

Fertilizer use by crop in the Sudan



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**Land and Plant Nutrition Management Service
Land and Water Development Division**

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Preface

This study, commissioned by the Food and Agriculture Organization of the United Nations (FAO), is one of a series of publications on fertilizer use on crops in different countries.

The aim of the series is to examine the factors underlying present fertilizer usage. These factors include the agro-ecological conditions, the structure of farming, cropping patterns, the availability and use of mineral and organic plant nutrients, the economics of fertilizers, and research and advisory requirements. The reports examine those factors that will or should determine the future development of plant nutrition on a country-by-country basis.

In the past two decades, there has been an increasing focus on the adverse environmental impact of both the underuse and the overuse of plant nutrients. The efficient use of plant nutrients, whether from mineral fertilizers or from other sources, involves the shared responsibility of many segments of society including international organizations, governments, the fertilizer industry, agricultural research and advisory bodies, traders and farmers. The publications in the series are addressed to all these parties.

Fertilizer use is not an end in itself. Rather, it is a means of achieving increased food and fibre production. Increased agricultural production and food availability can, in turn, be seen as an objective for the agriculture sector in the context of contributing to the broader macroeconomic objectives of society. The FAO/IFA 1999 publication *Fertilizer strategies* provides a review of the options available to policy-makers.

The contents of the series of studies differ considerably from country to country in view of their different structures, histories and food situation. However, in each case the aim is to arrive at a better understanding of crop nutrition in the country concerned.

Acknowledgements

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The background cover photograph is from the FAO Media base: FAO/ F. Bots; the other photographs are from EcoPort: Arnaldo Mondadori Editore S.p.A. (eggplant), H.V. Dutuhurburu and Pankaj Oudhia (mango).

Abstract

The Republic of the Sudan is the largest African country in terms of area. The climate is generally hot, tropical in the south, arid in the north. Rainfed agriculture depends largely on the arrival of rain-bearing southwesterly winds in the main agricultural belt. When these fail, as happened especially in the 1970s and 1980s, drought and famine follow. The country has substantial surface water resources, especially in the Blue Nile River and White Nile River (which meet at Khartoum) and has extensive plains of cultivable soils. The cultivated area is 16.7 million ha but the potentially cultivable area is much larger. The frequency of low-rainfall years is tending to increase and creeping desertification is a problem in the north.

Despite increasing oil exports, the agricultural and livestock sectors continue to make a major contribution to gross domestic product. Cotton is the main export commodity, followed by oilseeds and livestock. The agriculture sector provides a livelihood for three-quarters of the population.

Large-scale, Nile-based irrigation schemes have dominated agricultural development in the Sudan. The largest and best known of these is the Gezira scheme, covering some 870 000 ha. However, a large proportion of the population depends on rainfed agriculture. Food production per capita has kept pace with population growth but is relatively low. The yields of the staple crops, such as sorghum, have not increased, and higher production has been obtained by extending the cultivated area, with a negative impact on the environment.

Almost 1.9 million ha (about 11 percent of the cultivated area) are equipped for irrigation, 96 percent of which is fed from surface waters. Wheat, cotton and sorghum are the most important crops in irrigated areas, followed by groundnuts. In the 1990s, irrigation schemes were privatized without adequate preparation. Cotton production is now half that of the early 1990s. Yields of all crops are well below their potential.

The Agricultural Bank of Sudan and commercial banks provide agricultural credit but farmers in rainfed areas have difficulty in obtaining formal credit. The Ministry of Finance subsidizes the irrigation sector.

Despite a moderate to poor mineral fertility of most soils, fertilizer consumption is very low, averaging about 4 kg of total nutrients per cultivated hectare. Farmers in the rainfed sector apply very little fertilizer. The price of fertilizers has risen steadily in the past decade.

Until 1992, the Government controlled the marketing of agricultural inputs and outputs. However, as part of the economic reforms in the 1990s, it removed most of the controls on private traders. However, parastatal organizations still dominate the fertilizer supply system.

The Sudan has a long-established agricultural research structure. In recent years, agricultural research has lacked adequate funding but it is still substantial. There have been a number of cooperative programmes concerning the use of fertilizers, notably the FAO Fertilizer Programme, a fertilizer programme funded by the European Economic Community, Sasakawa Global 2000, and assistance from various bodies, e.g. the German development agency and the Arab Authority for Agricultural Investment and Development. Recent programmes concerning the use of non-traditional fertilizers have yielded promising results in terms of response and the economics of application.

In the context of a 25-year plan, the Government is taking a number of measures to promote the development of agriculture and to improve rural services.

List of acronyms

AAAID	Arab Authority for Agricultural Investment and Development
ABS	Agriculture Bank of Sudan
AEZ	Agro-ecological zone
ARC	Agricultural Research Corporation
ARRC	Animal Resources Research Corporation
B	Boron
CEC	Cation exchange capacity
Cu	Copper
EEC	European Economic Community
Fe	Iron
GDP	Gross domestic product
GTZ	Gesellschaft für Technische Zusammenarbeit (German development agency)
IAEA	International Atomic Energy Agency
ICARDA	International Center for Agricultural Research in the Dry Areas
ILO	International Labour Organization
IMF	International Monetary Fund
LDC	Least-developed country
Mn	Manganese
MOAF	Ministry of Agriculture and Forestry
MOFNE	Ministry of Finance and National Economy
NVRP	Nile Valley Regional Programme
OPEC	Organization of the Petroleum Exporting Countries
S	Sulphur

SASC	Sudanese Arab Seed Company
SCC	Sudan Cotton Corporation
TTE	Technology Transfer and Extension Administration
UNDP	United Nations Development Organization
WUA	Water users association
Zn	Zinc

Fertilizers

AS	Ammonium sulphate
ASN	Ammonium sulphate nitrate
NPK	Complex fertilizer containing N, P and K
TSP	Triple superphosphate

N: Nitrogen

P_2O_5 or P: Phosphate*

K_2O or K: Potash*

Currency equivalents (August 2005): US\$1 = SD240

Weights and measures

1 ha = 2.4 feddans

1 feddan = 0.42 ha

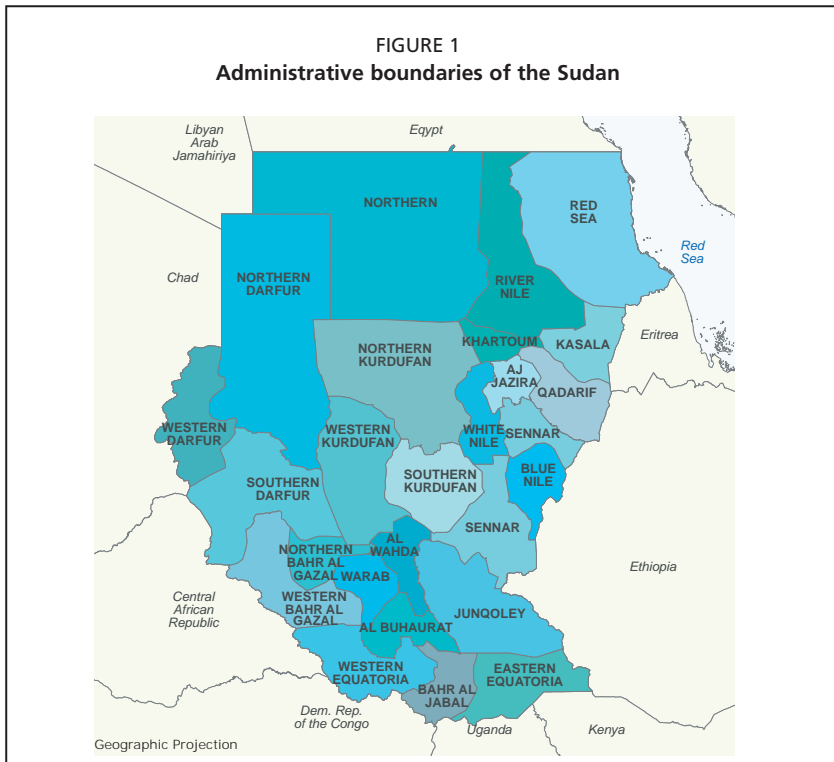
1 kantar = 143 kg

* Phosphate and potash may be expressed as their elemental forms P and K or as their oxide forms P_2O_5 and K_2O . Nitrogen is expressed as N. In this study, phosphate and potash are expressed in their oxide forms.

Chapter 1

Introduction

The Republic of the Sudan is located in the northeast corner of Africa (15.00 °N, 30.00 °E). The country comprises 26 states (Figure 1) and has three levels of government: federal, state and local. Khartoum is the capital. The Sudan is the largest African country in terms of area (2.5 million km²), accounting for 8.3 percent of the total area of Africa. The topography is that of a gently sloping plain, generally flat and featureless with the



exception of Jabal Marrah, the Red Sea Hills, the Nuba Mountains and the Imatong Hills.

According to FAOSTAT, the area of “arable land and permanent crops” in the Sudan is 16.65 million ha, of which 0.42 million ha are under permanent crops. However, estimates of the total area of potentially cultivatable land range from 36 million to 84 million ha (see Chapter 2). Some 117 million ha of permanent pasture support a livestock population of almost 120 million head.

The estimated population (2005) of the Sudan is 35.3 million, compared with 23 million in 1993, with an average growth rate of 2.6 percent/year. More than two-thirds of the population in the Sudan work in agriculture and animal husbandry. The absolute population density is 7 persons/km². Vast areas, such as the western desert, are almost unpopulated. The population density is higher in areas with water and fertile soils, such as areas adjacent to the Nile River and its tributaries. For example, the Al-Gezira area (between the White Nile River and the Blue Nile River) has a population density of 20 persons/km².

In spite of the large area of agricultural land in the Sudan, the continuing rapid growth of the population results in pressure on land resources in certain favoured areas of the country.

THE ECONOMY

Negative growth rates and internal and external imbalances characterized the national economy in the 1970s and 1980s. The Government launched a liberalization programme in 1992. This reform programme succeeded in reversing the decline in economic growth. However, the accompanying monetary expansion resulted in triple-digit inflation by 1996. A macroeconomic reform package prepared by the International Monetary Fund (IMF) and launched in mid-1996 led to the restoration of macrostability and a reduction in inflation. In 1999, the Sudan began to export crude oil. Together with the monetary policy, this stabilized the exchange rate and led to economic growth. However, despite the oil exports, agricultural production remains the country’s most important sector. As regards average per-capita food supplies, statistics place the Sudan just above the least-developed countries (LDCs).

GEOGRAPHY

The region known as Northern Sudan lies between the Egyptian border and Khartoum. It consists of two distinct areas: the desert and the Nile Valley. The Nubian Desert lies to the east of the Nile River, and the Libyan Desert lies to the west of the river. Both deserts are stony with sand dunes. The Nile River flows through the desert and provides an alluvial strip of habitable land some 2 km wide, whose productivity depends on the annual flood.

Western Sudan is a generic term describing the regions known as Darfur and Kordofan, amounting to 850 000 km². Its dominant feature is the absence of perennial streams, and people and animals must remain within reach of permanent wells. Consequently, the population is sparse and unevenly distributed. Western Darfur is an undulating plain dominated by the volcanic massif of Jabal Marrah with an elevation of 900 m above the Sudanese Plain. Drainage from Jabal Marrah supports a settled population. Unlike western Darfur, northern and eastern Darfur are semi-deserts with little water either from the intermittent streams (known as wadis) or from wells that normally run dry in the winter months. Northwest of Darfur and continuing into Chad lies the region called the *jizzu*, where sporadic winter rains from the Mediterranean Sea frequently provide excellent grazing into January or even February. The southern region of Western Sudan is known as the *qoz*, a land of sand dunes. In the rainy season, there is extensive grassland. The sources of water are more reliable than in the north, with boreholes and *hafir* (constructed ponds). A unique feature of Western Sudan is the Nuba mountain range of southeast Kordofan, a conglomerate of isolated dome-shaped, sugarloaf hills that ascend steeply and abruptly from the great Sudanese Plain. Many hills are isolated and extend for only a few square kilometres, but there are several large hill masses with internal valleys that cut into the mountains high above the plain.

The Central Clay Plains of the Sudan stretch eastward from the Nuba Mountains to the Ethiopian frontier, broken only by the Ingessana Hills, from Khartoum in the north to the far reaches of southern Sudan. Between the Dindar and the Rahad Rivers, a low ridge slopes down from the Ethiopian highlands with occasional hills. The Central Clay Plains

are productive and provide the main support of the national economy. Settlements cluster around available water supplies. The Gezira is located on the Central Clay Plains, between the Blue Nile and the White Nile Rivers. The Gezira produces cotton for export.

Eastern Sudan is located northeast of the Central Clay Plains. The region is divided between desert and semi-desert and includes Al Butanah, the Qash Delta, the Red Sea Hills and the Coastal Plain. Al Butanah is an undulating territory located between Khartoum and Kassala. It provides good grazing for cattle, sheep and goats. East of Al Butanah is a peculiar geological formation known as the Qash Delta. Originally a depression, it has filled with sand and silt brought down by the flash floods of the Qash River, creating a delta above the surrounding plain. Extending 100 km north of Kassala, the whole area watered by the Qash River is rich grassland and arable land that is productive long after the water of the river has reached its delta. Trees and bushes provide grazing for camels from the north, and the rich moist soil provides an abundance of food crops and cotton.

The Red Sea Hills are located north of the Qash River. Dry, bleak and cooler than the surrounding land, particularly in summer, they stretch northward into Egypt, a mass of hills where life is hard and unpredictable for the inhabitants. Below the hills is the Coastal Plain of the Red Sea, varying in width from about 56 km in the south near Tawkar to about 24 km near the Egyptian border. The coastal plain is rocky, dry and barren.

The Southern Clay Plains, which can be regarded as an extension of the Northern Clay Plains, extend from northern Sudan to the mountains on the Sudan–Uganda border. In the west, they extend from the border with the Central African Republic eastward to the Ethiopian Highlands. Several features divide this great Nilotic plain. First, the White Nile River bisects the plain and provides large permanent areas of water, such as Lakes Fajarial, No and Shambe. Second, As Sudd, the world's largest swamp, constitutes an expanse of lakes, lagoons and aquatic plants whose area at the time of the high floodwaters exceeds 30 000 km². As Sudd has a high rate of evaporation and consumes on average more than half the waters that come down the White Nile River from the equatorial lakes. These waters also create a floodplain known as the *toic* that provides grazing

when the floodwaters are lost in the permanent swamp and sluggish river, the Bahr al Jabal, as the White Nile River is called in the Sudan.

The land rising to the south and west of the Southern Clay Plains is referred to as the Ironstone Plateau (Jabal Hadid), a name derived from its lateritic soils and increasing elevation. The plateau rises from the west bank of the Nile River, sloping gradually upward to the Congo–Nile watershed. The land is well watered, providing rich arable land, but the streams and rivers that descend from the watershed divide and erode the land before flowing onto the Nilotic plain into As Sudd. Along the streams of the watershed are the gallery forests, the beginnings of the tropical rain forests that extend far into the Democratic Republic of the Congo. To the east of the Jabal Hadid and the Bahr al Jabal are the foothills of the mountain ranges along the Sudan–Uganda border – the Imatong, Didinga and Dongotona – which rise to more than 3 000 m, contrasting with the great plains in the north.

CLIMATE

The Sudan lies within the African tropical region belt. Its climate ranges from equatorial in the south to savannah in the centre and continental in the north, and from arid in the north to tropical, with wet and dry seasons in the far southwest. Temperatures do not vary greatly with the season at any location; the most significant climate variables are rainfall and the length of the dry season. Variations in the latter depend on which of two airflows predominate: dry northeasterly winds from the Arabian Peninsula, or moist southwesterly winds from the Congo River basin. The average annual rainfall varies greatly between the south (1 200–1 500 mm) and the north (less than 75 mm).

From January to March, the country is under the influence of the dry northeasterly winds. There is practically no rainfall in the country during this period except in a small area in the northwest where the winds from the Mediterranean Sea bring occasional light rains.

By early April, the moist southwesterly winds reach southern Sudan, bringing heavy rains and thunderstorms. By July, the moist air reaches Khartoum. In August, it extends to its usual northern limits around Abu Hamad (although in some years, the humid air may even reach