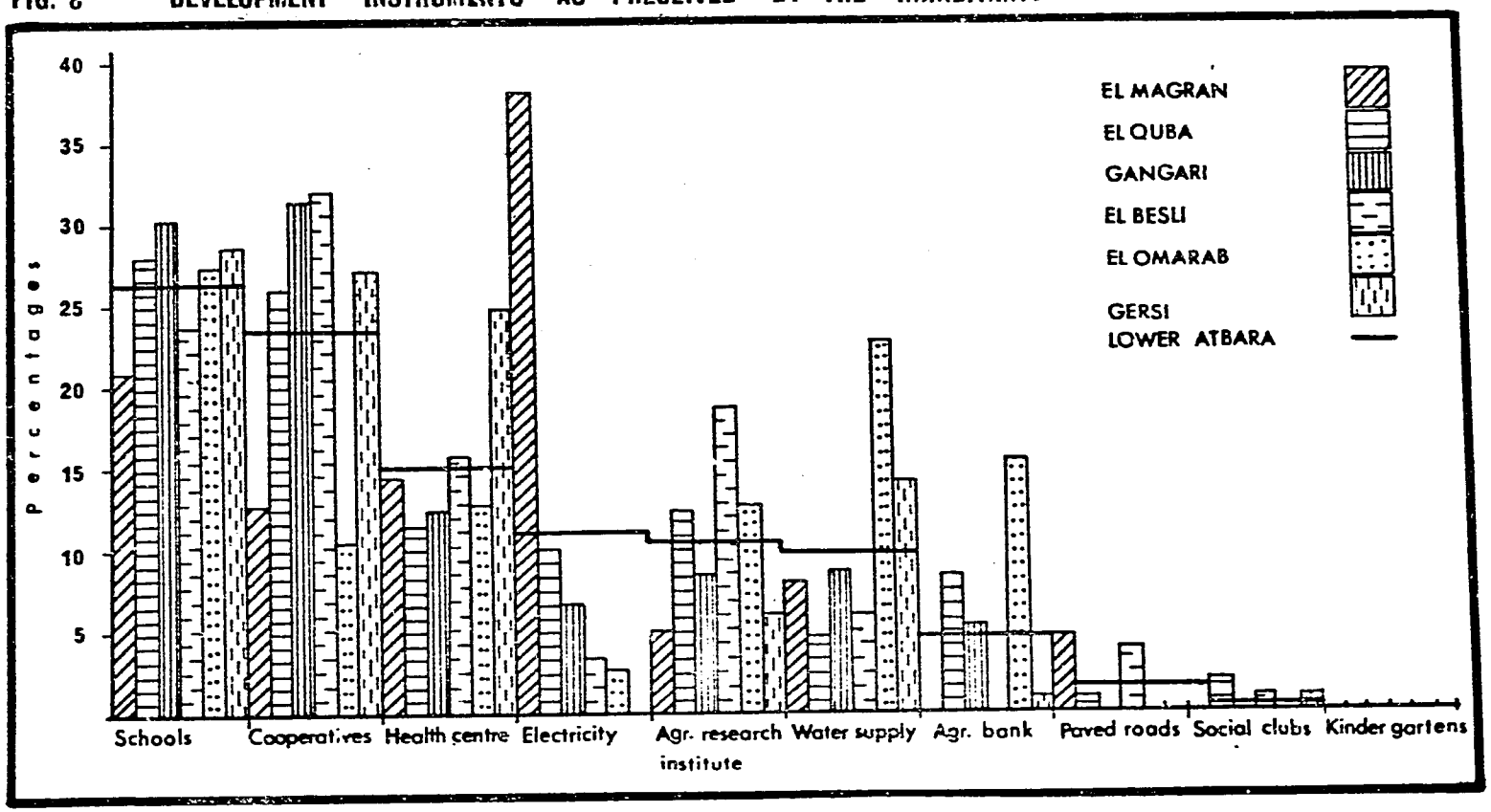
harmful
beneficial
not effective
no idea

1 lower production
2 lower income
3 lower market opportunities
4 unemployment
5 other reasons

a Higher incomes
b New Agricultural Techniques
c Better market opportunities

Source H.A Abdel All (1979)

FIG. 8 DEVELOPMENT INSTRUMENTS AS PRECEIVED BY THE INHABITANTS



Source:-H. A. Abdel Ati ,(1979).

A SUMMARY OF INDICATORS AND CONCLUDING REMARKS

7. A SUMMARY OF INDICATORS AND CONCLUDING REMARKS

From the previous discussion a number of indicators of environmental degradation in the Lower Atbara area can be identified, varying in their intensity, significance and impact and including both physical and human factors. A number of these indicators are listed in Table 8, in which an attempt is made to show, qualitatively, the magnitude of degradation in the study area, based on:

a. the quantified information provided in the text;

b. observations made in various visits to the area between 1978 and 1984; and

c. the perception of the local population of the different changes they experienced

Although these indicators are subgrouped into physical, economic and demographic factors in the table, in reality they are not so easily divisible. Instead, as indicated in the diagram below, the problem is in fact made more complex by the interconnectedness of these indicators (Fig. IX). This interconnectedness reflects the cumulative-causational nature of man's relationship with the natural environment, i.e., his impact on that environment and his response to the consequences of that impact. In some cases some indicators are so interwoven into each other that it is not possible to differentiate the cause from the effect. For example, in the case of the drop in livestock numbers and the removal of natural vegetation, ignoring the drought condition, it is not easy to determine whether overstocking had caused the deterioration of pastures, or the removal or clearance of vegetation

Table 8

Indicators of Environmental Degradation

	Indicators	Magnitude	Expected Consequences	Explanation
PHYSICAL	1.Shrinkage of arable lands	H	further shrinkage	Caused by erosion, desert creep and areas going out of irrigation water reach.
	2.Drop in farm size	M	marginal drop	Balanced mainly by out migration.
	3.Water shortage	S	Continuous drop	Increase in water intake at el Girba + Loss by evaporation.
	4.High intensity of Haboob (dust storms)	H	Increased	It reflect the dryness of the area, lack of vegetation cover and high of disintegration of top soil particles.
	5.Drop of soil fertility	M	Became high	Loss of river silt + overuse of land + haboob.
	6.Deterioration of Pastures	S	Continue	Doponds on rainfall conditions in Butana.
	7.Deforestation	S	Slow down	Caused by blockage of river floating wood, removal and clearance of forests by man, restrictions imposed by forestry dept. and the long distance involved.
	8.Change of crop system	I	Increase	Mainly a shift from food crops to cash crops by the emerging landlord class.

Cont..

Table (8) Cont..

	Indicators	Magnitude	Expected Consequences	Explanation
ECONOMIC	9. Sale of agric. land by small holders.	I	Intensify	Caused by migration or the uneconomical size of plot.
	10. Sale of livestock	L	Slow down or stop.	Livestock has already approached the zero level.
	11. Drop in livestock number	S	Slow down	Linked to (10).
	12. Drop in livestock productivity.	S	Continue	Drop in farmers incomes, the poorer pastures and long distance covered.
	13. Low crop output.	M	Continue	Crop in soil fertility and shortage of water are the main causes.
	14. Unemployment	H	Slow down	Caused by degradation and lead to migration.
	15. Change of occupation	H	Continue	Mainly away from agricultural and livestock, and strongly associated with out-migration.
	16. Drop in income level	S	Continue	Caused mainly by the loss of agric. land and secondary income sources.
DEMOGRAPHIC	17. Out-migration	H	Intensify	Caused by the combination of environmental and economic problems.
	18. Drop in marriage rates	I	Continue	Caused by migration and drop in income levels.
	19. Age Sex imbalance	L	Slow down	Migration started to involve families rather than individuals.
	20. Depopulation of certain areas.	I	Likely	Total loss of agric. land or livestock is possible, caused by any natural hazard.
	21. Disputes and Conflicts	L	Slow down	Nomads who used to compete with farmers over water, no longer move into the area and shifted southwards.

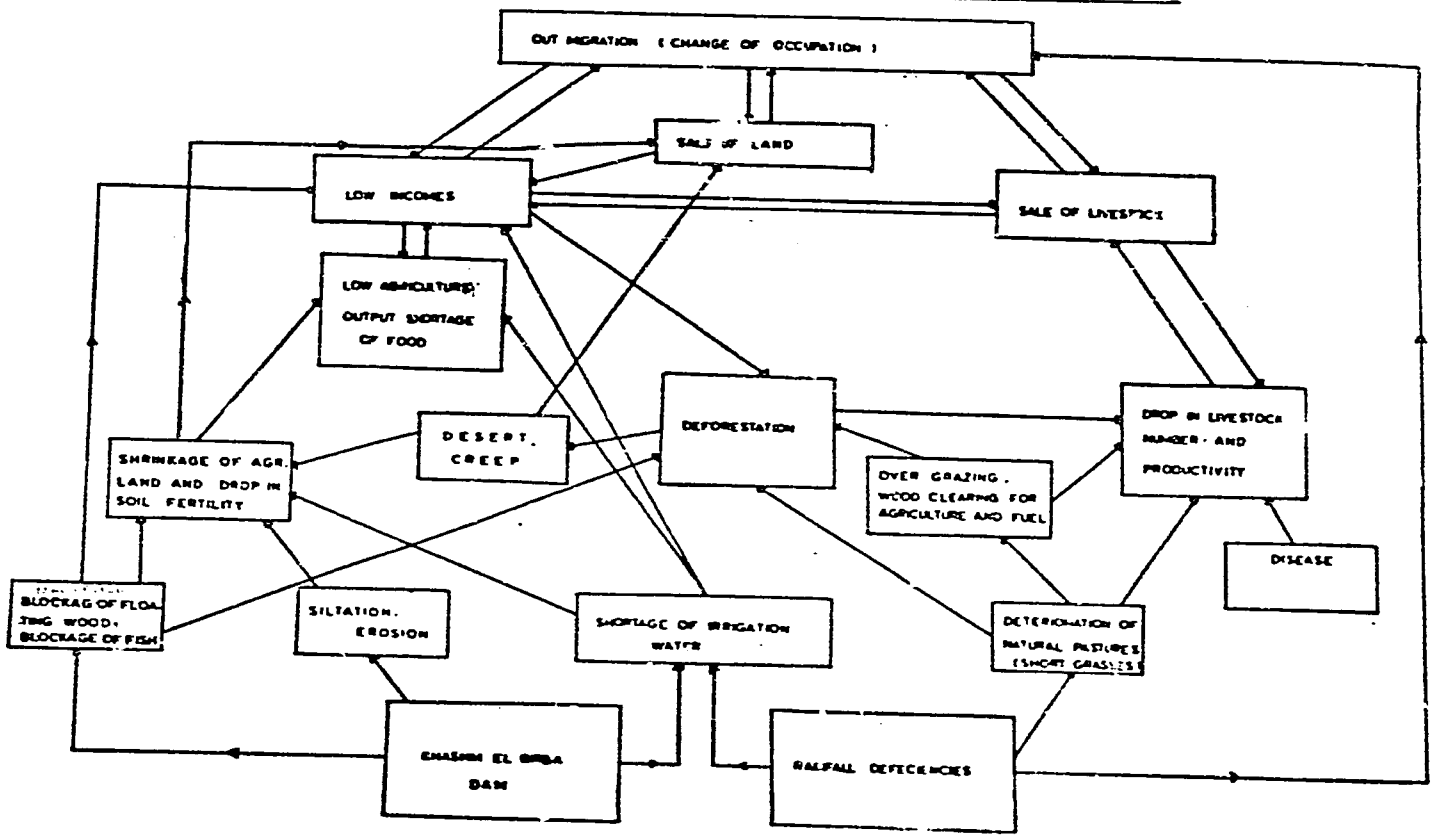
S = Severe. H = High. M = Medium. I = Increasing. L = Low.

by man had, and hence negatively influenced livestock. In other cases it is less complex and consists mostly of a pair of factors that have a reciprocal influence on each other such as migration and change of occupation or the low agricultural output and the drop of incomes (Fig. IX).

All these indicators share two common things. The first is their estimulation, either by the rainfall deficiencies that started in the mid-1960's, or the construction of Khashm el Girba dam in 1964. The second is that all these indicators share a trend of further deterioration, except those that have already approached the point of total collapse, such as the drop in livestock numbers or the loss of the gerf lands caused by haddam.

A number of physical, economic and political factors have contributed to cause extensive ecological changes in the area which in turn have led to significant changes in the local economy. The most influential physical factors are the arid climate of the area and the seasonal nature of the River Atbara. The pressure to settle the Nubians of Wadi Halfa and the absence of any comprehensive pre-scheme investigation or an appraisal of the "non-economic" consequences of the dam, especially in the downstrean area, represent the main political factors behind the problem. Besides, the lack of coordination and/or communication between the dam authorities, the Provincial authorities and the local population has also contributed to accelerate the magnitude of the problem. Economically it seems that the relatively poor economic potential of the area seems to have made it receive less attention from both the Central and Provincial authorities at that time. More-

Fig.(9) FACTORS OF ENVIROMENTAL DEGRADATION IN THE STUDY AREA : A Schematic Simplification



over, it seems that when planning the Khashm el Girba scheme the preservation of the environment does not seem to have been rated high among other "economic" considerations.

The local authorities' position can so far be described as only peripheral to the problem; its interference was very limited and timewise widely spaced. The role never seems to have exceeded a vision of sympathy on humantarian grounds which in the end materialized in some relief operations during the early 1970's. The major reason behind that "neutral" position seems to be the lack of financial and other resources that could have been used to alleviate the problem. The only positive steps were the supply of some irrigation pumps by the Ministry of Agriculture in 1976 and the closure of some areas by the Forestry Department to protect it, and this has, in fact, denied the local population an important source of income.

To describe the position of both the local population and the local authorities in relation to the tragic situation of the Lower Atbara, it is only fair to quote G.F. White "People who feel themselves unable to cope with a situation, feel it less severe than others."[1]

That leaves the question open for research: What is to be done? or, more precisely, what could be done now, bearing in mind the financial situation of both the local and regional authorities? How can we

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1/ G.F. White, Organizing Scientific Investigation to deal with Environmental Impacts, in Farvar M.T. and Milton J.P. (ed.) Op.cit., 1972.

revitalize the local economy and recreate its self-sufficiency? What are the necessary adjustments that could be made to rehabilitate the local environment and return back to it some of its lost properties and prevent further degradation? How and to what extent can the local people participate in the effort of maintaining their environment?

These questions cover a wide spectrum of activities such as enriching soils, reproducing and protecting the natural vegetation in order to check or, at least, slow down the speed of the spreading desert. They also raise the need for two important qualities that must characterize any scientific investigation attempting to deal with the phenomenon. These are:

a. the interdiciplinery nature requiring the involvement of specialists from a number of fields and the coordination among themselves, between them and the local authorities, and between them and the local inhabitants, and at all stages of the research;

b. the practicality and realism both in understanding the problem and in the recommendations and future plans to be formulated to deal with the problem, to move within the financial capacities and resource base of both the local authorities and the local population.

Similar studies so often boil down into a financial constraint explanation, which in fact reflects the inability of researchers to come out with practical and feasible solutions. But there must be a starting point for any effort, no matter how massive it must be. Assuredly there are certain things in the degradation trend that are irreversible, but many others are. Similarly, Khashm el Girba dam is a fact and is not possible to be removed, but doing nothing, be it by expressing unrealistic recommendations, will lead in the end to the total loss of the area. Since the whole Northern Region falls into the lower part of the main Nile, doing nothing now means to expect the same fate now faced by the Lower Atbara.

PART TWO

MONITORING REPORT

INTRODUCTION

In this part a summary of the main findings of the study carried out over the last year is presented. It represents a testing of the hypothesis and assertions spelled out in part I, regarding environmental degradation in the Lower Atbara. Thus it implies an assessment of environmental conditions measured by the various physical, economic and social indicators specified in part I earlier.

The study was based on a sample survey that covered 15 villages along the two banks of the River Atbara. The villages selected on the western side include El Magran, El Qubba, El Besli, Goz el Halag and Gersi of Ed Damer Rural Council, and El Abaka, Marzouqa, Shababit west and Baaluk of Seidon Rural Council. On the eastern bank the villages selected were El Hudi, Keneidra, Nukheila, Seidon, Hilgi, Shababit east and Salalat.

The sample size was 200 households, representing about 2.5% of the total number of households in the area. This percentage, however, goes down to about 2% when measured by the number of persons. The difference is caused by the assumption that the average number of persons per household is 10 individuals upon which the sample size was decided in the first place.

The lack and/or irreliability of data on environmental conditions in the area, as well as the main objectives of monitoring changes that actually occured made inevitable, the heavy dependence on the comprehensive questionnaire that was designed to collect information about the various ecological,

economic and social changes that occured in the area. This includes information on the local population, its ethenic composition, age-sex structure, mobility, employment situation, economic activities, income levels and the social services provided in the area, in addition to their perception of environmental changes, how they reponded to it and their prediction or expectation for the future situation. Also the questionnaire attempted to cover the areas of agriculture, livestock, natural pastures and vegetation, ground and surface water and forestry. Furthermore a sample survey and lab tests were made to know the quality and potential of the soils of the area. The data extracted from these questionnaires was tested and/or supplemented by official documents and reports especially on ground water and forestry.

In what follows the main findings are presented in different sections despite their strong connections. In fact these strong connections made inevitable some repetition under various subheadings. Section I and II are devoted respectively to the description of the properties and potential of soils and ground water in the area. Emphasis were laid on ground water because it seems to be the only option still open as the River Atbara waters are exploited to irrigate Khashm el Girba dam and rainfall is negligible in the area. Section III discusses the demographic structure and how it was influenced by environmental degradation both socially and economically. Section IV deals with the economy of the area, with emphasis on agriculture as the major occupation in the area, and how people responded to the recent drought conditions and the effect of the latter on the distribution of incomes

and living standards of various social groups. The scale of deterioration of natural pastures and the effect of that on livestock is discussed in section V.

An account on the deforestation in the area that was one of the consequences of the erection of the Khashm el Girba dam and the recent drought that hit the area, is given in section VI. The discussion is centred on the dom forests as the most dominent species and the highest in its economic value. Section VII gives an account on the social services provided in the area. The local inhabitants' perception of the present state of degradation of their local environment its scale, causes, impact, its future trend, how to check it and their contribution to the effort to restore the environment, is provided in section VIII.

The third part of the report contains three major sections. The first summarizes the main changes that occurred and an assessment of the level of Part degradation measured by the indicators specified in One. In the second a project proposal is drawn out as an experimental scheme that, if implemented could participate in alleviating some of the problems in the area and present a step towards a balanced and rational use of resources. And the third section carries a list of recommendations that are felt necessary to apply if the degradation trend is to be reversed. These recommendations were passed in the end of the workshop on the Environmental Degradation in the Lower Atbara and the Possible Alternatives held in June-July 1985.

SECTION I

SOIL RESOURCES: NATURE AND POTENTIAL

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SOIL RESOURCES: NATURE AND POTENTIAL*

The present situation in the Lower Atbara area has been aggravated by two main incidences in the geographical cycle of the region: the recent drought and the construction of Khashm el Girba dam. These two incidences greatly interrupted the normality of natural conditions which existed more than two decades ago. Of the various resources affected by malpractices in this and similar situations, soil is the one most susceptible to deteriorate.

The Geomorphology of the Area:

Geomophologically the area can be divided into four main landscape divisions:

(1) Nubian Sandstone:

This is the northern boundary of Lower Atbara area where the hilly nature of the Nubian sandstone formations is dominant. The latter is a sedimentary rock of varried lithology and textural grades and ranging in depth up to 100 m. In the area investigated the Nubian sandstone formation is highly weathered and dissected by seasonal streams e.g. Wadi el Hudi and Wadi el Mukabrab. This geological unit is associated with a minor unit the controvesial Hudi chert, The

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* This section is written by Dr. Abbas S. Musa of the Geography Department, University of Khartoum, based on his paper presented at conference on Environmental Degradation and Possible Alternatives in the Lower Atbara Area, Ed Damer, June 1985.

Nubian sandstone in the study area is famous by its aquiferous layers and high potentials of groundwater have been discovered.

(2) Basement complex Rocks:

These are solid rocks pre-cambrian in age underlying the Nubian sandstone formation and other recently deposited materials. They do not outcrop to the surface except in the northern - western part of the Lower Atbara area. Drainage in this part is greatly affected by these rocks due to their prominant relief and competent structure.

(3) Alluvial Deposits:

These are the recent deposits of R. Atbara and the surrounding Wadis forming extensive flood plains.

(4) Sand Dunes:

These are believed to be the youngest and least stabilized sediments in the area occupying the left bank of R. Atbara and forming a complex of dune and interdune zone to the south.

Marphology and genesis of the soils:

Although there are more than four parent materials in the area, only two soil orders are encountered according to U.S soil classification (three according to FAO classification).

(a) Entisols[1/] (fluvisols and Regosels)

These are recently developed soils from river alluvium or colluvium (Fluvidols) and sand regosoils. They are characterized by having undifferentiated profiles with no horizonation.

1/ Entisols: Us Dept. Agric. soil equivalent to FAO fluvisols and Regosols.

(b) Aridisols[1/] (Yermosols)

These include soils of dry land with one or two horizon at most. The profile contains one cambic horizon or an horizon of accumulated calcium carbonate or salts or leached clay (argillic) or silica.

Soil Characteristics:

A semi-detailed survey for the soils of the area was conducted by the Arab Organization for Agricultural Development early in 1982 at a time when the present crises were just ascalting. The survey however, emphasized on agricultural development without considering future environmental changes. Other soil surveys include those of Ayoub (1970).

The present investigation has in consideration the past, present, and future environmental conditions as influencing or being influenced by the human activities. Periodical monitoring is thus of paramount importance to make a sound judgement on the different environmental components.

The distribution pattern of soils in Lower Atbara follows closely the geomorphic setting of the area and its associated parent materials. Accordingly, five soil types have been observed (Fig.10).

(i) Soils of River Atbara flood plain:

These soils occur on flat to gently undulating topography extending from el Nukheila village eastwards to el Hagar and Baaluk inclusive. They are formed from materials derived from the Ethiopian plateau. Two series of soils have been encountered along this flood plain,

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1/ Aridisols: USDA = FAO Yermosols.

dicated by geomorphological variation. the old and new terraces. These two soil series however, have many characteristics in common. They both belong to the fluvisols soil order, with deep, permeable and well drained top soils. Texture is somewhat variable and soils are deeply cracked in some places indicating montmorillonitic clay composition. Clay content is not high enough for soils of a flood plain (20-46%) at Salalat, Shabit, el Mukheila and el Besli (See table 9). The neutral reaction and moderate to high fertility of these soils rate them high for agricultural purposes.

(ii) Soils of the Nubian Sandstone Erosional plain (Yermosols)

These occupy the area between River Atbara and Wadi el Mukabrab, Wadi el Hudi extending northwards to the Red Sea Hills. Being colluvial in nature they are stony and gravelly forming extensive desert pavements. They are well drained, brown in colour, sandy loam textured, calcic, slightly saline, alkaline but non. Sodic (sample 12 north of el Nukheila).

(iii) Flat Sandy plain Soils: (Regosols)

These are soils occurring east of Sidon village between River Atbara and Wadi el Hilgi on a flat sandy plain. Soils are deep, permeable, low in moisture retentivity, well drained, structureless, sandy loam in texture, calcic, alkaline, very sodic with $CaCo_3$ concretions reaching up to 50% (Nachtergaele, 1976). No soil samples were taken here for the present study.

(iv) Mobile Sand Dunes Soils: (Regosols)

South of River Atbara from Baaluk westwards to Sidon is an extension of mobile sand dunes formed as a result of north east and north dry winds. They are too

Fig 10

SOIL FORMATIONS IN THE LOWER ATBARA

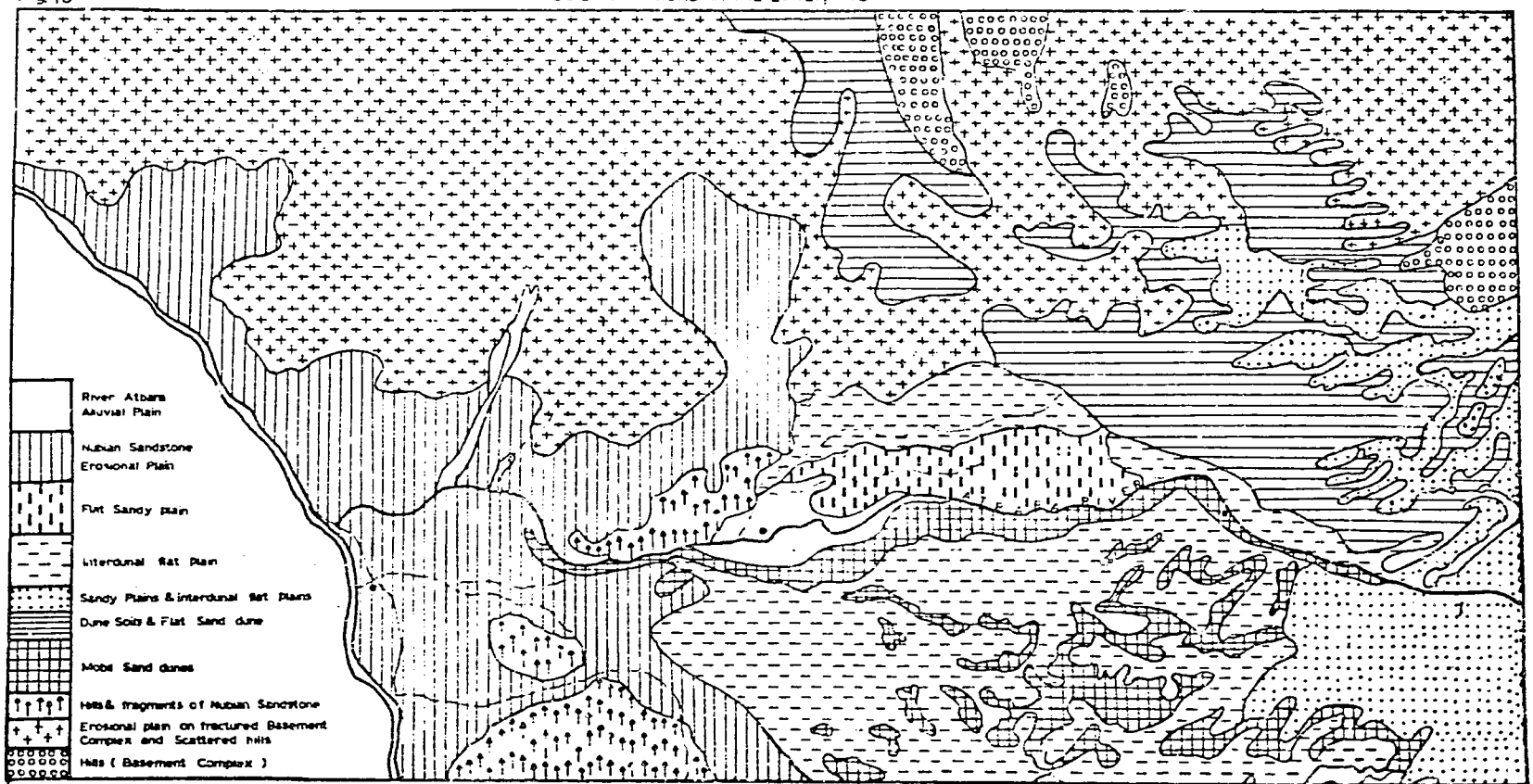

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Table 9

Top soil structure: Laboratory analysis of selected sites.

Site	PH	CaCO3	E.C.	CEC	Na	Ca	Mg	HCO3	Cl_2	SAr	Sand	Salt	Clay
(A) Old terrace Shababit	7.2	2.1	6.5	39	8.8	31	21	3	2	1.7	44	38	18
New terrace	8.6	2.7	0.61	29	3.5	1.0	5	2	2	2	54	24	22
(B) El Nuldheila	8.8	2.9	0.6	30	4.3	2.0	1.0	3	2	3.6	50	26	24
(C) Site 19	8.0	14.9	11	33	152	2.3	6	3	35	71.8	40	32	28

friable and too unstablized to be used for any kind of human activity. Sand content exceeds 90% of particle sizes and clay content rarely exceeds 1% at the topsoils. They should be stabliized before they stretch onto nearby arable lands.

(v) Interdunal plains of the Butana:(Yermosols)

South of River Atbara and merging into Butana land is a complex interdunal plain with a flat topography and infrequent sandy undulations. Deep soils, moderately drained, calcic (with dark concretions of calcium carbonate), clayey loam to clay texture, high salinity and sodicity characterizes these soil types. They are often utilized for rainfed agriculture in good rainy seasons and for camel grazing. Similar soils occur along Wadi el Hilgi flood plain with parent materials derived from adjoining Red Sea Hills.

(vi) Soil Suitability Classification:

Soil suitability depends on the purposes or goals made by the user. The approach is only recently applied for the soils of Sudan and is mainly based on the FAO (1976) suitability classification. It is based on compiling land units approximate values bearing in mind the needs of the plants (climate, evaporation, water flow, water retentivity, fertility level, drainage erosion, topography, salinity, sodicity etc..). Accordingly lands are divided into two divisions: (a) suitable for utilization (s) and (b) Not suitable (N).

These two divisions are further classified according to the degree of limitations which could hinder maximum utilization. Thus the suitable soils are subdivided into classes S_1, S_2 and S_3 according to the severity of limitations from nonexistent (S_1) to

serve (S_3). Sub-classes are made also by showing these degrees of severity to indicate the specific type or types of limitations necessary to be remedied before utilization is made. Not suitable soils are subdivided into N_1 and N_2 classes (N_1 = not suitable at present and N_2 = permanently unsuitable for use).

According to the above classification the five soils types of the area are evaluated. Table 10 summarizes the soil suitability for the crops normally grown and adapted to the area climate.

Table 10

Suitability Classification of Lower Atbara Soils

Soil Category	River Atbara Flood Plain	Erosional Plain Soils	Flat Sandy Soils	Mobile Sand Dunes	Inter-dunal plains of Butana
Order	S	S	N	N	S
Class	S_2	S_2	N_1	N_2	S_3
Subclass	S2ow	S2fw			S3wtf
Suitability classification	High to moderate	High to moderate	needs improvement suitable for grazing	permanently unsuitable for any use	needs irrigation & fertilization
Area	120,000 feddans	150,000 feddans	---	---	---

Table 10 shows that there are extensive lands for agricultural purposes varying in the degree of suitability. Most of these are very good, suitable for the cultivation of most crops that can be grown in this semi-arid climate ?120,000 feddans). In addition there

are several wide Wadis with extensive agricultural lands (150,000 feddans). The utilization of these soils is hindered however by certain limitations e.g. lack of water (W) erosion (e), topography (t), fertility (f) and sodicity (s).

It is realized that lack of water (W) is the common limiting factor to agricultural utilization in the area and is hence considered a grave problem which needs an immediate solution. The availability of large quantities of good quality ground water makes agricultural development in the area feasible. This will facilitate access to more agricultural lands in the area instead of heavily depending on the riverine lands.

(vii) Soil Erosion and Degradation:

Any incidental ecological imbalance between climate, soil and vegetation cover associated with land use pressures could be irreversible unless corrected by natural processes to help regenerate the normal physiognomy (Kassas, 1974). The ultimate result of such malpractices coupled with drought are what we currently know as desertification, desert creep or desert encroachment.

Three controversial schools of thought exist as to the actual causes of desertification. These are (a) the geologicial (b) climatic and (c) human factors.

It is not the aim of this paper to challenge any of these schools of thought, but it is generally agreed that whichever causes it one of the drastic results is the deterioration of soil conditions.

It has been observed however, that these factors could work singly or synergistically, but the influence of any one of them could be more pronounced than the others. In Lower Atbara Area the dual effect of the prevailing drought and the erection of Khashm el Girba Dam led to certain mispractices at the expense of the former existing environment.

To make life better (in fact things worse) destructive over grazing, wood cutting, uprooting shrubs, lowering of water table due to increase land use and burning of grasses and trees left the soil bare-prone to wind and water erosion. In the villages of Sidon, Shababit, Sellalat, el Besli and Baaluk and all along the river flood plain the effects of such malpractices are apparent. Of interest here is the physical side manifested by soil degradation in the form of soil erosion, sand movement, dune formation and other possible effects yet to be proven i.e. Salinity and sodicity and loss of soil fertility.

Before the dam erection the flow of River Atbara was slow and gradual obeying all the physical laws which govern the development of a river i.e. incision and deposition prevailed. One could easily judge that the river was passing a late maturity stage (deposition) incision. Two or three terraces have been formed during this stage providing enough land for earlier traditionally irrigated agriculture. Cultivation of cereals and vegetables was mainly for subsistence and hence no significent changes were observed either in soil fertility or crop yields. The annual load of silt enriched the flood plain and kept it "alive" while the Symbiotic relationship between man and his environment ensured a balanced ecosystem.

Post-dam conditions were however different. The closure of the dam after floods meant a trickle of water reaching the lower reaches of River Atbara. This was followed by an abrupt decrease in land; incision and deposition. When the dam opens its gates the velocity of the water becomes, more violent and of course no deposition is expected. Instead, a difference in the magnitude of erosion is created i.e. an accelerated erosion prevails. This is accompanied by lateral erosion (locally known as hadam) of the unconsolidated younger terraces. This phenomenon is destructive for the Gerif lands especially on gentle slopes normally utilized for vegetable growth after floods. These gerif lands are now completely wipped out and terraces stand almost vertically 6-8 m above the river bed.

The older, more consolidated terraces resist lateral erosion for some time but are of little use since they are higher than the river bed and traditional irrigation methods are unable to raise water to such levels. Many of the remaining gerif lands have been abandoned by the peasants because of the lack of the appropriate means of raising water. The economic and social ills of the drought years since 1973 have aggravated these physical problems. The consequences are a substantial loss of fertile topsoils, burial of fields by losse wind blown silt and prevalence of haboobs in the area.

Conclusions:

Lower Atbara has suffered during the last two decades from drought and shortage of irrigation water since the construction of Khashm el Girba dam. These

dual factors have upset the natural symbiotic relationship which existed before between man and his environment. This meant pressure on both human and animal population in the area. The inhabitants resorted to other means of increasing their income by down-cutting dom and other tree species. Overgrazing of pastures and uprooting of shrubs and seedlings left the soil bare and ready for the agents of erosion to operate. From here the wheel of desertification gradually started to roll.

To solve these problems and restore the environment to its previous situation, it was necessary first to assess the degree of deterioration which followed. Lateral erosion of flood plain soils and deflation of other agricultural lands by wind are two of the apparent signs of deterioration attributed to land misuse in the area.

In the present study it was not easy to estimate quantitatively the magnitude of deterioration in the physical and chemical attributes of the land investigated. This is because samples were collected only during the last visit to the area late in December 1984. Trend analysis is not possible in such circumstances and further monitoring is required to complete the picture.

The laboratory analyses showed no indication of any serious changes caused by land misuse. The high sodicity and alkalinity encountered at certain sites e.g. el Besli and el Nukheila are believed to be attributed to earlier non-agricultural practices (salt works) and not to inherent pedogenasis. The anomalous alkalinity figures however, call for concern if these soils are to be irrigated by groundwater.

Although it is theoretically proved that removal of topsoils leads to a decline in soil nutrients, there is a complete lack of adequate information needed to assess the relationship between crop yield and soil response to a particular use and management. Sound judgement on this relationship from the present data is not possible and the results should be cautiously interpreted.

It is clear from what has been mentioned that the immediate problem of the area is that of water shortage for irrigation purposes and for pasture away from the flood plain of River Atbara. The hydrogeological potentials in the area are confirmed to be adequate enough to warrant large scale irrigation by ground water.

The following recommendations can be considered if a balanced plant-animal and human relationships with land is sought in the Lower Atbara:

1. A mass education in schools and among peasants is needed to stop the present land misuse and to help combat desertification.
2. A rational exploitation of resources available is of vital importance to ensure a balanced environment after studying their potential and the ways and means of exploiting them.
3. Green belts are needed to protect agricultural schemes and it is vital that the forestry authorities should help in designing these projects.

4. A thorough teaching of suspected saline soils is required if they are to be irrigated by groundwater.

5. A programme of sand dune stablization is required to protect settlements and agricultural schemes from encroaching sand.

6. Further monitoring of soil response to particular uses and management is needed to make sound judgements on the behaviour of different soil types in the area.

SECTION II

GROUND WATER AND ITS POTENTIAL USE IN THE LOWER ATBARA

SECTION II

GROUND WATER AND ITS POTENTIAL USE IN THE LOWER ATBARA 1/

The major problem faced by the Lower Atbara and the core of the problem of environmental degradation is the shortage of both irrigation and drinking water. This shortage as shown in Part I and will be indicated elsewhere in this part, was caused partly by the recent drought (drop in rainfall levels) but mainly by the drop in the amount of the River Atbara waters passing down stream, a trend that started with the erection of Khashm el Girba dam in 1964. Over the last two decades the River Atbara waters, in addition to the drop in its overall amount, especially those passing down stream and the ceasing of all small feeders (Khors and Wadis) on both sides of the lower part of the river channel, has been characterized by significant variations in both amounts and times of flow from one year to another (See Table 11 and Fig. 11 as well as the change of the channel itself. Therefore, and with the drop in the storage capacity of the Khashm el Girba dam as a result of siltation and evaporation,2/ to the extent of not allowing the utilization of all the agricultural lands of

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1/ This Section made great use of a draft paper by E.M. Ahmed and M.E. Abdel Rahman titled "Ground Water and its Role in Combating Desertification in the Lower Atbara", (1984).

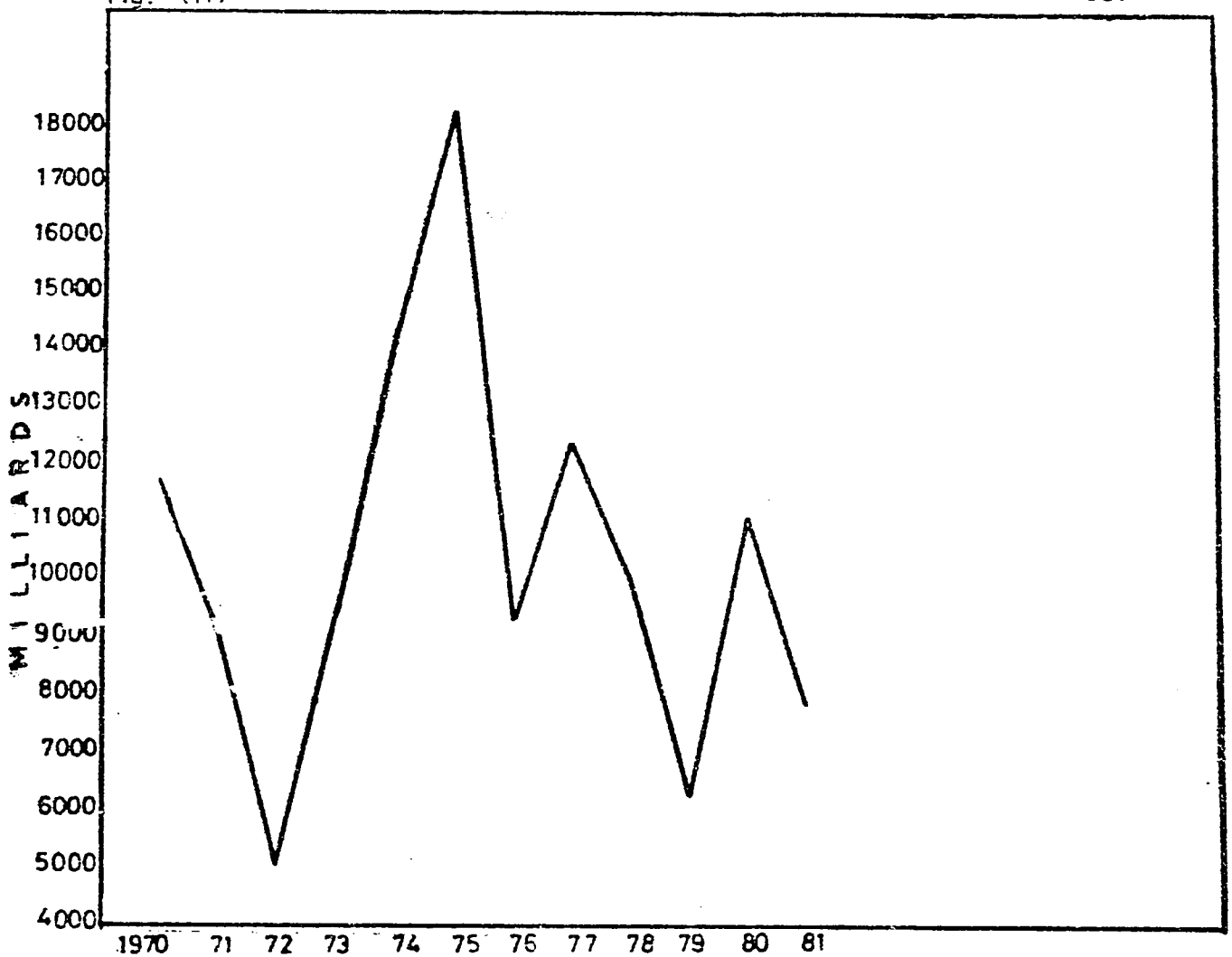
2/ See H.U. Thimm, Development Projects in Sudan: An Analysis of their Performance with Implications for Research and Training in Arid Land Management, U.N. University, 1979, p.16.

Table 11

Annual Discharge of the River Atbara
1970 - 1981

Year		No. of dry months (under 2)
1970	11843.3	2
1971	9222.1	3
1972	5136.4	2
1973	9463.9	2
1974	14411.2	4
1975	18329.8	-
1976	9368.9	-
1977	12481.8	-
1978	10159.2	-
1979	6340.4	-
1980	11250.8	-
1981	7910	2

Fig.: (11) RIVER ATBARA DISCHARGE AT KHASHM EL GIRBA DAM 1970–1981



Khashm el Girba Scheme, it is most unlikely that the water deficit now encountered in the Lower Atbara could be balanced from the River Atbara. This fact gives the imputus to both the study and use of the ground water potential in the area. For this reason in what follows, the discussion will concentrate mainly on ground water and the possibility of using it for irrigation.

Research on ground water, conducted mainly by the regional authorities in the Water Corporation, has covered the following areas:

a) A preliminary survey using the electric resistance method in 1972;

b) a comprehensive geophsical survey using the gravity method that covered 88 stations, together with the altra-sound method;

c) the excavation of various production and observation wells for the hydrogeologic studies;

d) the construction of an automatic for the permanent water table at two points at the western bank of the River Atbara (El Besli and Goz el Halag); and

e) some experimental studies on the excavated wells and the analysis of those informations.1/

1/ Source: The National Water Corporation, Regional Headquarters, Ed Damer.

These preliminary studies indicated the presence of a good stock of ground water in the area that can be utilized for agricultural purposes. In what follows and in conjunction with the previous section, we present the main findings of those studies.

The Basement Complex rocks covers all the eastern area of the Lower Atbara as its southern boundary extends from Gummaiza village, 87 kilometres southwest of the Nile-Atbara junction, to Um Shadida and Abu Dleig on the southern boundaries of the Nile Province (See Fig. 10). This type of rocks is formed of gruis, sehist and quartz that are consolidated in structure and poor in their ground water content except in very few cases.

On the southern fringes of the Basement Complex, we find the Nubian formations the most important and richest in its ground water potential. It consists of very small portions of sand and clay and in most cases free of cement. For this reason these formations are characterized by a high degree of permeability (10-20%) which qualifies it to be a good ground water reserve.

The newest formations in the area, consist mainly of sand dunes and clay around the various wadis and streams especially the Nile and the Atbara. The thickness of this layer ranges between 30 and 70 feet. These present an accessible source of water for the use of man and animal as well as for agricultural purposes.

Ground water in the area is concentrated primarily within those permeable sandstone layers or the aquifers, that consist of sandstone, loose sand or gravel and sometimes in weathered-cracked rocks near rivers and other water sources.

The study of the capacity of wells in the Lower Atbara covered the area between Shababit on the intersection point of longitude $16^{0}57'$ east and latitude $34^{0}57'$ north, the Nile-Atbara junction, the area of Wadi El Makabrab at the intersection of longitude $17^{0}25'$ east, and latitude $33^{0}55'$ north and Um Shadida on latitude $34^{0}25'$ and longitude $16^{0}25'$. The main findings of that study are summarized in Table 12. On the basis of that it can be said that:

a) There is a good ground water reserve in the area that can support some agricultural schemes in the areas of El Besli, Qoz el Halag, Seidon, Gersi and Abu Sinoon ranging between 136,000 and 250,000 gallons/day/feet under an artizian pressure of between 0.002 to 0.005.

b) In the area around El Abaka the capacity is over 40,000 g/m/ft. under a 0.008 artizian pressure which means the possibility of establishing some small agricultural schemes. All these aquifers are fed mainly from the River Atbara.

c) In the area between Ed Damer and Wadi El Makabrab the capacity ranges between 38,000 and 71,000 g/m/ft. which indicates that the store is a semi-confined one.

d) As shown in the table the depth of the Static Water Level (S.W.L.) range between 20-40 feet near the Nile and the River Atbara and reaches up to 175 feet away from the river near Um Shadida.

e) All the wells excavated near or at the land fault are of a very limited storage capacity and low in productivity and therefore can not be used for purposes other than drinking for man.

The depth of the ground water store, ranges from 20-50 feet near the Nile-Atbara junction and gradually increases to 150 feet away from the Nile, to 160-360 near Wadi el Makabrab and over 500 feet near El Besli.

The Nile and the River Atbara are the two major feeders to these aquifers. The Atbara supply is seasonal in nature which necessitates conducting more intensive geophysical studies to determine exactly the impact of the Khashm el Girba dam and the recent drought on the ground water potential of the whole area.

With regard to the suitability of these purposes and on the basis of the chemical analysis, it is proved that it is useful for both human and animal use and for agriculture as it contains no metal or salt that could reduce its value.

Table 12

Capacity of Ground water wells in the Lower Atbara

Well No.	Location	Co-ordinates	S.W.L. ft.	I.D.W.L. ft.	Aquifer Thickness	Screen placing	Average T.g/d/ft.	Value of S.	Sp.Cap. Q/S g/m: ft.
7920	Masspio (*)	Lat.17-45 Long.34-00	25	—	15-50	20-50	50,000	—	—
—	Atbara (**)	—	—	—	—	—	27763.2	—	—
8541	Ed Damer	Stadium	26	35	155	—	38528	0.13	8.00
7517	El Makabrab	Lat.17-25 Long.33-55	41-16	56-71	100.36	262 348	71280	0.002	17.5
7901	El Besli	Lat.17-32 Long.34-11½	20-27	23-69	50-535	500-591	136708	0.0005	73.00
7501	El Abaka	Lat.17-17 Long.34-24	23.99	31.75	105-135 179	113 179	43824	0.008	20.5
7504	Abu Sonoun	Lat.17-20 Long.34-21	39-93	59.20	65-110	65-110	105600	0.0005	8.32
7902	Goz El Halag	Lat.17-24 Long.34-17	24.82	34.82	50-125	73-118	210680	00004	10.00
7903	Gersi	Lat.17-32 Long.34-19	25.09	36.00	—	—	250440	0.003	25.00
7506	El Shababit (***)	Lat.16-57 Long.34-57	—	—	10.20	—	—	—	—
7503	Umm Shadida (****)	Lat.16-25 Long.34-25	175	140-180 240-320	143-178 240-306	—	—	—	—

Source: E.I. Ahmed and M.E. A/Rahman.

(*) Basement complex at 50ft. near Nile River bank.
(**) Atbara (2) in the same location, shown rapid drawn down.
(***) Very poor aquifer (dry) Basement Complex at 40ft.
(****) Very poor aquifer Basement Complex 320.00

Definition of Terms

Coefficient of Storage (S):

Is the volume of water released from storage or taken into storage per unit of surface area per unit change in head dimensionless.

T. Coefficient of transmissibility of an aquifer is the rate at which water will flow through a vertical strip of the aquifer one foot wide and the entending through the full saturated thickness, under a hydraulic gradient of 1.00 on 100 per cent measured in gallons per day per foot.

S.W.L. Static Water Level:

Derth to the water before pumping.

D.W.L. Dynamic Water Level:

The depth to the water after pumping.

Sp.Cap. Specific Capacity:

Measured in gallons per minute per foot, which is the discharge rate divided by total draw down.

Aquifer:

Water-bearing formation.

SECTION III

THE POPULATION OF THE LOWER ATBARA

SECTION III

THE POPULATION OF THE LOWER ATBARA

The Tribal Composition:

According to our sample survey results, the Jaaliyin is the largest tribal group, followed by the Rubatab and Bisharin in terms of size. As shown in Fig. 12 the Jaaliyin occupy the western part of the Lower Atbara while the Rubatab occupy the eastern side. In the upper part of the Lower Atbara the Bisharin occupy most of the western and parts of the eastern bank of the river. Between these two parts we find the Kamalab in the west and Nifidab in the eastern part of this middle zone (See Fig. 12).

Table 13 below provides some indications on the ratios of all tribal groups encountered in the survey. However it can not be claimed that it reflects the actual figures for the simple reason that the study did not cover all the villages.

Table 13

Tribal Composition of the Lower Atbara Population (1985)

Tribe	In Western Bank (%)	In Eeastern Bank (%)	Lower Atbara (%)
Jaaliyin	66.0	25.5	47.5
Bisharin	17.9	19.1	19.0
Rubatab	2.8	39.4	20.0
Atbara	-	2.2	1.0
Kawahla	10.4	-	5.5
Reshaida	0.9	1.1	1.0
Nifidab	-	8.5	4.0
Other tribes	0.9	4.3	2.5
Total	100.0	100.0	100.0

From the table the following points can be made:

1) The close location of the Jaaliyin tribal homeland as well as the long settled life they practiced seem to be the main reason behind the high proportion they represent.

2) The Bisharin represents the largest of the originally nomadic groups in the area and the reason also seems to be the short distance between their homeland in Butana and the River Atbara and also their long association with the river in their seasonal drive to it for water during the dry seasons. Furthermore they seem to be the first among the tribal groups to feel the pinch of environmental degradation soon after the Khashm el Girba scheme was established, as it expanded on their natural grazing areas of the Butana.

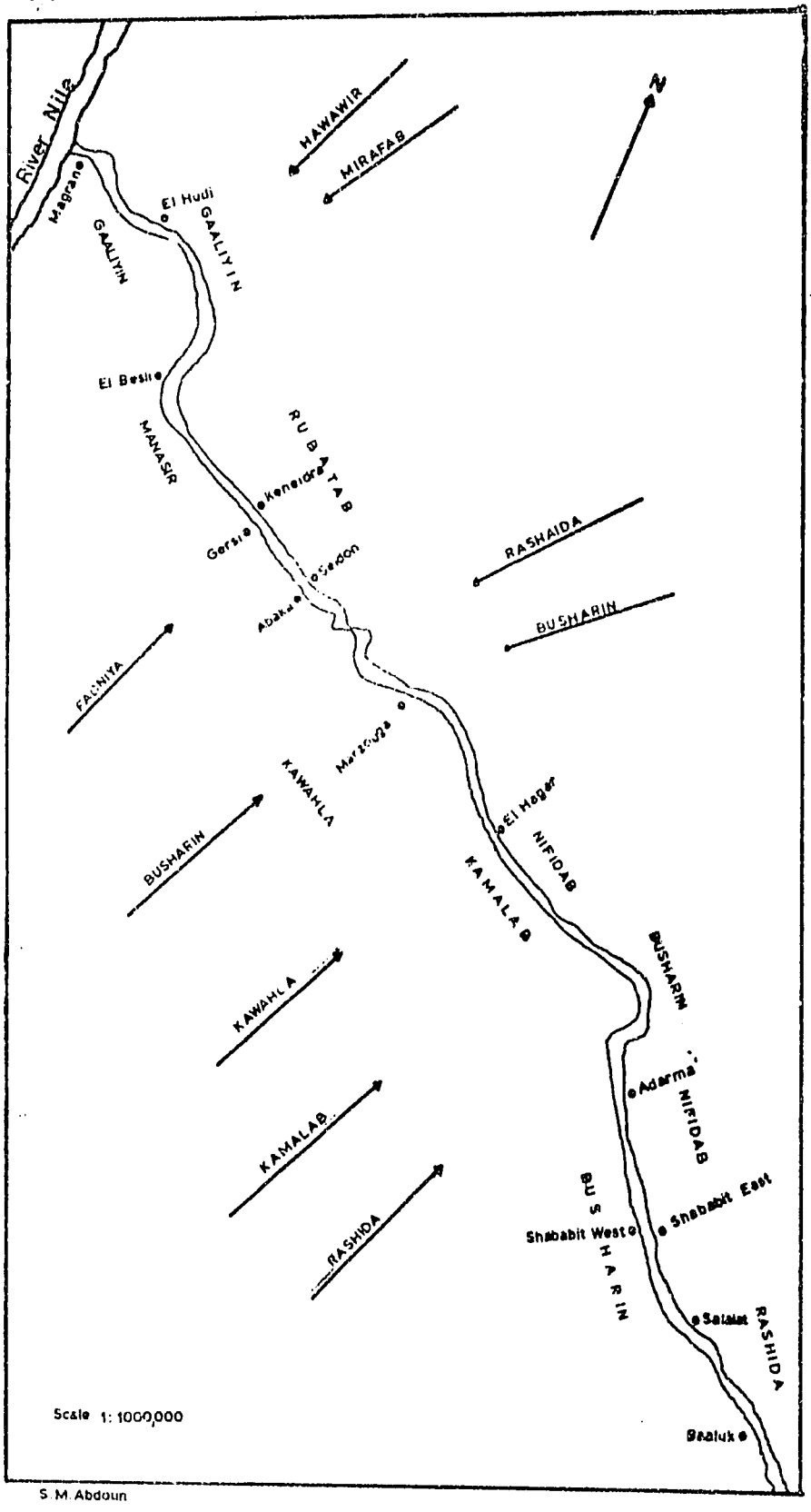
3) The small tribal groups such as Rashaida, Ababda and Kawahla are mostly recent commers to the area, driven by the severe droughts over the last five years especially in the north-eastern parts of Sudan.

It must be noted however, that a considerable number of Bisharin has now completely abandoned nomadism and animal herding and is engaged in agriculture either as farmers or, mostly in fact, as agricultural labourers. All those covered by the sample of the Rashaida and Ababda are working as casual agricultural labourers in the area or in the close-by urban centres.

The Age-sex Structure:

According to the sample survey the Lower Atbara area can be described as a young society as some 80% of the population is under 40 years old and of these about 46% are under 15 years. This means that people

Fig.(12) TRIBAL GROUPS IN THE LOWER ATBARA



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in the working age from both sexes constitute 43% but of course this does not mean that all of these are actually employed.

Regarding the marital status about 30% of adult males (over 18 years) and 22% of females are not married which is a strange phenomenon by Sudane rural standards. This is further emphasized by the fact that 9% of males and 45% of females over 25 years old are still single. This reflects the deteriorating economic conditions in the area, otmigration of males as well as the influence of urban social habits on migrants from the area. This might have been the reason for the expansion of polygamy in the area as 15.2% of married males have more than one wife, while divorce cases are very limited and do not exceed 1% of the married population.

The overall male/female ratio is 96.8% which is generally balanced. The male/female ratio however, is slightly different for the different age groups. According to our sample results it is 85.6%, 95.3% and 132.5% respectively for the age groups under 15, 15-45 and over 45 years, (See Table 14). This sex imbalance and the presence of a high percentage of unmarried males reflect the impact of migration.

The average family size is 8 persons per household but the economic dependency ratio is about half that figure standing at 4.1 persons. This means that on average there is more than one income earner per household, which indicates the presence of extended families in the area.

Table 14

Age-sex structure, marital status and male/female ration percentage

Age Group	Sample population			Marital status								M/F Ratio by Age Group %	
				Single		Married		Divorced		Widowed			
	Total	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female		
0-4	11.28	11.72	10.85	11.72	10.85	-	-	-	-	-	-	104.55	85.58
5-9	13.72	13.12	14.30	13.12	14.30	-	-	-	-	-	-	88.79	
10-14	11.28	9.17	13.32	9.17	13.32	-	-	-	-	-	-	66.67	
15-19	14.16	14.14	14.18	13.63	10.48	0.51	3.70	-	-	-	-	96.52	95.33
20-24	10.09	10.45	9.74	7.77	6.54	2.68	3.21	-	-	-	-	103.80	
25-29	7.27	8.15	6.41	5.48	2.59	2.68	3.82	-	-	-	-	123.08	
30-34	6.58	6.24	6.91	1.91	1.73	4.33	5.06	-	0.12	-	-	87.50	
35-39	4.76	4.59	4.93	0.51	0.12	4.08	4.19	-	0.25	-	0.37	90.00	
40-44	4.26	3.19	5.30	0.51	-	2.68	4.44	-	0.74	-	0.12	58.14	
45-49	4.39	4.59	4.19	0.13	-	4.46	3.82	-	0.25	-	0.12	105.88	132.46
50-54	3.01	3.19	2.84	0.26	-	2.93	2.59	-	-	-	0.25	108.70	
55-59	2.32	2.80	1.85	-	-	2.80	1.48	-	-	-	0.37	146.67	
60 and over	6.89	8.66	5.18	0.13	-	7.52	3.08	-	0.25	1.02	1.85	161.91	
Total	100.0	100.0	100.0	64.33	59.93	34.65	35.39	-	1.60	1.02	3.08	96.79	

Comparing these results with those of 1978, shown in Part One of this report, we can note two very strange changes:

a) Although the average family (household) size has decreased by about 17% (from 10.5 to 8 persons), the economic dependency ratio has risen by about 17% from 3.5 to 4.1 dependent persons per income earner.

b) The population is less balanced in its sex structure as the male/female ratio has dropped from 99.3% in 1978 to 96.8 in 1985. But at the same time the situation became more balanced among the middle age group (15-45 years) as the ratio rose from 89.3% in 1978 to 95.3% in 1985, despite the fact that this age group is the most influenced by migration and is expected to be the least balanced.

Although it is not easy to come to the actual reasons behind these strange phenomena, it could be explained, in addition to the natural birth conditions, by the following:

1) The influx of relatively large numbers of population into the area over the last five years. Various originally nomadic groups such as Bisharin, Rashaida and Kawahla has abandoned or were forced to abandon nomadism as an economic activity and settle by the River Atbara under the pressure of severe drought conditions in their tribal dars in the eastern region of Sudan or the Butana. These groups are engaged in agriculture either as farmers or as agricultural labourers and male migration among them is extremely limited.

2) Migration from the area in the past was partial involving mostly the young male section of the population and for a limited period of time, now it seems to have taken a new form, that is of the complete family that intends to settle for good in the destination point, as it is the case for many families from Lower Atbara now living in Ed Damer.

3) The last explanation is related to our sample itself, as all respondents were males, the thing that might have obscured the situation of women living on their own or without a male head family in the area.

Population Mobility:

a) Migration into the area:

It has been mentioned previously that until very recent times the Lower Atbara area has remained a marginal area complementing the agricultural activities along the Nile or the nomadic activities in the Butana and the north-eastern parts of Sudan. This means that an enormous number of tribal groups made use of the area at certain periods in time and this in turn makes it difficult to talk about in-coming migration with a high level of certainity. However some generalizations can be made depending on the sample survey, whose results are summarized in Table 15 and 16 below. From the tables one can arrive at two facts. These are:

1) That about 95% of the sample population was born within the villages they now live in. Of the remainder 52% were born in other villages within the Lower Atbara and 48% (representing 2.4 of the

Table 15

Place of Birth and Place of Residence for Lower Atbara Population (1985)

(%)

Age Group	Place of Birth				Place of Residence				
	Village	Lower Atbara Area	Northern Region	Other Regions	Village	Lower Atbara Area	Northern Region	Other Regions	Abroad
0-14	35.98	0.25	-	-	36.23	-	-	-	-
15.-29	30.35	0.44	0.51	0.18	27.73	0.98	0.94	1.13	0.63
30-44	14.65	0.57	0.39	-	13.58	0.50	0.32	0.82	0.38
45-59	8.13	0.59	0.69	0.18	9.02	0.19	0.26	0.19	0.06
60 and over	5.88	0.69	0.38	0.06	6.70	0.25	0.06	-	-
Total	94.99	2.63	1.94	0.42	93.24	2.07	1.50	2.13	1.06

Table 16

Immigrants to the Lower Atbara

Age Group	Migrant Population Ratio: Total Population	Migrant Population	Date of Migration: Before 1960	1960-1970	1970-1980	After 1980
0-14	0.25	4.93	-	-	2.47	2.47
15-29	1.12	22.22	3.70	4.95	9.87	3.71
30-44	1.0	19.76	9.88	6.14	2.47	1.24
45-59	1.57	30.87	20.99	3.71	3.71	2.47
60 and over	1.13	22.22	14.82	4.95	2.47	-
Total	5.08	100.00	49.38	19.75	20.99	9.88

total sample population) were born outside the Lower Atbara. This indicates how minute is migration into the area (See Table 15).

2) That about 55% of those who migrated to the Lower Atbara from other areas, are over 45 years old. Also about half of them came into the area prior to 1960 and the ratio started to decline to about 10% after 1980 (Table 16). In fact most of these latter group arrived into the area over the last three years and all of them were nomads in the past.

This restresses the point mentioned earlier that before the construction of Khashm el Girba dam and the drop in rainfall levels over the last two decades, the area was most attractive to Jaaliyin and Rubatab tribes especially in the extreme lower parts but recently the ex-nomadic tribal groups were forced to leave their homelands to various areas, including the Lower Atbara, under the pressures of the expansion of the Khashm el Girba Scheme, drop in rainfall and the deterioration of natural pastures especially in the eastern region. These resulted in large losses of livestock, severe drop in incomes[1/] and in some cases famine.

b) Outmigration

With regard to outmigration, which is more reflective to local conditions and more effective on its economic and social structures, we notice that it

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1/ An indicator of the drop in incomes was found in the area in 1984 when the prices of livestock decreased considerably. For example camels were sold at a price of 50 pounds per head although its average normal market price was ten times that level or even more.

has increased considerably over the last few years. Some villages have completely disappeared from the map,[1/] several other were heavily depopulated such as Kalalab, Salalat and most of the villages on the upper parts of Seidon Rural Council especially on the eastern bank of the river and the nomadic and semi-nomadic camps around Um Shadida in the northern Butana.

It was previously mentioned that the sex balance among various age groups does not reflect stability as much as it reflects migration of complete families from the area. This is emphasized by the fact that 28% of the sample population reported having one or more of their family members now living outside their home village. Furthermore 20% of them have migrated for some time and returned back to the area.

Also the total number of migrants constitute about 5% of the total number of the Lower Atbara population (See Table 16).

As for the destinations of these migrants, as shown in Figure 13 , they include:

1) The Eastern Region receiving about 34% of migrants, mainly in Khashm el Girba Scheme, the mechanized crop production area around Gedaref and Kassala town.

2) The Nile Province in the Northern Region, receiving about 29.8% of migrants mainly in Ed Damer and Atbara towns.

1/ See Part One.

Fig.13(a) DESTINATIONS OF MIGRATION FROM THE LOWER ATBARA

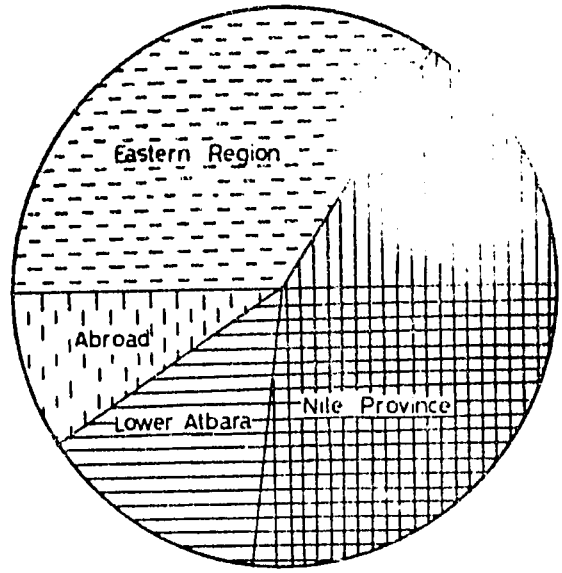

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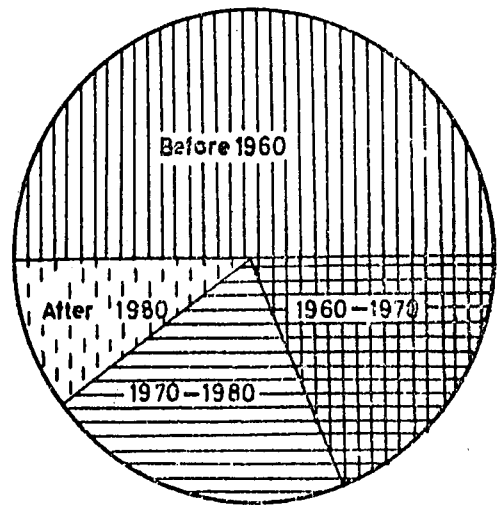
Fig.13(b): MIGRATION INTO THE LOWER ATBARA 1960 – 1980



S. M. Abdoun

3) Khartoum, and it receives about 16% of migrants.

4) The Lower Atbara absorbing 14.3% of migrants who live outside their place of birth.

5) About 8.9% of migrants go abroad mainly to Saudi Arabia and Kuwait.

Comparing this to the informations about migration in the past, shown in Part I, we find no major change in the destinations of migrants except for the increase in the ratio of those moving to the neighbouring towns of Ed Damer and Atbara as well as the increase in internal mobility within the area. This latter feature in fact involved a south-easterly movement from the upper to the lower parts of the area where a number of cooperative and private pump schemes was established and attracted labour from other areas.

A closer look to the migrants who returned back to the area revealed the following:

a) Over 73% of them migrated within the last 10 years;

b) The absence did not exceed five years for 86% of them and it was one year or less for 44.6% of them;

c) Over 46% practiced this type of migration more than one time; and

d) Social factors were the main reason for coming back (46.4%) and the other factors include lack of jobs or low incomes in the areas they moved to.

When asked about the reasons causing migration for these returnees, the answer of the vast majority was the deterioration of economic conditions in the area (59%), followed by unemployment (16.1%), drought (10.7%) low incomes (5.4%) and lack of essential social services (5.4%). These reasons were also the main determinents of the selected destination.

What emphasizes the significance of environmental degradation in the area is the fact that 80% of these migrants were mainly cultivators who lost their lands as a result of haddam or lack of irrigation water. The rest are ex-nomads who do not own irrigated agricultural lands and lost the rainfed area of Butana (6%) or those who depended in the past on the River Atbara collecting floating wood (8%) or as fishermen (2%). Furthermore it must be noted that for 57% the move was not only geographical but also occupational, the rest continued to work in the field of their previous activities.

With regard to future trends of migration it was found that about 36% of the sample population are thinking to leave the area, mainly to the same destinations that attracted their predecessors. Furthermore about 82% of those thinking of migration plan to move alone while the rest are planning to accompany their families. The reasons given to migration included:

a) Environmental degradation and deterioration of natural conditions (54.2%);

b) the search for work with a regular income (27.8%);

c) the search for better and for larger agricultural lands (9.7%);

d) social reasons (8.3%).

However, 98% of those who plan to migrate actually favoured abandoning the idea if conditions improved in the area. The significance of these facts is that out-migration from the area will continue as long as the present environmental conditions and their socio-economic consequences prevail unless something is done to check the deterioration and promote socio-economic development in the area.

SECTION IV

ECONOMIC ACTIVITIES

SECTION IV

ECONOMIC ACTIVITIES

Agriculture is still the dominent economic activity in the area as indicated by the proportion of population engaged in it (See Table 17). But agriculture as well as the other economic activities practiced in the area witnessed significent changes over the last two decades as a result of environmental changes in the area, as it was indicated in part one of this report and as will be shown later. The other economic activities include manual work in and outside agriculture, trade, nomadism and animal herding and handicrafts.

Table 17

The Distribution of Lower Atbara Population by Occupations (1964-1985) 1/

Occupations	1964	1985	Rate of increase or decrease in ratio of population engaged
Agriculture	92.0	80.5	- 12.5
Nomadism animal herding	2.0	0.5	-75.0
Fishing	2.0	Zero	-100.0
Wood collection	0.7	Zero	-100.0
Trade	Zero	5.5	+
Handicrafts	Zero	0.5	+
Manual work	3.3	13.0	+294
Total	100.0	100.0	

1/ Source: H.A. Abdel Ati, The Impact of Khashm el Girba Dam on the Western bank of the Lower Atbara Area, M.Sc. Thesis, Wales University, 1979 and Field Work 1985.

From the table above and in terms of the ratios of population engaged in the various economic activities, the following changes can be depicted between 1964 and 1985:

1. The ratio of those engaged in agriculture declined by 12.5% despite its remaining the activity for the majority of the working population.
2. The ratio of nomads dropped by 75%
3. Fishing and wood collection disapeared completely
4. Trade and handicrafts emerged as new economic activities in the area.
5. The ratio of those engaged in manual work was doubled by almost three times.

Comparing these changes to those shown in part one (1978-1984), we find that the ratio of the farming population has infact increased mainly at the expence of nomadism, fishing and handicrafts. Furthermore, the major drop seems to have been in the activities that developed from a marginal or secondary activities prior to 1964 into major activities in 1978, such as handicrafts.

These changes reflect both the impact of the Khashm el Girba dam and the drought that affected the area since the late 1960's. The blockage of floating wood, for exaple, has led the population to the cutting of wood from the neighbourhood including the dom trees, thus uprooting the main source for handicrafts in the area (saaf). Also the drop in the river waters after the construction of the dam, erosion and the blockage of silt has all contributed to the severe drop in the ratio

of those depending on agriculture for living. But the disappearance of natural vegetation for those dependent on handicrafts, th deterioration of pastures and the shortage of water for the nomads (as well as the expansions of Khashm el Girba scheme) from the one hand and the impossibility of practising fishing and wood collection from the sedentry population from the other hand, has left no option open to work other than agriculture the thing that caused the gradual rise in the ratio of the farming population between 1978 and 1985 after the severe drop experienced between 1964 and 1978.

From the sample survey it can be said that the change of occupation is still active in the area as indicated by (a) the fact that 28.5% of the working population over 40 years of age, now practice activities they were not practicing in the past, and (b) 30% of those under 40 years of age practice activities different from their father's. It must be noted that the direction of change is mainly from agriculture and nomadism towards trade and manual work. The reasons for changes are either the impossibility of practicing the original job, mainly for environmental factors, or the severe drop in income from the previous job.

The Employment Situation:

The results of the sample survey indicate that the ratio of those earning incomes, regular or irregular, constitute 24.4% of the total population. This ratio represent 38.3% of the total population over 15 years old or those in the working age. This infact emphasizes the point made earlier that on average there are about two income earners per household in the area.

However there is enormous variations between the two sexes with regard to employment. Among women the level of unemployment is over 94%, compared to about 13% for males. These represent respectively 46.2% and 6.5% of the total females and males in the working age excluding those enroled in schools. This means that over half the population (52.7%) in the working age are actually unemployed (See Table 18).

Changes in Agriculture:

It was monticned in part I that the construction of Khashm el Girba dam and the drought that hit the area over the last two decades, had its most profound effect on agriculture, the major economic activity in the area. Although the main trend of change is similar to that monitored in 1978, some important changes has been reported in 1985.[1] In summary the major changes reported include:

(a) the decrease in the cultivable land and the average household plot size (See Fig. 14);

(b) the loss of gerf land under the effect of haddam;

(c) the loss of atmur land as a result of the drought;

(d) the failure to make use of the river bed for the cultivation of mugat due to the changes in the river waters amount and time of flow; and

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1/ A major area of change was the responce of local farmers to these changes which is discussed in a seperate section below.

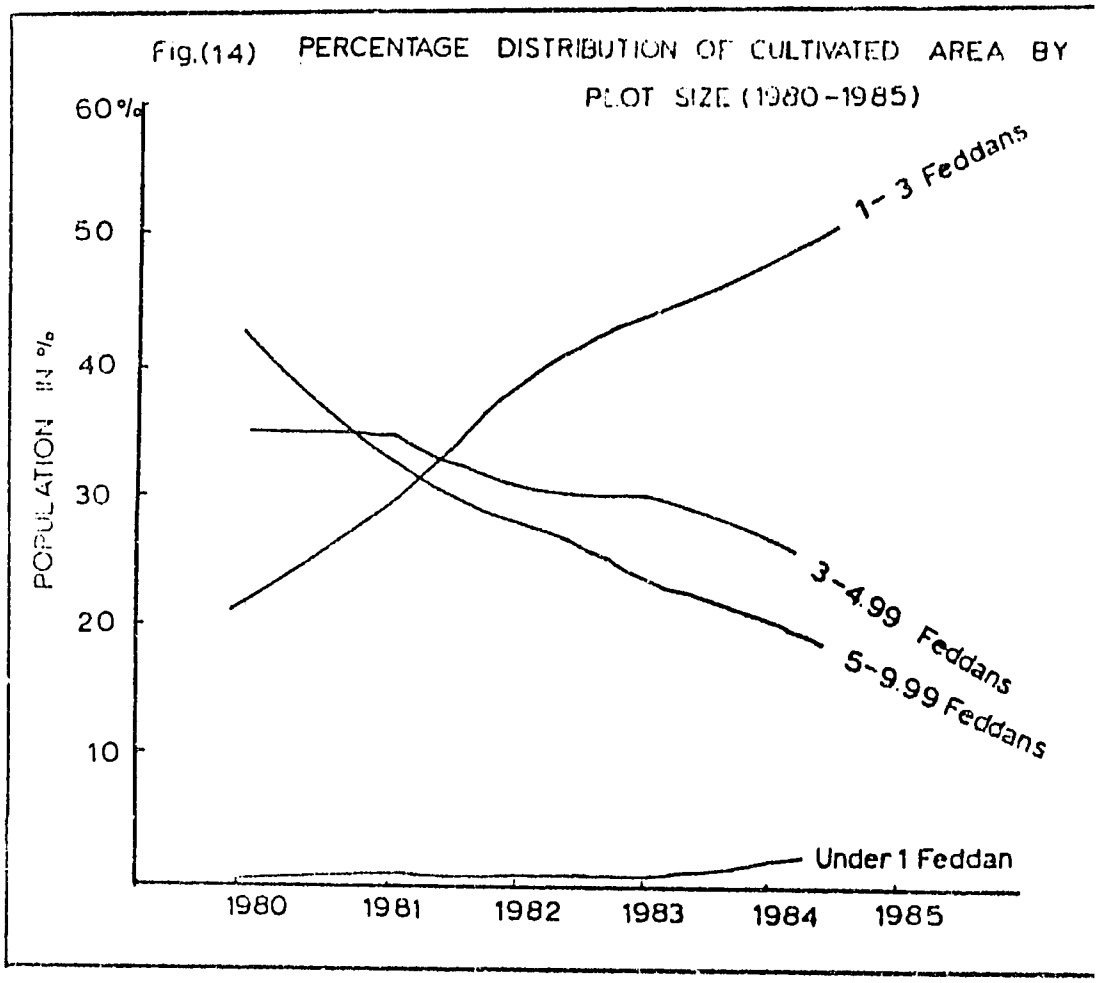
Fig.(14) PERCENTAGE DISTRIBUTION OF CULTIVATED AREA BY PLOT SIZE (1980-1985)
60%
50
40
30
20
10
POPULATION IN %
1- 3 Feddans
3-4.99 Feddans
5-9.99 Feddans
Under 1 Feddan
1980
1981
1982
1983
1984
1985

Table 18

Employment situation in the Lower Atbara by Age and Sex (1985)

Age groups	Total			Working Population	Unemployed			Students			Ratio of employed by age group
	Both sexes	Males	Females		Both sexes	Males	Females	Total	Males	Females	
15-19	22.2	10.9	11.3	12.3	3.6	8.7	8.5	5.8	2.7	6.6	
20-24	15.8	8.1	7.8	8.1	0.4	7.7	0.4	0.3	0.1	46.6	
25-29	11.4	6.3	5.1	5.1	-	5.1	0.2	0.1	0.1	54.3	
30-34	10.3	4.8	5.5	6.1	0.6	5.5	-	-	-	41.0	
35-39	7.5	3.5	3.9	3.9	-	3.9	-	-	-	47.4	
40-44	6.7	2.5	4.2	4.2	-	4.2	-	-	-	36.8	
45-49	6.9	3.5	3.4	3.3	-	3.3	-	-	-	51.4	
50-54	4.7	2.5	2.2	2.4	0.1	2.3	-	-	-	50.0	
55-59	3.6	2.2	1.5	1.6	0.1	1.5	-	-	-	56.8	
60 & over	10.8	6.7	4.1	5.8	1.7	4.1	-	-	-	46.4	
Total	100.0	50.9	49.1	52.7	6.5	46.2	9.1	6.2	2.9	38.3	
Ratio to total population	63.7	32.5	31.3	33.6	4.1	29.5	5.8	4.0	1.8	24.4	

Source: Field work.

(c) the failure to cultivate the high karu lands as a result of the high altitude of gerf[1] and the use of small irrigation pumps in the area.

These changes have obviously caused changes in the system of landuse and ownership and hence in production relations. In addition to the changes refered to in part I and comparing the findings of the 1985 survey to that of 1978, we find the following differences:

(a) The ratio of farmers depending on flood for cultivation has increased by about 35% while the ratio of those using sagius has dropped by about 95%. Also reliance on rainfall has dropped giving way to the use of diesel pumps (See Table 19).

Table 19

Distribution of Farmers by Method of Irrigation 1978 and 1985 (%)

Ratio of Farmers	Irrigation Method			
	Flood	Sagia	Pumps	Rain
1978 (%)	25.0	10.0	64.0	1.0
1985 (%)	33.7	0.5	65.3	0.5
Degree of change (%)	+34.8	-95.0	+2.0	-50.0

(b) With regard to ownership, although in terms of numbers the ratio of private holders is extremely high, in terms of area privately owned land is generally small. In fact the ratio of private holders in 1985 is less than that of 1978 by over one tenth

1/ The high intensity of haddam has considerably raised the bank level to over 6 metres in some areas.

while land hirers increased by over 31% and the communal use which was associated with nomadism has almost disappeared (Table 20).

Table 20

Distribution of Farmers by Type of Land Ownership (1978-1985) 1/

Year	Type of Holding (%)			
	Private ownership	Hired from Gov.	Hired from Landlords	Communal Use
Farmers ratio (1985)	51.9	5.7	41.8	0.6
Degree of Change(1964-85)	-24.8	+42.2	+74.2	-80.0
Degree of change(1978-85)	-12.8	- 1.7	+31.5	-80.0

This also reflect the continuation of the trend of changes that started after 1964.

(c) The average size of holding that dropped from 3.5 to 3.0 feddans between 1964 and 1978, has risen in 1985 by over 42% to 5.0 feddan (Table 21). This seems to have been caused by various reasons such as migration and most importantly the expansion of land hiring practices in the area that is associated with the use of more powerful irrigation pumps and the excavation of matarat wells away from the river banks by the better of people. However the rise in the average plot size in fact conceels the fact that over 76% of farmers operate on plots under that average. Comparing the 1964-78 period with 1978-85 period, it can easily be depicted that the medium size-plots were

1/ This table should be read in connuction with table 5 in part I.

generally eroded and for the first time it was reported in 1985 that over 6% operate on plots under one feddan in size (See Table 21).

Table 21

Distribution of Farmers by Plot Size (1964-1985)(%)

Ratio of Farmers / Year	Plot Size In Feddans						Average plot size
	Under1	1-2.99	3-4.99	5-9.99	10-19.99	20 and over	
1964	-	64.7	15.3	12.7	5.2	2.1	3.5
1978	-	70.2	13.5	4.8	7.8	3.7	3.0
1985	6.29	42.14	28.30	10.06	8.18	5.03	5.0

Finally it must be noted that this increase in the average plot size and increase in land hiring in the area seem to be strangely associated with the another phenomenon, that is the increase in the use of hired labour in agriculture. The ratio of plots relying on hired labour (as a replacement for family labour) has increased slightly from 12% in 1978 to 12.5% in 1985 from an original 7% in 1964. Migration of males (i.e. family labour) the presence of surplus labour in some villages and the incoming and settlement of some ex-nomadic groups into the area have all contributed to the increase in the use of hired labour.

Farmer's Responce to Change:

According to an agricultural census made in 1984 there were 283 small schemes in the area,[1/] considerably varying in size and the size of pump used for irrigation as it is shown in Table 22 below. In addition to these there are 72 *matara* each irrigating between 5 and 10

1/ Scheme as used in the census seems to refer to the diesel pump as the main irrigation machinery.

feddans. Altogether an area of about 10,000 feddans in total is annually irrigated according to the 1984 Census.[1] These relatively large areas indicate a significent deviation from the 1964-78 trend refered to in part I previously. It also imply an increase in the amount of water available for irrigation in the area, the thing that raises the question of how was that increase achieved?

Table 22

No. of Pump Schemes in the Lower Atbara by Size Pump (1984)

Pump Size (Diameter in inches)	Number	%
1 - 3"	135	47.7
1 - 4	134	47.3
1 - 5	4	1.4
1 - 6	6	2.1
1 - 8	1	0.4
1 - 10	1	0.4
1 - 12	2	0.7
Total	283	100.0

1/ A.E. El Haga, Environmental Degradation in the Lower Atbara and its impact on agriculture, a paper presented at the "Environmental Degradation and Possible Alternatives in Lower Atbara" Workshop, ed Damer June 1985 (in Arabic) p.2-3. This section has heavily relied on this paper for the statistics and figures given here.

Source: A.E.El Haga, Environmental Degradation in the Lower Atbara and its impact on agricultural Degradation and Possible Alternatives in Lower Atbara" Workshop, ed Damer June 1985 (in Arabic) p.2.

It was mentioned previously that the major cause of the whole problem was the shortage in irrigation water caused either by the reduction in the amount passing downstream of the River Atbara or the decrease in the duration of its flow, in addition of course to the drought that influenced the lands away from the river.

The immediate response to these problems included

(a) the frangmentation of the relatively large schemes as indicated by the changes in the type of pumps used. Diesel pumps of 3-4" diameter that irrigate no more than 30 feddans started to replace the 6-8" diameter pumps that were originally installed along the river banks,[1/]

(b) Changes in the crops produced (See part I);

(c) The decrease in the cultivated areas mainly to ensure irrigation throughout the season; and

(d) the use of fertilizers to compensate for the loss of silt accumulated behind the dam.

Beside these and as a result of the drought and the impossibility of Wadis and rain cultivation, the ex-nomadic groups, that used to practice these types of agriculture and with the deterioration of natural pastures, were forced to transfer themselves into cultivators.

All these problems and the severe need, especially with the loss or degradation in all other non-agricultural sources of income, farmers were forced to invent ways by which they managed to continue cultivation with reasonable success. These inventions of new

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1/ Ibid., p.4.

ways were mainly in the field of irrigation, with the prime objectives of making use of the river waters to the maximum despite its short period of flow, and finding alternative sources of irrigation water other than the river. The most important of these include what is called the iron pipes method, emergency wells, matarat, and the Kalatat system and the use of swamps and marches left by the river after it ceases its regular flow.

1. The Iron Pipes Method:

This a pilot and generally successful idea in which an iron pipe (mostly 3 inches in size) is enforced into the soil to depths ranging between 6 and 40 metres near the river bank. When water flows from the upper end of the pipe, it is directly attached to a diesel pump that pumps the water to the fields (See Fig.15 a). This idea despite th reservations made by the ground water specialists,[1] has in fact saved about 940 feddans of dura from disaster during the winter season of 1984/85. This included 42 pipes on the eastern bank and 5 on the western bank of the Atbara River, respectively irrigating 760 and 180 feddans.[2]

1/ During the workshop on Environmental degradation in the Lower Atbara and Possible alternatives, some of the specialists of the National Water Corporation has pointed to the fact that (a) most of these iron pipes are small in size and hence with limited capacity for drawing water, and (b) that in some cases these pipes produce negative results, especially when there are two groundwater tanks one underlaying the other, such pipe system can block the lower one although it might be larger than the upper basin.

2/ A.E. El Haga, Op.cit., p.6.

2. Emergency Wells:

This is another way for ensuring irrigation of crops throughout the season. Here a shallow well is dug and water is pumped out by diesel irrigation pumps (Fig.15 b). The number of these wells totalled 42, 30 of which on the western bank irrigating about 700 feddans and 12 on the eastern bank irrigating 240 feddans of dura during the 1984-85.

3. Matarat:

The use of matara for irrigation is not a new idea in northern Sudan although it might be of a recent history in the Lower Atbara area. The use of matarat wells for irrigation has for long been associated with use of sagia in the region along the Nile, as an ensurance against sudden changes in the river level and the damage that might occur.

This is practiced in areas relatively far from the river banks where the river water is inaccessible and the capacity of a matara does not exceed 10 feddans but in most cases it continues for the whole year round. The idea here is similar to the emergency wells but it differs in that the pump is installed inside the well itself close to the water table (See Fig.15c). There are now 82 matara scattered along the two banks of the river irrigating 820 feddans of different types of crops.

4. Kalatot:

This an expensive way of using irrigation water located at relatively long distances from the fields it is supposed to irrigate. This is dictated by either:

IRRIGATION METHODS IN LOWER ATBARA

Fig.15 (a) IRON PIPE

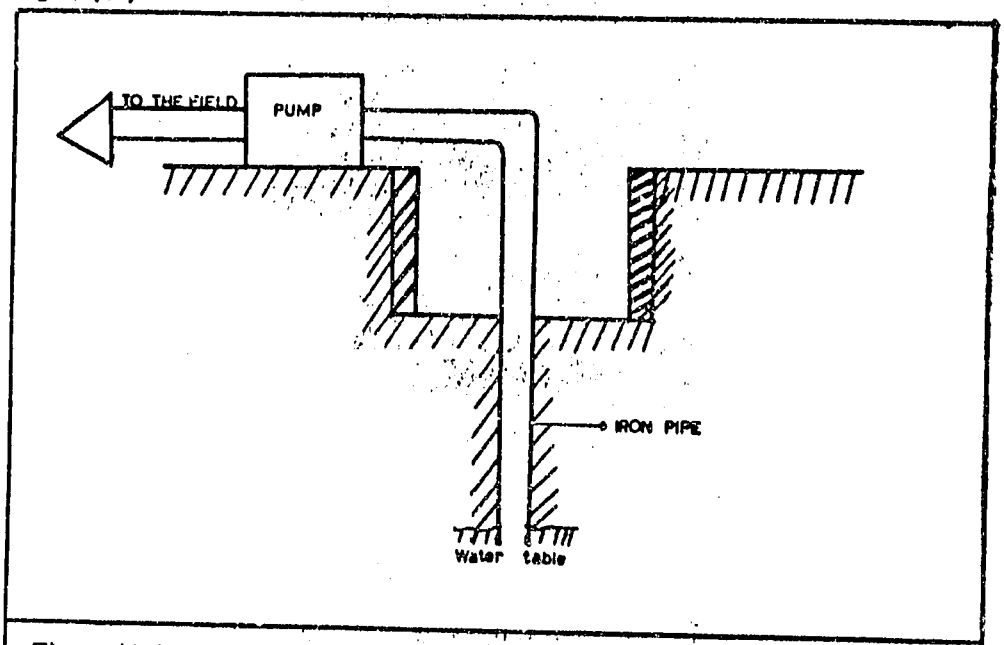


Fig.15 (b) AN EMERGENCY WELL

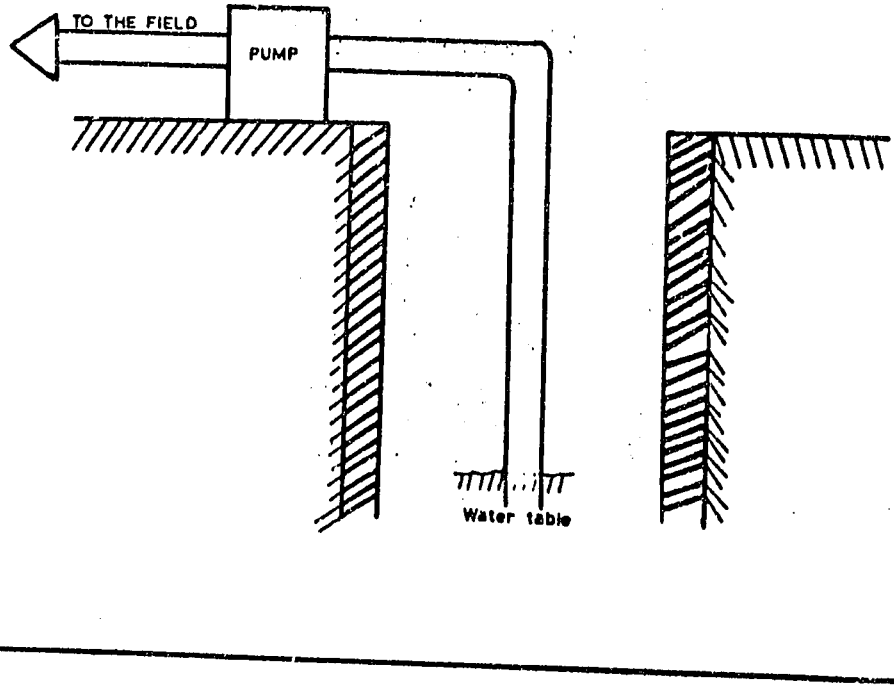


Fig.15(C) MATARAT

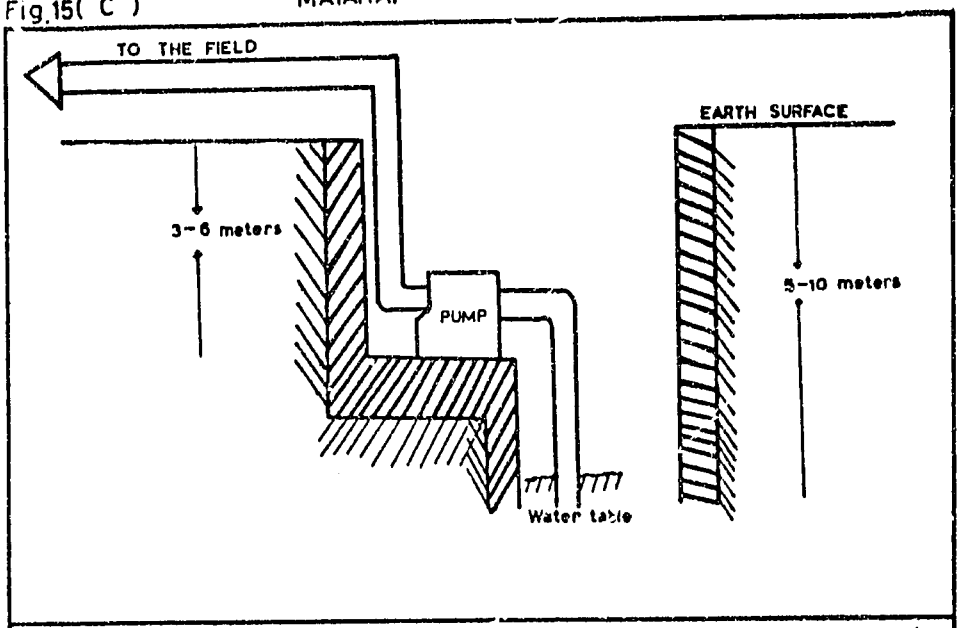
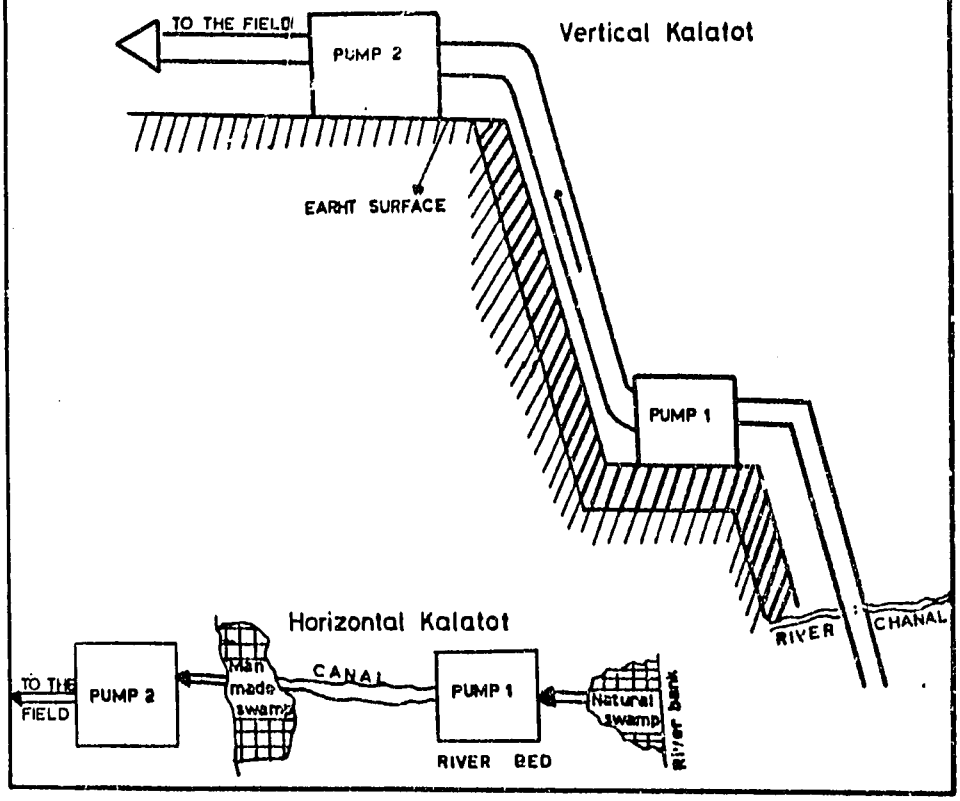


Fig.15 (d) KALATOT



(a) the changing location of swamps and water ponds after the river recedes, especially during the summer season, from one year to another; or

(b) the erosion of the river banks to the extent of making irrigation water far below the land to be irrigated.

The main idea is to use two or more diesel pumps to help in irrigation of fields from far distances horizontally where one pump feeds the other through a canal, or vertically from low to high elevations. (See Fig.15 d)

The problem with this method is its high cost as it requires the purchase or use of more than one pump and at least doubles the costs of fuel, spare parts labour and so on, to irrigate the same plot. For this reason this method is generally limited and is not attempted unless no other alternative is available and mostly used for a very short period of time just before harvest.

5. Use of Swamps' Water:

In addition to the various ways mentioned above these stagnent waters are also used for irrigation either using an irrigation machinery, cultivation of the swamp edges as it recedes or the cultivation of crops within the river bed mostly irrigated through human power. There were over 250 plots dependent on this method during the 1984-85 season. Crops dependent on this method are mostly millet and corn, that are short maturing and do not require particularly good soils, or dura to be used as fodder.

All these changes of practices indicate a low reliance on the river waters and a strong tendency towards making use of ground and sub-surface water for irrigation. The prospects and viability of this move as shown above seem to be the only immediate option open to farmers in the area.

Income Level and Distribution:

It is obvious that environmental changes on the scale described above would have teremendous impact on the sources of income, its level and distribution among various social groups. Although the straddling between various jobs practiced by many people and the irregular nature of most of these jobs, make it difficult to calculate incomes, some estimates are provided in Table 23 below. The table shows the percentage distribution of households in the Lower Atbara by level of income.

Table 23

Income Levels in the Lower Atbara (1985)
(in Sudanese pounds) (%)

Income in Sudanese pounds	Eastern bank	Western bank	Lower Atbara
Under 150	7.5	10.4	9.0
150 - 300	12.8	13.2	13.0
301 - 600	16.0	13.2	14.5
601 - 1000	31.9	24.5	28.0
1001 - 3000	27.7	33.0	30.5
over 3000	4.3	5.7	5.0
Total	100.0	100.0	100.0

From the table, it is clear that the average annual income for over one third of the sample population is over one thousand pounds. However, it must be noted that:

(a) the income level here represent the annual household rather than the per capita income;

(b) it depends entirely on calculating the total value or production for the 1984 season without any consideration for production costs or inflation rates; and

(c) income here refers to all earnings from the major job, secondary jobs and remittances received from relatives outside the area. All this, in addition to the defects of the average or aggregate system that in many cases obscure reality especially the facts about the distribution of incomes.

On the basis of this sample survey, therefore we can say that about 68% of the households surveyed, depend on a monthly income of about 84 pounds which, with an inflation rate of no less than 300% by any means, leave them under the poverty line. As the average household size is about 8 persons, that means the average monthly income for the individual is under 11 pounds. This infact explains or justifies the statements made by about 18% of the sample polulations that their incomes do not meet their basic needs. The deterioration of resources, the high rate of inflation, and the breaking down of the traditional self-sufficiency system and expansion of the market economy, seem to be the main reasons behind those claims.

Comparing the present situation with that of 1978 and 1964,[1/] with regard to income level, we find that:

1/ For the 1964 and 1978 figures see part One, pp.46-48. Also see H.A. Abdel Ati (1979) Op.cit., p.77.

(a) although the actual average now is far higher than the previous level, when measured against the general rate of inflation, the lack of any control over prices in that rural area and the recent crisis that influenced strongly the marketing of livestock, we find that incomes have actually declined quite considerably;

(b) a decrease in the ratio of middle income groups and a parrallel huge increase in the ratio of high income earners. This reflect the inequality in income distribution which has been caused mainly, in addition to the deterioration of environmental conditions, by the differential access to modern sector facilities of credit, technology and licences for agricultural land; and

(c) most of the population have more than one source of income. These include agriculture, mainly as labourers, (55.5%), seasonal migration (11.5%), selling domestic animals or their products (9.5%), remittences (12.5%) and cutting wood (7.5%). This means that, if no one has more than two sources of income, only 3.5% of the working population depend on one job for earning a living. This in turn reflects the pressure on the inhabitants for survival, contributes to unemployment in the area and justifies the high rates of outmigration from the area.

SECTION V

NATURAL PASTURES AND LIVESTOCK

SECTION V
NATURAL PASTURES AND LIVESTOCK

It was mentioned previously that the ratio of nomads and semi-nomads in the Lower Atbara has declined substantially over the last two decades. The main reason behind that decline was the loss of livestock as a result of disease, the shortage of water and deterioration of natural pastures. What made the drop so severe is the total dependence on natural pastures. As a result of the lengthy drought that hit the area, many of the nomads and semi-nomads were transferred into cultivators or agricultural labourers by the side of the River Atbara. For all these reasons now we find that nomadism and nomads in the Lower Atbara is a seasonal phenomenon constituted mainly of tribal groups moving towards the river during the dry seasons. Furthermore, nomadism does not depend on open grazing areas as it was the case when rainfall levels were high, especially in Butana, but it is heavily concentrated around the seasonal Wadis east and west of the River Atbara.

As shown in Fig. 16 below, the tribal groups that still practice nomadism include the Bisharin, Rashaida, Gihemab and Mirafab in the area east of the River Atbara, while on the west we find Khawalda, Rashaida, Bisharin, Fadniya, Kawahla, Manasir and Hassaniya. From the map, we can emphasize three major trends regarding the nature of mobility. These include:

a) That the movement towards the river is limited to the dry season;

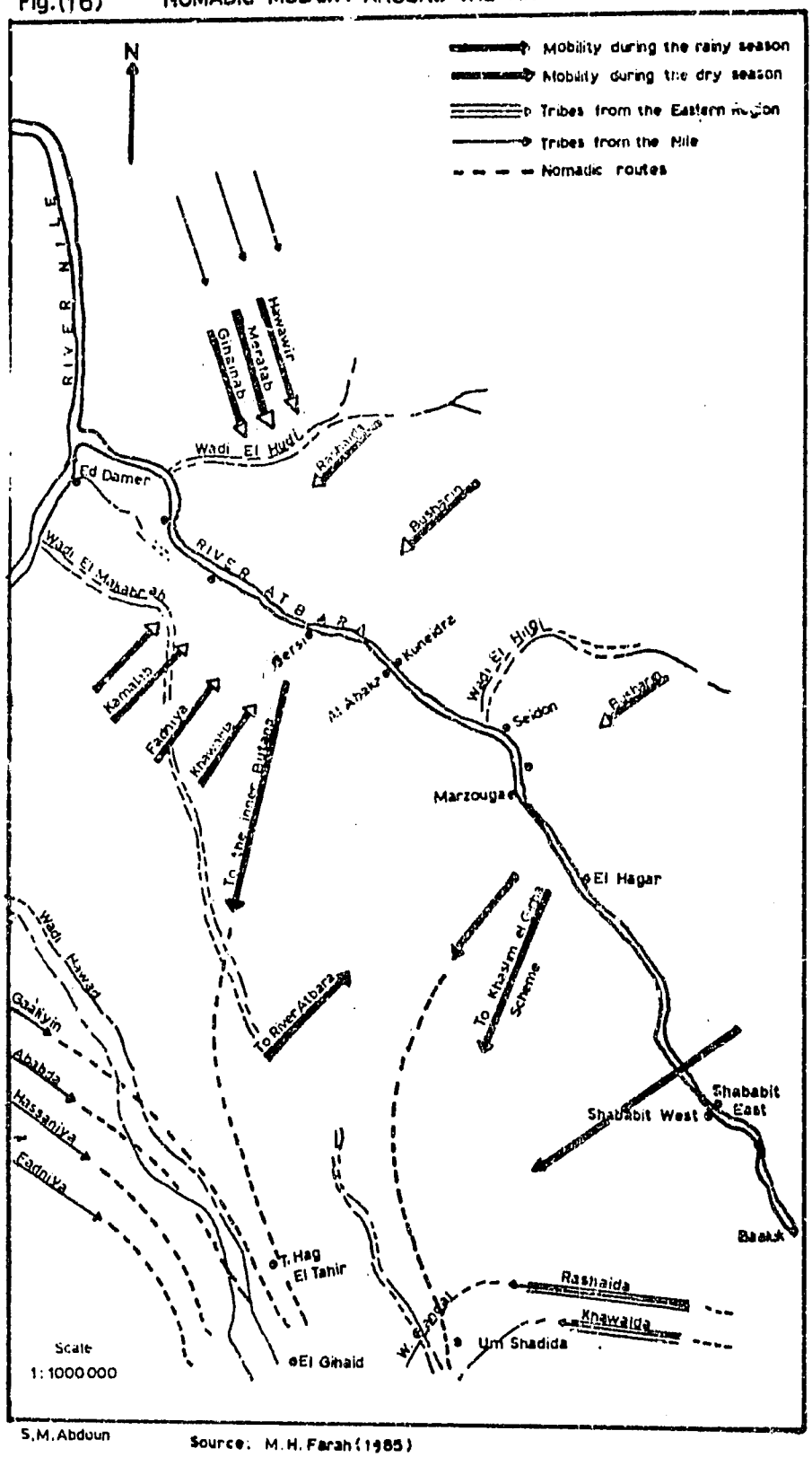
b) that in the eastern part, concentration is around the seasonal wadis and khors such as Wadi el Hudi, Hilgi and Ammab i.e. when water and vegetation are available.

c) that west of the River Atbara, mobility from most directions seems to be directed towards the inner Butana where rainfall is high and the soil is far better than the one east of the River Atbara.

This means that the presence or otherwise of nomads in the area reflect the distribution of pastures. While most of those coming from the east e.g. Bisharin were compelled to settle down, in the Butana conditions allowed its continuation especially in the central part. The reason is that, although other than Wadi el Makabrab there are no large wadis in the Butana, the higher rainfall levels and good soil that has formed some rich pastures e.g. Abu Higlig, Um Aranib and Migesir, as well as the presence of many wells has helped the survival of nomadism in the area. However, there are a number of short wadis such as Wadi Hawad and Wadi el Gangal near Um Shadida and the even shorter ones closer to the Nile that include Wadi Awatib, Aroos, Karbakan and Bagalil. Also nomads here were helped by their closer contacts with the agricultural areas such as the Khashm el Girba Scheme and irrigated agriculture on the Nile banks, where they use to send their herds after the harvest season to feed on the agricultural residues in a move locally known as Talag. Movements some times go very deep into the southern Butana to the areas of Basai, Mahawish and Faragalla.

The concentration of nomads in the central Butana has led to severe competition and hence conflicts between them especially for water and pasture especially in the northern parts where rainfall is low. Also conflicts arise between the nomads and the rainfed cultivators

Fig.(16) NOMADIC MOBILITY AROUND THE ATBARA RIVER



S.M.Abdoun

Source: M.H.Farah(1985)

who depend on the wadis fertile soils for cultivation. Recent examples of such conflicts included the conflict between the Jaaliyin (Masalomab) and Ababda over the Faki Abdel Manan well, between Ababda and Batahin over Wadi Abu Harique, and between the Ahamda and Misiyab at Wad el Sawad (1982). These conflicts in fact reoccur every year especially when rainfall is low. Near the River Atbara, however, such conflicts are almost non-existent, for the simple reason that nomadic tribes no longer depend heavily on the river during the dry seasons because in recent years the river itself used to dry up during those seasons.

The deterioration of pastures and the clearance of vegetation in the area were responsible for the drop in livestock population whose concentration around certain areas has also contributed to the above causes. The factors that led to that deterioration were:

1) The loss of huge traditional grazing lands in the Butana as a result of the expansion of Khashm el Girba Scheme, which at the same time closed the way to the upper parts of the River Atbara and caused the reduction of the amount of water that goes downstream,

2) Scarcity of drinking water for man and animal as the main source is the very old shallow wells and the few artisan wells in the area. This has led to the heavy concentration of livestock around these water points and through over-grazing caused desertification.

3) The clearance of wood for commercial and domestic purposes.

4) The increase in the cultivation of the wadi flood plains that was in the past the richest grazing lands in the Butana.

The problem of overgrazing within Butana was expressed by Farah (1985) in a mathematical formast (See Fig. 17) in which he concluded that, with regard to the carrying capacity of pastures around the water points, the distance between the three major points that form the grazing triangle were 35.8%, 40.6% of the required acceptable distance, (See Table 24).

Table 24

Acceptable and Actual Distance Seperating Water Points in the Northern Butana 1/

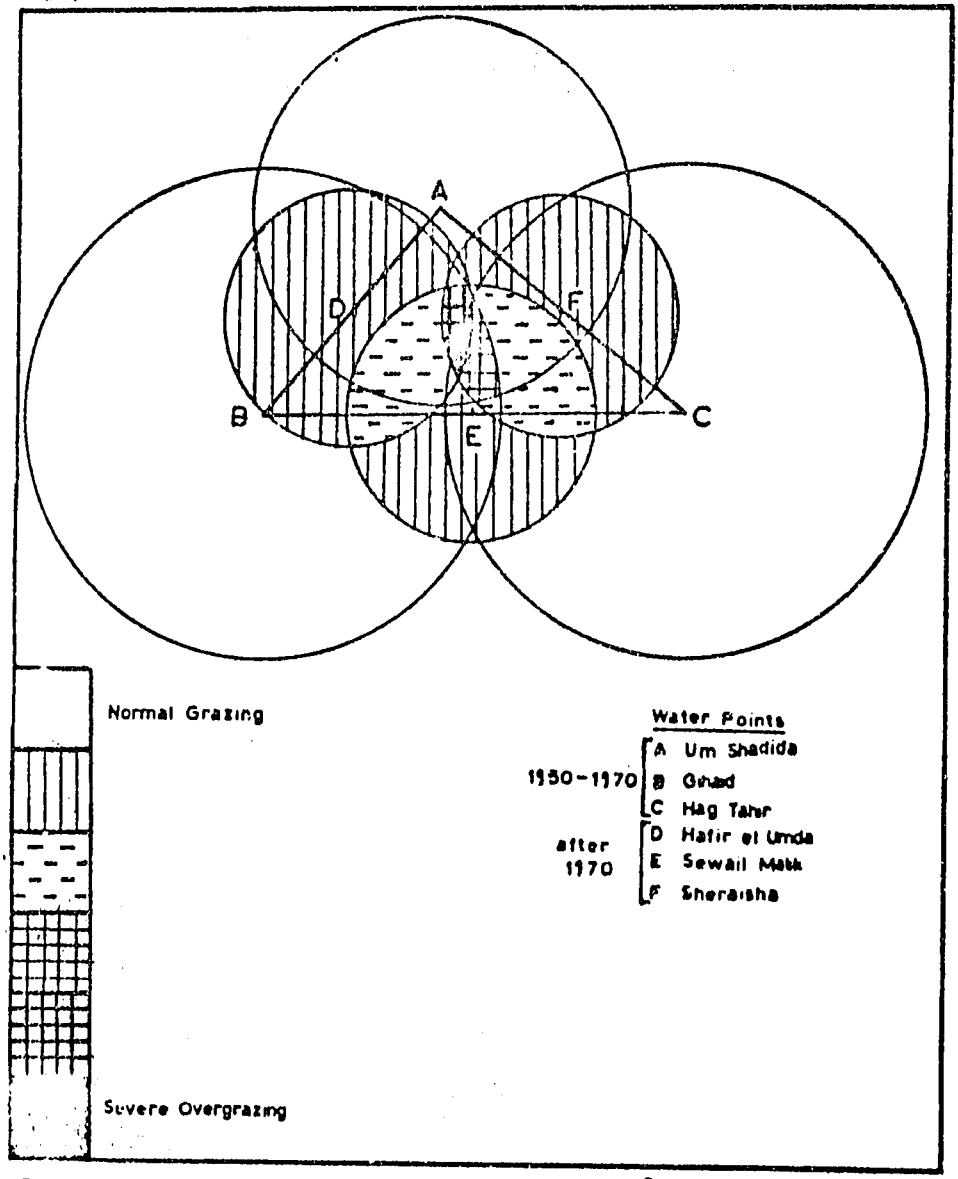
Distance seperating water points (in miles)	(A) Acceptable	(B) Actual	(B) a, a: ratio of (A)
Hag Tahir to Gihaid	125.5	45.0	35.8
Hag Tahir to Um Shadida	148.0	60.0	40.6
Gimair to Um Shadida	199.5	30.0	15.0

Between these villages we find three water points respectively at Shiraisha, Hafir el Umda and Swail Malik. The location of these water points, without any regard to the carrying capacity of the grazing area or the livestock population dependent on these wells, has been a major cause of desertification in the area.

These pressures on the natural pastures were reflected on the livestock population especially over the last five years (1979-1984) when rainfall deficiency

1/ The table should be read in conjunction with Fig.17. For a detailed account see M.H. Farah "The Impact of Environmental Deterioration on Natural Pastures" A paper presented at the Conference on Environmental Degradation and Possible Alternatives in the Lower Atbara, Ed Damer, June 1985.

Fig.(17) OVERGRAZING AROUND WATER POINTS IN THE NORTHERN BUTANA●



S.M.Abdoun

● Based on M.H.Farah(1985)

became a chronic problem. Some evidence is provided in Table 25 below, where in two years the total livestock was cut down by over 34% which equal 43.6% when calculated in animal units.

Table 25

Livestock Numbers and Animal Units in the Lower Atbara Area (1981-1984) 1/

Type	Livestock Number 1981 (1)	Livestock Number 1981 (2)	Livestock Number 1983-84 (1)	Livestock Number 1983-84 (2)	% Decline (1)	% Decline (2)
Cattle	5705	5705	4877	4877	14.5	14.5
Sheep	66259	11043	42775	7129	35.4	35.4
Goats	64087	10681	45366	7561	29.1	29.1
Camels	11216	16824	3376	5064	69.9	69.9
Total	147267	44253	96394	24631	34.5	43.6

(1) Livestock in numbers (2) Livestock in animal units.

The decline in numbers and quality of livestock was also caused by the change in the type of natural vegetation in the area. Changes in rainfall and temperature levels has caused considerable changes in the type or shrubs and bushes in the area. These took the form of:

1/ For the 1981 figures, See Arab Organization for Development Report.

For the 1984 figures: Taxation Records, Ed Damer and Seidon Rural Councils. See also M.H. Farah, Op.cit., pp.4-5.

Note: (a) The 1984 figures should be taken with caution as the livestock number are most likely to be higher in reality then these figures.

(b) Animal units are calculated on the basis of cattle units where 1 unit = 6 sheep = 6 goats and camels.

a) The complete disappearance or severe deterioration of shrubs with high nutritional value for animals such as Um al Beina (Suphorbia aegytica), Um Asabi and Mulokhiya Bariya (Corchorus olitorus).

b) The growth or replacement of these species with others that are low in nutritional value and sometimes harmful to animals such as Halfa (Anthephora hochshett), Um Shiwika (Hygrophila spinosa), Sanamakka (Cassia ilutica), Maharaib (Cymbopogen proximus), Kharata (Tephrosia bracteolata) and Usher (Calotropis procera).

c) The disappearance of perennial species such as Tamam (Paicium turgidum), Gharaz (Andropogon-gayen) and Sekran (Datora spp.).[1]

d) The shortening of the length of the plant and/or its life cycle.

Beside these the change in climate, especially the rise in temperature level, among others, lead to:

i) Reducing grazing hours;

ii) causing indigestion to animals;

iii) reduce the natural rate of increase; and

iv) reduce the immunity of livestock against disease and epedemics.[2]

1/ See M.H. Farah, op.cit., pp.6-7.

2/ Ibid., p.11.

Finally the level of veterinary services in the area is also responsible for the huge losses encountered in the area. For example the numbers of livestock vaccinated in 1983 constituted respectively 55.6%, 2.5% and a mere 0.5% for cattle, sheep and goats in the area.[1/]

1/ Source for the number of vaccinated animals, H. Mekkawi, "A Study on Livestock on the Lower Atbara Area," A paper presented to the Environmental Degradation and Possible Alternatives in the Lower Atbara Conference, Ed Damer, June 1985, p.2.

SECTION VI

DEFORESTATION IN THE LOWER ATBARA

SECTION VI

DEFORESTATION IN THE LOWER AT

The River Atbara area contains over 50% of forests in the Northern Region. The dom tree represent 90% of the species prevelant in the area both in terms of number and area occupied. For this reason the Atbara forests are usually referred to as the dom forests. That fact in addition to its economic value and the destruction it suffered over the last two decades,[1] qualify it to be the centre of research and discussion.

The life cycle of the dom tree starts wherever irrigation water is available for it during its early stages, and with the minimum level of soil fertility. Up to the age of four or five years, the dom tree produces sa'af which is considered a valuable diet for animals, and of course the main raw material for handicrafts. The dom tree provides the inhabitants with firewood up to the age of 18 when it starts bearing fruits that are also used for feeding animals,[2] and when it is 30 years old it provides people with the building materials (shagig) while the stem is used as the roof support for houses (morrog).[3]

1/ See Part One.

2/ The fruits of the dom tree is believed to have saved thousands of lives in the area during the 1888 famine that hit the country and caused the death of large numbers of the population. The richness of these dom forests during the 1950s and early 1960's was to the extent that enhanced the establishment of buttons factory in Atbara town which was closed in the mid-sixties.

3/ See M.H. Hammad and O.A. El Mak, "The Development of the Dom forests in the Lower Atbara," A paper presented at the workshop of Environmental Degradation and Possible Alternatives in the Lower Atbara Area, Ed Damer, June 1985, pp.1-3.

In Part one, the major reasons behind the deterioration of the dom forests were given. This is indicated in Table 26 below, by the astronomical increase in the prices of the dom tree products over the last two decades.

Table 26

Dom and Dom Products Prices in the Lower Atbara in Selected Years 1/

Item	Unit	Price in (Ls) 1970	1975	1985	% increase 1970-1985
Dom block	piece	0.35	4.00	35.00	10,000
Stem (roof support)	piece	2.00	6.50	55.00	2,750
Brush mattings	piece	0.10	0.40	1.40	1,400
Sa'af	metre	0.40	10.00	20.00	5,000
Sa'af baskets	piece	0.05	0.20	0.75	1,500
Ropes	piece	0.05	0.15	0.40	800
	metre	0.05	2.50	10.00	20,000
Dom fruit	sack	1.00	1.90	8.00	800

This indicates the high demand for these products and reflects the scarcity in supply caused by that damage. In fact the supply of dom wood to Ed Damer and Atbara towns has gone down between 1983/84 and 1984/85 by 39% for dom blocks, 24% for dom stem and by 17% for firewood. But the supply of charcoal to the two towns, which consists of dom and other species, has risen by about 123% (See Table 27). This again indicates the deterioration of forests and the negative effect of urbanization on the natural environment.

1/ Source: Department of Forestry, Ministry of Agriculture, Ed Damer.

Table 27

Dom Products Supplied to Ed Damer and Atbara 1983/84-1984/85 1/

Item	1983/84	1984/85	% Increase or Decrease
Dom Blocks (No.)	1,545	940	- 39.2
Dom stem (No.)	587	448	- 23.7
Firewood (metres^3)	4,034	3,345	- 17.1
Charcoal (sacks)	10,823	24,137	+123.0

The total area under forests along the River Atbara is over 47,000 feddans, about 10% of which is officially reserved and all the rest is now suggested to be reserved.2/ This encompasses 31 small forest reserves on both banks of the River Atbara.

To preserve these dom forests and in recognition to its economic importance the Regional Forestry Authorities started recultivating the dom trees in the area but on a very small scale. Furthermore, of the 75 feddans cultivated only about 12 feedans proved successful. However the idea of irrigated forests, was first introduced into the area in the late 1960's and a total area of 110 feddans was designated to that purpose, but the project failed due to its high costs and the meagre financial resources of the forestry authorities.

The major reasons for the deterioration of dom forests and deforestation in the area can be summarized as follows:

1/ Source: M.E. Hammad and O.A. El Mark, op.cit., p.8.
2/ Ibid., p.3.

a) The acute economic need of the local population who found in the dom forests an alternative to the loss of income sources caused by the construction of the Khashm el Girba dam and the drought.

b) The treatment of dom forests in general as a form of wealth rather than a renewable resource that need to regenerate. For example the inhabitants used to cut down immature trees and the method adopted in cutting down trees led to massive losses. They tend to burn down the bottom of the stem to reduce the time and effort needed to bring it down and in the process a large number of young shoots is destroyed.

c) The almost complete absence of control by the forestry authorities over these forests. A few number of low paid and old-aged guards are appointed by the authorities as the only means of control. The absence of efficient means of transport, the lack of incentives and the physical ability of these guards and their lack of legal power all combined to that lack of effective control. Many laws and rules were passed but none was enacted due to the above factors. In the past the Native Administration system with the Sheikh, Omda and Nazir, having the power to arrest and prosecute, plus the financial incentives, has helped those forests be preserved.

d) The longitudinal expansion of those forests along the river banks and the poor financial resources of the forestry authorities, and the Regional Government, also contributed to that deterioration by hindering regular visits, research and the revitalization of these forests.

SECTION VII

SOCIAL SERVICES IN THE AREA

SECTION VII

SOCIAL SERVICES IN THE AREA [1]

Table 28 below shows the social services now available in the lower Atbara. It is clear that none of these services, other than the dispensaries, covers all the area, bearing in mind that the villages listed in the table are the main villages that are supposed to serve other smaller ones.

Assuming that the total population of the area is about 80,000 persons,[2] this means that there is only one dressing point for every 6,154 persons in the area. This over and above the problems of staff shortages, lack of essential equipments and medicines and the geographical distribution of these points. The situation of schools is not much different. Taking the sample population as an indicator, we find that about 25% of the total population is between 5 and 14 years old. Assuming that 20% of these are under 7 years, the school-enrolment age, we find that we have about 16,000 boys and girls elegible for schools. In reality

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1/ This Section is largely based on a paper on "Population and Environmental Degradation in the Lower Atbara" presented by the author to the Workshop on Environmental Degradation and Possible Alternatives in the Lower Atbara, Ed Damer, June, 1985.

2/ The latest local official estimate is that the population of Seidon Rural Council is 27,000 and Ed Damer Rural Council 47,000.

Table 28

Social Services in the Lower Atbara (1985)

Area	Primary Schools: Boys	Primary Schools: Girls	Primary Schools: Mixed	Intermediate Schools: Boys	Intermediate Schools: Girls	Dressing point	Police Station	Flour Mill	Bakery	Artizen Well	Co-operative	Rural Council	Court
El Megran	x	x				x		x	x		x		
El Gubba			x			x					x		
El Besli			x			x		x	x	x	x		
Goz el Helag			x			x				x	x		
Gersi			x			x		x			x		
El Abaka			x			x		x	x	x			
Marzouga	x					x		x					
Shababit west			x			x		x	x		x		x
Ba'aluk	x					x		x	x				
Western Bank	3	1	6	-	-	9	-	7	5	3	6	-	1
El Hudi			x			x							
Nukheila						x							
Keneidra			x			x		x	x		x		
Seidon	x	x	x	x		x	x	x	x	x	x	x	
Eastern Bank	1	1	3	1	-	4	1	2	2	1	3	1	-
Lower Atbara	4	2	9	1	-	13	1	9	7	4	9	1	1

the number actually enrolled does not exceed 30% of the total elegible.[1]

The main reasons for these acute shortages are the poor financial situation of both the inhabitants and the Regional Government, poor transport facilities and the elongated pattern of the settlements that are supposed to be served. The effect of distance is clearly reflected in the extremely low standards of female education in the area.

From the table we also observe the inequality in the distribution of these services between Ed Damer and Seidon Rural Councils (i.e. the eastern and western banks.) The closer geographical location of the western bank to the regional headquarters (the provincial headquarters in the past), seems to have favoured it more than Seidon Rural Council. Although the population of the latter represent 37% of the Lower Atbara population, it has 25% of dressing points and artisian wells, 22% of flour mills and less than one third of bakeries and cooperatives. Also what has been said about schools and dressing points applies to other services with regard to population pressure on it and the problems caused by the scattered nature of settlements.

A very important problem faced by the local population with regard to the necessary social services, is that related to drinking water. From our sample survey results it appeared that for drinking water about

1/ The number actually enrolled is exactly 4,609 children of both sexes according to the official records, which represent 28.8% of total.

about 72.5% of the population depend on shallow wells, 14.5% on the river and 13% on artisan wells. But over 51% of the sample population reported having problems with drinking water such as its seasonal shortages (74.8%), unhealthy or polluted water (7.8%) or it is too far from settlements (17.4%).[1/]

In what follows we discuss the inhabitants' vision on the type of social services they see necessary for the rehabilitation and development of their villages. The views expressed in fact and as will be shown later, bears a very strong association with the environmental changes that affected the area in recent years.

Water (for both irrigation and drinking) topped the list of the selected services as it was seen by 30% of the population to be the most needed, followed by schools (22.7%), health centres (20.8%), electricity (7.9%), then agricultural cooperatives (6.4%), agricultural credit institutions (3.9%) and lastly agricultural research institutions (2.9%) (See Fig.

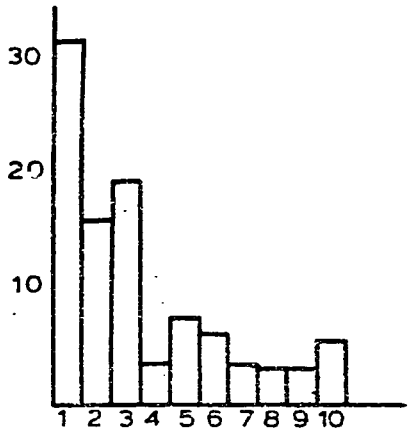
It is clear that the ones rated first are primarily social services while those rated last are of economic nature and are related to the main jobs practiced by most of the inhabitants, i.e. agriculture.

As shown in Figure 18 below, some differences of opinion were encountered between the inhabitants of the eastern and western banks of the river. For example in the eastern bank schools topped the list, followed by water and electricity came in a very advanced position, compared to the western bank, while the things

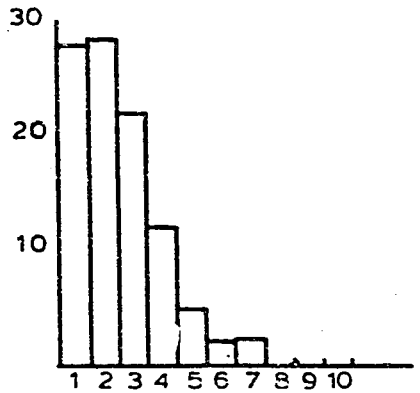
1/ Actually about 20% of the population live over 3 kms away from the drinking water source.

Fig (18)

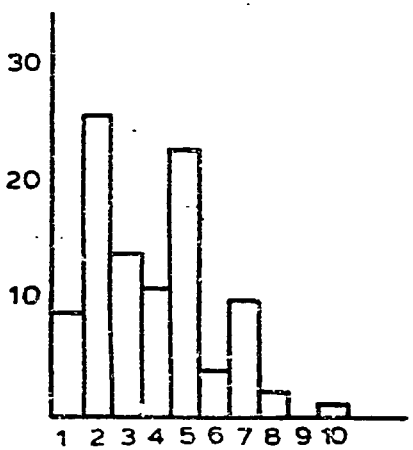
DEVELOPMENT INSTRUMENTS FOR LOWER ATBARA
AS PERCEIVED BY THE LOCAL INHABITANTS
1978-1985



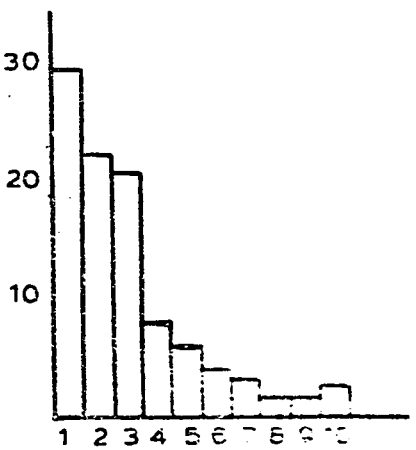
The Western Bank 1985



The Eastern Bank 1985



Lower Atbara Area 1978



Lower Atbara Area 1985

No.	Services
1	Water Supply
2	Schools
3	Health Centres
4	Electerity
5	Cooperative Societies
6	Agri. Credit Institutions
7	Agri. Research Centres
8	Good Roods
9	Veterenary Services
10	Other Social Services

related to agriculture came bottom and none of them mentioned roads or veterinary services. The rating on the western bank was generally similar to the overall picture of the Lower Atbara as a whole but unlike the eastern bank, veterinary services was considered important by 6.6% of the population and electricity came seventh in the rating and after the services with economic nature (See Fig.

Comparing these results with those obtained in 1978, especially for the western bank where that study was conducted,[1/] the following points emerge:

1) The severe shortage of water (for irrigation and human use) over the last few years mainly as a result of the drop in the amounts of the River Atbara waters passing downstream and the shortening of the period of flow. This is reflected in the sharp rise in the rating of water as a service necessary for development, from the sixth position in 1978 to the first in 1985;

2) Despite the complex problems experienced in the area, priority is still given by the inhabitants to the basic social services which again reflect the scale of suffering in the area.

1/ See H.A. Abdel Ati, The Impact of Khashm el Girba Dam on the Western Side of the Lower Atbara Area, M.Sc. Thesis, University of Wales (Swansea), 1979.

3) The contact with urban centres and its effect on the choice of the population, is indicated by high rating of electricity in the eastern bank as a result of the relatively strong contact it maintains with Atbara town.

4) The rating of agricultural cooperatives declined from second position (25%) in 1978 to the sixth position (6.4%) in 1985. The reasons for that drop seem to be:

   a) The failure of the cooperative experience and mal-practices during the May Regime as a result of the politicization of those cooperatives and corruption,

   b) the fact that the establishment of agricultural schemes under conditions of uncertainity about the supply of irrigation water supply, raises the cost and effort with no or low reward,

   c) the decrease in the ratio of population engaged in agriculture and the cultivated area, Table

   d) the poor financial resources of farmers that hinders the formation of capital to invest in cooperatives.

5) No body in Seidon Rural Council mentioned veterinary services as a pre-requisite for development despite the nomadic background of the population of the area. This seems to be caused by the severe reduction in the livestock population and its economic value to the people.

SECTION VIII

ENVIRONMENTAL DEGRADATION AS PERCEIVED BY LOCAL POPULATION

SECTION VIII
ENVIRONMENTAL DEGRADATION AS PERCEIVED BY LOCAL POPULATION

This part depends entirely on the information collected from the inhabitants of the Lower Atbara, on what they think about the causes of degradation, the scale of the problem, the possibility of checking that trend and the steps necessary to achieve that and finally their own contribution in the effort towards the recreatiation of a more balanced environment.

Over 99% of those surveyed believe that the Lower Atbara environment has deteriorated substantially and 3.5% of them think that the area has already passed the point where any recovery can take place or any control can be maintained.

In response to a question about whether they have experienced a drought on the present scale before, the answers were somewhat different, although the majority stressed that the present situation is the worst in its effect on the area. About 46.5% of the population claim to have never witnessed or heared about a drought on this scale, 29.5% heared about it bud did not experience it, 7.5% experienced similer conditions once in their life before, and only 4.5% admitted having experienced similer conditions more than once during their lifetime. These latter group seems to be those who used to practice pastural nomadism in the marginal areas of eastern Sudan, mainly the Rashaida tribe.

The same differences appeared again in the opinions about the date or period of time when they witnessed the most severe of drought conditions: Although 81% of the population believe that drought conditions continued for two years, but a great difference between the populations of the eastern and western banks was noticed in specifying dates. While 55.8% of the people in Seidon Rural Council think that the worst drought was within the last ten years, about 61% of those on the western bank claim to have not experienced a similar drought for more than 20 years. These differences can be attributed to the difference of environments and economic activities practiced by the two groups in the past and at present as the answer is based primarily on the individual's personal experience. For example it is known that the settled farmers living by the river banks started to feel the change two orthree years after the erection of the Khashm el Girba dam with the gradual drop in the amount of waters passing downstream as the Khashm el Girba scheme started to expand. But for those who used to depend on fishing and floating wood collection the change was felt immediately after th dam was erected, while the Butana nomads were the latest to feel the pressure as a result ofthe gradual influx of various groups towards the water sources in their area. Similerly the nomads of the north-eastern part of Sudan and inspite of their long history of contact with the Atbara River, their movement and settlement in large numbers is a recent phenomenon that intensified

over the last few years. It must also be noted that the type of animals raised was also important in hastening or slowing down the time after which the pressure is felt as for example the sheep herders of the Butana have been hit far quicker than the camel herders of eastern Sudan despite the marginality of their natural environment.

With regard to the causes of environmental degradation in the area, 61% of the surveyed population believe that only natural conditions are responsible, 30% blame the offecial policies and local authorities for the escalation of the problem, and the remaining 9% of them accuse the people themselves for what happened.

Those who blame natural conditions, attribute that to rainfall defeciencies (72.9%), the drop in the River Atbara waters (24.1%), changes in the river channel and deterioration in soil fertility (1.9%) and the changes in temperature levels and animal and plant disease resulting from that (1.2%).

Offecial policies and local authorities role in deterioration is believed to have been in the form of its responsibility about the decision related to the construction of Khashm el Girba dam without the necessary studies or the provision of economic alternatives to those affected (66.4%), neglecting the area after the problem occurred and their negative attitude towards it (30.2%) and the poor financial resources of the regional government that handicapped its effort in coping with the present situation (3.4%).

Those who believe that the local population has contributed to the present degradation are largely concentrated in the western bank (ed Damer Rural representing about 17% of its population. They attribute that to the commercial clearance of forests for firewood and other domestic uses (80.7%), the expansion of the cultivated area and hence the increase in the demand for irrigation water (16.1%) and the overstocking of animals beyond the capacity of natural pastures in the area.

Indicators of environmental degradation in the area are summarized by the population in the drop in the river waters (47%), rainfall defeciencies (24%), deterioration of pastures and the vegetation cover (7.5%) the decline in soil fertility levels (6.5%) and the emasculation of livestock population through disease and food shortages.

The results of degradation for the local population were the shrinkage of the cultivated area and the drop in production and productivity and the disappearance or sharp decline in certain tree and plant species such as dom (Hyphaena thebaisa), sunt (Acacia albida), talh (Ac. seyal), tarfa (Tamarix ophylla), nal (Cymbopogon nervatus) and tabas (Scrub) abd the presence or increase of other species which are more drought resistant and of low or no value to humans and animals in the area such as ushar (Calotropis procera), halfa (Anthephora hochsfeff), sanamakka (Cassia illutica) adar and amayoga.

Environmental degradation also resulted in the severe drop in livestock population in the area due to the shortage of water and/or pasture, death through disease and epedemics, migration from the area, and the increase in the intensity of sales under economic pressures.

As for the personal reaction in the case of the continuation of the present drought conditions and water shortages for sometime in the future, about 30% of the sample population either did not answer or hasn't formed an opinion yet, Of the rest 37.7% think that migration from the area is their would be response, cutting wood from neigbouring forests (11%), changing the crops cultivated by using th thirst resistant and short-maturing crops (7.5%), selling livestock and domestic animals (6.2%), expanding the cultivated area irrigated from wells (4.1%) or abandoning agriculture to other economic activities (3.3%).

Although 76% of the surveyed population refused to predict what will happen, with regard to drought, in the future for those who answered a state of pessimism seems to dominate their thinking. About 34% of those who answered the question believe that drought conditions are going to last for ever, 22% think it is going to continue for a very long time, 24% believe it to continue for a number of years and 20% only predicted its ending within the coming three years.

That pessimism was repeated again in response to a question about the possibility of checking the present trend of degradation and reviving the local environment. Of the 76% responded, 16.5% believe it to be impossible to control the degradation or reverse the trend, 65.8% believe it to be possible but require huge costs and efforts from the authorities and the local population and it would take a very long time and only 17.8% think it is possible and feasable to create a more balanced and healthy environment in a relatively short time.

The economic conditions of the local population and the limited financial resources of the Northern Region as a whole on the one hand and the extensive damage of the natural environment on the other, to a large extent justify these pessmistic views.

About 19.5% of the population did not respond to the question about the first step that should be taken to control the degradation process and restore the local environment. For those who answered, regulating the flow of the River Atbara was seen by th the majority (68.9%) as the first step towards rehabilitation, followed by the cultivation or trees and regeneration of local forests (6.8%), and th use of more powerful irrigation machinery (3.5%). Other answers included the education of local population and raising the level of environmental awareness among them, control of human and animal disease, making use of

ground water available in the area for agricultural purposes, the reclamation and use of Karu lands and about 0.6% of them see emigration as the most urgent step to be taken.

Questioning the local contribution and participation in the effort to restore the local environment, over 90% of the sample population showed the willingness and enthusiasm to the idea. That participation took various forms such as providing manual labour for any period of time (72.5%), financial assistance (16.5%) and 4.5% of them promised to accept any decisions that can help restore the local environment, but about 5% showed their objection to any kind of participation. Trying to test the degree of acceptance of decisions that could be unpleasing but necessary for the restoration of local environment, a number of options were put for the respondent to choose from. The results are summarized in Table(29).

Table 29

The Level of Acceptance by the Local Population of Options Designed to Restore The Local Environment

	Eastern Bank	Western Bank	Lower Atbara
Reducing Cultivated area	8.9	8.3	8.5
Changing the Cultivation methods	7.1	16.7	12.5
Changing the crop cultivated	9.8	10.4	10.2
Reducing the number of livestock	4.5	5.6	5.1
Replant & maintain trees	60.7	26.4	41.4
Emigration from the area	8.9	6.9	7.8
No idea	-	25.7	14.5
	100.0	100.0	100.0

PART THREE

- CONCLUSION
- A PROJECT PROPOSAL FOR THE REHABILITATION AND DEVELOPMENT OF THE LOWER ATBARA AREA.
- THE WORKSHOP ON ENVIRONMENTAL DEGRADATION AND POSSIBLE ALTERNATIVES IN THE LOWER ATBARA AREA - (NILE PROVINCE). (List of Recommendations).

CONCLUSION

PART THREE

CONCLUSION

In concluding this study four major points need to be stressed. The first is that most of the indicators of degradation, mentioned in part One, have been proved to be real, though at various degrees of influence. The second point is that, the local people seem to have managed, through various measures of adaptation and change of behaviour, to ensure a minimum level of survival. However, some of the changes of behaviour are more damaging to the environment in the long term. The third and most important point is that it seems to be the high time for doing something or loosing the area for good as a habitable area. The fourth point, which is closely linked to the third one is the strong need for a comprehensive vision to all environmental aspects together and the need for an interdisciplinary approach in tackling it and planning ahead, if a balanced environment is the objective.

A) With regard to the first point it is clear that most of the indicators were confirmed by the study. Among these are the following:

1. The area has been depopulated in spite of its receival of various ex-nomadic groups. According to 1973 unpublished census figures, the Lower Atbara Area, the population growth rate was 0.06% compared to 3.09% in 1955/56. During the same period, the neighbouring towns of Ed Damer and Atbara, respectively recorded an increase of 3.39% and 6.55%. It is known that these two towns received a large number of the Lower Atbara migrants.

2. Water shortages are acute along the river Atbara for both agriculture and humans. However, as has been shown in the text, people are more and more depending on ground water instead of the River Atbara.

3. Soil fertility level in the areas under cultivation has recorded a drop caused by its lack of the regeneration maintained in the past by the river annual supply of silt, its over use, or the cultivation of areas with low fertility, away from the river banks, depending on ground water.

4. The enormous deforestation of the area, in response to the loss of the other means of making a living including the preserved forests. This was also influenced by the astronomical price rise of forest products over the last decade.

5. The drought conditions has influenced more severely the natural pastures of the north-eastern parts of Sudan and, to a lesser degree, those of the Northern Butana. This has its repurcussions on the Lower Atbara as it led to the movement of large numbers of human and animal population into the area, in search of water and pasture. The pressure on the limited pastures of the area has led to the destruction of local pastures, and in fact, contributed to the deforestation of the area. This has its influence on the livestock wealth in the area leading to a drop in its numbers, quality and prices.

6. The shrinkage of cultivable land has naturally caused the decline in the agricultural output and led to the underemployment of the labour force of its absolute unemployment. The same resulted from the clearance of the dom forests in the area.

7. The cropping system has changed in that it is now totally irrigated, limited to one season and the ratio of land under thirst-resistant and short-maturing crops started to increase.

However, some of the indicators used in Part One were not throughly confirmed or the change experienced was not in the scale previously stated. Among these we find that:

1. The change of occupation seem to have slowed down in intensity and it is generally towards, rather away from agriculturally, and this is particularly true for the ex-nomadic groups that moved recently into the area.

2. Although the overall male/female ratio is more balanced than it was in 1978, it is less balanced for the middle-age groups. Besides, marriage rates have picked up, according to the local population, and this is probably linked to the phenomenon of males temporary migration.

3. Despite the heterogenity of population, no conflicts were reported among the riverine population. However, some conflicts did take place between some nomadic tribes over the water points of the northern Butana.

4. Although income levels has dropped in relative terms compared to the cost of living, in their absolute terms they have actually risen considerably for a large proportion of the population.

B) The responses of people and the ways by which they adapted their life to the changing circumstances in the area involved changes in their ways of doing things and inventing new ways. This is reflected most clearly in their ways of utilizing irrigation water, the resource that is scare most. For example, the use of Kalatot represent an expansion of the ability to transfer irrigation water for larger distances, while the cultivation of dukhn on the river bed minimise the risk of failure, as its water requirement is less than dura and most other crops. On the other hand, people made possible the irrigation of relatively large areas away from the river bank, through the exploitation of ground water potential in the area using the iron pipe and other methods described in the text. Although some of these innovations have their shortcomings, still it has the advantages of indicating the human ability in its abstract context and within the limits and constraints of the technology available, to resist the effects of the drought. Furthermore, this might also indicate the strong attachment to the land, a factor that must be considered when explaining migration and human mobility in general. Finally, these ways of response might also have indicated the direction which research and future planning should take.

C) The extent of damage that has already occurred and the "negative" effects of some of the ways in which people responded to degradation the Lower Atbara, seem to emphasize the point raised earlier that the area is on the dividing line between retrieval and complete loss. For example with the knowledge that ground water is the only source of water supply at least in the forseeable future, the misuse of that potential that was forced by the strong need of the population, if not rationalized would certainly reduce the time that the area could sustain its present population, let alone its potential resource attracted more people to the area. This is one area where urgent intervention by the authorities is extremely needed, not to stop it, but to educate and help people make the best use of it. The same may apply to forests, soils and many other resources in the area, where cooperation rather than competition between the state and the individual is more likely to work as the latter proved a failure as a measure to conserve or protect the environment.

D) The complexity of the environmental question in general and the meagre resources of the area and the Northern Region as a whole together with the delicate balance that is to be maintained, all suggest the need for closer contact and cooperation between the different government departments and research institutes concerned with the area.

APPENDIX I

A PROJECT PROPOSAL FOR THE REHABILITATION AND DEVELOPMENT OF THE LOWER ATBARA AREA

APPENDIX I.

A PROJECT PROPOSAL FOR THE REHABILITATION AND DEVELOPMENT OF THE LOWER ATBARA AREA:

The construction of Khashm el Girba dam and the defeciencies in rainfall levels over the last two deca decades has caused the severe shortage of irrigation water and in some areas that of drinking water. The consequences of that were enormous and reflected in the following:

1. the shrinkage of the cultivated area mainly due to the shortage of water erosion and covering of agricultural land with sand, both on the river Atbara banks and on the wadis east and west of it.
2. the drop in livestock numbers and deterioration of its quality.
3. the clearance of extensive forest areas to compensate for the loss of wood that was annually brought by the River from the Ethiopian plateau prior to the construction of the dam. Also influencial here was the overgrazing of the area that was caused by the intrusion of various nomadic groups from Northern Butana and east of the River Atbara into the area to live a settled or semi-settled life, thus exceeding the carrying capacity of the local pastures.

For the local population these changes led to:

a) a real drop in the income levels and hence the standard of living.

b) the spread of unemployment and more seriously large scale under-employment among males.

c) outmigration from there, with its concomitant social consequences.

d) the spread of an attitude of despair, loss of hope, and even in some areas, the loss of self-confidence.

The objectives of any plan targeted to alleviate these problems and promote some economic development in the area should be:

1. To stablize the population through the creation of a durable economic base with the potential for further expansion.
2. Water supply for both human use and irrigation.
3. The expansion of agricultural land via the increase in water supply, and it might also requir the cultivation of some "enclosed" forests.
4. The inclusion of livestock in the agricultural cycle.
5. The revival of natural vegetation, not only to maintain a source of income and fire wood but also to avoid further degradation of agricultural lands and combat desertification, and
6. The improvement of the region's economy to raise the living standard in the long turn.

The Selection of the Project Area:

With regard to the impact of the dam and the drought on the area it can be said that it was almost equal on all villages both east and west of the river except those close to the river junction with the main Nile, (such as Elmogran and El Hudi), as the inhabitants are mostly involved in urban jobs mostly i in Atbara town. And it is infact the least influenced by outmigration and even experienced some incoming migration. On the other hand the impact of the drought was more severly felt in the areas where nomadism and livestock herding were the main occupations, i.e. the areas of Gersi - Shababit and Baāluk on the western bank and Seidon Kurbi Council in the east. Besides, some areas on eastern bank has experienced an acute shortage of drinking water. These areas are underlain by the Basement Complex rocks, and hence heavily dependent on the shallow wells, that were in the past annually fed from the small streams that used to flow towards the river (e.g. Wadi el Hilgi and Khor Amab). These streams have now ceased to flow causing some of these wells to dry up and put more pressure on the existing water sources especially during the dry season when the river bed dries up.

The Selection of the Project Site:

Bearing all the above in mind and the information so far available, two areas or alternatives can be nominated for a comprehensive project to be located with the minimum cost and the maximum economic and

social benefits for the whole area. The two areas are:

(1) El Hilgi area on the eastern bank (Seidon Rural Council)

(2) El Besli on the western bank (Ed Damer Rural Council).

The Criteria for Selection of the two areas:

1. Administratively both lie in easy access to the different Regional Government departments as the project is supposed to combinethe official know--how and local participation where coordination and cooperation is vital at least in the initial stages.

2. Both areas enjoy a relatively large agricultural land and hence can afford a number of farmers above the inhabitants of the village or the sheikhship itself. Besides nearly all the land is governmental land, thus no compensation problems or social conflict problems are forseen. It must be noted, however that the determination of plot size should be decided upon the arable area that to be irrigated (being dependent on ground water) and it must include farmers representatives of all sheikhships.

3. The availability of already dug wells in El Besli and the strong indicators of ground water availability in El Hilgi area. Irrigation however can depend partially on the river waters for the early part of winter season and on ground water for the rest of the year to reduce the pressure on it.

4. The impression given by all those recently interviewed, that they are willing to participate financially, manually and accept some form of representation if a project is located outside their home-village as a starting point.

The selection of the project area can therefore be decided upon the following:

1. the availability of irrigation water
2. the availability of cultivable land
3. the availability and the interest in the project of the local inhabitants.

With regard to the third item, it is clear from the studies made that the population characteristics are similar, all of them share the interest in the project and the willingness to accept sharing the benefits of the project among all the villages throughsome form of representation in the allotment of plots.

El Basli area has the advantage of having a ground water potential that has been tested and there are three unused artisan wells with capacities of 1400, 7,000 and 14,400 gallons that were excavated over the last decade, at a relatively shallow depthes of 20, 25 and 20.27 respectively. The thickness of the water table ranges between 15.3 and 54.3 metres, and at Qoz el Halag, close to it, between 27.9 and 37.8 metres.[1] But although the cultivable land at El Basli is good and close to the river bank, it is very small when compared with the land available on the eastern bank in Wadi el Hilgi.

Wadi el Hilgi is located between longitudes $34^{o}18'$ - $34^{o}45'$ east and latitudes $17^{o}15'$ and $17^{o}24'$N. It is an alluvial plain that forms a triangle with its head towards Atbara town. It expands for 18 kilometres from the river Atbara eastwards near the village of Seidon and in its eastern end it is joined by various tributeries such as Um Seyala and Abu Adar all covered with the alluvial soils. The total cultivable land area is about 15,000 feedans in the area between Kereidra and El Gezeira.[1/]

In respect to all the above, the land surveys that were made and the suggestions of the local inhabitants and if the grownd water proved sufficient at El Hilgi, and in fact there are many indicators to suggest that, it becomes more sound to locate the project there. The reasons are:

1. The land now available is larger in size and hence can support more population.
2. The potential for future expansion within the protected forests which the local population claim to be underlain by a large surface of ground water potential.
3. That expansion in fact, contrary to common belief, can be the most effective device for the protection of thise forests, as its supervision and control will take the form of personal responsibility of the farmer who cultivate that particular plot.

1/ Ipid., p.38.

4. This also make easier the enclusion of livestock in the cycle to depend on natural vegetation for some part and on the cultivated area.

5. Most of the land is registered under the government ownership and hence a minimum level of conflict and disagreement is to be expected.

Project Characteristics:

1. Being a pilot project and the size limited by by the availability and future prospects of ground water potential, the project should not involve any displacement of population and this could be attained via the proposed representation system of tenants.

2. Plot size and number of units are to be worked out on the basis of the crops to be cultivated and its water requirement, level of fertility of soil, household economic return and as the problem now is mainly the shortage of water rather than land, the present average holding can be an indicator and should be exceeded and if possible doubled.

3. The concentration on food crops production within the central areas, mainly dura and dukhn, to make use of the past experience of the population, and to ensure sufficient supply of animal fodder for the livestock raised. Diversification of production can be a second step in the future.

4. The production of winter and/or Summer fodder crops on the outer zone of irrigated area to minimize the risk of drop in water output and gradually involve livestock in the agricultural cycle.

5. Introduction of new livestock breeds as a first step in improving livestock production and encouraging fatening and diary schemes in the area. A similar experience has been conducted in order villages, financed by the Agricultural Bank and cooperative societies and seems to be going well under the supervision of the veterinary services department at Ed Damer. An attempt was made at Gangari village and the project is supposed to take off next season and can be taken as a test or experimental project before implementing it.

6. To facilitate the formation of cooperatives, an idea that has already proved successful in the area (i.e. Nukheila and Gangari), and ensure the local population contribution to the basic capital no matter how small tht contribution is.

7. To try to minimize the use of hired labour in order to block absenteism and reduce migration and the practise of off farm time consuming jobs.

8. To establish an administrative body consisting of local people and representatives of government departments preferably the individuals who are actually involved in the planning process, i.e. representatives of National Water Corporation, Veternary Department, Soil Survey Department, Department of Forestry, Agricultue, Health and other relevant authorities of the Northern Region.

9. The establishment of nurseries to supply sufficient of shoots of date palm and other tree species to be cultivated within and around the scheme area. Also to expand the replanting of trees throughout the area especially in the villages with schools, providing sufficient training for school teachers about the need and ways of replanting trees with emphasis on the revival of dom forests.

10. The local inhabitants, having known the value of wood and the vegetation cover now, should undertake the responsibility for protecting the vegetation cover at the village level, and manually participate in replanting trees in order to combat desertification. Surveys made in fact indicate the interest and willingness on the part of the local population to participate in that effort.

11. To stop the issuance of commercial wood clearance licence by the forestry department for a number of years to insure the revival of local

forests and providing the means of protecting them e.g. through incentives for forest guards i.e. increasing salaries.

Economic Justification:

1. The creation of an integrated and balanced economic base and improvements of local incomes.
2. Strengthening the traditional economy by fitting the project into the existing system.
3. Regaining full employment in the parts of the area that now experience over 2/3rds of the year as a slack season.
4. Production of commodities badly needed not only in the area but also in neighbouring areas (dura, fodder, milk and meat).
5. Building up of a taxation system at the council level through which and the improvement of local incomes, the self help financed social services can be provided and sustained.

Social Justification:

1. Raising the accessibility of social services (health and education) for the local population making use of the concentration of population at one location plus the likelihood that some of the extra incomes that is generated could be syphared into the service sector.
2. The creation of a homogeneous group of population from various tribal groups in the area who are bound by the same economic activity and, probably, settlement.

3. Readressing the sex imbalances, that was disturbed by the tendency of young males to migrate outside the area or the financial inabilities for some to get married, through the increase in income levels and stable job opportunities in the area.

4. The project as a comprehensive one will act against the currently spreading spirit of despair and fatalism among the population.

Environmental Justification:

1. Checking the present trend of environmental degradation, combating desertification and restoring the vegetation cover in the area.

2. Minimizing the economic and social impact of natural hazards in the area.

3. Enhancing environmental awareness and community education among the local population and the officials concerned with the implementation and management of the project.

4. The project allows an opportunity for the coordination of effort by all government departments whose interests sometimes are conflicting, into one body concerned with the restoration of balance to a rural environment.

Components:

1. Land survey, preparation and allottment into farming units.

2. The completion of the studies started on ground water potential and the excavation of a number of shallow and artisan wells in the area.
3. The purchase of agricultural implements.
4. The procurement of seeds, fertilizers and the necessary know-how at least at the initial stages.
5. The design and erection of an irrigation system.
6. The development of nurseries in the area.
7. The creation of an administrative body and the recruitment of local staff.
8. The purchase of a number of irrigation pumps.
9. Possibly, the construction of heir-like concrete basins to store the river water for the dry season.

Cost:

The cost of the above items

APPENDIX II

THE WORKSHOP ON ENVIRONMENTAL DEGRADATION AND POSSIBLE ALTERNATIVES IN THE LOWER ALBAMA AREA - (NILE PROVINCE)

(List of Recommendations)

APPENDIX II

THE WORKSHOP ON ENVIRONMENTAL DEGRADATION AND POSSIBLE ALTERNATIVES IN THE LOWER ATBARA AREA-NILE PROVINCE

LIST OF RECOMMENDATIONS

A. General:

1. Declaring the Lower Atbara a national problem area and as such addressing the problem of environmental degradation as a national one since it represent the first defence line of the areas of the heavy concentration of economic activities in the country.

2. The setting up of a High Regional Committee for the Rehabilitation and Development of the Lower Atbara Area, with sufficient executive power to help it achieve its objectives. The Committee should:
   a) investigate the means and methods of promoting investment in the area.
   b) follow up the implementation of the workshop recommendations, and
   c) coordinate the efforts of all the bodies and government departments concerned with the problem.

3. The implementation of the project proposed during the workshop (Paper 12), as an experimental pilot scheme and if successful to spread the idea to other villages where the basic requirements are present.

4. The legislation and enforcement of the laws and local orders necessary to protect the local environment via the rational use of its natural resources.

5. Spreading the idea of environmental awareness through official and public channels throughout the northern region. Special attention is to be paid to the education of local inhabitants to stop the present land misuse in the area.

6. Intensifying the media coverage of the scale of environmental deterioration and its consequences both at the national and international levels.

7. The promotion of local rural industries in the area to lessen the dependence on agriculture and contribute to raise the standard of living in the area.

8. Working towards the formation of a data bank for the area to help attract local and foreign investment into the area.

B. Water:

9. Contacting the Khashm el Girba Dam authorities to investigate the possibilities of releasing more water to pass down-stream and regulate its discharge in a way that makes possible its use down-stream for longer periods.

10. To maximize the use of the flood waters by:
    a) changing the cropping system
    b) increasing the pumping capacity in the area (larger pumps)
    c) using the spray and drops system of irrigation
    d) Storing water in concrete basin to be build in areas especially where livestock is concentrated.

11. e) The reopening of areas that was usually covered by the flood waters in the past (i.e. ex river feeders) in the areas of Gersi, Hilgi and Gezeira, in coordination between offecial and public efforts to allow the maximum use of the river waters.

11. The exploitation of the unsused ground water wells in the area to irrigate the pilot agricultural schemes.

12. To speed up the implementation of all projects approved by the National Water Corporation such as the completion of the network in Um Agaga village.

13. The construction of small barrages on the wadis that flow into the river Atbara such as Wadi El Hudi and Abu Adar.

14. Carrying out a comprehensive hydrological study in the Lower Atbara Area to complete the geo-physical, hydrogeological and hydrochemical survey that has already been started in order to assess the location and capacity of the ground water reservoir and the suitability of its water for agriculture and hence decide on the location of the proposed agricultural schemes.

15. The individuals (inhabitants) should stop the digging of unplanned irrigation wells (matarat) and work in cooperation with National Water Corporation to decide on the location of wells and balance between the capacity of the well and the cultivated area.

16. The provision of one small excavation machine to help dig some temporary relief wells untill the large water supply schemes are completed.

17. The construction of water stations (wells) in all government institutions in the area (i.e. schools and health centres) to supply drinking water and encourage settled life.

C. Agriculture:

18. Investigating ways to practice agriculture within the closed forests with the necessary measures for its protection.

19. The encouragement and promotion of agricultural cooperatives in the area.

20. Easing restrictions by the Ministry of Agriculture in the short term on linking pump sizes with sizes of holdings or type of crop produced and also easing procedures in the process of issuing licences for matarat and small schemes.

21. Making available sufficient amount of fuel to cover the whole agricultural season in the area.

22. Revising the agricultural Bank credit and insurance rules to make credit accessible to the maximum number of farmers.

23. Supplying the Lower Atbara with the necessary agricultural technical staff and intermediate experties and instructors together with the intensification of field visits to the area by the forestry authorities.

24. The promotion of agricultural services in the area, such as agricultural extension and plant protection and making available the necessary agricultural inputs such as fertilizers, simple agricultural implements, improved seeds, and most importantly drought-resistant and quick maturing and high productive crop varieties.

25. The modernization and development of the experimental fodder farm in Seidon to include horticultural and field crops, and the encouragement of experimental farms within the proposed project.

D. Livestock:

26. The excavation of wells along the stock routes (maraheel lines) between the Lower Atbara and the eastern Sudan.

27. Carrying out a comprehensive survey on natural pastures in the area to locate it and economize its use and to cultivate platable species within forests in order to protect the livestock wealth in the area.

28. Carrying out a survey on livestock in the area and the provision of preventive and curing veterenary services and the introduction of new breeds into the area to improve the quality of local livestock.

29. The inclusion of livestock in the agricultural rotation by making use of the residues of the agricultural products whose quality could be improved via modern scientific means.

30. Making the maximum use of the milk surplus in the area by establishing small scale cheese factories in the area and improving transport facilities between the area and the nearby urban centres.

31. The establishment of poultary farms in the area to activate women contribution towards the self-sufficiency of the local community. In this respect, use can be made of the project of "raising incomes of rural women" that is currently being sponsoured by FAO in the Northern Region.

E. Foestry:

32. The distribution, by the department of forestry, of shoots to farmers who should be obliged to cultivate protection belts in their farms and look after it.

33. Revising the ways in which wood-clearance licences are issued and stopping the issuance of those licences for a time sufficient for the revival of local forests.

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