

CROPPING

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Areas under cultivation in the arid and semi-arid zones of the Sudan are considerably greater than they are in the other countries of the Sahel. A full treatment of cultivation and cropping patterns is therefore justified for several reasons:

I. the agricultural systems are diverse and include enormous areas under irrigation and mechanized farming as well as traditional rainfed ones;

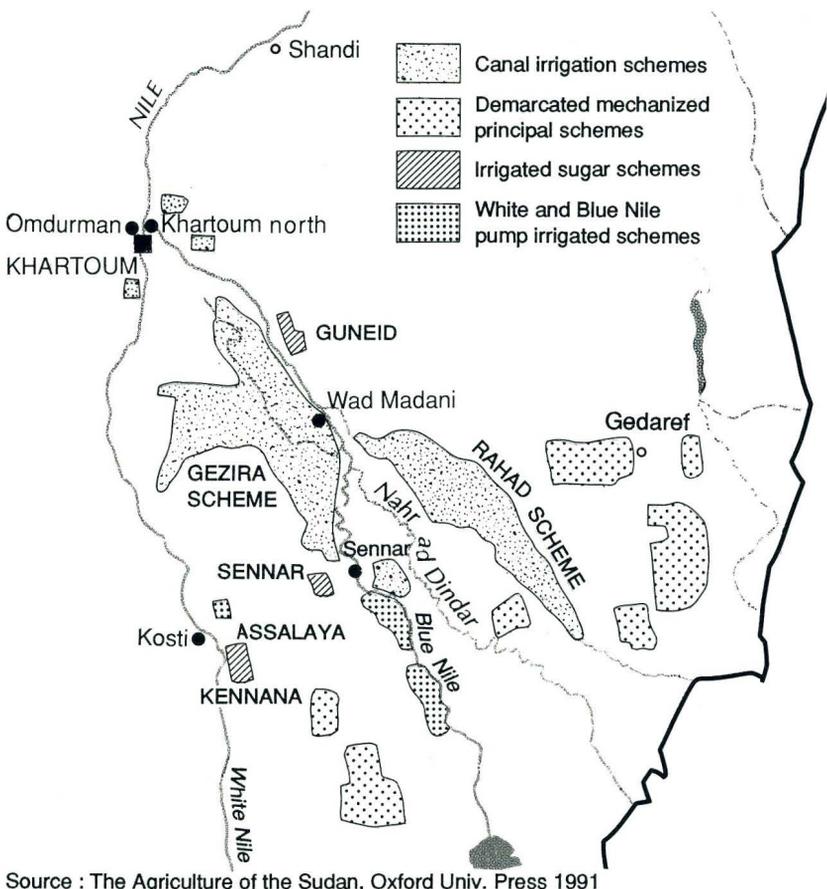
II. cropping is accompanied by small scale sedentary animal production which competes for resources with extensive nomadic pastoralism, in particular on the better grazing areas;

III. the rapid development of large mechanized schemes often leads to loss of traditional migration routes, causing problems between pastoralists and farm authorities, with the former complaining that the livestock corridors provided are too few and too small and the latter that animals cause damage to crops;

IV. the development of large scale agriculture seems to be outstripping even the normal statistical services and their estimations of the areas under cultivation (variable as they are, depending on the source) are seldom in agreement with what can be ascertained from satellite imagery.

With respect to this last point it is interesting to compare the "official" view of large scale irrigated and mechanized schemes (Figure 1) with the latest imagery. Satellite mapping of areas under mechanized cultivation shows these to be three or four times more extensive than the official figures, while irrigated schemes show an explosion in their numbers.

Fig 1 - Central Sudan : principal agricultural schemes



The mapping done from satellite data, covering 805,000 km² north of the 12°N parallel of latitude, has allowed a reasonably accurate and up-to-date estimate of agricultural areas to be compiled. It shows that irrigated agriculture covers 16,380 km² (equivalent to 2.0% of the total area), mechanized schemes extend to 23,280 km² (2.9%), there are 70,350 km² (8.7%) of land under rainfed agriculture, and cultivation in wadi beds covers a further 8,050 km² (1.0%).

It should be noted, however, that agriculture is concentrated east of the White Nile up to 15°N where some two-thirds of available land is under cropping. To the west of the Nile cropped areas represent 20% of all land in the zone with an annual rainfall in excess of 300 mm.

Mapping criteria

The figures quoted for the satellite image analysis are subject to some reservations even though identification of cultivated areas is done according to certain criteria which are more or less reliable.

Irrigated areas

The main criterion is the marked contrast between the actively growing vegetation of the irrigated areas during the dry season and the dead areas that surround it. Absolute identification of these areas is limited only by the size of the pixelles, which correspond to an area some 250 metres square, equivalent to about 6 ha. Areas smaller than this cannot be identified with certainty and the figure for irrigated areas does not therefore include the numerous small gardens irrigated by mechanical pumps which are common along the Nile.

Mechanized farming

These areas are clearly recognizable as characteristic rectangular blocks. It is not possible on the images, however, to determine what proportion actually carries a crop and what is fallow. The area given for this activity is thus certainly greater than that which is actually being cultivated. The area figure nonetheless represents that which is effectively denied to livestock, especially as current fallows are very recent and have little vegetation.

Traditional rainfed agriculture

Similar reserves about the actual cropped area and the area of fallow apply as for mechanized farming. Many individual cropped areas are below the limit for correct identification but the whole presents a characteristic pattern on the imagery. Identification of this type of activity is also aided by the numerous villages and by a considerable reduction in the woody vegetation. Degraded areas around villages are included in the area calculated for this activity but this is compensated for on the map by the many isolated small areas of cultivation which are not shown because of the scale used. Mountain areas (and especially Jebel Marra) are not mapped as cultivated because such areas do not show sufficient contrast with the surrounding savanna woodland for them to be clearly identifiable. Small cultivated areas along narrow river valleys, which are often under or very close to dense tree cover, are similarly not mapped.

Traditional rainfed agriculture is thus certainly under-estimated in the areas of higher rainfall with a concomitant overestimation of areas available for grazing. The date also represent the state of affairs at the time the satellite images were taken. The areas actually marked on the map are valid at a later time only insofar as the shifting cultivation that is practised does not take the cultivation outside the zone covered by the analysis. The usefulness of this type of synthesis, however, is to show the pattern of cultivation, which is due at least as much to social and economic factors as to those which normally strictly govern arable cultivation such as climate and soils.

Irrigated agriculture

Large irrigated areas are restricted by the regional topography and are found at the level of the major rivers. They can then be irrigated by gravity from the large dams constructed to raise the river level and store its water. Generally speaking, cotton comprises one-third of the area, one-third is in food crops (groundnuts, sorghum in the hot season and wheat in the winter, sesame and vegetables) and one-third is fallow. The exception to the general rule is the large scale monoculture of cane sugar.

Gezira

The Gezira is the oldest and by far the largest of Sudan's irrigation schemes. It takes its water from the Sennar dam on the Blue Nile. It covers much of the area between the two Niles from Jebel Aulia in the north to Blue Nile Province in the south where it interdigitates with the two southern branches of the El Managil Extension. The whole of the area is cultivated with the exception of the village areas and a few sandy eminences rising above the general level of the surrounding plain.

Rahad

The Rahad scheme is situated to the east of the river of the same name, the river itself being a major tributary of the Nile. The scheme became operational in 1977. A characteristic of this scheme is the standard form of the plots, which are rectangular and in the ratio 7:1. Water for irrigation is drawn from the Rahad, although there are no large dams on it. The villages of the scheme, the principal one being Fau, are situated at regular intervals throughout.

New Halfa

The New Halfa scheme is second in size only to the Gezira. It is found to the west of the Atbara river. The Khasm el Girba dam provides a regular supply of water for irrigation. The general plan of the scheme is identical to that of the Rahad. New Halfa town is in the centre of the scheme.

The least productive areas of this scheme were converted to cane production during 1986: by the end of that year almost 60% of the area was down to cane. The remainder of the area was not cultivated but there were no indications of degradation on the satellite images.

Kenana

This is the largest of the specialist cane schemes and started to become operational in 1981 on an area of 41,000 ha. According to the World Bank this is one of the biggest sugar schemes in the world. The main sectors are 1.5 km x 2.0 km in extent and divided into narrow beds that are unmistakable on the satellite images.

Kenana is located, close to the White Nile, to the east of Kosti and to the south of the railway line from Kosti to Sennar. An additional area of 10,800 ha is found to the north of the railway and there are several smaller areas close to the Nile.

Guneid

The Guneid scheme comprises two irrigated areas close to the village of the same name to the village of Rufa'a, east of the Blue Nile. The northern area is less developed and only about 50% of it is cultivated.

Sennar schemes

There is a large number of small irrigated areas on either side of the Blue Nile in the vicinity of Sennar town, particularly in the rhomboid whose top section is formed by the Nile and the Dinder rivers at their confluence. They extend as far south as El Suki and the line of rail from Sennar to El Gedaref.

One of the areas, 5 km x 50 km in extent and cultivated to sugar cane, is effectively an extension of the Gezira. The other blocks are smaller and somewhat scattered. They are situated in an area of fragile ecology. There are numerous indications of degradation, especially on thalweg slopes and at the bases of the interfluvial areas, including within the irrigated areas themselves.

The Gash delta

The gash delta, to the north of Kassala, is watered seasonally by the normal run of the river between July and September. There are no major engineering works to control the flow. The river is very flash and torrential at times. As a result the individual blocks are small (at the limit of perception on the satellite photos) and scattered, with groups of blocks being connected by canals. The cultivated areas are on the alluvial terraces from the north to the centre of the delta and are under water for only a short period. The main crops are cotton, sorghum and castor. The area shown cultivated on the map is certainly an underestimate of the actual area because of the small size and scattered nature of the blocks.

Mechanized agriculture

Mechanized agriculture occupies large blocks of land with an average size of 350 ha. This area is sub-divided into smaller plots. This type of operation is usually found on sandy-clay or clay soils which are not normally used for traditional agriculture as they are difficult to cultivate without heavy machinery. The requirements in capital investment are consequently high. The entrepreneurs owning these schemes operate in a system that is totally divorced from the traditional small scale agriculture in which farm size is usually less than 1 ha.

Crops are grown for the market and are mainly sorghum and sesame. The diversity of soil types induces a corresponding diversity in field sizes. The mechanized schemes benefit from large financial loans that are not available to small farmers because these latter are still not organized

sufficiently to be able to influence national agricultural policies. The technological and managerial skills required to operate large farms also differ from those required or usually available in the small scale sector. It is difficult to see how, in the foreseeable future, the dichotomy of large and small scale operations can be integrated.

There was little development of mechanized agriculture to the west of the Nile up to 1986. In fact there were only two in the zone covered by the satellite imagery, between the flood plain of the Abu Habil river and the Nuba mountains. In contrast the area occupied between the Niles is almost as much as that under traditional rainfed cultivation and mechanized agriculture is continuing to take over all available land as far as the boundaries of the Kenana scheme. The areas actually under cultivation are apparently greater than those originally granted and marked out. This expansion does not seem to be in competition with other agricultural systems, nor is it limiting their future development.

Better rainfall and higher population densities have encouraged the development of mechanized farming to the east of the Blue Nile and as far as the Ethiopian border. Southern Kassala Province, for example, is almost entirely under cultivation as far as the foot of the mountains, with the different systems being tightly interwoven. Mechanized agriculture is, indeed, rapidly occupying land as far north as 14°30'N to the west of Gedaref.

The natural savanna woodland has almost entirely disappeared along a 150 km wide band in the south of Kassala Province. Land available for livestock is now very limited and that is mostly fallow of very poor quality. It will be necessary, within a very short time, to abandon the traditional migratory movements between the Butana and the wetter foothills of the border area, which will entail serious consequences for livestock production.

Traditional agriculture

Subsistence production is the major objective of the traditional systems. The main crops are cereals. Bulrush millet (*Pennisetum typhoides*) is the principal species on sandy and clayey-sand soils: short or long season varieties are used in response to local climatic conditions. Sorghum is grown on heavier soils and in the valleys or in areas of higher rainfall. Subsidiary crops include a wide range of vegetables, including Irish potatoes, tomatoes, squashes and other cucurbits, onions, kerkadeh (= *Hibiscus sabdariffa*), sweet potatoes and other root crops. Some oilseeds (principally groundnuts and sesame), and pulses are also grown, as well as small areas of tobacco.

The zone north of the 300 mm isohyet

In the north of the area covered by the satellite imagery almost all cultivation is in the river valleys: 90% of the population lives in these valleys and on their terraces, even though these zones are equivalent to only 5% of the area. Small vegetable gardens cover a third of the area suitable for this form of production and they are often watered by small pumps. It is thus possible to obtain crops in the winter season, including wheat and barley. Date palms are an important element of these systems. Agriculture is usually closely associated with animal production and most livestock owners have at least a part of their family resident in a river valley. Partly as a consequence of this, livestock movements are limited in time and in space. Off-farm income from wage labour or from commercial business adds to the total resources available to many of the families.

The zone south of the 300 mm isohyet

South of the 300 mm isohyet the agricultural systems vary from west to east.

- **Darfur:** there are major areas of cultivation close to the main population centre such as El Fasher or Umm Keddada. The sandy plain between the Wadi el Ku and Jebel Marra, where there is clear evidence of wind erosion, is also densely cultivated: sandy areas at higher altitudes are less degraded. In the El Geneina area the density of cultivation decreases from south to north. There is, however, a heavily cultivated area along the border with Chad north of the 14th parallel of latitude where food crop production of millet and sorghum is reputed to be surplus to local requirements. The alluvial terraces of the major wadis (Kadja, Barsi, Azum, Debarei and Kulma) to the west and south of Jebel Marra are very densely cultivated and highly productive. The narrowness of the valleys and the scattered nature of the many small plots in the shallow depressions that receive run-on water have not allowed these areas to be mapped at the scale used. Similarly, the numerous small plots at altitudes in excess of 800 m have not been mapped.

CROPPING (CONTINUED)

Land higher than 1 000-1 200 m, for example in the valleys to the south-west of the Deriba crater on Jebel Marra and on the southern slopes of Jebel Gorgueil, is pocked with many small plots. Terrace cultivation on Jebel Marra shows maximum concentration to the north-east of Deriba, around Suni, Tora Tonga and Terang at altitudes greater than 2,000 m.

- **Kordofan:** a large number of small villages is regularly distributed over the gently undulating "qoz" which is an area of dense human settlement. The major area of cultivation is in the south-west of the Province, to as far north as En Nahud. The area under crops decreases towards the east. The major desert tracks strongly influence the amount of land cultivated and there are concentrations to the north of the En Nahud-El Obeid road, along the route to Kosti especially around Umm Rawaba, and to the north of Bara on the road to Khartoum.

Agriculture here extends somewhat to the north of the 300 mm isohyet, most probably because this is a zone in which the gum arabic (*Acacia senegal*) tree is a dominant feature of the vegetation. The current vegetation is indeed to a large extent anthropic insofar as the gum tree is encouraged to grow by the human population. Increased demographic pressure no longer allows the traditional cultivation-fallow cycle which to a large extent allowed the maintenance of long term fertility while the fallow duration was of at least 7-8 years. The cycle is becoming shorter and shorter and in some areas, as indicated by cultivation and fallow having the same aspect on the satellite images, cultivation is now almost continuous.

As cultivation intensity increases the production of gum decreases. Rational exploitation of gum, with only moderate tapping, allows stable production over a tree life of 18-20 years (Vidal & Hall, 1953). Tapping the trees when they are too young results in a much shorter life. Currently there is rapid transition from a stable sylvo-pastoral production system in which animals and trees are in equilibrium with light and short term cropping, to one in which agriculture dominates to the detriment of the other two components. This has serious consequences for the pastoral economy, which was well aware of the value of the gum belt and was always careful not to damage it.

- **The east of the study zone:** discontinuous small scale traditional rainfed agriculture covers large areas of the sandy-clay plateaux where the rainfall is adequate. Between the two Niles the expansion of the traditional agricultural system has been helped by the parallel development of large scale modern production and by population increase. Cultivation on the good quality basaltic soils of the Gedaref ridge, which extends as far north as the Khasm el Girba scheme, has nonetheless been practised for many centuries.

The valleys and the alluvial terraces which border them are very heavily utilized. Even the permanently water-logged soils of the Dinder and Rahad river basins are used by small scale traditional farmers for crops with high water demand. Pressure on the land is so strong that the Rahad Nature Reserve has already been invaded and it will not be long before the Dinder National Park suffers the same fate.

Supplementary livestock feeds

The expansion of agriculture and the decline in the natural resources of the rangelands have induced pastoralists to seek and use supplementary feeds. Three principal types can be recognized.

Hay

Standing hay has been a traditional feed, particularly in the west, for a long time. Up to the 1960s it was collected or purchased in small amounts and used for the animals left at the camp or homestead. Large stacks of hay are now, however, a familiar site in camp and village. The trade in hay has expanded rapidly since 1980 at the major as well as the intermediate centres of population in Darfur and Kordofan. A fourfold increase in the price between 1983 and 1989 helped many poor pastoralists, their herds devastated by the drought, to gain a kind of living but has done little to help range production as a whole.

Cultivated forages

Crop stubbles have always been used as livestock feed and have for long been collected and stocked by farmers and agropastoralists for their own use. More recently nomadic herdsmen have made full use of the feed opportunities provided by the irrigated cotton and mechanized sorghum schemes.

Crops cultivated purely as livestock feed, particularly in the east of the country, now include Sudan grass (particularly the short season variety "abu sabeen") and "berseem" or Egyptian clover. In recent times Sudan grass and sorghum stalks have also been used by the nomads of Northern Kordofan and the Red Sea hills, even though the feeds may have had to be transported over long distances to be used for store stock or to be used for animals making the long treks to the main markets from the pastoral areas. The expenses incurred in providing this kind of feed is now an accepted item in the nomadic budget.

The use by government of some irrigated schemes to provide feed for animals is encouraging. The 70,000 feddans (of 140,000 cultivated) of sorghum grown in the New Halfa scheme in 1985 was in support of this policy. On a smaller scale the production of green feed in peri-urban areas is a major growth industry, not only in the major centres in the east and along the Niles but in the medium-sized and larger population centres in the traditional pastoral areas in Darfur and Kordofan.

Crop residues and industrial by-products

There has always been a degree of complementarity between pastoralism and agriculture. This has been exemplified by the free access of nomadic animals to harvested fields to graze stubbles and residues in nominal exchange for the value of the manure. In recent years however the increased value of feed has resulted in farmers, and particularly large farmers, selling the rights to stubble grazing. As another and wholly undesirable development the large scale farmers are burning stubbles to prevent incursions by pastoralists under the guise that animal droppings introduce weed seeds and reduce the future potential crop production.

The traditional influence of the pastoral community has occasionally, even recently, been able to secure some concessions in order that they be compensated for both loss of traditional grazing areas and of crop residues. As an example there is the case of the Rūfa'a el Hoi who have secured a promise to have allocated to them 50 newly demarcated mechanized schemes as a step in the directions of reacquiring tribal rights and in the integration of agriculture and animals.

Large scale agricultural production and manufacture provides a major feed source. In Sudan, oil seed cakes are the most important commodity, with cotton seed cake now being the most common. Cotton seed cake has become commonplace in small rural shops and is also sold in large quantities in the bigger regional centres. Although fed mixed with ground sorghum the demand now exceeds supply to such an extent that prices increased fivefold from 1983 to 1989.

Settlement of pastoralists

The growing involvement of pastoral groups in agriculture, whether this be in subsistence, cash or fodder crops, is leading to a reduction in herd mobility and even to voluntary settlement in more or less permanent villages. There have, however, been previous attempts at settlement of pastoralists extending back over 40 years and usually involving some form of coercion. Some have been relatively successful and others not.

Hadendowa 1948

Following continued failure of the rains over several years some 500 Hadendowa families were moved to Gedaref in 1948. Each family was allotted an area of 50 feddans which was prepared and ploughed by the government and sowed to sorghum under the supervision of a government-appointed agricultural inspector. At the end of the first year 80% of the families deserted the scheme, ostensibly because many of their number had died due to malaria.

The Hamshkoreib experiment 1951

Sheikh Ali Betai attracted some Hadendowa to Hamshkoreib village for Koranic studies in 1951. There has been some spontaneous settlement in six other centres which benefit from education, health and veterinary services. Except for settlement the Hadendowa have continued to practise their traditional way of life by raising livestock and producing some sorghum.

Beja tribes 1958

Several small schemes of about 1,000 feddans each were established and allocated to the Hadendowa, Artiga, Amrar, Ashraf and other Beja groups. The settlers were provided with tractors which were to be repaid in installments from income. After five years, however, due in the main to fluctuations in production most of the schemes were abandoned. Only three are known to be operational at present.

New Halfa 1962

The flooding of Lake Nubia behind the Aswan High Dam resulted in the displacement of many thousands of people, many of whom were ethnic Nubians whose ancestors had lived in the area for millennia. Members of pastoral tribes that were displaced included Shukriya, Beja and Rashaida. The New Halfa scheme has a favourable location for pastoralists close to the Butana and the Atbara river, to sorghum mechanized schemes, and to the Gash and Baraka schemes. The advantages of being able to maintain a pastoral way of life coupled to irrigated agricultural production have resulted in some success for this project.

Gireih es Sarha 1969

A pastoral association was planned with the objective of establishing a consumer cooperative and a flour mill by means of shares purchased by the Kababish. The project, with 50 families participating, operates in the Kawahla area to the west of Umm Badr. Other planned inputs included a water supply, development of a small irrigated farm and a contribution to cover the costs of some personnel. The government inputs included planning assistance, fencing and management staff during the early years. Although the original management plan was never adhered to and the Kawahla 'nazir' (chief) came to dominate the scheme it was considered successful in conserving the rangeland for the use of a limited number of herds.

The Suki experiment 1972

Following the failure of the rains in 1972 some 350 Hadendowa, Beni Amer, Amrar and Bisharin families were allotted tenancies at the newly developed Suki scheme. The settlers were all placed in a new village. Problems with the levelling of the land resulted in 150 of the tenancies not being adequately irrigated and 130 families sold their tenancies to return to their original homes. The remaining tenants have apparently adjusted to their changed circumstances and run a cooperative shop, a flour mill and a bakery.

Beja settlement 1972

An attempt to settle several Beja on 3,000 feddans at Umm Barakeit village near the Ethiopian frontier has met only limited success. In spite of the provision of tractors about 80% of families returned to their original area over a short period. The 20% remaining have some rainfed cultivation but mainly practise cattle pastoralism.

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