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« South Kordofan »

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MESSERIYA HUMR

Initial Indicator Assessment

ETMA Project

Sudan.

This Report is prepared by :

Dr. Salih A. Al Ariri.
Dr. Musa Adam Abdel Galiel.
Dr. Babiker A. A/Rahman.
Sayed/Mohamed Ahmed Ibrahim Ghanim.
Sayed/Sharhabeil Ali Al Tayeb.
Sayed/Mohamed Mousif Mabruk.

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MESSERIYA HUMR STUDY SITE.

Introduction:

The Messeriya Humr Study Site has been selected for environmental monitoring because of environmental changes that are taking place there. Increases in human and animal populations within the site put pressures on natural resources, leading to environmental change. Government provision of limited medical and veterinary services in the area has contributed to local increases in human and animal populations. These increases were accompanied by a concomitant increase in human and animal water supply sources. Ignored in the construction of additional water supply sources was the necessity of balancing needs with environmental carrying capacities. These interventions produced new water supply distributional patterns which are manifest, in particular, by high human and animal population densities around many of the newly created water sources. Of course, in the absence of proper planning and policy measures to ensure protection and rational use of resources, overgrazing and deforestation are expected to occur, specially around large centres such as Muglad, Babanussa and Ettboun. Such degradation can endanger future prospects that the Messeriya Humr homelands will be capable of sustaining and supporting human life.

The recent expansion of agriculture within the study site is no less serious in its environmental impact than the above mentioned factors. Messeriya pastoral nomads are progressively learning to engage in agricultural production. This process, in addition to the improved water supply situation, has spawned spontaneous settlements of the nomads in new villages. Settlement has necessitated clearance of extensive tracts of land for farming purposes and large scale cutting of trees to obtain wood for home construction and fuel needs.

In addition to the above factors, livelihood patterns within the study site have been influenced by the recent discovery of petroleum near the study site in another Messeriya inhabited area. This discovery has introduced a new factor into the process of environmental change in the study site. As a result of the discovery more people are moving into the area, particularly to the towns, adding to local demand for building material and fuel. Also of significance is the fact that prospecting companies are initiating environmental changes as a consequence of a road opening programme, clearance of drilling sites, and extensive (but accidental) fires set while conducting their prospecting operations.

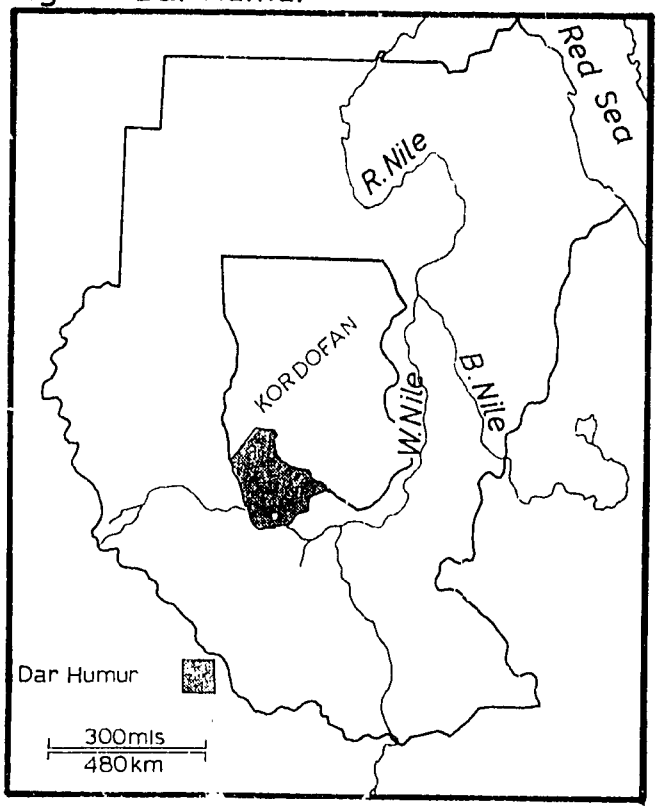
Although the Messeriya Humr area is located in the Savannah belt where rainfall ranges from 500 mm. to 800 mm. per year, the aforementioned factors have led to many changes in the fauna and flora of the area. More importantly the same factors have accelerated resource degradation and desertification in some parts of the region. Because processes occurring at the Messeriya Humr site are representative of those occurring in the region, it has been selected as a site for monitoring environmental change. Monitoring data will provide a base upon which to analyze environmental trends.

Location of the Study Site :

Geographically the Humr site is located in the Savanna belt of the Sudan bounded by Latitudes 9°, 30'N and 12°N and Longitudes 27° , 30'E. and 29°, 30'E.(Map I).

Administratively the Humr country is located just west of Lagawa Rural Council in the Western District of Southern Kordofan Province. The Humr's rural council has its headquarters at Tugdad but is supervised from Regl el Fula, the capital of the Western District.

Fig. Dar Humur



Historically Humr grazing rights extend beyond their own administrative boundaries into Bahr el Ghazal Province to the south, Southern Darfur to the west, and to Lake Abyad east of Lake Keilak in the east. The latter sites extend deep into the dmaring (summer grazing) sites of the Messeriya Zurg. But as a result of recent conflicts over grazing and water with other groups, such as the Dinka Ngok, the Rizeqat and the Zurg, the Humr today are confined more or less to the boundaries of their rural council. In fact their Dar or homeland has contracted, particularly along its southern boundaries, as a result of continuous warfare with the Dinka Ngok.

The Humr area is a flat plain, with minor geomorphological variations producing four broad zones. These are : the northern Qoz around Babanusa; the alternating Gardud and Qoz of Muglad; the central Qoz mainly west of Muglad, and the alluvial deposits of the Bahr el Arab region. In these areas variations in vegetative cover, soils and drainage are noticable and to a great extent influence the nomadic migration system and land use patterns.

The area has few naturally occurring perennial water sources. Most significant are : 1) Bahr el Arab, 2) The Ragabas (meandering channels and ox-bow lakes connected to Bahr el Arab during the rainy season), and 3) Lake Keilak. Seasonal water sources are numerous and include: 1) Rehads and Butas (both are clayey depressions where rain water collects and stands until shortly after the rainy season); and 2) seasonal wadis such as Shallengo, el Ghalla and el Magia. Seasonal wadis contain flood water after rains, but during much of the year, when they carry no surface water, provide subterranean water supply sources in their beds and along their banks.

Indicators of Desertification which were Selected :

A tentative list of indicators used for Humr area includes :

1. Biological indicators :
   a) Change in the distribution and frequency of *Dalbergia melanoxylon*, *Anogeissus Leiocarpus* and *Terminalia Laciflora*.
   b) Distribution and frequency of fires
   c) Changes in rangeland plant communities.

2. Physical indicators :

a) Changes in the size and distribution of seasonal surface water

b) Rilling on gerdud and clay soils.

3. Social indicators :

a) Increase in the number and sizes of rural and urban settlements.

b) Changes in herd sizes and herd composition.

c) Changes in grazing habits and traditional migration routes.

d) Changes in crops and areas cultivated.

e) Industrial development (for example in the forms of oil factories, milk factories and traditional manufacturing processes).

General Physical Background to the Humr Area :

In this section a brief account will be given of the geology, climate, soils and the vegetation of the study site.

Geology :

The following formations are dominant in the Messriya area (Map II).

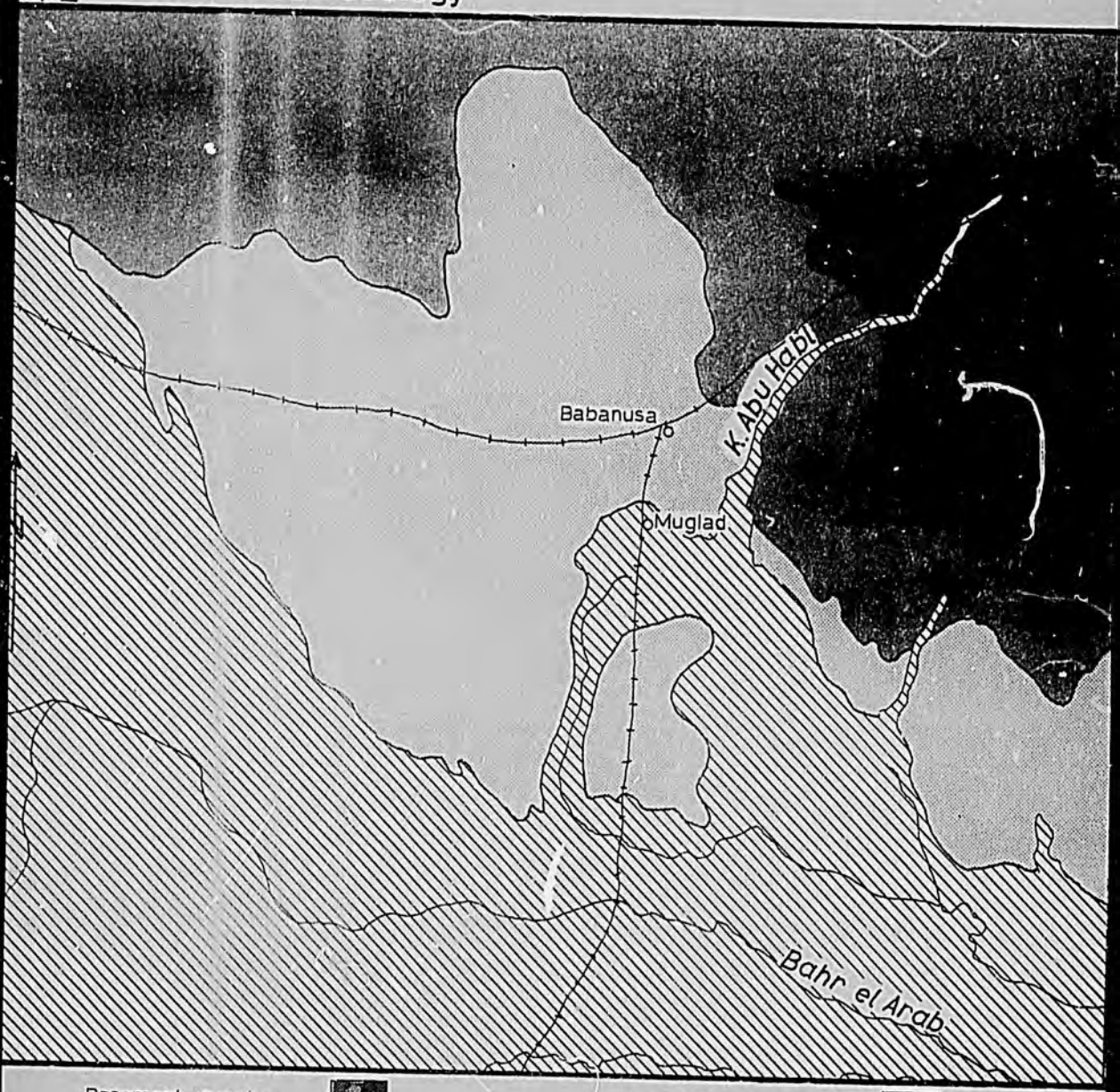
a) Basement complex: These are pre-cambrian formations composed predominantly of granites, gneisses, mica, schists, graphite schists, quartzites and crystalline limestone. The Basement Complex rocks

hold little ground water and are dominant in the eastern parts of the Humr homeland.

b) Nubian sandstones: These are Mesozoic formations described by Rodis, Hassan and Kahadan(1964) and consist of sandstone, conglomerate and mudstone, compacted into hard ferruginous and siliceous layers. Karkanis (1965) divided the formation into: basal, middle and upper series. The basal series is made up of coarse and very coarse grained silicified sandstone and conglomerate beds, cemented together with silica. Thus the formation has been rendered very hard and resistant to weathering. The middle series are composed of poorly cemented, friable mudstone and sandstone beds that weather into undulating surfaces with thick, sandy covers. The upper series are composed of poorly sorted, weakly cemented quarzitic sandstone, in which grain sizes range from clay to medium and fine sand.

These Nubian sandstone formations are mainly found to the west and north of Babanusa town. They are by far the best aquifers and on average the water table in them lies at 300 and 400 feet. Water is usually found in pebble conglomerates and quartzoses sandstones. Rarely is it found in mudstones.

ap II Humur Area - Geology



Basement complex

Nubian sandstone

Railway

Umm Ruwaba series

Alluvial deposits

River

SOURCE. Strojexport (1976)

0 km 100

c) Um Ruwaba Formation

These are plio-pleistocene formations most dominant in the western and southern parts of the Humr Bar. They consist of unconsolidated sands, sometimes gravelly and clayey sands, and clays. The sediments are poorly sorted and are more than 1,000 feet thick in places. Underground water yields are variable, ranging from moderate to low.

d) Pleistocene and Recent Unconsolidated Deposits:

These are mainly superficial deposits consisting of gravels, sands, sandy clays, silts and clays. They occur in a variety of environments in the Messriya area, such as in Wadi deposits, Qoz and sand sheets, river terraces and alluvium and valley fills. Water potential varies in these different strata, with sands being the least productive.

Climate :

According to Irland's(1948) division of the climate of the Sudan, South Kordofan Province falls in the Western Savanna region and enjoys a hot semi-arid continental climate. Rainfall is clearly seasonal and is related to the inter-tropical convergence zone.

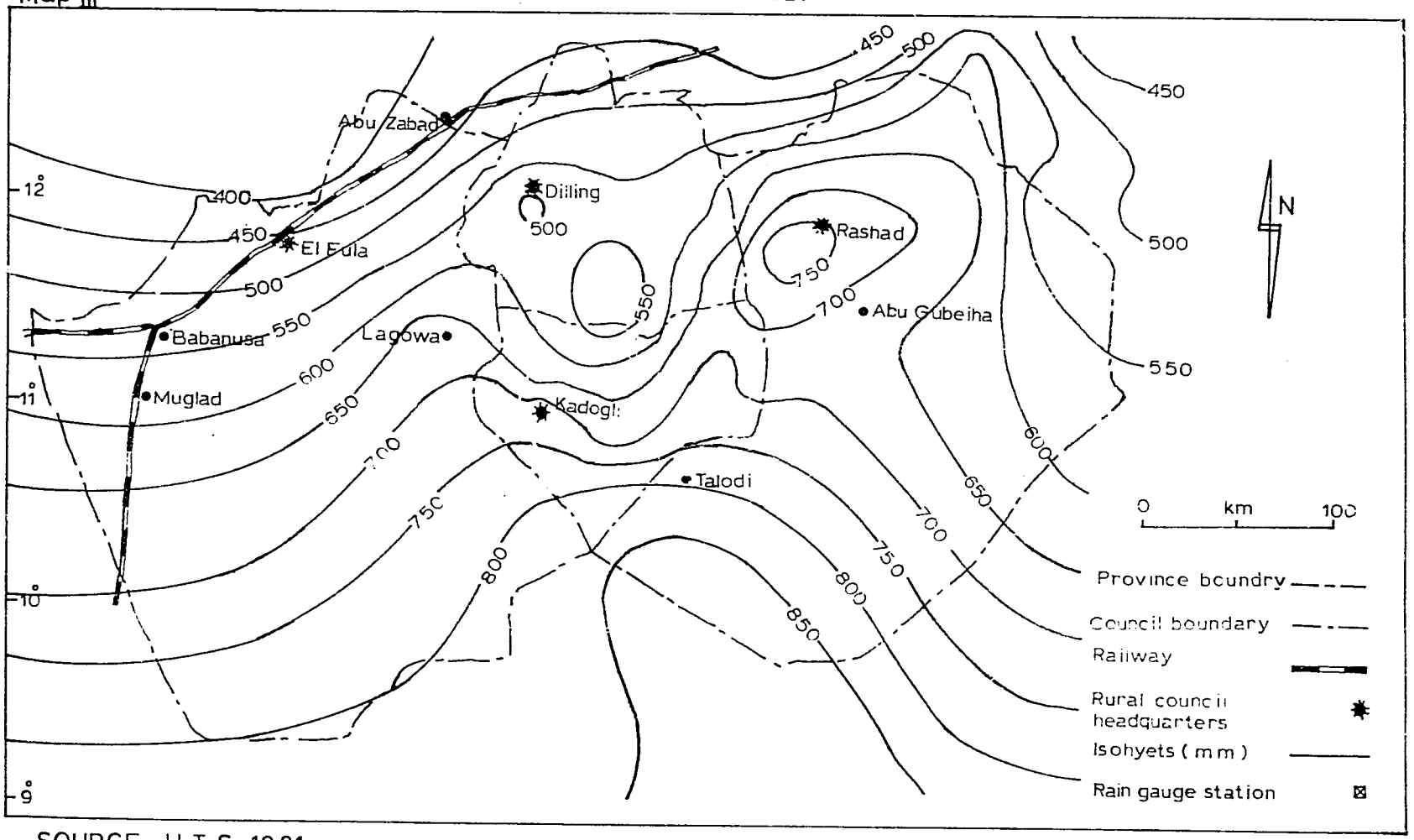
Average annual rainfall varies between 500 mm. in the north and 800 mms. in the south. It is fairly reliable with a variability of 10 to 15% decreasing from north to south (HTS, 1981). The rainy season extends from June to October reaching its peak in August. However the length of the rainy season and the characteristics both of the dry and rainy seasons are the products of the major annual ocillations of pressure and air currents within the tropical zone.

The northern boundary of the Humr country coincides with the 500 mm. isohyet and the southern boundary with the 800 mm. isohyet (Map III). The mean start of the rainy season is the 25th. of May in the south and the 14th. of June in the north. The mean end of the rainy season is the 1st. of October in the north and the 21st. of October in the south. Since the growing season averages 120-160 days, the study site lies within the boundaries of the area considered safe for rainfed agricultural production.

Temperatures are high with a daily maximum of 35°C in summer and 26°C in winter. Potential evaporation thus reaches its peak in summer where monthly values of around 220 mm. can be expected. This is a direct result of maximum insolation and low relative humidity. Potential evaporation declines to about 170 mm. per month in the

Map III

STANDARD 40 YEAR AVERAGE AINTALLY



SOURCE: H.T.S. 1981

rainy season due to lower temperatures and high relative humidity. It rises again in the post rainy hot season before it begins to fall in the winter season, (HTS,1981).

Soils :

A large part of the Messeriya area is covered by free-draining soils. The parent material and mode of formation of these soils varies quite widely but they have a number of common features. They are infertile and susceptible to wind and water erosion. They also tend to form surface crust, specially when exposed and they dry out quickly.

The majority of cultivation in the region is on sandy soils which can't support continous cultivation successfully more than four to five years. The farming plots require almost fifteen years under bush fallow to recover. Substantial areas are grazed and in some parts specially the west over grazing, trampling and burning has led to crust formation and degradation of sandy soils.

a) Nubian Aeolian and Nubian Residual Soils :

These residual soils are derived from weathering of Nubian sandstone formations and mostly occur in Wadi El Ghalla, Felaita and Fula Catena. They vary in colour from dark red to yellowish red. Textures range from fine

and medium sand at the surface, to sandy loam and sandy clay loam at depth. For example one site west of Lake Keilak in the Felaita land system has a high very fine sand content. The very fine composition of these soils may be related to the fact that they overlay Nubian sandstones comprised of sands of fine texture. In the shallow soils, ferruginised sandstone fragments occur.

b) Qoz Sands :

These soils occur along the western margins of Messeriya District and are a continuation of the Qoz soils of the Eastern District. They are highly permeable and have low fertility. Overgrazing in areas having this type of soil has resulted in extensive sand dune mobility.

c) Atmur :

These aeolian soils are found in the alluvial transition zone of the Qoz land system. They are also found as part of the Baggara Catena in the Ghalla fan around Muglad. Atmur soils occur in areas of level to gently undulating shallow sand sheet, or in isolated dune formations.

d) Qoz Alluvial Soils :

These soils, which contain a higher percentage of silt than the aforementioned soils, lie within the topographic feature called the Ghalla sandy fan.

e) Gardud Soils :

These medium and heavy textured alluvial soils occur on the interfluvial areas between Regebas. Gardud soils do not have an aeolian mantle; at the surface they range in texture from loam to clay loam.

f) Fula Complex :

The fula complex soils are found on the dissected sandy pediplain of the Ghalla land system. This pediplain has been dissected by numerous streams which drain into the Wadi El Ghalla. Erosion on the interpluves between the streams is severe. Fula complex soils are red, reddish brown, and yellowish red sands derived from eroded Nubian aeolian, Nubian residual and Qoz soils. They have been deposited by aeolian action in a thin mantle over Basement Complex strata and Nubian bed rock.

g) Sandy Alluvial :

Clay soils with high sand content occur within the valleys and flood plains of the three large wadis which out through the Felaita sandstone ridge. (These Wadis are called Shallengo, El Ghalla, and Al Hagiz).

h) The Ragaba Catenas :

Soils within this classification range from sandy clay to heavy cracking clay varieties. Generally these soils are poorly drained. Frequently deposits of iron and manganese oxides are found in them.

The soils of the Meseriya Humur country were surveyed as part of the Savanna project by Hunting Technical Service (1981). According to the survey, soils of the Humur area have been provisionally classified into eleven landforms as follows :-

Landform	Soil type	Description.
1. Flat to gently undulating aeolian and locally reworked alluvial sand sheet.	WP_1	Deep aeolian and reworked alluvial sandy soils.
2. Sandy-plain-flat to gently undulating interluves.	WP_2	Deep coarse-textured residual soils.
3. Sandy plain(dissected) gently undulating mid-slope.	WP_3	Medium-textured residual soils.
4. Sandy plain(dissected) flat to gently undulating lower slopes.	WP_4	Fine-textured residual soils.
5. Aluvial complex(Baggara repeating pattern) sandy ridges.	WP_5	Atmur sandy soils.
6. Alluvial complex(Baggara repeating pattern) sheet wash plain.	WP_6	Nagga non-cracking medium and fine-textured alluvial soils.
7. Alluvial complex(Baggara repeating pattern.	WP_7	
8. Aeolian sand sheet and sandy plain depression areas.	WP_8	Shaqq medium to coarse textured soils.

Landform	Soil type	Description.
9. Flat to gently undulating sand sheet rewaked by alluvial processes shallow depression.	WP_9	Baroya - Sandy material overlying medium textured subsoil.
10. Flood plain complex	WP_{10}	Stratified recent alluvial soils of variable texture.
11. Jebels and rock out-crops.	WP_{11}	Lithosoils and skeletal soils.

WP_1 soils are deep coarse textured soils developed on asolian sand. In some areas the sand has been reworked by alluvial processes. Texture is normally sand or loomy sand to more than two metres. Average sand content determined in South Darfur from the same soil type WP_1 was 88% (68% coarse sand and 20% fine sand). Clay content varies from five to twenty per cent increasing slightly with depth. A weak coarse subangular structure is observed below one metre but the upper horizons are unconsolidated and structureless. Colour is variable commonly yellowish brown in top soil becoming yellowish red in the subsoil.

WP_2 soils are deep sandy soils in which the dominant process of formation is <u>in situ</u> weathering of Nubian Sandstone or Basement Complex rocks. The profile comprises

a variable thickness usually 50 to 75 cm. of dark red or reddish brown sand or loamy sand which overlies yellowish red sandy loam or light sandy clay loam. The top 20cm. often shows evidence of reworking by wind. WP_2 soils are not well documented in the available literature, the only authoritative source is HTS, 1964. WP_2 soils are similar to WP_1 in the low fertility status they are also freely drained and susceptible to water and wind erosion. The surface has a tendency to crust formation and sealing particularly when cleared of vegetation.

The WP_2 soils have more fine material than WP_1 and therefore can hold more available moisture. The colour of WP_2 soil is redder than WP_1 soil.

The top soils of WP_3 (10-25 cm.) are of reddish brown loamy sand overlies brown sandy loam passing into sandy clay loam between 75 and 100 cm. The sandy top soil is moderately alkaline and exchangeable sodium percentage are moderately high (about 10). Top soil fertility is very low but the medium textured horizons have higher cation exchange capacities.

The WP_3 soils also contain medium textured soils formed from the <u>in situ</u> weathering of sandstones and

conglomerates of the Nubian series. A thin topsoil of loamy sand is underlain by sandy loam or sandy clay loam, but these soils are less shallower. Coarse angular Nubian sandstone graved is encountered at variable depths, usually about one metre. In this soil pH value decreases from around neutral in the sandy topsoil to moderately or strongly acid in the subsoil. The top soil is often lost by erosion.

The WP_4 soils developed on Basement Complex rocks and comprises 60 cm. of dark greyish brown sandy clay overlying greyish brown structureless alkaline gravelly clay to at least 1.5 metres. The subsoil gravel is largely carbonate concretions, and this, rather than an excessive amount of exchangeable sodium appears to account for the high subsoil pH. Cation exchange capacity is higher than in WP_3 soils but phosphorus, nitrogen and organic carbon are very low.

The WP_5 soils are one of the three soil types which occur regularly together as the so-called Baggara repeating pattern. The atmur soil is sandy soil that frequently occurs in the forms of elongated sinuous ridges. Wind action has redistributed some of the sandy material into dune like formations. The thickness of the atmur sands can vary from a thin mantle less than

30 cm. deep to well developed dune-like formations more than two metres deep. In places, sand has been blown or washed over the upper sheet - wash plain giving it a thin sandy mantle give to twenty cm. thick. The alluvial deposits of the Baggara repeating pattern have been laid down on top of the aeolian sandsheet. In the Abu Bateikh plain the alluvial fan is discontinuous and the sandsheet protrudes in the form of fairly wide sandy ridge (WP_1 soils). Also in other places subsequent wind action has transported substantial quantities of sand from the surrounding sand sheets which has been deposited on top of the entire Baggara repeating pattern which is quite noticeable in Abu Bateikh.

The WP_5 soils are similar to WP_1 sandy soils except that they are underlain at variable depths by fine textured alluvium. In places the sand is more than two metres deep but normally the underlying alluvium is encountered within the top metre. The WP_5 soils have higher percentage of sand than WP_1 soils. Average figures in the eastern part of Darfur Province are 93% in WP_5 soils and 85% in WP_1 soils.

The WP_5 soils vary from middly to moderately acid (pH 6.6 to 5.7). They are very infertile, the ction exchange, the level of organic carbon, the available amounts of phosphorus, copper, zinc and manganese are all low.

The WP_6 Naga'a soils are a fairly complex group of non-cracking stratified and non-stratified medium and fine-textured alluvial soils with occasionally a thin mantle of sandy material. They form the almost flat sheet wash plains of the Baggara repeating pattern.

In unstratified WP_6 soils clay content almost increases with depth. A typical profile comprises an upper horizon of sandy loam or sandy clay loam with a conspicuous coarse columnar structure and a very hard non-cracking surface crust overlying weakly structured to massive, compact heavy sandy clay loam or clay loam and normally passing in the deep subsoil into clay or occasionally sandy clay. Colours are variable but commonly dark grey, dark greyish brown or olive brown. There are slight variations associated with position on the sheet wash plain. Textures are generally somewhat lighter on the highest part of the plain alongside the atmur sandy ridge. It is these soils which most frequently have a thin surface mantle of sandy material, most it wind blown or ashed from the atmur immediately above. Textures are finer in WP_6 soils on the lower parts of the sheetwash plain. These heavier soils have some vertic characteristic. When dry some cracks develop in the upper horizon, although they are normally covered

by the hard surface crust and slickensides are common in the subsoil.

Moisture availability in WP_6 soils (Naga'a) is strongly influenced by the low permeability of the hard surface crust. A large porition of rainfall flows off as sheetwash in the neighbouring buta depressions. Permeability in individual stratified WP_6 soils but overall profile permeability is normally slow to very slow (0.01 to 0.07 m/day - AHT, 1976(b). Available moisture capacity also varies according to exture. In South Darfur sandy clay loam, clay loam and light clay horizons in WP_6 soils have an average available moixture capacity of 16% (HTS, 1974(b).

WP_6 soils are generally well supplied with exchangeable bases and micronutrients. Cation exchange capacity normally rises with the increase in clay content as moving from top soil to subsoil. Soil reaction in non-stratified WP_6 soils is normally mild alkaline in the topsoil (PH 7 to 8) becoming strongly alkaline in the subsoil (PH 8.5 to 9.3). Salinity levels are low throughout and carbon and nitrogen levels are low or very low.

The WP_7 buta soils have the typical profile, physical and chemical characteristics of montmorillonitic

vertisols. The soil reaction ranges from neutral to strongly alkaline but levels of exchangeable sodium do not appear to be dangerously high.

WP_8 Shaqq soils are medium to coarse textured soils in depressions and hallows in aeolian sand sheet and residual sandy plains where they occur in association with soil types WP_1 and WP_2. These hollows act as collecting sites for upslope drainage and collodal material from the surrounding sandy soils. As a result WP_8 Shaqq soils have higher clay contents and superior physical and chemical properties.

Clay content in this soil is higher than the neighbouring soils of WP_1 and WP_2 and may reach an increase of 5% specially in the deeper subsoils. The texture is mainly heavy loamy sand and light sandy loam.

WP_8 Shaqq soils are generally redder in colour and contain more evidence of faunal activity (insects and animal burrows) than surrounding WP_1 and WP_2 soils. The greater clay content gives the Shaqq soils the significant advantages in term of fertility and available moixture capacity. Plants in such soils rarely suffer from mixture stress during occasional dry periods in atumn, and the soil remain moist for longer periods after rains.

WP_9 baroya soils are polycyclic. A typical profile comprises 20 to 60 cm. of unconsolidated aeolian sand overlying medium textured alluvial material. Occasionally the alluvium reaches the surface. The upper horizon is usually dark greyish brown fine sand or loamy fine sand with a single grain or very weak subangular blocky structure. The subsoil is massive compact greyish brown sandy clay loam. The boundary between the upper aeolian sands and the massive sandy clay loam is abrupt and the presence of moltling immediately below the boundary suggests that the massive subsoil is impeding profile drainage.

Moisture availability in WP_9 soils is much higher than in neighbouring WP_1 aeolian/alluvial sandy soils. Although the sandy topsoil is excessively drained, the finer textured subsoil is much less permeable and water is held back within reach of plant roots for longer period. However the sandy clay loam subsoil is very compact and this may impede root development particularly where it occurs at shallow depth.

Fertility is generally low. Cation exchange capacity is very low in the sandy topsoil. Calcium is the dominant exchangeable base but a few profiles have moderately high exchangeable sodium percentages in the deep subsoil. The

PH value is high at depth. Organic carbon phosphrous and nitrogen are low in all WP_9 soils.

WP_{10} soils which are recent alluvial soils occupy relatively small areas in the Western plains. Fine textured recent alluvial soils are in the Abu Ganuk Dissected plain and the Wad Shalengo Valley. Outside these two regions, the only substantial tracts of recent alluvial soils are on the flood plain of the Wad el Ghalla and the lower valleys of its tributaries.

Fine and medium textured stratified alluvial soils appear to occupy most of flood plains of Wadi el Ghalla.

Stratified coarse textured horizons were encountered with increasing frequency below 100 cm. in the profile. The occurence of sandy material in the subsoil is probably a fairly consistent feature throughout the region. The flood plain contains a number of large backswamp depressional areas occupied by buta cracking clay soils of type WP_7 specially between El Fula and Abu Zabad.

In Wadi el Ghalla flood plain alluvial soils with coarse textured surface horizons are relatively scarce although conspicuous narrow levee-like features are identifiable on aerial photographs and wind-blown sand

has been deposited over the alluvium in places particularly in lower parts of the flood plain.

Coarse textures are more common in the valleys of tributaries particularly those on the northern side of the Wadi, draining from the eroded Abu Zabad and El Fula dissected plains. Over the years very large amount of material, mostly sandy, have been washed into the valleys from surrounding interfluves and valley sides.

WP_{11} soils are shallow soils developed on outcrops of Basement complex or Nubian series rocks. Both rock types outcrop occasionally in the Dubaibat plain and the Abu Zabad and El Fula dissected plains. Ironstones and sand stone also form more isolated jebels in the Kodurke and Keilak plains. The total area of such soil is negligible.

3. Vegetation Classification :

According to Jackson and Harrison (1958) the vegetation of the Messeriya Humr country is divided into four broad divisions and eight minor divisions. These classifications are show in Table 1.

Table 1.

Major and Minor Vegetation Division of the Messeriya Area.

Major Division	Sub-divisions
1) Low rainfall woodland savannah on sand.	a) Combretum Cordofinum-Dalbergia-Albizzia Sericocephalla savannah b) Terminalia-sclerocaryes-anogeissus prosopio savannah. c) Combretum Cordofanum-Albizzia Dalbergia - Acacia Senegal savannah.
2) Low rainfall woodland savannah on special areas.	a) Hill Catena. b) Baggara repeating pattern
3) Low rainfall woodland savannah on clay.	a) Acacia Seyal - Balanites savannah alternating with grass areas. b) Acacia Mellifera thronland.
4) High rainfall woodland savannah.	a) Flood region.

3.1. In the first major division of low rainfall woodland savannah occuring on sand, the following associations are found :-

a) The Combretum cordofanum - Dalbergia - Albizzia cericocephalla savannah association exists in a discrete vegetation unit in the Qoz land system around Babanusa. The dominant tree species are Combretum cordofanum, Albizzia sericocephala, Dalbergia melanoxylon and Guiera sengegalensis. However in the triangle of Muglad, Fula and Babanusa Albizia sericocephala and Dalbergia melonoxylon show clear dominance over all other species.

b) The Terminalia-sclerocarvea anogeissus-prospopis occurs in deep sandy soils.
The dominant trees in this association are Termanalia brownii, Sclerocarva birrea, Anogeissus Schimperi, prosopis africana, Combretum cardofarum and Albizia sericocephala.

c) The Combretum cordofanum - Albizia - Dalbergia - Acacia senegal association is found in alluvial soils occurring on the upslope of clay depressions. Acacia senegal and Lannea humilis are the main dominant species in this association. (Hunting Technical Services, 1976).

3.2. In the second major division of low rainfall woodland savannah occurring within special areas, two minor subdivisions have been recognized :

a) In the Hill Catena around Legawa three main zones are found. In zone I the rocky summits of granite and the gneiss Basement Complex hills are usually devoid of vegetation, except for occasional fiscus species that have gained a foothold amongst the boulders. In zone II, found on steep rocky hill slopes, a great variety of tree species are found. Frequently pure associations of single species,

mainly Boswellia papyrifera occur. Other species observed in this zone include Sclerocarye birrea, Anogeissus schimperi and Combretum hartmannianum. Zone III, found on the stony pediments at the foot of the jebels, supports a great variety of tree species. However, rain splash, sheet wash and subsequent surface scaling have given to patchy vegetation distribution. Where soil drainage is rapid, the following species occur : Albizia cericoephalla, Terminalia brownii, Bauhimia reliculala, Lannea humilis, Borassus aethiopium and Acacia senegal.

3.3. The third major division of low rainfall woodland savannah on clay is sub-divided into two minor divisions:

a) In this sub-division, Acacia seyal - Balanites savannah alternates with grassland and both overlie dark cracking clay soils. Vegetation is dominated by Acacia seyal and Balanites aegyptiaca, with scattered Anogeissus schimperi, Combretum hartmannianum and Acacia gerrardii also occurring.

b) In the second subdivision Acacia mellifera is the dominant species. This subdivision demarcates a transitional region between a zone of dark cracking clay soils (where Acacia seyal predominates) and sandy areas. Most common species found in this region are Acacia mellifera, and Acacia nubica. Scattered pockets of Acacia seyal and Balanites aegyptiaca are also found.

3.4. The flood region is used as a fourth major vegetation division. Main trees found within this division are : Anogeissus schimperi, Mitragyne inermis, Acacia siberiana, Hyphaena thebaica. Dominant grasses found here are Hyparrhenia rufa, Setaria incrassata, Echinochloa stagrina, Dryza longistamenata and Panicum spp.

Vegetation Transect Studies :

As shown in Table 2, the first vegetation transect studies have been done in the Southern region of Lake Keilak. Predominant grasses and herbs found there are : Hyparrhenia rufa, Pennisetum spp., and Oldladia senegalensis

Up to the time of the study animal grazing around Lake Keilak was very light, and the soil was well covered with vegetation. However, further from the lake extensive

areas had been devastated by fires. Although Abdel Magid stated in 1975 that fire destroys 60% of range forage in the Sudan, in this area the loss could be more than 60%.

Termites are also observed across much of the area. They are especially common in grasslands, but are very rare in forested areas.

Within the Lake Keilak area, young seedlings of Terminalia brownii have also been observed growing in dense stands under mature trees. This development is a sign of healthy recovery of the ecosystem.

On dark cracking clays east of Lake Kielak, the main grasses are Rottobellia exaltata and Echinocloa spp. The soil cover there is very rich, and forage production is relatively high. Very little grazing is done on this range. Fire occurs very frequently over vast areas. Young seedlings of Acacia seyal quickly take over previously cultivated areas and cover all bare land. That this process occurs is a sign that the ecosystem is balanced and healthy. (See Table 2, part II).

Along the northwest part of the lake the study was carried out on two sites. (See Table 2, Part III). Samples were taken from both hill catena and from dark cracking clay soils. Soils sampled showed little incidence of

erosion and forage production upon them was reasonably high. However, fires were common in the area. As consequence extensive tracts of land had been completely burned, especially tracts where dense stands of grass grew upon clay soils.

As shown in Table 2 Part IV, forage production is remarkably low in the southern part of El Fula area. Vegetation is sparse upon the seriously eroded sandy soils which exist in the area. Vegetation is aparsest where hard pan has formed as a result of heavy erosion.

Heavy grazing is observed at a radius of three kilometers from the town. The only area having a rich ground cover, and hence adequate forage production, is that near Wadi El Ghalla east of the town.

The area extending betwe n the towns of Baggara, Muglad and Babanusa has poor forage production because the soil there is mainly covered by Zornia diphylla, a short tender, prolific, but low yielding herb. Forage production is nil where an eroded sandy pediplain (which cannot support vegetation) covers a considerable portion of the land surface. (See Table 2, Part V). This area is a wet season grazing range for nomads. But the Range Management Officer at Babanusa stated in 1982 that because of poor grazing material, the period spent in the area

by nomads during the rainy season is becoming shorter (only two months). Overgrazing is affecting areas immediately around Muglad, Babanusa and Bongara. It has helped generate an extremely degraded soil cover, approximately 2.5 Km. in radius, around each of these settlements. In addition, termites are another agent of destruction. They destroy not only forage, but also trees such as Dalbergia melanoxylon.

In 1969 in order to improve the grazing situation, forty four settlement ranches for nomads were planned in the Babanusa area. Nomads rejected the schemes because livestock movements and number and the total amount of land available for grazing were limited on the scheme. Consequently all schemes were abandoned, except eight schemes which were downgraded to pilot farm status.

Sibeha, shown in Table 2, Part VI, is one settlement scheme where efforts can be considered successful. At Sibeha, soils are typically sheet sands supporting a Terminolia - Anogeissus Selerocarya (mixed deciduous) woodland savannah. While the soil cover is reasonably good, forage production is low, especially if we take into consideration government efforts on the scheme.

Officers in charge of the scheme claim that they do not have enough equipment and manpower to establish firelines. As a result, frequent fires on the scheme often lead to the elimination of perennial vegetation. In fact, about 80% of the range is composed of annual grasses and herbs. The dominant annual grasses and herbs in the Sibeha scheme are Cenchrus spp., Eragrostis spp., Zoria diphylla and Mitracarpus spp. Some perennial grasses are found, with Andropogon gayanus being the most frequently seen.

The present plan for settlement of nomads in Sibeha is to introduce families into an area of 10 square kilometers. Each family is to be given 30 feddans for cultivation and allowed to raise 50 animal units inside the scheme. After four years cultivation plots will be shifted. Subsequently the former cultivation plots will be sown to Hashab trees (Acacia senegal). Sale of these trees' products will augment farmer incomes.

Table 2.

Transects at the Humr Study Site.

Part	Sample No.	Average Percentage of soil Cover.	Average Percentage of Bare Soil.	Average Forage Production 16/fad.	Average Number of Trees/ hect.	Average Number of Dead Trees/ hect.	Remarks.
I	1	97	3	745	89	5	Undertaken at 6 kilometers south of Lake Keilak, at intervals ranging from 1-6 kilometers, on deep sandy soil.
	2	70	30	350	65	3	
	3	100	--	2590	79	4	
	4	100	--	1700	65	2	
	5	96	4	700	127	7	
II	1	100	--	3070	75	-	Undertaken at five kilometers east of Lake Keilak, at intervals of one kilometer for each sample. Soils are dark cracking clays covered with tall grasses.
	2	100	--	3000	70	3	
	3	100	--	3500	68	-	
	4	100	--	3500	60	1	
	5	100	--	3200	51	-	
IIIa	1	100	--	2070	106	6	The study was undertaken at 13 kilometers north-west of Lake Keilak.
IIIb	2	100	--	1550	73	4	The study was made at 23 kilometers north-west of Lake Keilak (in hill catena soils).
IVa	1	60	4	300	76	9	Undertaken 3 Kms. south of El Fula.
b	2	70	30	500	62	8	" 5 " " " "
c	3	85	15	1200	69	10	" 10 " east of El Fula near Wadi El Ghella.
Va	1	90	10	350	68	12	Undertaken midway between Baggara and Muglad.
b	2	87	13	380	71	10	Undertaken midway between Baggara and Muglad.
c	3	50	50	300	68	11	Undertaken between Muglad & Babanousa.
VI	1	95	5	640	42	6	Undertaken in Sibeha Ranch.

Summary for Vegetation Changes and Indicators of Degradation :

1. Although land around Lake Keilak is not intensively used, additional land is being cleared for cultivation, since villages around Lake Keilak are growing rapidly. Bushes of *Guiera Senegalensis* are spreading around villages in radii varying from one-half to one kilometer. Severely overgrazed land extends in a radius of up to two kilometers from the same villages.

2. Around old settlement centers such as Fula, Babanusa and Muglad, severe land use pressure occurs as a result of high animal densities and continuous cultivation. Heavy grazing radii range from two to four kilometers around these settlements. In addition, large scale destruction of trees has occurred because of a 50% increase in the amount of land cultivated (especially around Babanusa). Consequently, un-palatable plant species, such as *Cassia tora*, *Aida sarcofolia*, and *Acanthospermum hispidum*, dominate the immediate vicinities of the above mentioned settlement areas.

3. Because of heavy grazing, palatable perennial species of grasses and herbs, such as *Stylosanthes fruticosa* and *Andropogon gayanus*, have disappeared from the surroundings of main settlements.

4. Fifty per cent of the sandy pediplain in the triangular area bounded by Muglad, Babanusa, and Abu Zabad does not support grass or herb growth. This absence of vegetation could be mainly ascribed to heavy grazing in the wet season and to the impact on the soil of active wind and water erosion.

5. Destruction of vegetation by fire is another major agent of degradation within the study area, especially in heavy grass areas such as near Lake Keilak, and between Muglad and Bahr el Arab. For example fire destroys more than sixty per cent of the annual production of forage in Messeriya District.

6. Termites are also active agents in forage deterioration. They are concentrated in the northern part of the study area, around Babanusa and Fula. Their destructive activities are not limited only to grasses, but extend to trees in the poorer areas of Muglad and Babanusa regions.

7. In the Sibeha Settlement Scheme settlers are planting Acacia senegal upon fallowed lands. This is a healthy trend, since Acacia senegal will facilitate the recovery of land productivity. Because the scheme is new and experimental, it should be carefully monitored

Water Resources:

The availability and distribution of water plays a vital role on the distribution of the Humur population, their livestock, their agricultural activities and the pattern and routes of their seasonal movement. Water supply in the Humur area is derived from the following sources:

1. Underground-water sources
2. Surface water sources
3. Sub-surface water sources

Underground water:

According to the Geophysical Investigation of Underground water in Kordofan (1976), rocks taking part in the geologic structure of the Study area represent a highly variable environment in this respect of the circulation and accumulation of underground water, the variability is related to their lithology, structure and texture which are results of post geologic processes. The Geology of the Humur land allows to distinguish the following hydrogeological units: Basement complex, Nubian Sandstone Groups and Umm Ruwaba formation.

Fresh and unfractured rocks of the Basement complex do not represent a favourable environment for the flow and accumulation of underground water. Generally they are considered as impermeable except in areas of fissures and faults.

The Nubian Sandstone formation represents the most important aquifers in the Study area. They form continuous storage areas of a regional extent characterized by pore permeability. Marginal faulting is the decisive factor in the formation of dynamic reserves of underground water, while faulting in the centre of the basin play a negative role as it disturbs the continuity of the water bearing horizon. Water bearing properties of the Nubian Group depend on the presence of sandstones and conglomerates. Interbedded sandstones are imperoneable and represent a barrier for circulation of water.

The Umm Ruwaba formation is also favorable hydrogically and water accumulates in sands and Gravel which make it highly capable of water storage.

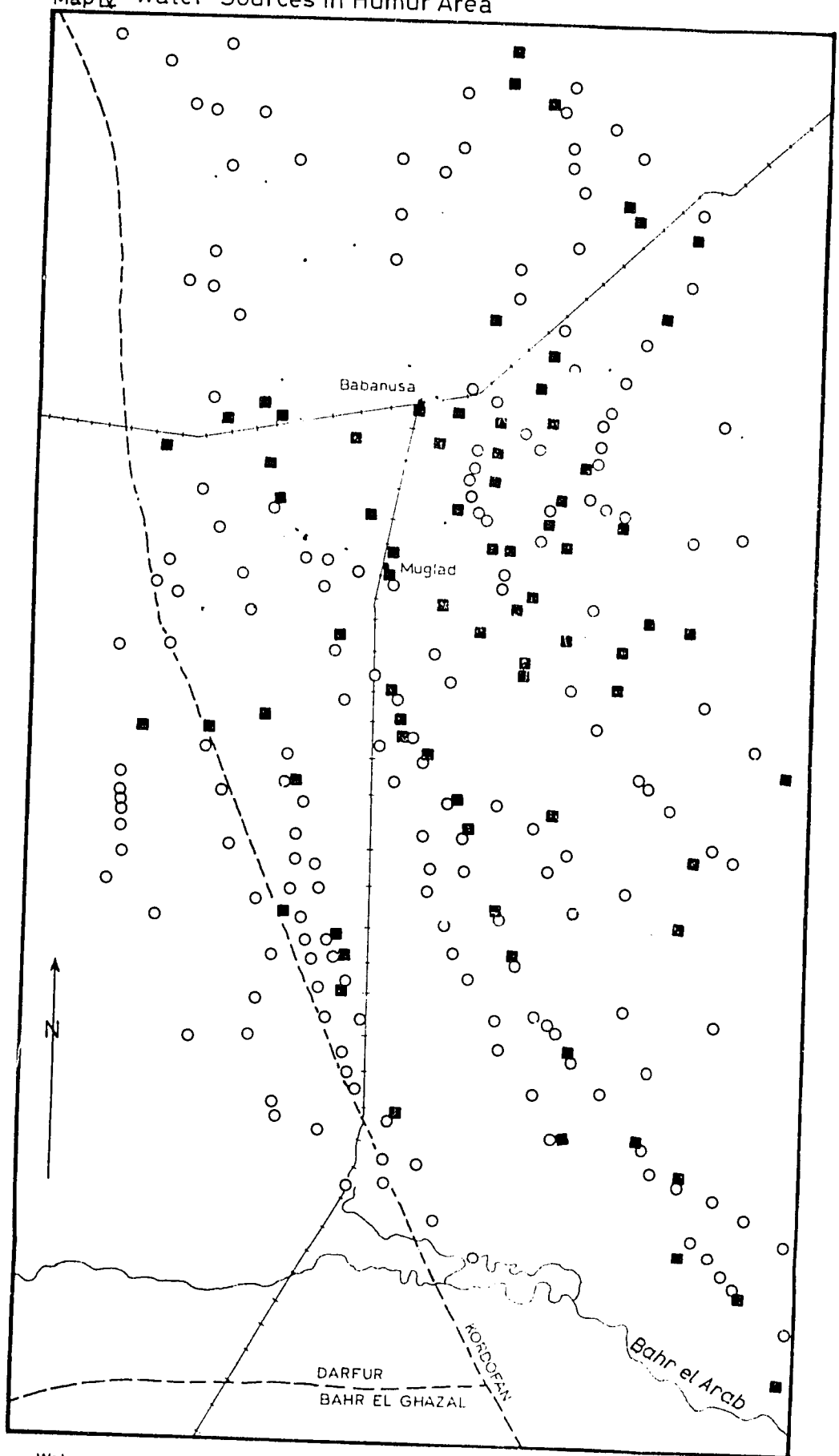
Development of underground water in the Humur land which is dominated by Nubian sandstone and Umm Rwaba formations started in 1927-28 when two boreholes were drilled in Muglad. Drilling of boreholes was discontinued since then but was restarted after the Second World War and proceeded at an increasing rate specially during the anti-thirst campaign in 1967. In fact fifty percent of the total 280 boreholes existing in the Humur area were drilled after 1967.

The spatial distribution of boreholes is dictated by the availablity of underground-water, types of landuse and population distribution. As map (IV) shows boreholes are concentrated along migration routes and in points of settled population specially larger urban centres like Muglad and Babanussa where twelve and six boreholes were drilled respectively.

Surface and Subsurface water:

Surface water is of varying degrees of quality and reliability. They consist of surface pools (Butas and Rahads), and seasonal streams and pernomial water

Map IV Water Sources in Humur Area



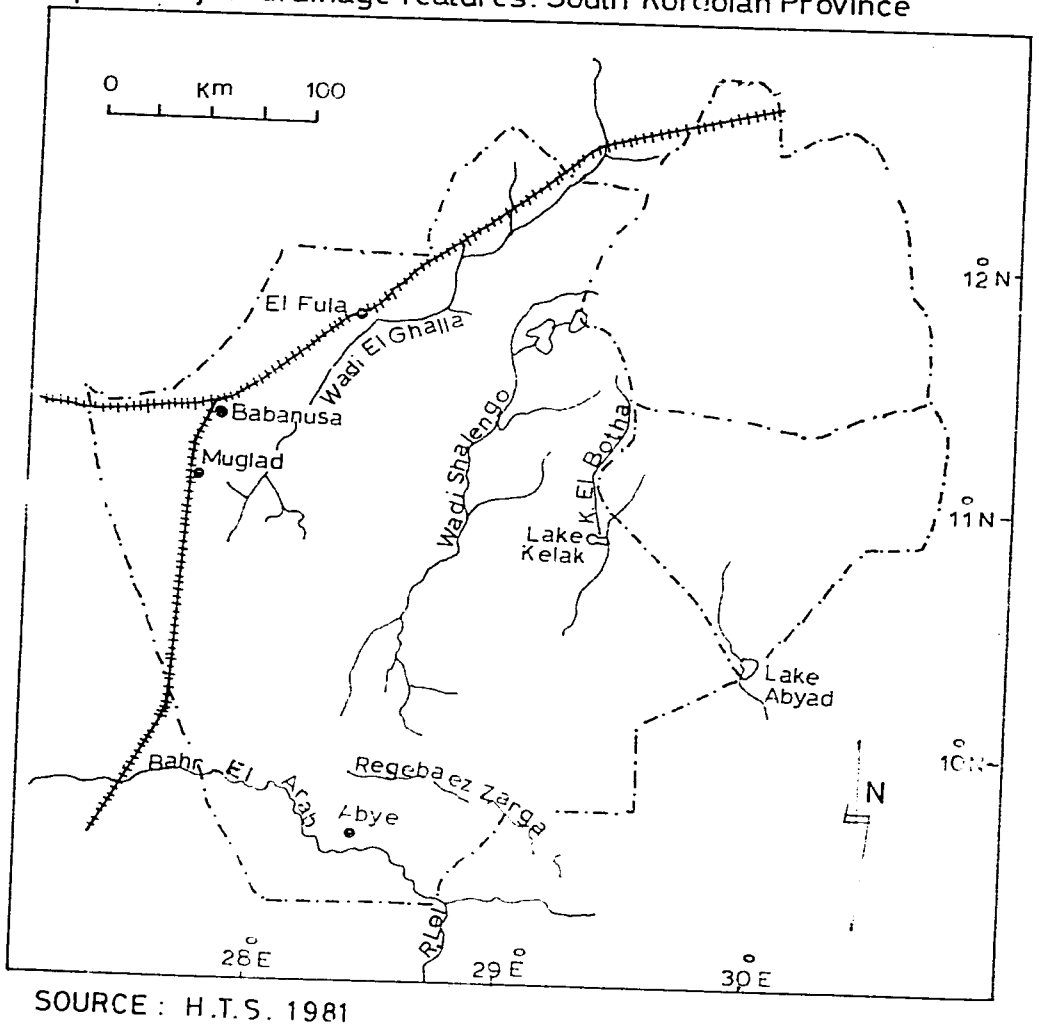
SOURCE : Savana Development Project

courses. Butas and Rahads are used for both livestock watering and domestic needs during the rainy season. They are usually short-lived but in areas of clay soil they may provide sources of water supply up to the end of December. Seasonal streams include Wadi Shellengo, el Ghalla and el Hagiz with high discharged during the rainy season. The main catchment area of these streams lies in the Nuba Mountains. Pernenial water sources are Bahr el Arab, Lake Keilak and the Ragabas (Map V).

Subsurface water is obtained from Jamams and hand dug wells. Jamams are shallow pits in the stream beds or pools which tap underground-water stored in sandy beds or banks of streams. This is relatively clean water and is used for domestic purposes only.

Domestic water supplies are also obtained from hand-dug wells sunk three to ten meters in the clay sediments of wadi-beds and their surroundings. They are most common in the central and eastern parts of the Humur land (HTS 1976).

Map V Major drainage features: South Kordofan Province



SOURCE : H.T.S. 1981

Utilization of water sources have no serious negative impact on natural vegetation and soils except in areas of nomadic concentration around major centres namely Muglad, Babanussa and Ettboun where indicators of change in quality and species are observed. This is attributed mainly to the misuse of land as a result of expanding cultivation besides overgrazing of pastures by nomads. Around seasonal water sources the intensity of pasture utilization is determined by the amount of water stored. As the amount of water is limited, it is observed that pastures are not overgrazed to the ground level leaving bare soils to be subjected to wind and water erosion. However, the degree of degredation around open water sources is relatively increasing as more and more camel owners (Hamar) from northern Kordofan come to spend the dry season in the Humur land.

Economy:

Economic activities in the Humur area are basically pastoral nomadism and subsistence farming. According to Cunnison (1966) the Humur before the

Mahadiya relied on livestock for most of their requirements and commitments and agriculture was limited to a very small scale. After the re-occupation of the Sudan the area has progressively been drawn into the cash economy.

Since then Agriculture began to expand. Expansion of agricultural activities among the Humr has been enhanced by the development of permanent water sources and the establishment of the railway line along which settlements emerged. However it must be mentioned that the Humr still prefer cattle husbandary to cultivation.

Pastoral Nomadism:

In this section some changes in Messeriya Humr nomadic systems will be considered in the light of recent environmental and socio-economic changes. Social indicators (in the form of changes in patterns of social organization) are evident and can be documented at length. At this point we are just making tentative and simple statements, but the actual situation is reasonably complex.

Cattle Movements and Migration Routes:

Fortunately, the pastoral system of the Messeriya Humr was studied and described in detail by Cunnison in the late 1950s. Cunnison's findings, when compared with present day data, help us detect any changes that have occurred in the system over the past thirty years. The necessity of adaptation to varying environmental conditions is an intrinsic part of the Humr pastoral management strategy. The specific response to these environmental conditions is adoption of a seasonal migration cycle that covers four ecological zones: the Babanusa, the Muglad, the Qoz and the Bahr. From the point of view of the Humr, seasonal cattle movements help them optimally utilize and manage their natural resource base. A combination of the presence or absence of the following factors determines the utilization of each region (zone) during a given period of the year; these are:

1) water; 2) grazing; 3) flies; 4) mud.

The Babanusa is a northern zone which is utilized during the rainy season. The Muglad is a transitional zone, south of the Babanusa, and contains most Messeriya

Humr farming. The Qoz is another transitional zone bordering on the Bahr zone. The latter zone is mainly utilized by herders in the dry season. According to this classification system Lake Keilak lies in the Bahr region and is therefore one of the most popular dry season grazing and watering centres. However it is not important only for its water resources, but also for services which are found there, such as a market, a dispensary, and a court.

In the fifties, herds were driven from the Muglad in December and reached the Bahr in early January. If there was enough water in the pools found at the edge of the Qoz region, herders usually deferred their herd's arrival at the large water sources of the Bahr region until the second half of the dry season. This strategy helped them make optimal use of the grazing and water resources of the Bahr.

With respect to the north-south movement of Humr herdsmen, one can say with confidence that some vertical adjustments have taken place. For example this year we met a group of herders near Keilak who claimed to have arrived there by the

beginning of October. Moreover, they started to graze near the lake at a time when there was still water in the Ragabas south of Keilak. This change in herd movements was engendered by the increased number of animals brought to the lake, especially after the arrival in the area of the Um Bororo and their large herds. (The Um Bororo are a West African pastoral group). Because the Um Bororo do not cultivate, they quickly move southwards after the rains in order to gain the advantage of being the first to utilize the green pastures near water sources in the Bahr region. The Um Bororo are therefore imposing new demands on the existing system, compelling the Humr to readjust the timing of their herd movements if they are to remain competitive.

Considering the fact that the average number of days spent by the Humr in each region in a complete year used to be as follows (Cunnison 1966) :-

The Babanusa ..... 72 days

The Muglad .....102 days

The Qoz ..... 49 days

The Bahr .....142 days

it becomes clear that the number of days now spent in the Bahr will have been increased by about three to eight weeks (varying for the different grazing units). One can imagine the adverse effect this change could have on the pastoral system in general, and the Bahr region in particular. The Bahr region is no doubt one of the areas that will need close monitoring, since it undoubtedly will undergo significant environmental change.

Other minor adjustments in herd movements have also taken place. Watering points and the so-called "nomad settlement schemes" in the Muglad area have enticed some herders (those with few animals) to stay in this region during the dry season, thus saving themselves the trouble of going to the Bahr. The tendency to adopt this strategy has been frequently observed in the Baggara scheme area. (This scheme lies on the Fula-Muglad road). One of the factors which made such an alternative acceptable to some has been the security risk they would otherwise have encountered in the Bahr. Tribal tensions there often end in fights that result in deaths. However, the current fuel shortage has rendered this more

sedentary alternative a very risky one, since motor--driven well pumps are often shutdown for lack of fuel.

Migration of different Humr tribal sections still follows the same general east-west routes (Map VI). The Ajaira follow the western routes and the Flaita use the eastern routes. There are only a few instances where horizontal adjustments in cattle routes (marahil) have taken place. Tension between the Fagyarin section of the Ajaira and the Maaliya tribe of Darfur has led to the Fagyarin shifting their murhal eastwards.

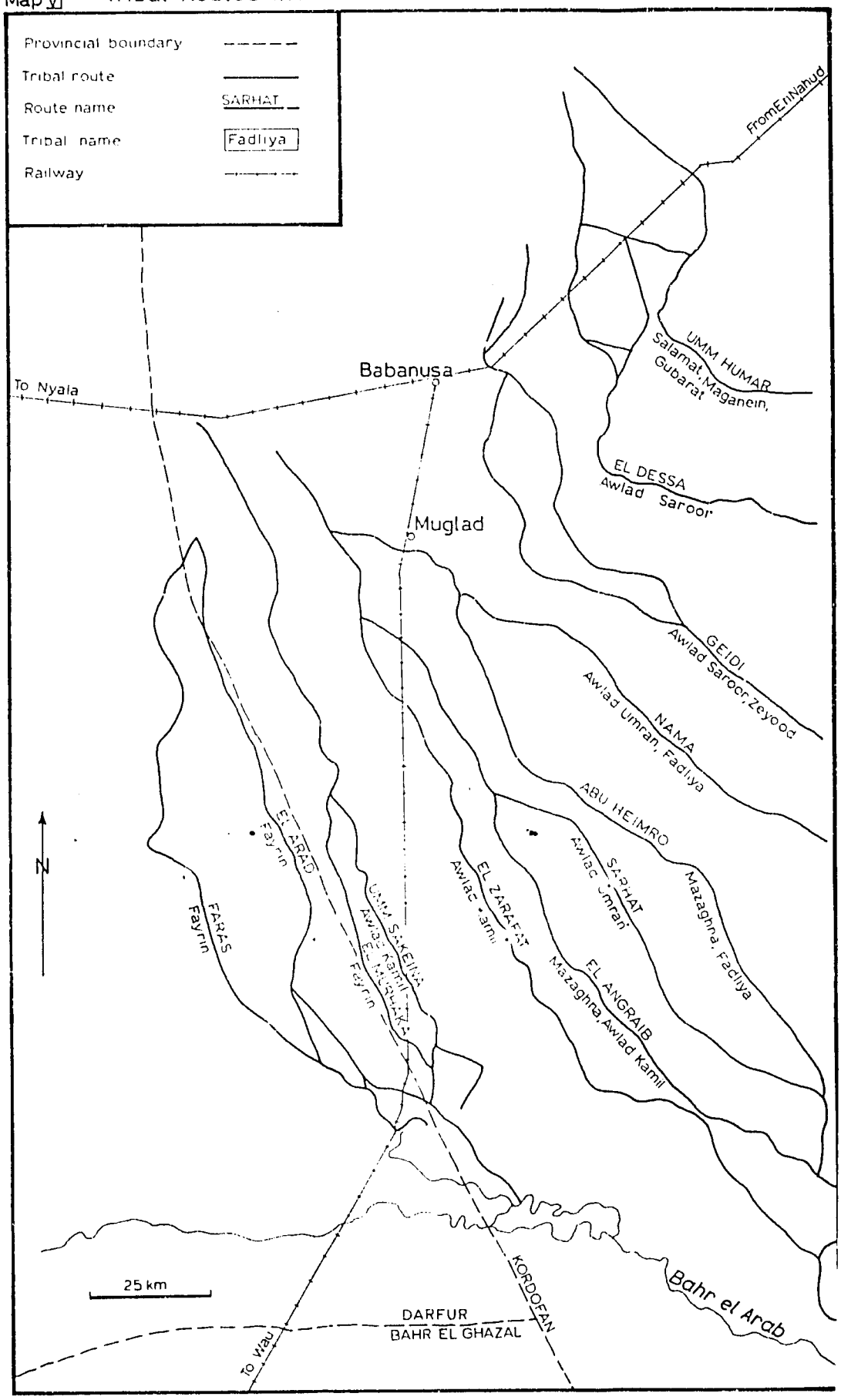
2. The Interplay Between Cultivation and Pastoral Nomadism. (The Tendency Towards Transhumance)

Traditionally cultivation has been second in importance only to pastoralism within Humr society. However, formerly not all people within the society cultivated, and those who did so were subsistence oriented. Cotton was introduced before the 1950s, but because its diffusion was limited, did not alter the subsistence nature of Humr cultivation.

Today, many changes have taken place in the Humr agro-pastoral system. Table 3 shows the range of

45a

Map V Tribal Routes in Humur Area



SOURCE Savana Development Project

crops cultivated by a sample of twenty settled farmers from Keilak village.

Table 3

Crops cultivated by settlers around Lake Keilak

Crops	Number of farmers who cultivate
Cotton	2
Dura (sorghum)	19'
Dukhn (bullrush millet)	12
Groundnuts	7
Sesame	11
Kerkade (hibiscus)	2
Vegetables(tomatoes & okra)	3
Rice	3
Bafra (cassava)	3
Maize	3

It is clear from Table 3 that sesame and groundnuts are the third and fourth most frequently cultivated crops, respectively, after the two staples (dura and dukhn). The obvious conclusion that can be drawn from the above table is that for a considerable number of farmers cultivation of cash

crops is becoming increasingly more important.(However, cotton cultivation actually decreased around Lake Keilak, primarily because of management problems faced by the Nuba Mountains Agricultural Corporation). Total area cultivated by each farmer has increased as a result of greater emphasis on cash crops. For instance, nine of the farmers interviewed admitted to having, over the past ten years, increased the total area they cultivate.

Some farmer nomads indicated that the rising price of dura has made it difficult for them to rely on sale of animals to obtain money for subsistence needs, without seriously depleting their herds. (Every pastoralist in Sudan seeks to avoid seriously depleting his herd). In Um-Janah (south of Keilak) we met a 30 year old man who started to cultivate for the first time in his life in 1981. This man acknowledged that he began cultivation in order to give his herd the chance to increase.

Another important observation we made, was to observe the spread of agricultural activities around Lake Keilak. In the past cultivation was limited within the Behr region, since most farms were in the

Muglad zone. Today many people cultivate in the vicinity of Keilak. One obvious advantage with this arrangement is that households do not have to wait until harvest time in the Muglad before they can move southwards.

Cessation of the need to migrate is especially important for those households who cannot afford, because of insufficient labor, to operate two distinct production units.

Utilization of Dinka (and now also Nuba) wage labour is becoming more common. About thirty per cent of the farmers interviewed in Keilak village employed wage labour during the past agricultural season. Increases in the production of groundnuts and sesame could well stem from this addition of wage labor to the production process.

The conditions described favor the continuation of a mixed economy, rather than a pure pastoral nomadic one in the area. (In any event pure pastoralism was formerly practiced by only a small number of households). But the most important aspect of the new conditions is the spread and increase of

cash crop production. One immediate impact upon the pastoral system of this trend toward cash crop farmig is the local decrease in the amount of grazing land. Today many disputes brought to court in Keilak concern the damage done by animals to crops.

The two aforementioned trends of (1) spending the dry season around government-provided water sources in the Muglad zone and (2) cultivation of fields in the Bahr have transformed the pastoral system from a nomadic one to a transhumance one. However this is only a tentative observation which will need further qualification in the light of better data. And it should not be taken to mean that transhumance strategies were not utilized in the past within the Humr pastoral system. What is suggested is that formerly pastoral nomadism was the more dominant strategy.

3. Nomadic Competition in the Keilak Area:

Keilak is one of the largest areas witnessing concentration of pastoral activities during the dry season. Concentration around the lake is not a new phenomenon, for it existed at the time Cunnison wrote.

There are certain groups which historically exploited the pastoral niche around Lake Keilak. Dry season grazing areas in its vicinity have always been carefully divided among different groups. The Zurg mainly utilize Lake Abyad and share it with Awlad Serur (Humr). The Ajaira utilize the Bahr al-Arab, while the majority of the Flaita are encamped at Lake Keilak, with smaller numbers at Abyad and Bahr Al-Arab. The dominant groups at Lake Keilak have always been two sections of the Flaita, the Salamat and Jubarat. Although they are not welcomed by the other groups, the Ghazaya section of the Messeriya Zurg also spend the dry season in Keilak.

In December 1981 fighting took place between Humr and Zurg herdsmen south-east of the lake. We were told that fighting near the lake is essentially a yearly business. As a consequence of hostilities, some households from A. Serur(Humr) have abandoned Lake Abyad and resettled near Lake Keilak.

Ideally the Baggara utilize sources of water and grazing in those Regebas (water courses) which are not near the main dry season water sources. As the

dry seson approaches, animals can only be watered at Keilak. However, this alternative is resorted to only reluctantly, since, as the following examples show, it adversely affects animal well being. First of all, the concentration of large numbers of animals around a single water source increases the possibility of disease transference between herds. Second, in the latter stages of the dry season water in the lake gets extremely muddy and becomes unhealthy for both human and animal consumption. Third, grazing resources become very scarce near Keilak. This means that animals have to travel longer distances in their journey from pasture to sources of water.

All these difficulties are aggravated by the fact that during the last decade nomadic competition over the natural resources of the Lake Keilak area has increased. Not only is this reflected in the increased tension between Humr and Zurg sections, but also, on a larger scale, in the open hostility of the Arabic tribes with the West African Um Bororo. The use of firearms in these clashes makes them extremely bloody.

Thus, two main factors probably account for the increased nomadic competition around Keilak. The first is a large increase in animal production in the area. (This increase results from the operation of many factors). (See also table 4). The second is increase in tribal conflicts between the Humr and the Dinka along the Bahr al-Arab in the Abyei area. Because of increased conflict many Humr households have refrained from spending the dry season along the Bahr al-Arab. Keilak, therefore, became the alternative dry season range for these people.

TABLE 4.

Reasons for current problems over grazing resources, Um Janah interviewees

Lack of water	7
increased animal numbers ...	7
fire	3
low rainfall	3

4. The Encroachment of West Africans:

The presence of West African people in the Lake Keilak region dates back to the early 1950's. These people are of two origins:

(a) First they are sedentary cultivators who now constitute between one-quarter to one-third of the

population of Keilak village. Forty years ago there were only two or three families of West Africans in the area, but new arrivals from West Africa quickly integrated themselves with the original settlers. West Africans now occupy residences just east of the market. More recent West African immigrants settled in a newer part of Keilak village. This extension, called Boboya, is separated by fields from the original village. Founded some thrity years ago, Boboya is now completely occupied by sedentary West African cultivators. These people are of the Hausa, Melle, and Barno ethnic groups.

West Africans have introduced new crops such as rice, bafra, tomatoes, and maize into the Lake Keilak area. They also engage in fishing-and monopolize commerce at a dry-fish market. Some of them are also engaged in petty-trading. (in fact, at least half of the shops in Keilak market are run by them). Other important economic pursuits for West Africans are cash crop cultivation and trade in agricultural produce.

(b) The second group of West Africans in the Lake Keilak area are Um Baroro pastoral nomads.

(The Um Baroro are a nomadic tribe belonging to the Fulani nation). If any social organization exists that could be described as pure nomadism, Um Baroro organization would be it. Although records indicate that the Um Baroro visited Keilak during the days of British Administration in the Sudan, there is no evidence that the same households which formerly roamed the Dar Messeriya frequent it today. In fact Um Baroro households usually stay in the area for a few years and then migrate towards the east. (Today some Um Baroro graze animals east of the Blue Nile). It is difficult to determine whether Um Baroro pastoral movement is cyclical or a constant movement eastwards. This type of movement is, of course, not new in the history of the Sudan. For example, the Baggara Arabs followed the same general route in their migration to Darfur and Kordofan.

In conclusion it must be stressed that West African groups are competing with local populations for the limited resources of the Dar Messeriya. If this continues beyond reasonable limits, it may result in increased friction and eventually in open

hostilities at a level that cannot be predicted. Another point worth mentioning here is that the number of new arrivals (both sedentary cultivators and nomadic pastoralists) from West Africa is increasing. Thus, about half the West Africans we interviewed had spent less than ten years in Humr country.

5. The Causes and Effects of Labour Migration in Dar Messeriya:

Labour migration from Dar Messeriya to central Sudan has had a long history. A dramatic increase in the rate of this migration took place in the sixties. In addition this was the period when many young men wanted to join the army. Finally Messeriya youth were among the first to respond to the increasing number of job opportunities available in neighbouring countries.

While the causes of labour migration are generally of an economic nature, it is difficult to say with certainty at this time which environmental factors in Dar Messeriya have supported this trend. It is aways safe to assume that the labour requirements of a pastoral economy are less than the available amount

of labour. Hence, to supplement household income, excess manpower could be released from the pastoral sector in order to perform local agricultural sector tasks, or wage labor tasks outside the region. But, as stated earlier, cash crop cultivation has only recently flourished in the region. Thus, Messeriya youth have only been able to obtain supplementary incomes by working in central Sudan. The present boom in the Muglad job market (because of the discovery of oil locally) has initiated a reversal of migration direction. If we consider that the oil companies alone employ about one thousand workers, and that many other local jobs are indirectly created as a result of oil exploration, our argument about reverse migration can be acknowledged as not far fetched.

Migrants, on the other hand, also contribute directly to the Messeriya economy. Of the twenty persons we interviewed at Keilak, five admitted receiving regular money from relatives working in Khartoum. It is clear that the other people receive remittances, but not on a regular basis. In addition,

migrants send money to their relatives so that the relatives can buy animals for the migrant. Every young Messeriya migrant has two general aims: (a) to get married and (b) to be able to purchase more cattle. During our trip many stories were told to us describing fierce competition in cattle buying between local youths who had returned from working in Saudi Arabia.

This single-minded investment strategy has now been altered to some extent by a trend toward investment in petty-trading and service industries (i.e. transport, restaurants and so forth). But it will take some time before the cultural preference for investment in cattle is changed.

Meanwhile, the effect of the present investment trend upon the environment cannot be neglected. First of all, it helps generate an increased population of animals in the area, which, as we indicated earlier, puts further strain on local natural resources. Tracing the exact contribution of migrants to the pastoral economy with a small sample household survey would be an interesting exercise. But more than that, an intensive

investigation of this matter would enable us to determine the effect labour migration has on environmental change. More precisely it would allow us to look at the interrelationships between labour migration and environmental conditions.

6. The Use of Camels and Carries:

The presence of camels in the area (functioning as beasts of burden) is an innovation that warrants some consideration and discussion. The long term implications of this experiment are difficult to foretell. However, one possible repercussion from this experiment may be that the camel herders from Northern Kordofan will extend the boundaries of their operations further south. (Already the Humr spend the dry season in Baggara country). If Northern Kordofan camel herders actually extend their operations southward, the present pattern and degree of nomadic competition within the Lake Keilak region will probably change. Further stress on the natural resources of this zone will aggrevate the present situation and result in further tribal tension and environmental deterioration.

Lorries are also being used to carry household luggage to and from dry season camps. While use of lorries does not affect the pastoral system directly, it certainly opens up possibilities for non-pastoral exploitation of the environment. However, this development is dependent upon establishment of good roads in the area. We have noticed that the demand for roads was given second priority by those questioned about primary local needs. (see Table 5).

TABLE 5

Primary Needs

Service Needed:	Number of persons interviewed with a positive response
Water	16
Roads	13
Hospital	6
School	5
Police Station	3
Rural Council	2
Fishing Licenses	1
Agricultural Schemes	1

(It is important to note that the demands for a police station, fishing licenses and agricultural schemes were all made by West Africans).

If we consider the fact that Humr cattle cover about 200 miles between dry season (Bahr) and rainy season camps, one can anticipate the future possibility of using trucks for transporting animals over this distance. Presently utilization of trucks is constrained by bad roads and expensive fuel. Nevertheless, with prospects of oil just round the corner, such a possibility may not be far-fetched.

The use of camels and donkeys (donkeys are also today more frequently used) in the Bahr region is something that requires further investigation from the ecological perspective, since the Bahr environment is known to be inhospitable to both types of animals.

7. Management Strategies and Attitudes in Relation to Animal Types and Numbers :

With more involvement in the cash economy, the Messeriya Humr have adopted a new strategy regarding herd composition. According to local interviewees, the proportion of small animals (sheep and goats) in herds has increased significantly. The main reason given for this increase is that selling a small animal is always an easy decision and does not affect the owner's wealth, since the rate of increase of

small animals is double that of cattle. The types of goods and services required by nomads has also changed, and today more cash is needed in order to satisfy these requirements.

By and large cattle are still the favourite animals to keep, and he who saves some money will invest it in cattle. The diversification of animal wealth is, therefore, not intended to be at the expense of cattle. A group of those interviewed near Al-Fula expresses the old time Humr attitude by quoting the following proverb:

> "The ploughman died and the trader died, but the world remains for the cattleman."

This saying is, of course, the expression of a still prevalent pastoral ideology. However, it is not implied here that people remain pastoralists only because of cultural preference or ideology. Ideology is rather used as a justification for the strategies made in management of the pastoral economy. Such strategies are based on realistic considerations of the local environmental conditions (i.e. the economy in the wider sense).

As mentioned earlier, camels have been introduced in the area as beasts of burden. On the other hand, donkeys are becoming more popular, probably as a substitute for horses. They are used for individual transportation. The disappearance of horses is an expression of social and environmental factors. In the past, tribal raids were common and the horses played a very important role in them. Today, although tribal fights do take place, the use of firearms has made the old style of raiding an obsolete tactic. Horses were also used in giraffe hunting in the past. This activity was a social institution in and of itself. To prepare for it youth of the tribe constantly engaged in training. The initiation to youth-hood, also known as warriorship, was linked to giraffe-hunting. Without question, the folklor of giraffe-hunting is one of the richest of Humr oral traditions, for it symbolizes the glory of the past.

Today, giraffe have disappeared from Dar Messeriya. (Their total number in the Sudan has also decreased significantly). It goes without saying that the disappearance of giraff is a result of social (excessive hunting) and environmental (changes in the

ecosystem or niche) factors. Because of their deadly efficiency, the introduction of firearms has been critical factor in the extermination of the giraffe population. Other factors, like a modification of the climate (i.e. extended drought and an increase in total population of animals on the giraffe's range) have led to the withdrawal of the giraffe to more southern pastures.

Returning to the issue of types of animals kept by the Humr, it is evident that most people own cattle, sheep and goats. But many of them also own camels and donkeys. In Um-Janah, interviewees, in answer to the question of what types of animals they keep, indicated the following pattern:(Table 6).

TABLE 6

Animals Kept by Humr Pastoral Nomads

Type of Animal:	Number of Pastoral Households herding it.
Cattle	8
Sheep	8
Goats	8
Camels	5
Donkeys	3

In regard to total numbers, there is no doubt that the overall livestock population is increasing. Whether this is a result of improved health and water services, or a result of individual household responses to basic economic factors (shaped by wider environmental conditions) is difficult to ascertain. It is safe to assume that both factors are involved. Also remaining to be investigated is whether the total increase in animal numbers is simply an expression of increases in human population and household units or, in addition, a sign that the number of animals per household has increased. The Humr argue that lack of water and increases in animal populations are the main factors leading to grazing problems.

Nomadic Settlement Schemes in the Messeriya Humr Area:

In 1969 eight area sites (see Table 7) were selected as appropriate for development of nomadic settlement schemes. Development is based primarily on providing water supplies to a group of nomads selected to settle on a 100 square kilometer reserve. Settlers are expected to remain on the site year-round and are restricted as to the number of animal units they can graze on the reserve. While the

concept seems to be attractive, the site selection and planning processes for the schemes were poor and this led to the closure of four schemes by 1981. (The closed schemes are: Al Hajiz, Targialla, Buta and Um Dagig). The remaining four are not without significant problems which lower their performance. Table 7 summarizes some of the main problems which face these schemes. No doubt these problems are planning and implementation problems.

Although these schemes are welcome as measures for improving social and economic conditions of pastoral nomads, with poor management they engender severe deterioration of surface vegetation. When this happens, as at Buta and Al Hajiz, the schemes are abandoned.

Table 7.

Problems of Settlement Schemes in Babanusa Area

Name of Settlement Scheme.

Problem Confronted	Al-Hajiz.	Al-Haddadi	Buta.	Kilbat.	Baggara	Sibeha	Um Dagig.	Targialla
1. Lying across traditional migration routes.	X	X			X			
2. Railway line close to site.	X		X					
3. Main truck road crossing site.	X		X					
4. Pools (traditional water sources) inside site.		X	X					X
5. Problems with government constructed water points inside site.	X	X	X	X	X	X	X	
6. Animals seek refuge from flies inside site.				X				
7. Tribal conflicts (Local politics).							X	X
8. Fires	X	X	X	X	X	X	X	
9. Conflict over grazing rights.	X	X	X	X	X	X	X	
10. Conflict over land-owning rights (agricultural land).	X			X				
11. Locals not conviced of the value of the scheme.				X			X	X
12. Poor plant cover.			X					

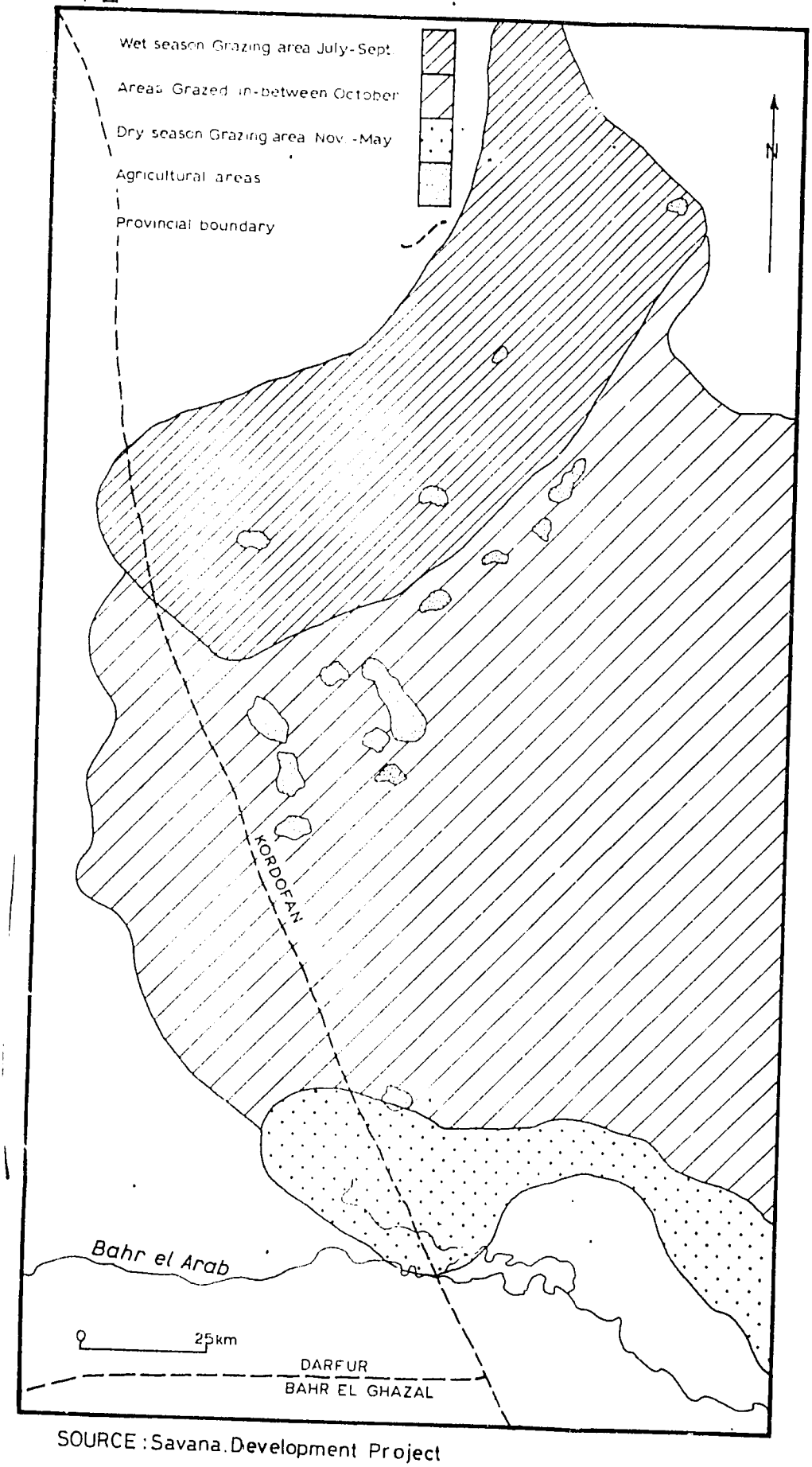
Agricultural Activity:

Two types of farming activity can be identified in the Messeriya Humr area: a) Farming by pastoral nomads, and b) farming by settled Humr and other minority groups. The two types are different in terms of land requirements, crops grown, and degree to which farming activity is relied upon to meet subsistence needs.

As mentioned in the previous section, farming by pastoral nomads has the following characteristics :

1. It is mostly geared for subsistence food needs. Therefore, crops grown are mainly Dukhn (bullrush millet) and okra.
2. Cropped areas are generally small and range in size from two to ten Mukhamas.
3. Traditionally, land was cultivated only around Muglad. However, in recent years expansion of cultivated area has occurred on sandy and clay soils near most permanent settlements of the area (Map VII).
4. On the clay soils Werig (fire) cultivation has become well established.
5. Farming by pastoral nomads is often abandoned when it interferes with the needs of the nomadic

Map VI Pattern of Pastoral & Agricultural use in Humur Area



SOURCE : Savana Development Project

system or when it generates sufficient capital for livestock investment needs. At least twenty per cent of people surveyed claim to have stopped farming once their herds reached sufficient size to require their full attention.

This episodic pattern of farming is still dominant among pastoral nomads, but provision of permanent water sources along traditional stock migration routes and in the makhraf (rainy season grazing areas) has led some nomads to consistently produce crops for the market. In fact, permanent water sources have encouraged many pastoral nomads to settle in villages and expand their farming activities. This phenomenon has led to a new division of labour within nomadic families. However, the new division of labour has been designed in such a way that different tasks complement each other and help maintain mutual links between the settled and mobil factions of the family. As such when nomadic settlers expand their cultivation areas, they begin to grow commercial crops such as groundnuts, sesame and Kerkade in addition to subsistence crops like Dukhn and Marig (dura).

Agriculture practiced by settled, non-nomadic people is of two types: 1) rain fed Qoz cultivation and 2) irrigated or non-irrigated cultivation on Wadi banks.

1. Rainfed Qoz cultivation has the following characteristics :

   a) Size of areas cropped ranges from five to twenty Mukhmas, and in a few cases may reach 100 Mukhmas. From interviews we discovered that at least one per cent of farmers around Muglad, Babanusa, and El Fula cultivate 100 Mukhmas. The majority, however, cultivate between three and five Mukhmas of peanuts and two and five Mukhmas of Dukhn. Those farmers growing Kerkade usually grow between two and four Mukhmas of the crop.

   b) Emphasis in the Qoz is on cash cropping. Credit for cash cropping is furnished from household savings or from Sheil loans obtained through local merchants.

   c) Most farmers, whether pastoral nomads or settled cultivators, maintain some livestock around villages all year round. From interviews it can be estimated that settled families own (on average) 20 head of cattle and 15 head of sheep. With reasonable returns from the sale of crops, future averages will increase, since an investment in animal wealth is both highly regarded and the only feasible alternative available.

2. The second type of settled farming is usually practiced within and along the main Wadis which flow through the area, and near large settlements. Within the region the growth of urban population in the last 20 years has created a market for fruits and vegetables. These items are produced from fields lying near the banks of Wadis. In most cases no irrigation is required for sustaining fruit trees (mangos and citrus) wherever the water table lies at a reasonable depth. Such settled farming along wadis has resulted in :

a) Competition between settled farmers and pastoral nomads over watering sites. (This competition often leads to bloodshed).

b) Movement of experienced West African farmers into these high potential areas. The presence of West Africans provides an ethnic dimension to potential resource conflicts.

c) Evolution of a system of land tenture based on private land rights. Although for all practical purposes land is privately farmed, as of yet the government has not officially registered land to individuals.

d) Where water pumps are installed underground, water levels often drop. This threatens shallow well users in the vicinity of such pumps. Few government controls or regulations govern the installation of pumps.

Farming and Environmental Relationship:

As a subsistence activity, agriculture has always been of secondary importance to pastoral nomadism within the area. In a form well-fitted to their mobil behaviour, some Messeriya pastoral nomads have always practised some form of cultivation. Of course, areas cropped have always been small and crops grown have emphasized subsistence needs.

With introduction of cotton in the eastern clay soils west of El Fula in 1924, the Messeriya Humr area entered an era of organized commercial agricultural production. However, in the early years farmers did not readily grow cotton. Cotton demanded substantial amounts of labour and its cultivation was more laborious than cultivation of traditional crops. A water provision programme begun in late 1940's was effective in enhancing the acceptance and expansion of cotton growing.

During the 1960's many new settlements emerged along a newly established railway line that passes through the Messeriya Humr country. This line connects central Sudan to the western and subsequently the

southern parts of the country. Services offered in these new settlements attracted many, particularly those who had lost their herds and had no real option except to become sedentary. Equally important, markets were developed in these centres. Markets encouraged the evolution of a cash economy in the area. As a result, farming began to expand around these settlements. For example it is estimated that the amount of cultivated land around Muglad and Babanusa increased by over 50% between 1969 and 1981. This expansion was encouraged from the demand created by these settlements and the favourable crop prices that prevailed after 1973. New settlements, in areas priviously inaccessible to man, grew up around permanent water centres established during a remarkable (late 1960's and early 1970's) expansion of government-provided water services to the area.

A consequence of the functioning of these processes has been the clearance of forests for farming purposes. Fire has been the main agent used for clearing land, particularly land in those thickly vegetated regions which overlie clay soils. Both manual and fire methods of clearing land have contributed to the

destruction of substantial amounts of forest and grazing vegetation within Humr country.

Traditional agricultural practices do not include utilization of inputs to improve soils or fields. These factors, along with the shifting nature of much traditional agriculture, help increase pressure on the resource base.

Fields are generally abandoned every five to six years and new cultivation sites are cleared. As the old sites begin to be overworked, they become overrun by Gibeesh. The formation of extensive rings of Gibeesh around settlements indicates loss of soil fertility on those sites. The most spectacular spread of this plant has been around Babanusa where it forms a circle no less than three kilometers in radius. (Gibeesh's dominance in this zone is the result of overgrazing as well as overcultivation).

Low yields of crops grown in the area are common. They encourage farmers to reduce rotation cycles and, whenever possible, shift to new sites. (For example, sorghum yields on average four sacks of grain per acre, millet one and one-half to two sacks per acre,

and groundnuts five to six sacks per acre). Some of the farmers interviewed reported cropping their fields for only one year before shifting. Later they cleared new sites using the least expensive method - fire. Of course the repercussions of these highly exploitative farming techniques are serious and endanger the vegetative cover and soils of the Messeriya Humr region.

Urbanization and Its Environmental Relationship:

Until 1955/56 Muglad was the only settlement classified as an urban place in the Messeriya Humr region. Its total urban population at that time was 4025. By 1964/65 two new settlements emerged (see Table 8). Babanusa and El Fula had increased the urban population of the region to 15,932, giving an increase in the urban population of approximately 300% within ten years. In 1973 and in 1981 the number places classified as urban remained constant, but the total urban population increased to 24,277 and 51,100 persons, respectively. Between 1955/56 and 1981 the urban population had increased seventeen fold.

It can be argued that the present urban population is small compared with available resources. This would be the case if the surrounding land, wood and range resources were utilized rationally. However, from group field observations and previous studies it has been established that areas immediately around these settlements have suffered the most resource degradation within the Messeriya Humr region. The nature of urbanization in the region is certainly different from that in other parts of the country. Most urban migrants, until very recently (late seventies), were engaged in primary types of production <u>within</u> the urban area, since towns rarely offered them sufficient numbers of wage jobs or opportunities. Emphasis on primary production has increased the density of animals in such localities, (since most migrants from the region brought their animals with them) and has boosted the amount of wood cut to use in building homes for new comers. Between seventy per cent and eighty five per cent of buildings in the towns are constructed from grass and wood. Very heavy use is made of <u>Dalbergia melanoxylon</u> and <u>Anogeissus leiocarpus</u> wood in construction. Because

of heavy usage, these tree varieties are disappearing in the vicinity of towns.

Equally significant is that a recent commercial boom, engendered by the discovery of petroleum in the region, has led to increased commercial building construction and home improvement. Since red bricks are heavily used in this new construction, many new brick ovens have been built. For instance, in Muglad area the number of red brick burning ovens increased from two in 1975 to about twenty in 1980. Each oven produces about 80,000 bricks and uses about 2.3 tons of wood per year. Therefore, the total amount of wood used for brick burning in Muglad alone would total about 44 tons annually. It is possible that within the region 100 tons of wood are consumed annually to produce red bricks. Of course the boom created by the discovery of petroleum will continue to expand the construction of structures. Concomitantly, the accelerated consumption of red bricks will increase the clearance of forests.

Development of towns also increases per capita energy use. Migrants learn to cook differently and use new food varieties which require more energy in

the cooking process. Many energy consumptive industries and services also are developed to cater to the needs of the people. Charcoal and wood are widely used in Messeriya Humr towns and represent over ninety five per cent of the total amount of fuel consumed in cooking. Trade in charcoal is expanding and, for example, Muglad currently has about twenty charcoal dealers, while in 1975 it had only six. Other towns experience the same situation, and consequently increasing stress is placed on nearby forest resource

TABLE 8

Populations of Towns in the Humr Region

Town	1955/56	1964/65	1973	1981 *
Muglad	4,025	4,709	6,932	26,000
El Fula	--	4,131	5,294	7,000
Babanusa	--	7,092	12,051	18,100
	4,025	15,932	24,277	51,100

Source: First Population Census 1955/56, Population and Housing Surveys 1964/65, Second Population Census, 1973.

* 1981 figures are estimates.

Some Environmental Implications of the Babanusa Milk Factory:

The Humr country was selected by the government for establishment of a milk dehydration plant. The plant was constructed in the early 1960's and had the following four goals:

1. to improve the regional economy
2. to expand cash transactions among pastoral nomads
3. to encourage nomads to settle around the plant
4. to use resources otherwise wasted.

Although the factory has not been successful economically, it has produced many social and environmental changes. These changes still await full investigation.

Economically the factory was unable to operate efficiently because of poor handling procedures and milk shortages. Table 8 shows that a sizable proportion (sometimes over 60%) of milk is spoiled and becomes useless before it reaches the factory. The table also indicates that the working season for the factory can be as short as 19 days. Milk shortages and lack of spare parts are mainly responsible for the short working season. The factory is designed to

process 50 tons of milk a day. However, rarely did it average four tons for any working day over the period 1968/69. In 1979/80 the factory stopped producing all types of milk products, except powdered milk.

TABLE 9.

Milk Received in Babanusa Milk Factory for the period 1968/69-1977/78

Year	Total work days of factory	Unspoiled milk, in kilograms	% of unspoiled milk to total amount of milk received.
1968/69	154	131,900	73.4
1969/70	157	119,845	49.0
1970/71	88	137,194	37.4
1971/72	91	284,271	55.8
1972/73	82	614,852	69.4
1973/74	72	704,808	58.8
1974/75	85	517,077	83.0
1975/76	37	371,254	81.1
1976/77	19	86,620	76.7
1977/78	21	80,585	69.7

Source: Babanusa Milk Factory, Babanusa

Table 10.

Kerkede Received by Babanusa Milk Factory for the Period 1969/70-1979/80

Year.	Quantity in Kilograms
1969/70	790
1970/71	340,178
1971/72	179,000
1972/73	498,000
1973/74	173,076
1974/75	146,000
1975/76	---
1976/77	60,644
1977/78	56,041
1978/79	133,867
1979/80	72,790

Source: Babanusa Milk Factory, Babanusa.

The factory has be ctive in the effort to provi'e water points in the Humr country. The water development in the late 1960's had three objectives: 1) facilitating nomadic movement, 2) expanding milk production, and 3) encouraging settlement in the Dakraf (rainy season areas). As a result of water development, new rangelands were opened and some settlement has occurred, both around water points and close to the factory. The actual size of this settlement near the factory has not been fully determined. However, it has grown at a remarkable rate, much more quickly than at any time prior to the establishment of the factory.

The increase in water supply points and amount of usable rangeland facilitated growth in livestock numbers (especially sheep and cattle) in the area. Thus the usual process of overstocking and eventual overgrazing was begun as well. Unfortunately, increases in cattle numbers did not improve the factory milk supply situation. Humr cattle are generally poor milk producers, averaging three pounds of milk per year. Many cows start production late in life, or never produce milk.

To improve the economic performance of the milk factory, processing of Kerkade (Hibiscus sabdariff) (see Table 10) and gum Arabic (into powder) was begun. Consequently the production of Kerkade boomed in the area; Kerkade became part of the crop rotation in places as far south as the Maram. Most settlers around the factory, and particularly in the Ettboun area, increased the size of their Kerkade holdings to between two and four Mukhmas. It has been estimated that within the region the total area cropped in Kerkade increased from less than 50 Mukhmas in 1969/70 to approximately 8,000 Mukhmas in the mid-1970's. Taking into account the fact that most Kerkade is cultivated using shifting cultivation, the total area grown in Kerkade is estimated to have exceeded 15,000 Mukhmas since 1969. Introduction of Kerkade expanded the amount of land farmed and increased the intensity of cropping. Both outcomes put greater pressure on the soil and wood resources of the Humr.

Conclusions :

There is no doubt that environmental changes are taking place in the Humr area. However the degree and intensity of degredation of the environment is not disturbing except around larger settlements like Muglad and Babanussa and around permanent water sources. Degradation in the eco-potential of the area is attributed to a number of factors which could also serve as indicators of change. Most import among these are :-

1. Spread of agriculture.
2. Development of underground water sources(boreholes).
3. Environmental fluctuations.
4. Increase in the size of livestock and human population.
5. Encorachment of significant numbers of camel-herding nomads from Northern Kordofan specially H mr.
6. Urbanization.
7. Oil exploration.
8. Improvement in transportation.
9. Fires.

Degradation of the environment around major centres of nomadic concentration is evident in the disappearance of favourable grass and tree species and emergence of

vast traces of gibeash which is an indication of loss of soil fertility and excessive grazing pressure. However it must be stressed that the Humr area still provides a rich and diversified grazing potential source. The richness of this potential is reflected in the pastoral system that exploit it. Cattle traditionally are the major livestock, small stock are numerous and migration distances are relatively short and follow well-defined corridors. Until recently camels were unknown. Yet water for animals and humans in the areas remains in short supply and retreat to permanent water sources in the south during the dry months of the year is a necessity.

Although the scale of degradation in the Humr area is not high and the vegetation cover in most parts is still intact the area provides a good site for monitoring environmental changes. The study will be more fruitful if comparatively linked to the results of the monitoring study underway in the Dar Hamid area which is located at the drier part of Kordofan Province.

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