Nigeria

GEOGRAPHY, CLIMATE AND POPULATION

Nigeria is located in the tropical zone of West Africa between latitudes 4°N and 14°N and longitudes 2°2'E and 14°30'E and has a total area of 923 770 km². The country's north-south extent is about 1 050 km and its maximum east-west extent is about 1 150 km. Nigeria is bordered to the west by Benin, to the northwest and north by Niger, to the northeast by Chad and to the east by Cameroon, while the Atlantic Ocean forms the southern limits of Nigerian territory. Land cover ranges from thick mangrove forests and dense rain forests in the south to a near-desert condition in the northeastern corner of the country.

Three broad ecological zones are commonly distinguished in the country: i) The northern Sudan Savannah; ii) The Guinea Savannah zone or Middle Belt; and iii) The southern rainforest zone. Based on rainfall and temperature the county is divided into eight agro-ecological zones. In Table 1 these zones are presented in a north-south succession, except the mountainous zone which is found at the border with Cameroon and the plateau zone in the center of the country.

The climate is semi-arid in the north and humid in the south. Except for an ultra-humid strip along the coast with rainfall averages of over 2 000 mm/year, where it rains almost all year round, rainfall patterns are marked by distinct wet and dry seasons. Rainfall is concentrated in the period June-September. Deficiency in total annual precipitation is a problem in parts of the country, particularly in the northern parts. In most other areas, however, the major problems are the distribution in time and space and the low dependability of rainfall. Mean annual rainfall over the whole country is estimated at 1 150 mm. It is about 1 000 mm in the center of the country and 500 mm in the northeast. Mean annual pan evaporation is 2 450 mm in the southeast, 2 620 mm in the center and 5 220 mm in the north of the country.

TABLE 1
Agro-ecological zones in Nigeria

Zone description	Percentage of country area	Annual rainfall	Monthly temperature		
			Minimum	Normal	Maximum
	(%)	(mm)	(°C)	(°C)	(°C)
Semi-arid	4	400 - 600	13	32 - 33	40
Dry sub-humid	27	600 - 1 000	12	21 - 31	49
Sub-humid	26	1 000 - 1 300	14	23 - 30	37
Humid	21	1 100 - 1 400	18	26 - 30	37
Very humid	14	1 120 - 2 000	21	24 - 28	37
Ultra humid (flood)	2	> 2 000	23	25 - 28	33
Mountainous	4	1 400 - 2 000	5	14 - 29	32
Plateau	2	1 400 - 1 500	14	20 - 24	36

TABLE 2
Basic statistics and population

Physical areas			
Area of the country	2002	92 377 000	ha
Cultivated area (arable land and area under permanent crops)	2002	33 000 000	ha
• as % of the total area of the country	2002	36	%
• arable land (annual crops + temp. fallow + temp. meadows)	2002	30 200 000	ha
• area under permanent crops	2002	2 800 000	ha
Population			
Total population	2004	127 117 000	inhabitants
• of which rural	2004	52	%
Population density	2004	138	inhabitants/km^2
Economically active population	2004	50 940 000	inhabitants
• as % of total population	2004	40	%
• female	2004	36	%
• male	2004	64	%
Population economically active in agriculture	2004	15 159 000	inhabitants
• as % of total economically active population	2004	30	%
• female	2004	38	%
• male	2004	62	%
Economy and development			
Gross Domestic Product (GDP) (current US$)	2003	50 200	million US$/yr
• value added in agriculture (% of GDP)	2002	37.4	%
• GDP per capita	2003	405	US$/yr
Human Development Index (highest = 1)	2002	0.466	
Access to improved drinking water sources			
Total population	2002	60	%
Urban population	2002	72	%
Rural population	2002	49	%

Total cultivable area is estimated at 61 million ha, which is 66 percent of the total area of the country. In 2002, the cultivated area was 33 million ha, of which arable land covered 30.2 million ha and permanent crops 2.8 million ha (Table 2). About two-thirds of the cropped area is in the north, with the rest about equally distributed between the Middle Belt and the south.

Nigeria is by far the most populous country in Africa, with its 127 million people accounting for about one-seventh of the total population of Africa's 53 countries (2004). Population density is 138 inhabitants/km^2, annual growth rate is 2.2 percent and 52 percent of the population is rural. In 2002, 60 percent of the total population was using improved drinking water sources, with 72 percent in urban areas and 49 percent in rural areas (Table 2).

Poverty worsened during the 1980s and 1990s, with more than 35 percent of the population living below the US$1/day poverty level in 2001. Real income and consumption per capita are as low as at independence 40 years ago. Poverty is particularly widespread in rural areas, where 40 percent of the population lives below the poverty line. More than 5 percent of the rural population is affected by HIV/AIDS and more than 50 million Nigerians suffer from a combination of diseases of protein-energy malnutrition. The social and economic consequences of this pandemic and malnutrition are felt widely, not only in the health subsector, but also in education, agriculture, services and human resources.

ECONOMY, AGRICULTURE AND FOOD SECURITY

Nigeria's economy is highly dependent on oil revenues, which account for about 90 percent of total exports and for about 70 percent of government revenues. The country's GDP in 2003 was estimated at US$50.2 billion, and in 2002 the contribution from agriculture was 37.4 percent, with about 90 percent of the agricultural output

coming from the smallholder sector. Agriculture provides occupation for 30 percent of the economically active population. 38 percent of agricultural workers are female.

Nigeria is listed by FAO among those nations that are at the moment technically unable to meet their food needs from rainfed production at a low level of inputs and appear likely to remain so even at intermediate levels of inputs at some points time between 2000 and 2025. Farming systems are mainly smallholder-based and agricultural landholdings are scattered. Simple, low-input technology is employed, resulting in low-output labour productivity. Typical farm sizes range from 0.5 ha in the densely populated high-rainfall south to 4 ha in the dry north.

Nigeria's wide range of agro-ecological zones allows for a diversity of crop production activities:

- The dry northern savannah is suitable for sorghum, millet, maize, groundnuts and cotton; sorghum and millet are the most important crops;
- In the Middle Belt and south the main food crops are cassava, yam, plantain, maize and sorghum;
- In the south, the main cash crops are oil palm, cocoa and rubber;
- Low-lying and seasonally flooded areas are increasingly producing rice.

WATER RESOURCES AND USE

Water resources

The country is well drained with a close network of rivers and streams. Some of these, particularly the smaller ones in the north, are seasonal. There are four principal surface water basins in Nigeria:

- The Niger Basin has an area of 584 193 km^2 within the country, which is 63 percent of the total area of the country, and covers a large area in central and northwestern Nigeria. The most important rivers in the basin are the Niger and its tributaries Benue, Sokoto and Kaduna;
- The Lake Chad Basin in the northeast with an area of 179 282 km^2, or 20 percent of the total area of the country, is the only internal drainage basin in Nigeria. Important rivers are the Komadougou Yobe and its tributaries Hadejia, Jama'are and Komadougou Gena;
- The southwestern littoral basins have an area of 101 802 km^2, which is 11 percent of the total area of the country. The rivers originate in the hilly areas to the south and west of the Niger River;
- The southeastern littoral basins, with the major watercourses being the Cross and Imo Rivers, have an area of 58 493 km^2, which is 6 percent of the total area of the country, and receive much of their runoff from the plateau and mountain areas along the Cameroon border.

Nigeria has extensive groundwater resources, located in eight recognized hydrogeological areas together with local groundwater in shallow alluvial (fadama) aquifers adjacent to major rivers:

- The Sokoto Basin Zone comprises sedimentary rocks in northwest Nigeria. Yields range from below 1.0 to 5.0 l/s.
- The Chad Basin Zone comprises sedimentary rocks. There are three distinct aquifer zones: Upper, Middle, Lower. Borehole yields are about 1.2 to 1.6 l/s from the Upper unconfined aquifer and 1.5 to 2.1 l/s from the Middle aquifer.
- The Middle Niger Basin Zone comprises sandstone aquifers yielding between 0.7 and 5.0 l/s and the Alluvium in the Niger Valley yielding between 7.5 and 37.0 l/s.
- The Benue Basin Zone is the least exploited basin in Nigeria extending from the Cameroon border to the Niger-Benue confluence. The sandstone aquifers in the area yield between 1.0 and 8.0 l/s.

- The Southwestern Zone comprises sedimentary rocks bounded in the south by the coastal Alluvium and in the north by the Basement Complex.
- The South-Central Zone is made up of Cretaceous and Tertiary sediments centred on the Niger Delta. Yields are from 3.0 to 7.0 l/s.
- The Southeastern Zone comprises Cretaceous sediments in the Anambra and Cross River basins. Borehole numbers are low due to abundant surface water resources.
- The Basement Complex comprises over 60 percent of the country's area. It consists of low permeability rocks and groundwater occurs in the weathered mantle and fracture zones with yields of between 1.0 and 2.0 l/s.

Lake Chad is an important wetland lying in the semi-arid Sahel corridor. With a mean depth of 3.9 m, its surface area is highly variable, ranging from a minimum of 2 000 km² in 1907 to a maximum of 22 000 km² in 1961.

Low-lying areas flooded during the wet season, known as fadama areas, are scattered across the ecological zones of Guinea Savanna, Sudan Savanna, and the Sahel. These diverse wetlands are valuable for grazing, agriculture, and other domestic uses, and are deemed of international importance as breeding grounds for migratory birds, thereby having a global value for biodiversity.

Nigeria's total annual renewable water resources are estimated at 286.2 km³ (Table 3). Annual internally produced resources amount to 221 km³, made up of 214 km³ surface water and 87 km³ groundwater, while 80 km³ of the latter is assumed to be overlap between surface water and groundwater. External water resources are estimated at 65.2 km³/year, being surface water coming from Niger, Cameroon and Benin. Exploitable surface water resources are estimated to be 80 percent of the natural flow, which is about 96 km³/year. Annual extractable groundwater resources are about 59.51 km³, distributed as follows: 10.27 km³ in northern Nigeria; 25.48 km³ in the Middle Belt; 23.76 km³ in the south. Dam capacity is estimated to be 44.2 km³.

Water use

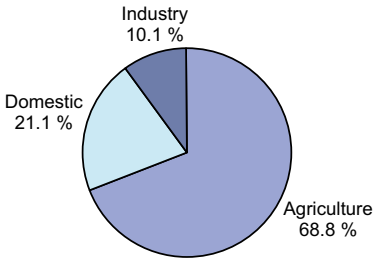
Total annual water withdrawal was estimated at 8 km³ for the year 2000. Agriculture was the biggest water user with 5.5 km³, or 69 percent of the total water withdrawal,

TABLE 3
Water: sources and use

Renewable water resources			
Average precipitation		1 150	mm/yr
		1 062	10^9 m³/yr
Internal renewable water resources		221	10^9 m³/yr
Total actual renewable water resources		286.2	10^9 m³/yr
Dependency ratio		22.8	%
Total actual renewable water resources per inhabitant	2004	2 251	m³/yr
Total dam capacity	2000	44 166	10^6 m³
Water withdrawal			
Total water withdrawal	2000	8 004	10^6 m³/yr
- irrigation + livestock	2000	5 507	10^6 m³/yr
- domestic	2000	1 687	10^6 m³/yr
- industry	2000	810	10^6 m³/yr
• per inhabitant	2000	70	m³/yr
• as % of total actual renewable water resources	2000	2.8	%
Non-conventional sources of water			
Produced wastewater		-	10^6 m³/yr
Treated wastewater		-	10^6 m³/yr
Reused treated wastewater		-	10^6 m³/yr
Desalinated water produced		-	10^6 m³/yr
Reused agricultural drainage water		-	10^6 m³/yr

followed by the domestic sector with about 1.7 km³ (21 percent) and industry with 0.8 km³ (10 percent) (Table 3 and Figure 1).

FIGURE 1
Water withdrawal
Total: 8.004 km³ in 2000



International water issues

Nigeria is a member of two regional authorities dealing with the management of shared water resources:

- The Niger Basin Authority (NBA) was formed in 1964 and is made up of the nine countries that share the Niger Basin (Guinea, Côte d'Ivoire, Mali, Burkina Faso, Algeria, Benin, Niger, Chad, Cameroon). The principal aim of the authority is to ensure the integrated development of the basin.
- The Lake Chad Basin Commission (LCBC) comprises representatives of Cameroon, Central African Republic, Chad, Niger and Nigeria. Its objective is to ensure a rational and equitable development of natural resources, including water, of the Lake Chad Region.

In addition, Niger and Nigeria by signing the Maiduguri Agreement in 1990 have established a joint commission to monitor and assess development options, in particular water resources development, in the four major sub-basins common to the two countries. However, the implementation of the Agreement has been ineffective so far.

IRRIGATION AND DRAINAGE DEVELOPMENT

Evolution of irrigation development

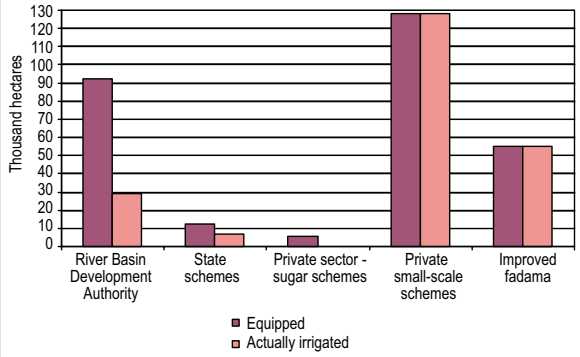
Irrigation potential estimates in Nigeria vary from 1.5 to 3.2 million ha. The latest estimate gives a total of about 2.1 million ha, of which about 1.6 million from surface water and 0.5 million ha from groundwater. However, as far as groundwater is concerned, it should be mentioned that while the extractable water resources are sufficient for up to 0.5 million ha in the north of Nigeria, areas suitable for irrigation with groundwater have, as yet, not been assessed. Areas with irrigation potential using surface water are given in Table 4.

During the oil boom of the 1970s, an investment programme in support of public irrigation was launched. Public irrigation in the Nigerian context means schemes run either by River Basin Development Authorities (RBDAs) or by the States (Figure 2). The programme included the construction of large dams and pumping stations, especially in the drier northern part of the country. By 1990, 162 dams had been constructed with a total storage capacity sufficient to irrigate 725 000 ha if developed. Many of these dams, however, were built with little or no infrastructure and the sites chosen do not always have sufficient irrigable areas close by. The schemes that were developed have not been brought into production fully or they have been implemented with inappropriate infrastructure. By 2004, only about 20 percent of the area planned

TABLE 4
Irrigation potential using surface water

Zone	Uplands (ha)	River valleys (ha)	Inland swamps (ha)	Delta swamps (ha)	Total (ha)	Total %
North	343 000	578 500	154 100	-	1 075 600	68
Middle Belt	82 000	28 000	28 000	-	138 000	9
South	180 000	11 000	93 400	78 000	362 400	23
Total (ha)	**605 000**	**617 500**	**275 500**	**78 000**	**1 576 000**	**100**
%	**38**	**39**	**18**	**5**	**100**	

FIGURE 2
Structure of the irrigation sub-sector in Nigeria in 2004
Total equipped: 293 117 ha; total actually irrigated: 218 840 ha



for public sector irrigation had been developed and only 32 percent of the developed area was being irrigated.

The poor utilization of the developed irrigation area in the public irrigation sector can be attributed to a number of factors including: i) the lack of a coherent irrigation subsector development policy and strategy; ii) insufficient attention to management systems; iii) inadequate funding (including poor cost recovery); iv) high capital and operating costs; v) inadequate farm support services; vi) poor operation, repair and maintenance; vii) a low level of project ownership acceptance by the direct beneficiaries; and viii) uncertain financial and economic viability. Because of these lapses, a number of schemes have already deteriorated badly and are in urgent need of major renovation and repair, less than 20 years after their construction.

Traditionally many farm families in Nigeria had cultivated small areas in fadamas during the dry season, using water manually drawn from shallow wells or streams. Major fadama areas are located along the flood plains of the Niger, Sokoto Rima, Benue and Yobe rivers. The promotion of pumps and tubewells, which allow for the extraction of greatly increased amounts of water, began in the late 1980s through Agricultural Development Projects (ADPs). By 1992, more than 80 000 pumps each irrigating between 0.5 and 1.0 ha had been distributed. From 1993 onwards, the National Fadama Development Project (NFDP) funded by the World Bank built on the ADPs' achievements and by the end of the project in 1999, over 55 000 pump sets had been distributed with an equipped area of about 1 ha per pump.

Private sector irrigation in Nigeria is small-scale with the exception of two sugar estates, which operate as private companies but receive government support (but they are almost non-existent at present; for example, of the 7 000 ha equipped for irrigation in Savannah sugar estate only 500 ha were cropped and irrigated in 2004). About two-thirds of the irrigated area of the private sector are small-scale areas of commercial vegetable, horticulture and flower producing schemes around larger cities. The remaining is classified as fadama irrigation, which resulted from the NFDP.

The Special Programme for Food Security (SPFS) of the FAO commenced in 1999 with a pilot phase including 280 ha in three villages in Kano State, where farmers were provided with motorized pumps and tubewells to enable them to engage in irrigated agriculture in the fadama lands. The project adopts a participatory community development approach, where farmers' groups themselves are primarily responsible for planning and have ownership of the project. After the success of the pilot phase, the project was extended in 2002 to 109 sites in all 36 States.

The area equipped for irrigation in 2004 was 293 117 ha, comprising 238 117 ha of full or partial control irrigation and 55 000 ha of equipped lowlands, i.e. improved fadamas. About 75 percent, or 218 840 ha, of the equipped area were actually irrigated in 2004 (Table 5, 6 and 7). Non-equipped flood recession cropping is being practised on 681 914 ha, bringing the total water-managed area to 975 031 ha. Surface irrigation in its various forms (basins, borders and furrows) is used predominantly for water application in both public and private irrigation schemes. Sprinkler irrigation was practised on only 3 570 ha in 1991 and was reduced to about 50 ha by the end of 2004.

TABLE 5
Irrigation and drainage

Irrigation potential			**2 330 510**	**ha**
Water management				
1. Full or partial control irrigation: equipped area		2004	238 117	ha
- surface irrigation		2004	238 067	ha
- sprinkler irrigation		2004	50	ha
- localized irrigation		2004	0	ha
• % of area irrigated from groundwater			-	%
• % of area irrigated from surface water			-	%
2. Equipped lowlands (wetland, ivb, flood plains, mangroves)		2004	55 000	ha
3. Spate irrigation			-	ha
Total area equipped for irrigation (1+2+3)		**2004**	**293 117**	**ha**
• as % of cultivated area		2004	0.9	%
• average increase per year over the last 13 years		1991-2004	1.8	%
• power irrigated area as % of total area equipped			-	%
• % of total area equipped actually irrigated		2004	75	%
4. Non-equipped cultivated wetlands and inland valley bottoms			-	
5. Non-equipped flood recession cropping area		2004	681 914	ha
Total water-managed area (1+2+3+4+5)		**2004**	**975 031**	**ha**
• as % of cultivated area		2004	3.0	%
Full or partial control irrigation schemes	**Criteria**			
Small-scale schemes	< ha		-	ha
Medium-scale schemes			-	
Large-scale schemes	> ha		-	ha
Total number of households in irrigation			-	
Irrigated crops in full or partial control irrigation schemes				
Total irrigated grain production		1999	135 000	tonnes
• as % of total grain production		1999	0.6	%
Total harvested irrigated cropped area			-	ha
• Annual crops: total			-	ha
- wheat		1999	19 000	ha
- rice		1999	7 000	ha
- maize		1999	19 000	ha
- potatoes		1999	4 000	ha
- tomatoes		1999	28 000	ha
- onion		1999	20 000	ha
- pepper		1999	16 000	ha
- sugar cane		1999	19 000	ha
- cotton		1999	8 000	ha
• Other crops (cowpeas, oil palm, citrus, cocoa, rubber, etc.)		1999	24 000	ha
Irrigated cropping intensity			-	%
Drainage - Environment				
Total drained area			-	ha
- part of the area equipped for irrigation drained			-	ha
- other drained area (non-irrigated)			-	ha
• drained area as % of cultivated area			-	%
Flood-protected areas			-	ha
Area salinized by irrigation		1999	100 000	ha
Population affected by water-related diseases			-	inhabitants

The existing water lifting options for small-scale basin irrigation in the northern States of Nigeria were found to be:

- Manual lifting from an open well using a calabash or similar container to irrigate 0.01-0.05 ha. Resource poor farmers with very small land holdings and limited water supplies use this option.
- Manual lifting with a mechanical advantage using a Shadouf or treadle pump to irrigate 0.05-0.1 ha. The use of Shadoufs is declining with the introduction

TABLE 6
Structure of the irrigation sub-sector in Nigeria in 2004

Scheme type	Equipped area (ha)	Actually irrigated area (ha)	Actually irrigated as % of equipped area (%)
River Basin Development Authority	92 317	29 140	32
State schemes	12 200	6 700[1]	55
Private sector - sugar schemes[2]	5 600	0	0
Private small-scale schemes[3]	128 000	128 000	100
Improved fadama (equipped lowland)	55 000	55 000	100
Total	**293 117**	**218 840**	**75**

[1] Estimated figure
[2] Savannah Sugar Scheme (7 000 ha equipped, 500 ha irrigated) is included in Upper Benue RBDA
[3] Estimate by FMWR, based on 80 000 ADP fadama pumps and other small schemes. Figure seems too high and there might be some double counting with the non-equipped flood recession cropping area.

TABLE 7
Equipped and actually irrigated areas in the River Basin Development Authorities for the year 2004

River Basin Development Authority	Equipped area (ha)	Actually irrigated area (ha)	Actually irrigated as % of equipped area (%)
Anambra-Imo	3 941	10	0.3
Benin-Owena	317	0	0
Chad Basin	26 180	1 000	3.8
Cross River	364	40	11.0
Hadejia Jama'are*	18 475	21 000	113.7
Lower Benue	1 310	70	5.3
Niger Delta	187	0	0
Lower Niger	1 344	115	8.6
Upper Niger	3 697	722	19.5
Ogun-Osun	512	110	21.5
Sokoto Rima	27 580	5 290	19.2
Upper Benue	8 410	783	9.3
Total	**92 317**	**29 140**	**31.6**

* The higher value of actually irrigated area compared to equipped area is due to the fact that areas outside the equipped area are irrigated using water from the main canal

of small-motorized pumps. Treadle pumps are little known and in general not liked by both men and women. Costs for a pump and well are estimated at US$5-20 for the Shadouf and US$70 for the treadle pump.

- Fully mechanized lifting using 3.5-5.5 HP petrol motors driving small centrifugal pumps. Irrigated areas are 0.5-1.5 ha, and costs are between US$500-700 for a motor, pump and well, depending on the water source. Extraction from a river is the cheapest and from a tubule the most expensive option. Before the 1980s, water sources were mostly rivers or open wells in fadamas. Today, washbores and tubewells are most common in fadamas.
- Single-cylinder water-cooled diesel motor driving a pump and extracting from a tubewell in a fadama or in alluvial plains. Irrigated areas are 0.5-2.0 ha, and costs for a motor, pump and well are about US$950. This technology is not widely found and usually installed by well-off farmers for multipurpose use. A problem is that diesel is difficult to buy in rural areas, while petrol is always available.

An analysis of developed and actually irrigated areas in RBDA schemes reveals a large difference in performance between gravity-fed and pumped schemes. While 59 percent of the area originally developed for gravity irrigation was irrigated in 2000, this portion dropped to 6 percent for schemes originally developed for using pumps and sprinklers.

Role of irrigation in agricultural production, the economy and society

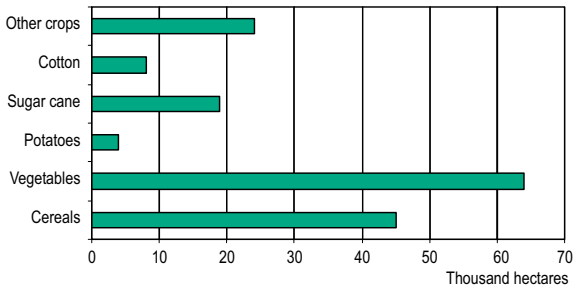
With irrigated land being less than 1 percent of the cultivated area, the contribution of irrigated agriculture to total crop production is small. The impact of irrigation is felt only with regard to specific crops such as wheat, sugar cane and to some extent rice and vegetables. In the 2003–2004 season irrigated grain production contributed to 0.9 percent of the total grain production and irrigated vegetable production contributed to 2.3 percent of the total vegetable production. The main irrigated crops in 1999 were vegetables, wheat, maize and sugar cane (Table 5 and Figure 3). Other irrigated crops were rice, potatoes, cotton, cowpeas, oil palm, citrus fruits, cocoa, rubber, taro and cashew nuts. Typical irrigated crop yields in Nigeria are given in Table 8. The crop with the highest increase in net return resulting from irrigation is sugar cane, due to a four-fold per hectare yield increase. Next are onions and tomatoes, the least profitable crops being rice and wheat. Cropping patterns and crop yields in the Kano River Development Project Phase I for the years 1997 and 1998 are given in Table 9.

TABLE 8
Selected crop yields in Nigeria in 1998/99

Crop	Yield	
	Rainfed (t/ha)	Irrigated (t/ha)
Wheat [1]	-	2.8
Rice [2]	2.2	3.5
Sugarcane	6.5	26.0
Tomatoes	6.4	10.0
Onion	6.1	6.6
Pepper	3.2	5.3

[1] Dry season crop in northern Nigeria.
[2] Weighted average yield for all irrigated lands.

FIGURE 3
Main irrigated crops in equipped schemes in 1999



Operation and maintenance (O&M) costs are estimated at US$61/ha for gravity-fed schemes and US$530/ha for schemes using pumps. Current policy is for RBDAs to charge on average US$10/ha per season for irrigation water supply (with some variations between schemes), but the fees have proven difficult to recover. Costs recovered vary from scheme to scheme but in any case cover only a fraction of the O&M costs. Nigeria has no culture of maintenance, certainly in the public sector, and it has been shown that small-scale individual farming schemes are successful and maintained when they are farmer-owned and individually operated. Of the larger schemes, few are operable and all are beset with O&M problems including the supply of and access to spare parts.

The capital cost of public sector irrigation schemes in Nigeria is high by any standard. Costs in some projects have been:

TABLE 9
Cropping patterns and crop yields in the Kano River Development Project Phase I

Crop	Wet season				Dry season			
	Crop area		Yield		Crop area		Yield	
	1997 (%)	1998 (%)	1997 (t/ha)	1998 (t/ha)	1997 (%)	1998 (%)	1997 (t/ha)	1998 (t/ha)
Rice	59	45	3.5	3.5	-	-	-	-
Maize	21	27	2.2	2.2	35	51	2.5	2.5
Vegetables *	12	19	5.0	5.0	32	25	6.0	6.0
Sorghum	8	9	3.0	3.0	-	-	-	-
Wheat	-	-	-	-	25	18	2.5	2.5
Other	-	-	-	-	8	6	-	-
Total	**100**	**100**	**-**	**-**	**100**	**100**	**-**	**-**

* Mainly tomatoes, but also onions, chillies, peppers and okra

- The Kano River Development Project: US$6 700/ha in 1978 (US$13 500/ha in year 2000 terms) with storage and gravity supply for 15 000 ha of surface irrigation;
- The Bakolori Project: US$13 500/ha in 1978 (US$27 000/ha in year 2000 terms) for storage and gravity distribution for 15 000 ha of surface irrigation;
- The Lower Anambra Irrigation Project: US$8 500/ha when completed in 1987 (US$11 200/ha in year 2000 terms) for a river lift (pump) scheme of 3 850 ha with a gravity distribution system.

In contrast, farmer-owned and -operated irrigation has low investment costs of about US$530 for a 3 HP pump able to irrigate about 1 ha, and annual operating costs of about US$280/ha. Returns are high as was demonstrated by NFDP. The predominance and availability of the small close-coupled centrifugal pump/motor units, in loan packages that do not reflect the full capital costs, has worked against the introduction of lower cost options such as the treadle pump. In addition, there was a negative experience with the treadle pump in some States due to bad publicity and poor performance of the first pumps. The truly resource-poor farmers still do not have easy access to lifting equipment.

Dry-season farming on fadama lands has two advantages for farmers:

- Fadama cultivation in the dry and wet season in addition to wet season upland farming allows crop diversification so that if one crop fails other crops will ensure food security;
- The income realized from dry-season cash crops improves household economics allowing investments for improving productivity and provides money to buy food in the event of crop failure.

Although the culture in some of the northern States prevents married women from direct participation in farming, it is the main productive activity and one of the most important occupations of women. Most women describe themselves as farmers first before they talk about other off-farm activities. Where cultural practices are enforced strictly, so that married women cannot engage directly in fadama farming, they cultivate land they may inherit or purchase by using the labour of their husbands, friends, other male relatives or hired workers. This presents a cost disadvantage to such women as all fadama cultivation involves relatively high labour inputs. Women who do not farm on their own land work on their husband's farms and women from poorer households work on farms as farm labourers. In some communities there is a belief that fadama farming is too complicated for women and women are excluded from the more productive aspects of farming.

Status and evolution of drainage systems

It is estimated that 4 000 ha are drained in Nigeria.

WATER MANAGEMENT, POLICIES AND LEGISLATION RELATED TO WATER USE IN AGRICULTURE

Institutions

The Federal Ministry of Water Resources (FMWR) is the main national coordinating body in the water sector. Its principal functions are to:

- Formulate and implement national irrigation policy;
- Develop and support irrigated agriculture;
- Coordinate the development and utilization of water resources for irrigation and other purposes;
- Update and implement the Water Resources Master Plan;
- Collect, store, analyze and disseminate hydro-meteorological, hydrological and other data;

- Support, monitor and evaluate programmes and performances of the RBDAs and the National Water Resources Institute (NWRI);
- Formulate appropriate water resources legislation;
- Undertake studies and investigations to allow the efficient use of Nigeria's water resources.

Four of FMWR's eight departments are directly concerned with irrigation subsector matters:

- The Department of Irrigation and Drainage (DID); among its major responsibilities are the supervision and monitoring of the River Basin Development Authorities (RBDAs);
- The Department of Planning, Research and Statistics;
- The Department of Hydrology and Hydrogeology;
- The Department of Dams and Reservoir Operations.

Other federal institutions involved in the irrigation subsector are:

- The National Council of Water Resources (NCWR) is the most important water resources policy formulating body.
- The National Technical Committee on Water Resources (NTCWR) is a sub-committee of the NCWR. The NTCWR has five specialist sub-committees that are important for information exchanges between federal and state level agencies: dams, water supply, irrigation and drainage, hydrology and hydrogeology, manpower.
- The Federal Ministry of Agriculture and Rural Development (FMARD) was involved in irrigation development in the past as it funded, with World Bank support, a series of state-run Agricultural Development Projects (ADPs), including the promotion of irrigation owned and managed by the farmer, particularly in fadama areas, and the provision of extension services to the public sector irrigation schemes of the RBDAs and the State Irrigation Departments.
- The River Basin Development Authorities (RBDAs) are the main bodies in charge of administering and developing Nigeria's water resources and are responsible for public sector irrigation at the federal level. They were established in the mid-1970s and the areas of operation are determined by the extent of the river basins they serve. The RBDAs were favorably financed until the end of the oil boom, when their scope and autonomy were limited.

State agencies involved in the irrigation subsector are:

- The State Ministries of Agriculture (SMAs). They were responsible for irrigation development before RBDAs were established. Irrigation responsibility within the Ministries is with the State Irrigation Departments (SIDs). In most States they are small and suffer from funding constraints and lack of staff capacity and capability to design, implement and monitor irrigation schemes. Their programmes consist more of plans than actual irrigation development, which amounts to 12 200 ha (2004), of which about 6 700 ha are actually irrigated. The informal division within a State is that schemes larger than 2 000 ha are handled by the RBDA concerned.
- State Ministries of Water Resources exist in some States, and where they exist the SID has been transferred to them.
- The Agricultural Development Projects (ADPs). They became involved in irrigation in the early 1980s, mainly in small-scale fadama development. In most States, they are responsible for extension services.
- Local Government Authorities are involved in irrigation in some limited instances by making small pumps available to farmers for fadama-type irrigation.

Water management

Semi-autonomous project management units manage federally owned and funded irrigation schemes. Those units usually consist of 3-4 departments such as Irrigation, Agriculture, Accounts, Stores and Workshops, etc. A Project Manager who reports directly to the Managing Director of the RBDA concerned heads the units.

Government policy is to subdivide schemes along the lines of one Water User Association (WUA) per distribution canal; thus, a WUA comprises 10-25 farmers. Responsibilities include O&M of the canal and its structure and adherence to water scheduling programmes. A scheme management committee (SMC), for which each WUA elects a representative, then acts as the interface between the WUAs and RBDA or other authorities. Currently WUAs are being established in two RBDA schemes and their activities include the desilting of distribution and tertiary canals and the collection of water charges.

The National Fadama Development Project (NFDP) resulted in the formation of more than 9 000 Fadama User Associations (FUAs). Most were formed with assistance from ADP staff and require further assistance and capacity building to face the challenges of operating and maintaining their schemes.

Finances

Under public sector irrigation (RBDA and SID schemes) the full costs of the schemes as well as a high portion of O&M cost are met by the Federal Government in the case of RBDA schemes and by State Governments in the case of SID projects. However, even in the case of SID schemes the Federal Government meets the cost indirectly as the States depend heavily on federal transfer.

One of the constraints to production under irrigation is the lack of agricultural credit.

Policies and legislation

Water legislation in Nigeria is use-oriented dealing with navigability, shipping and domestic use; navigability and confusion over the legal ownership of water as a resource can impede irrigation development. Decentralization is the defining feature of water administration in Nigeria, leading to different ministries and agencies at different levels administering laws without adequate coordination.

The functions of the RBDAs related to irrigation are defined in the River Basin Development Authorities Act No. 35 of 1986.

The Environmental Impact Assessment Decree No. 86 of 1992 lists drainage and irrigation as a Mandatory Study Activity, thus prescribing that environmental impact assessments are to be carried out for irrigation projects.

The Water Resources Decree No. 101 of 1993 gives the FMWR significant power to control and coordinate activities for proper watershed management and resources protection and for public administration of water resources. It confers to the FMWR the responsibility to make proper provision for adequate supplies of suitable water for, amongst others, agricultural purposes in general and irrigation in particular.

Nigeria's irrigation policy of 1995 is being updated by FAO. The second draft in 2000 makes provision for:

- Being responsive to macro-economic drivers, commodity prices and input costs;
- Sustainable operation, maintenance and management (including cost recovery);
- Better integration with agricultural production systems;
- Support services in irrigated agriculture including credit facilities, fertilizer, seeds, and machinery. However, it includes access to land and water in with 'support services' when this should be a separate category;

- Formation of WUAs – confirmation of legal status, training and transfer of O&M of some levels of the irrigation systems when WUAs are ready;
- Advice on on-farm water management;
- Research on irrigation including technology, environmental conservation, economics, sociology, health links and preservation techniques;
- Marketing strategies include a Government commitment to building rural roads, small-scale food processing, storage and price guarantees.

ENVIRONMENT AND HEALTH

In the past, no serious attention was paid to environmental considerations in the planning and implementation of water resources development projects, resulting in environmental damage. Hydrology downstream from dams and major diversions and pumping stations has been modified, especially in the north. Extensive areas of fadama, fisheries and wildlife habitats were wiped out. It is however encouraging that the functions of the DID were modified to include environmental impact assessments.

The Hadejia Nguru Wetlands in the northeast of the country receive their water from the Hadejia and Jama'are Rivers, which meet to form the Komadougou Yobe River, flowing northeast into Lake Chad. So far, more than half of the wetlands have been lost due to drought and upstream dams. It is feared that new development projects could divert still more water from the wetlands for irrigated agriculture in upstream areas. Apart from the ecology, such developments would also negatively affect irrigated agricultural production in the floodplain using water from the shallow groundwater aquifer, as recharging would decrease further.

Expansion of irrigated crop production in the fadama lands has led to a lowering of the water table in some areas. There is a need for detailed aquifer assessments prior to the installation of additional pumps.

In the Niger Delta, water resources are being polluted from oil exploration activities such as oil drilling and pipe leakages.

PERSPECTIVES FOR AGRICULTURAL WATER MANAGEMENT

The latest policy statement from the FMWR in 2000 proposed an updating of the National Water Resources Master Plan (NWRMP) and the strategies the Ministry intends to follow in the irrigation subsector are:

- Rehabilitation or completion of eight large dams (Goronyo, Zobe, Owena, Alau, Omi–Kampe, Kagara, Waya, Obudu).
- Rehabilitation of four existing irrigation schemes (Bakolori, Rivers State Rice project, Galma, Zauro) totaling 43 000 ha.
- Completion of five ongoing irrigation projects (Hadejia Valley, Kampe, Middle and Lower Ogun, Middle Rima) associated with dams and totaling 18 400 ha. Actions have also been initiated to assess needs for the completion of another ten schemes totalling over 100 000 ha.
- Institutional reform, greater farmer participation, training and capacity building, reintroduction of extension services by the RBDAs and assistance to farmer groups to improve input supply.
- A review study of the public irrigation subsector with FAO to develop an action plan for utilizing public irrigation schemes and improving crop output as well as an assessment of their financial and economic viability. The results of the study were to be used to prepare a National Irrigation and Drainage Policy in early 2005.

The FMWR has proposed a programme of community irrigation schemes in which the benefiting communities would play the central role by providing the land, 5 percent of investment cost, active participation in the implementation and taking over full responsibility for O&M. Components of the programme would be:

- Weirs, suction wells or small earth dams as necessary;
- Irrigated area of up to 1 000 ha per scheme;
- Domestic and livestock water supply;
- Aquaculture and vegetable gardens.

A Second National Fadama Development Project, taking place over six years from 2004 to 2009, is planned, including the following components:

- Capacity building of the Fadama Community Associations (FCAs);
- Investment in infrastructure, both water resources/irrigation infrastructure and general rural infrastructure;
- Pilot asset acquisition support, to enhance the fadama users' productivity and income by facilitating their acquisition of productive assets;
- Demand-responsive advisory services, to enable Fadama User Groups (FUGs) participating in the project to adopt productivity enhancing techniques and appropriate marketing practices.

The results of the FAO-initiated Special Programme for Food Security are encouraging and the impact of the project on food security is felt in each of the 109 project sites. In this regard, there is great potential for extending some of the technologies introduced and improvements made.

Farmer-owned and -operated small pump schemes, mostly of the fadama type, continue to expand. With the simplicity of their technology, easily manageable infrastructure and relatively low costs of development and operation, these schemes will increasingly play a catalytic role in rural development.

Land tenure has a bearing on the scope for increasing the number of farmers using irrigation. Many who do not have rights to land and only rent or lease, will not invest in any infrastructure. While land tenure and ownership is a difficult, complex and sensitive issue, it is clear that farmer-owned land in irrigation schemes is better looked after, more sustainable, and has greatly reduced opportunities for abuse by the farmer or the allocating agency when compared with leased or allocated lands.

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