

Sourec: DSMW-FAO-UNESCO  
Original scale: 1:5 million

central region; and the Ferralsols of the south. Less extensive and widely separated, but of major economic importance, is a fourth group consisting of Fluvisols found along the lower reaches of the White Nile and Blue Nile Rivers, along the main Nile River to Lake Nubia, in the delta of the Qash River in the Kassala area, and in the Baraka Delta in the area of Tawkar near the Red Sea in Ash Sharqi State.

For agriculture, the most important soils are the Vertisols in central Sudan that extend from west of Kassala through Al Awsat and southern Kordofan. They are known as cracking soils because of the practice of allowing them to dry out and crack during the dry months in order to

restore their permeability. They are used in the areas of Al Jazirah and Khashm al Qirbah for irrigated cultivation. East of the Blue Nile River, large areas are used for mechanized rainfed farming. West of the White Nile River, traditional farmers use these soils to grow sorghum, sesame, groundnuts and, in the area around the Nuba Mountains, cotton. The southern part of the clay soil zone lies in the broad floodplain of the upper reaches of the White Nile River and its tributaries, covering most of Aali an Nil and upper Bahr al Ghazal States. Subject to heavy rainfall during the rainy season, the floodplain is inundated for four to six months. As Sudd is permanently flooded and adjacent areas are flooded for one or two months. In general, this area is poorly suited to crop production, but farmers use the grass it supports in dry periods for grazing.

The Arenosols and Regosols in the semi-arid areas south of the desert in northern Kordofan and northern Darfur States support vegetation used for grazing. In the southern part of these states and the western part of southern Darfur are the so-called *qoz* sands. Livestock raising is the major activity in this area but a significant amount of crop cultivation, mainly of millet, also occurs. Farmers grow groundnuts and sesame as cash crops. Gum arabic is produced mainly on the *qoz* sands by tapping *Acacia senegal* (known locally as *hashab*). Farmers occasionally plant *hashab* trees when land is returned to fallow.

The Ferralsols of the south cover most of western Al Istiwai and Bahr al Ghazal States. They underlie the extensive moist woodlands found in these states. Crop production is scattered and the soils, where cultivated, lose fertility relatively quickly. Even the richer soils are usually returned to bush fallow within five years.

### **Mineral fertility status of soil series on some irrigated schemes in the Sudan**

The soil series of the Gezira, Rahad, New Halfa, Es Suki, Guneid, Sennar and Kenana irrigated schemes have different parent materials. They have moderate to poor mineral fertility. The main causes are the low content of nitrogen (N), available phosphorus (P) and sometimes potassium (K). There have also been reports of deficiencies of sulphur (S), iron (Fe), manganese (Mn), copper (Cu) and zinc (Zn). Nevertheless, the relatively high cation exchange capacity (CEC) and percentage base saturation

values of these soils indicate their greater ability to retain added nutrients and a reduced tendency to lose them through leaching.

## **HYDROLOGY AND WATER RESOURCES**

Except for a small area in northeast Sudan, the entire country is drained by the Nile River and its two main tributaries, the Blue Nile River (Al Bahr al Azraq) and the White Nile River (Al Bahr al Abyad). The longest river in the world, the Nile River flows for 6 737 km from its farthest headwaters in central Africa to the Mediterranean Sea. The importance of the Nile River has been recognized since ancient times; for centuries the river has been a lifeline for Sudan.

The Blue Nile River flows out of the Ethiopian Highlands to meet the White Nile River at Khartoum. The Blue Nile River is the smaller of the two; its flow usually accounts for only one-sixth of the total. However, in August, the rains in the Ethiopian Highlands swell the Blue Nile River until it accounts for 90 percent of the total flow of the Nile River. Several dams regulate the river flow.

The White Nile River flows north from central Africa, draining Lake Victoria and the highland regions of Uganda, Rwanda, and Burundi. At Bor, the great swamp of the Nile River, As Sudd, begins. Much water is lost through evaporation. In order to provide for water transportation through this region and to speed the river flow so that less water would evaporate, the Sudan began building the Jonglei Canal from Bor to a point just upstream from Malakal. However, security problems caused by the civil war in the south of the country led to construction work being suspended in 1984.

South of Khartoum, the Jabal al Auliya Dam stores the water of the White Nile River and then releases it in the autumn when the flow from the Blue Nile River slackens. Much water from the reservoir is diverted for irrigation projects in central Sudan.

The White Nile River has several substantial tributaries that drain southern Sudan. For example, in the southwest, the Bahr al Ghazal drains a basin larger in area than France.

Above Khartoum, the Nile River flows through the desert in a large S-shaped pattern to empty into Lake Nasser behind the Aswan High Dam in Egypt. The Atbara River, flowing out of Ethiopia, is the only

TABLE 2  
Water withdrawal in the Sudan

Water use	km <sup>3</sup>	%
Irrigation and livestock	36.10	96.7
Domestic	0.99	2.6
Industry	0.26	0.7
Total	37.35	100

Source: FAO AQUASTAT.

tributary north of Khartoum, and its waters reach the Nile River for only the six months between July and December.

The estimated total net flow from the secondary basins is more than 150 million m<sup>3</sup> (equivalent to

14 percent of the calculated general flow). The general constant discharge of the White Nile River is 16 000 million m<sup>3</sup> and that of the Blue Nile River is 34 000 million m<sup>3</sup>. The estimated seasonal discharge of the Atbara River is 3 000 million m<sup>3</sup>.

The Nubian stone sand represents 25 percent of the available formations in Kordofan, Darfur, Khartoum and the northern states and is considered the best source of good quality groundwater in Sudan. The water of these sediments supports the drinking-water and irrigation water network in Kassala and Darfur. The groundwater level is near the land surface but it experiences seasonal and annual changes depending on the rates of pumping and recharge. The formation of Om Rawaba accounts for about 20 percent of the area of the Sudan.

The estimated total natural renewable water resources of the Sudan are 149 km<sup>3</sup>/year, of which 30 km<sup>3</sup>/year are produced internally. In a dry year, the internal water resources fall to about 22 km<sup>3</sup>/year. Of the internal water resources, 28 km<sup>3</sup>/year are surface waters and 7 km<sup>3</sup>/year are groundwater, while the overlap between surface water and groundwater is an estimated 5 km<sup>3</sup>/year. By virtue of to the Nile Waters Agreement with Egypt, the total actual renewable water resources of the country are 64.5 km<sup>3</sup>/year.

Table 2 shows the breakdown of water withdrawals in the Sudan.

Water consumption amounts to 1 187 m<sup>3</sup>/inhabitant/year, representing 58 percent of total actual renewable water resources.

## VEGETATIVE COVER

Estimates of the area of "forest" vary from less than 60 million ha (Forestry Administration) to about 91 million ha (Ministry of Agriculture and Natural Resources and FAO) depending on how it is defined. In fact,

dense stands of trees cover only 20–24 million ha of the total forestland. Forests and woodlands are typically tall shrubs in areas of low rainfall in the north and tropical high forests in the south. “Forests” in the Sudan account for 70 percent of household energy, wood and animal feed.

Nomadic herders who follow traditional methods graze the rangelands in Sudan. The animal density is 0.99 head/ha. The area of natural rangelands amounts to about 56.4 million ha (25 percent of the total area). This pastureland meets 83 percent of the feed needs of livestock.

### AGRO-ECOLOGICAL ZONES

The agro-ecological zones (AEZs) in the Sudan vary from north to south (Table 3). The zones are determined by agroclimatic factors (the amount of rainwater and its distribution) and the soils. Temperature, moisture and vegetative cover are secondary factors. It is not possible to reverse or change the course of the ecological degradation in most of the areas.

The Sudan is divided into different agro-ecological areas, each characterized by a different vegetative cover resulting from the environmental factors (climate, land and topography). In addition to the role of people and animals, rainfall plays an important role in the composition of the plant groups from north to south.

The desert area is the largest. It extends across the country from east to west and from the northern borders to latitude 15 °N. The average rainfall ranges from 0 to 75 mm and the rainy period lasts for two months. The area is not populated and not suited to any form of irrigated agriculture.

TABLE 3

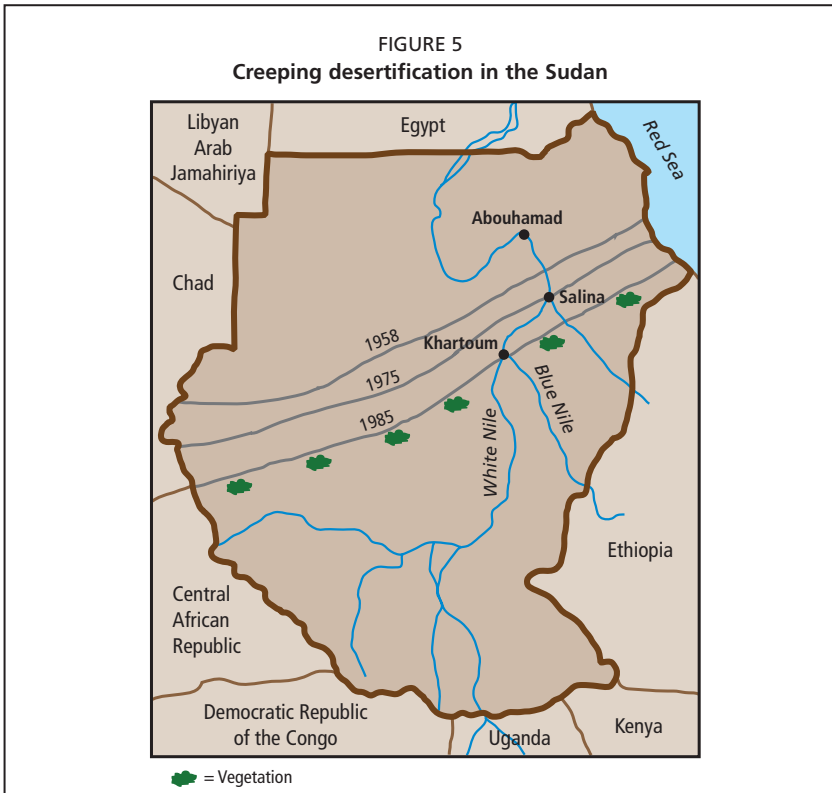
#### Agro-ecological zones in the Sudan

Agro-ecological zone	Average rainfall (mm)	Percentage of total area	Desertification
Desert	0–75	26.9	Completely desertified
Semi-desert	75–300	18.4	Greatly affected by desertification
Low-rainfall savannah (sandy)	300–400	9.7	Affected to a medium extent
Low-rainfall savannah (clayey)	400–900	17.4	Slightly affected
High-rainfall savannah	800–1 300	10.6	Very slightly affected
Flood area	800– 1 000	11.6	Not affected
Mountainous	Different	5.4	Not affected

Source: Sudanese Technical Committee, 2004.

The semi-desert area extends between 13 and 15 °N in the western direction from the Nile River, where the sandy soil is dominant, and 16 and 15 °N in the eastern direction of the Nile River. There is no irrigated agriculture, with the exception of some surface irrigation or irrigation with pumps or flood irrigation in the area located between the two Blue Nile and White Nile Rivers and to the east. Nomadic and semi-nomadic people use this area for grazing camels and sheep.

In the last three decades, most of the northern borders of this area have experienced degradation and become desert. The desert has also encroached on the low-rainfall savannah area on the southern borders (Figure 5). The average rainfall ranges between 75 and 250 mm and the



Source: Sudanese Technical Committee, 2004.

rainy period lasts for two to three months. Limited agriculture is practised in these areas on the edges of the wadis.

Irrigated agriculture starts in the savannah area. The area located west of the Nile River is known as the low-rainfall and sandy soil savannah area, while the eastern area is known as the clayey soil savannah area. Both areas have distinctive vegetative cover and land-use patterns.

The average rainfall in the low-rainfall savannah area ranges between 250 and 500 mm in a period of three to four months. The area is devoted to traditional rainfed farming, which includes millet, sorghum, groundnut, sesame, watermelon and gum arabic. In the rainy season, it provides grazing for cattle, sheep, camels and goats. Farmers grow early-maturing sorghum on the eastern part of the area, and sheep and camels graze the area during the rainy season. The farming systems lack even simple forms of technology, but the area contributes significantly to national production and exports.

The high-rainfall savannah area is the largest ecological area and the area with the greatest agricultural potential. It consists of: (i) the Central Clay Plains; and (ii) the Southern Clay Plains.

The area of the Central Clay Plains is considered to be the most productive. It is flat, with a deep, black soil covered by large trees and long, dense grass. This area is suitable for mechanized rainfed agriculture. It produces sorghum, millet, cotton and sesame. Research has demonstrated the possibility of growing other cash crops such as sunflower and soybean on a large scale. This area, except for the banks of the Nile River, is less densely populated compared with the western high-rainfall savannah area. Cattle and sheep graze the area in summer and it has good potential for livestock production. The rainfall in this area averages 500–800 mm/year in a rainy period of four to five months.

The Southern Clay Plains have a medium population density. They are home to Nile tribes whose livelihood depends mostly on livestock. The soils of the wadis consist of relatively recent Nile clayey deposits. Almost no economic or social development has taken place in this isolated part of the country, which is dominated by subsistence agriculture. Millet, sorghum and rice are grown, and these crops, together with dairy products, represent the main staples of the local population. The number of livestock has increased because only a limited number of the animals

is slaughtered, and overgrazing has increased for this reason. The average rainfall ranges between 800 and 1 000 mm and the rainy period lasts for five to seven months. Floodplains of the White Nile River are located in the centre of the area.

The tropical rainfall zone lies in the extreme south of the country. The soil is red. The rainfall ranges between 1 000 and 1 500 mm and the rainy period lasts for seven to eight months. A subsistence economy is dominant, except in areas surrounding the cities. Millet, sorghum, banana, root crops and legumes are grown in this area. The population lives mostly from hunting and fishing. The development of the agriculture sector has been very slow despite the possibility of growing cotton, tea, tobacco, coffee and pineapple on a commercial or semi-commercial basis. The area is infested with tsetse fly and contains only a limited number of livestock.