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Résumé


En dépit d'une pluviosité médiocre et irrégulière, cette zone s'avère être, depuis le début du xixe siècle, une des plus intensément cultivées en Afrique tropicale. Son développement débute avec l'installation à Sokoto, après le jihâd peul, du centre administratif du califat. L'intensification de l'agriculture résulte de la disponibilité d'une main-d'œuvre importante (libre ou servile), de l'utilisation de gadoues et de fumier, et d'une demande urbaine croissante de produits vivriers. Aujourd'hui comme hier, les cultivateurs pallient l'irrégularité des précipitations par un large éventail de techniques culturales, l'exploitation complémentaire des zones inondées comme exondées, et l'irrigation en saison sèche. Pendant la période coloniale, la région est devenue économiquement périphérique par rapport au développement des cultures de rente dans le Sud-Est, pour lesquelles elle a fourni une main-d'œuvre abondante. Depuis l'indépendance, on a entrepris d'améliorer l'agriculture grâce à des plans d'irrigation à grande échelle dont la réalisation devrait modifier l'écologie agricole du bassin Sokoto-Rima.

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Population and Agriculture in the Sokoto-Rima Basin of North-West Nigeria

A Study of Political Intervention, Adaptation and Change, 1800-1980

Tropical Africa is frequently described as an area of dispersed population interrupted by ‘islands’ of densely populated land and large towns of recent origin. In a continent as vast as Africa, it is easy to underestimate the importance of these ‘islands’ which reflect the history of particular sub-regions. For example, it is often overlooked that Nigeria contains about one quarter or one fifth of the total African population, and that within this country there are significant areas of high population density and levels of urbanization which are not simply the outcome of colonial rule. South-western Nigeria primarily occupied by the Yoruba is notable for its urbanism, some 40% of the population living in towns of precolonial origin. The development of these towns and their allegiance rural populations occurred in an area of subtropical forest, which refutes the notion that the forest was so inhospitable as to preclude sophisticated forms of settlement and complex political structures.

In south-eastern Nigeria, the Igbo have much less centralized political and economic systems, but this did not inhibit the development of flourishing agricultural-trading systems with high rural population densities. Further north, the Hausa-Fulani emirates and their cities reach back hundreds of years and are a part of a series of States which spread across the Sahel and Sudan of West Africa. Yet in the central regions of Nigeria one finds a relatively empty zone with low population densities and few cities, which in part is the product of slave raiding, and the abstraction of some eight to nine million people by Europeans during the period of the Atlantic slave trade. These Nigerian examples suggest that population, settlement and agriculture are geographically and historically specific. While one cannot ignore the ecologies of such areas, it is equally necessary to appreciate the particular historic events which have occurred, and the societies and political structures through

which the environment has been mediated. The account which follows examines the development of one of the densely settled and cultivated areas of northern Nigeria, located in the Sokoto-Rima river basin, centred on the town of Sokoto. Ecologically, this is one of the most marginal regions for agriculture in Nigeria, yet during the 19th century it emerged as the nucleus of the Sokoto caliphate, which was the most populous State in pre-Partition Africa. Sokoto city currently has a population of some 200,000, while its intensively cultivated hinterland has rural population densities which in places exceed 300 per km². This area of close settlement and permanent field systems is not unique in northern Nigeria, and is paralleled by much older zones around the major towns of the former Hausa States, notably Kano (Mortimore & Wilson 1965; Hill 1977). The Sokoto close-settled zone is of particular interest because its development was associated with the Fulani jihad of the 19th century, and because it includes more extensive areas of floodland cultivation than elsewhere in Hausaland.

The Physical Setting

In order to understand the development of the special cultivation systems and agricultural practices which characterize the Sokoto region, it is necessary first to examine its physical and historical setting. The Sokoto close-settled zone is predominantly under annual cultivation and extends some 110 km north-south and 40 km east-west of the city of Sokoto, which is sited just above the confluence of the Sokoto and Rima rivers (Fig. 1). The Sokoto-Rima basin can be divided into three physiographic regions: the uplands or high plains of the east and south-east, the Sokoto plains of the north and centre, and the riverine regions of the Niger and lower Rima valleys (Davies 1982). The high plains comprise a dissected plateau of complex crystalline rocks which are characterized by ranges of hills and massive inselbergs which intersect steeply with the surrounding plains. The Sokoto plains on which the close-settled zone is sited are derived from softer sedimentary rocks of the Tertiary and Mesozoic period, which are made up of clayey grits, sandstones, shales and sandy limestones. The topography is level and the monotony broken by isolated mesas and escarpments, which result from outcrops of limestone and gritstone. This low plateau is dissected by the Sokoto and Rima rivers whose floodplains on the sedimentaries are up to 8 km wide. These floodplains represent early stages of erosion in the Quaternary when the climate was wetter, but they now comprise a network of stream channels, some abandoned, others fringed by seasonal swamps.

and lagoons, and flanked by sets of river terraces which are remnants of former floodplains at higher levels. Climatic changes in the Quaternary period must have led to enormous fluctuations in the type and strength of the erosion process. When drier periods prevailed, wind processes resulted in the deposition of sand, and today relic dunes are distributed across the plain.

The soils derived from the sedimentary rocks and wind-blown deposits are generally ferruginous, light and porous; they are also low in organic matter and nutrients, but can be easily cleared. In contrast, the riverine areas have fertile hydromorphic soils, which are grey or black silts with a high clay fraction, and are annually renewed by flooding. Farmers are quick to perceive small local variation in soil types and they avoid outcrops of laterite and duricrust, which produces very hard surface horizons. Frequently it is the depth of weathered material above these lateritic horizons which determines the cultivability of an area.

The climate of the Sokoto-Rima basin is the result of the interplay of two different air masses: the moist tropical maritime airmass from the Atlantic and the dry continental airmass from the Sahara. The zone of convergence (the inter-tropical discontinuity, ITD) migrates north and south bringing an alternation of rainy and dry seasons. For much of the year the ITD lies to the south of the Sokoto-Rima basin when dry north-easterly air, or harmattan, predominates. But when the ITD moves northwards, it is accompanied by disturbance-line thunderstorms and followed by more continuous rain. The general trend of annual rainfall distribution is one of greater rainfall in the south (1,008 mm) with an onset of the rains around March, while further north Sokoto town has an average of 740 mm, which drops to 658 mm at the northern edge of the close-settled zone where the rains do not start until June and in some years finish by mid-September. Sokoto farmers divide the year into five (see Table): fasalin rani (dry season, from January to early March), fasalin bazara (hot season, from March until the end of April), fasalin damina (rainy season, from late May till early October), fasalin kaka (harvest season, from October till late November), fasalin dari (cold season, from late November till the end of December).

The rainfall of the close-settled zone is certainly not the best to be found within the basin, and the growing season for upland crops is no more than five or six months. But average rainfall figures say little of the reliability, cyclical patterns, and daily and monthly distribution of rainfall within any one season. These events are of crucial importance for the farmer. One important characteristic of the seasonal movement of the ITD is its irregularity; generally it advances north at about 160 km per month and retreats at about 320 km, which means the end of the rains is abrupt compared with their onset. However, this general trend varies; the annual total rainfall, its incidence and distribution can be very different from one year to the next. Most rain occurs during rela-
tively short but intense thunderstorms covering only small areas, and this is particularly so at the beginning and the end of rains. Days without rainfall in the rainy season are common and, also, their number and frequency alter from year to year. Heavy rainstorms at the beginning of the wet season fall on land with little or no vegetation cover; run-off is intense, with associated damage of valley and hill slopes and their soils through rill and gulley erosion. A more evenly distributed rainfall throughout the wet season is preferable, and an annual rainfall of as little as 500 mm has produced better crops than a high rainfall of 750-1,000 mm which is poorly distributed in time and space. A comparison of daily rainfall in Sokoto for 1977 and 1978 illustrates these points and is shown in Fig. 1.

Agriculture on the Sokoto plains is dependent on local rainfall during the wet season, but cultivation of the floodplains (fadama land) is related to rainfall and run-off in the upper Sokoto-Rima basin. The drainage density and run-off are high on the basement complex rocks of the high plains and the streams carry large amounts of sediment when they flood. On entering the level plains, the rivers deposit large amounts of sediment along the fadama. The slow-moving rivers on the plains and the sedimentation slow the pulses of water which are transmitted downstream from the hills after storms; water is stored in the alluvial tract, which is

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**Table. — Agricultural calendar for Sokoto 1977*.**

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of great importance for cultivation in the dry season. During the dry season most rivers and streams cease to flow; the main streams shrink towards the end of December, leaving pools and lagoons, and only the Niger, Rima and lower Zamfara are truly perennial. On the sedimentary rocks and superficial deposits of the adjacent plains, some pools and shallow wells may remain into the dry season, where there are perched water tables. Although the temperatures of the dry and wet seasons do show some sharp variations (see Fig. 1), it is the seasonal distribution of rainfall and occurrence of localized water in the dry season and the extensive fadama which are of particular importance for settlement, agriculture and cattle rearing. But while the distribution of rainfall and water influences the general pattern of settlement and cultivation, there is much more than a simple deterministic relationship between man and climate.

The Distribution of Population and the Development of Settlement

The most striking thing about the distribution of population within the Sokoto-Rima basin is its unevenness and variable density (Fig. 2). In some areas such as the Gundumi and Tureta bush, Tangaza and the Gulbin Ka forest reserve there is virtually no population, whereas in the close-settled zone around Sokoto city population densities can be over 300 per km², with villages of 2,000 to 3,000 inhabitants. One of the most important environmental factors influencing the distribution of population is the availability of drinking water during the long dry season, which is reflected in the concentration of population along the Sokoto, Rima and Gagere valleys. Even if rivers and streams are not perennial, the water table can be reached by shallow wells. It has been estimated that some 70% of the population live within, or near, the principal river valleys; also, all the major towns are close by rivers. Away from the valleys on the sedimentary rocks of the plains, the possibility of dry-season wells depends on perched water tables associated with ironstone bands, and it is their absence that makes water so scarce in the Gundumi, Tureta and Tangaza areas.

Although the influence of the physical environment on the distribution of population is evident in a general sense, the imprint of history is also very plain. The concentration of population around Sokoto is very much related to the Fulani jihad of the 19th century, while the concentration of people along the lower and upper Rima and its tributaries is associated with the earlier States of Kabbi and Gobir respectively (Last 1967). In the 20th century the impact of colonial rule was also important, and the growth of population around Gusau in the south-east
Fig. 2. Distribution of population in the Sokoto-Rima basin (SWINDELL 1982: 29).
was the product of the railway and the commercialization of cotton and groundnuts. But the most significant event was when this river basin became the core of the Sokoto caliphate. The jihad and emergence of the caliphate led to the peopling of what were empty areas in the middle Sokoto-Rima valleys. Old settlements were expanded and many new ones created, which led to the development of intensive cultivation in areas which formerly relied on bush-fallowing and herding.

At the end of the 18th century the Sokoto-Rima basin was dominated by two States, Kabbi and Gobir, located in the lower and upper Rima valley respectively. Kabbi was a province of the Songhai empire, which lay to the north-west, which had rebelled and become independent. The Kabbawa were successful rice farmers as well as fishermen and wild-fowlers; zones of dense settlement and intensive cultivation grew up along both banks of the river, and remain today. Another zone of intensive cultivation and settlement grew up along the upper Rima and its tributaries, the Bunsuru and Gagere rivers. This was the outcome of the expansion of the Hausa State of Gobir, which superseded the previous State of Zamfara and expanded into the upper Rima valley. The capital, Alkalawa, on the Rima was a major commercial centre in the Sudan, dealing in carpets, paper, cloth, kola and salt. Scattered throughout the basin were the Fulani, who were divided into the Toronkowa, who had originally come from the Futa Toro in Senegal in the 15th century, and the Sullebawa, who had migrated from Katsina. These two Fulani groups were partially settled, but there were others such as the Bororo who were nomadic herders. In addition, there were groups of pagan Hausa scattered through the Sokoto-Rima basin, especially in the hill areas of the south-east.

While the struggle for the mastery of the fertile land of the Sokoto- Rima basin continued, a new force had gradually arisen within the area. This force was an Islamic reformist movement led by Shehu Usman dan Fodio who was born at Degel in Gobir in 1754 (Boyd 1982). This movement by the end of the 18th century had attracted the opposition of Sarkin Gobir, because it posed a distinct threat through its attempt to persuade Muslims of the need for a return to the original precepts of Islam (especially those associated with justice and taxation), which had fallen into disuse in Gobir. In 1804, the shehu became the leader of the community, which went into exile and wandered across the Sokoto plains preaching and teaching. A base was eventually found in Gwandu, but the community was attacked by Gobir aided by the Kabbawa, and the region was engulfed by the jihad which finished in 1808 with the fall of Alkalawa.

After this successful outcome for the community, the shehu's son Muhammad Bello moved to Sokoto in 1809 where he built a new city in a place which had been a small village inhabited by a few dyers and occasionally used as a war camp. This location overlooking the Sokoto
river was in a zone of sparse population which hitherto had been on the margins of the former pre-jihad States. The caliphate was established by 1809, the western half centred on Gwandu was controlled by the shehu's brother Abdullahi, while the eastern half was held by Bello. Bello became caliph in 1815, the caliphate's sphere of influence was gradually extended and the other Hausa States brought under its control, so that it extended northwards into what is now the Republic of Niger, south-eastwards to the upper Benue river basin and southwards to include Ilorin.²

During the 19th century, the settlement pattern of the Sokoto-Rima basin was radically altered through relocation and immigration, together with the development strategies of Caliph Bello and his successors. Bello realized the importance of stabilizing the frontiers of the caliphate and he set up a network of fortified settlements (ribaataat, sing. ribaat) around which other settlements and farmland could flourish safe from the raids of the Kabbawa, Gobirawa and Tuareg (Last 1967). Ribaataat were built along the upper Rima valley and its tributary the Gagere and in the south-west near Gwandu facing the Niger lowland occupied by the Kabbawa (see Fig. 2). But Bello also encouraged the building of ribaataat within the frontiers close to Sokoto city, where mosques, schools, workshops and commerce could flourish. These early ribaataat became focal points for smaller ones built around them, and were the basis of a settlement pattern which today is notable for its numerous large nucleated villages. Therefore a network of settlements grew up which led to the development of areas of close-settled farmland, the most important of which was that centred on the capital, Sokoto. The 19th-century explorers such as Clapperton (1966) and Lander (1967) believed that Sokoto was the largest city in the interior of Africa that they had seen: Lander estimated Sokoto’s population as 120,000—compared with Kano’s 40,000. But by the time Barth arrived in 1853 it was thinly inhabited and greatly dilapidated. This was one of the periods in the 19th century when the caliph and his court were residing at Wurno 30 km away.

After the jihad, those who had been part of the shehu’s victorious forces were rewarded by being allocated land, instituted as district and village heads with the right to collect taxes, and they were also given slaves which could be used to work their farms. For example, the village of Gagi, some 5 km from the centre of Sokoto, was named after the second in command of the shehu’s army, whose father and brothers helped to build the walls of the original town after the jihad. Rather than accept land within the town, Gagi took land for their farms and flocks outside the walls and built the present village. Eventually eight vassal villages

² For a detailed account of the caliphate, see Last 1967.
of Gagi were built together with several hamlets, and at first these were farmed by slaves who were overseen by Gagi people, some of whom eventually went to live there. Although Gagi was not technically a ribaat (it is in fact a ward of Sokoto town), its location outside one of the main routes into the city made it a suitable forward defensive position, under the control of one of the caliph’s military lieutenants.

Clapperton, during his visit to Sokoto in 1824, also noted the manner in which slaves cultivated the land, tended cattle and collected wood around the city, while living in outlying villages. After the jihad all land was declared waqf, that is held in common for the benefit of the Muslim community, but the allocation of farms could be made by the emirs, or by the village and district heads acting on their behalf, so that the use rights could be inherited but not sold. One of the important aspects of the development of ribaataat was their contribution to the settlement of the Fulani population, something which had not been achieved hitherto. Bello believed towns and ribaataat were an essential part of the establishment of Islamic practice and law among the pastoral peoples who moved into the Sokoto region.

Once Fulani hegemony was established, taxes in kind, money and slaves flowed into the Sokoto and Gwandu emirates from the other Hausa States such as Kano, Zaria, Katsina who now owed allegiance to Sokoto. Slaves who were taken in battle or purchased were either part of domestic households, or belonged to office holders who put them to work on farms or villages under an overseer. Such slave settlements (rumada, sing. runji) and farm plantations were another means of settling, expanding and intensifying cultivation around the towns, the ribaataat and along trade routes. The slave farms and settlements went through cycles of growth and development, which could be quite short. On the death of the owner subdivision was likely, and sons would take their share of slaves and would build separate compounds, or possibly create new hamlets (unguwoyi, sing. unguwa) close by the village. In this manner there was a process of in-filling between the larger settlements.

Under the Maliki version of Islamic law, slaves had right to property and those who were part of domestic households frequently had farms of their own, which they worked for three days per week or at given times throughout the day. Slave households were partially reproduced by their own labour on these farms, but they were fed on the days they worked for their owners. Surplus labour was not only extracted in this manner from slaves, but also from junior members of households, who worked for given periods under the direction of the household head (mai gida) on his farms. It was from the mai gida’s farm that produce was taken to pay taxes, dowries and other expenses. The difference between slaves and freeborn subordinates in a household was in many ways negligible, but there was a difference in legal status, and slave marriages and their offspring were subject to control. Also, in many
villages only slave women assisted men with their farmwork, and slaves were not allowed \textit{fadama} farms. Work on irrigated \textit{fadama} farms in the dry season is very intensive and precluded periodic absence from an owner's farms.

But the population of the middle of the Sokoto-Rima basin was not only inflated by slaves; just as important were the many immigrants who followed the shahu, who came to settle within the sphere of influence of Sokoto and its leaders. For example, the support for the shahu by one branch of the ruling house of the Adarawa centred on Tahoua led to the drift of Tuareg into the area north of Sokoto city, where they became influential traders in the town during the 19th century. Villages to the north of Sokoto contain substantial numbers of people from Adarawa who are the descendants of those who fought with the shahu; their leader, Sarkin Adar, built the northern ward of the city, and was given fiefs north of the Rima river. The villages of Dundaye, Gwomfa, Gidan Bubu and Safatawa were founded by Adarawa, and the land cultivated by them and their slaves was in an area which had few Hausa. Other important groups were the Kamberin Beriberi from Agades who established early links with the community, and who became influential in the kola trade. Also the Nupe from the middle belt established themselves in Sokoto as blacksmiths and weavers (Abubakar 1979).

In a variety of ways, the active settlement of the hinterland of Sokoto city was continued by the caliphate's administration to the end of the 19th century. Under Caliph Ahmad (ca. 1850), Moriki and Acida were founded, while Rabah was expanded (Last 1967). In the late 19th century, settlement was pushed northwards towards the present-day Niger border and Gwadabawa town was founded in 1882. After the French capture of Segou, refugees were given land and settled at Karantudu near Binji.

The Development and Intensification of Agriculture

The introduction of so many people into the middle Sokoto-Rima basin not only transformed settlement but expanded and intensified agriculture, which formed the economic base of this new region. Food staples such as Guinea corn, millet and rice, together with commercial crops such as onions, cotton, henna and indigo, were produced to support not only the large rural population, but also those who lived in the towns. The Hausa towns of the Central Sudan have a long history of trading, industry and reliance on surplus food production provided by their surrounding regions. Not only did the concentration of people around Sokoto provide a demand for agricultural produce, it provided the means. The large number of free men and slaves meant that substantial inputs of labour were available for the cultivation of the low plateau of the Sokoto plains. During a
visit to Sokoto in 1910, the traveller and writer E.D. Morel (1911: 115) observed that the soil may look incapable of sustaining crops, but every year ‘blossoms like a rose’. Also, he was emphatic that ‘this means and needs inherited lore and sustained and strenuous labor’ *(ibid.)*.

On the other hand, perennial cultivation of the floodplains was widespread in the 19th century, with rice in the wet season and irrigated crops such as onions, tobacco, bananas in the dry season, which require intensive inputs of labour. Travellers such as Clapperton and Barth were particularly impressed by the cultivation of the *fadama* lands and the systems of irrigation. Onion growing, together with the cultivation of bananas, tobacco and sugar cane, was an integral part of the farming system. Sugar cane was processed by horse-driven sugar mills, probably an innovation from North Africa introduced by Caliph Bello. The cultivation of rice is frequently mentioned in 19th-century accounts, and Barth (1965: 125) believed that the rice lands at Wurno were the most extensive he had seen on his journeys.

A crucial element in the transformation of the Sokoto region was the huge inputs of manure to enrich the light porous sandy soils of the sedimentary rocks and the superficial deposits of the Sokoto plains. The improvement of farms by the application of compound sweepings, old latrines and the dung of sheep and goats kept in villages is common throughout Hausaland. Donkeys were, and to a lesser extent are still used to transport this refuse and manure out to the fields, where it is hoed into the ground (Mortimore & Wilson 1965). It is perhaps one of the sadder facts of modern farm management that donkeys are being replaced by small trucks, while motor cycles are a widespread form of transport: unlike donkeys, trucks and cycles do not produce manure.

The Sokoto-Rima basin is an important source of dry-season grazing for nomadic Fulani who come down from the north into this region after the rains have finished. But the settlement of many Fulani in the 19th century also introduced into this area large numbers of cattle which are kept in towns and villages and trekked out to the fields to graze on crop residues, or on the grasses of the uncultivated *fadama* during the dry season. Both nomadic and local herds are an important means of improving upland through manuring as the animals graze across the farmland. During the wet season, animals from the local towns and villages in the close-settled zone are taken out to the empty bush areas such as those around Tureta and Gundumi. This practice began in the 19th century when the control of Caliph Bello and his successors was such that movements through the cultivated farmland were organized along drove routes, which were marked by the planting of arguwa trees (*Demikon arguwa*), locally known as *buriali*. Cattle will not eat these trees, which have the added advantage that they also yield latex which can be used to repair calabashes used by fishermen as floats. Remnants of the droveways can still be seen today, although they seem to have
fallen into disuse, with a consequent increase in disputes between cattle owners and non-cattle-owning farmers.

The switching of local cattle from one ecological niche (the river bottoms) to another (the empty bush) according to season is not just a strategy which accommodates cattle-owners but one which allows the integration of cattle into a closely-settled cultivated zone. Farmers can annually cultivate upland and *fadama*, while at the same time keeping cattle, as long as the spatial shifting of herds is possible. Even non-cattle-owners benefit from the manuring of their land in the dry season, but the system does require careful control of animal movements to avoid a clash of interests. This is particularly important in the dry season, when irrigated farms have to be protected from grazing cattle by fences.

The creation of an intensively cultivated area around Sokoto bears a close relationship to the large inputs of labour in the 19th century and its control through a centralized hierarchical political system rooted in the precepts of Islam. It has been frequently remarked that in tropical Africa where hoe cultivation is still dominant, adequate labour power provides the key to successful agriculture. Boserup (1965) has suggested that the type of cultivation system is dependent on population density; as population increases, so agriculture becomes intensified and fallow systems give way to permanent field cultivation. The Sokoto case would appear to confirm this, but it is not sufficient to postulate that population is an independent variable, as we need to understand the historical processes which bring about population increase, and the kinds of production relations which support particular populations. Also, there is not necessarily a linear development from food gathering, through fallowing, to permanent field cultivation; there may be a mixture of systems with one dominant.

An examination of cultivation systems and techniques used in the Sokoto-Rima basin shows sophisticated levels of environmental management, which operate at the micro-scale, being responsive to seasonal and annual changes in climate. Present-day methods of farming and the types of crops grown show a remarkable continuity from their development hundreds of years ago in Hausaland and their introduction into the Sokoto area as it was developed during the 19th century. The accounts of travellers such as Clapperton, Denham and Barth indicate farming practices similar to those of today, and their reports are confirmed by the writings of the 19th-century Muslim cleric Imam Imoru (in Ferguson 1973). In the 20th century, writers and colonial officials were surprised at the flourishing and successful agriculture they encountered. To begin with, our attention is focussed on methods of foodstaple production and the long-established techniques of upland and lowland farming. Contemporary observations supplement our historical knowledge, and collectively illustrate the means whereby a relatively empty
Ph. 1. Eroded upper valley slope being cleared of lateritic rubble to allow the extension of agriculture in a densely populated area near Sokoto.

Ph. 2. Preparation of raised beds for the cultivation of sweet potatoes.
area in the middle of the Sokoto-Rima basin became an intensively cultivated zone. It was not until after independence, in the 1960s, that serious attempts were made to alter the methods of food staple cultivation, through the introduction of modern irrigation schemes.

Cultivation Systems and Agricultural Techniques

In the close-settled zone, farmland can be divided into two basic types: upland (tudu) on the low plateau, and lowland (fadama) along the edges of the major rivers and the bottoms of their tributaries. Upland farms are cultivated only during the wet season as they are rain-fed; fadama farms are also cultivated in the wet season, primarily for rice, but cultivation may continue into the dry season by using shallow wells, or lifting water from the rivers. As we have observed earlier, upland farms have soils which are largely man-made, and require continuous inputs of manure, while floodland farms have soils which are renewed annually by sedimentation and may be supplemented by manuring. It is important to realize that many farmers integrate upland and floodland cultivation along a catena of soils from the river edge up the basal slope of the valley side and onto the upland; this progression embraces several land-use elements and micro-environments, which are used differentially according to the type of crop, season, slope, soil and hydrological conditions.

Upland Cultivation

The upland of the close-settled zone comprises an intricate network of permanent fields, which form a more or less continuous cover broken only by low mesas, outcrops of laterite and the built-up area of the villages. Fields are small (between 0.05 and 1.15 ha) with their boundaries marked by a coarse grass, locally known as gamba (Andropogon gujanus), which stabilizes the soil during the dry season after harvest, when it is prone to wind erosion from the north-easterly harmattan. Grass boundaries also protect young millet at the beginning of the rainy season when line-squalls can be accompanied by localized windstorms. Over the years many fields have acquired a dish-shaped profile as soil is banked against the grass boundaries. Upland farm holdings measured in a survey during 1967-68 varied between 2.2 and 5.2 ha, and are usually fragmented although farmers do attempt to consolidate their holdings whenever possible (Goddard, Fine & Norman 1971).

The basic foodstaples grown on upland farms are bulrush millet (Pennisetum sp.), Guinea corn (Sorghum sp.), cowpeas (Vigna unguiculata) and groundnuts (Arachis hypogea). In the Sokoto area the
most important of these is probably millet, of which there are several varieties and many local names which farmers use to describe the form and habit of the plant. For example, two varieties planted around Sokoto are zango, a long slender spiked millet, and wuyan bajini, which literally means 'bull-neck' and is a much shorter and thicker spike. But a basic distinction is made between early millet (gero) and late millet (maiwa). Early millet can be harvested within about 107 days, whereas later millet and Guinea corn (dawa) can take up to 145 days, which may exceed the number of rainy days during the wet season. Together with late millet, Guinea corn relies on residual moisture in the soil in order to ripen fully, and yields fall if the rains come late, or end early. In addition, the longer growing period of these crops means their development may be limited by changes in light intensity related to day length (photoperiodicity). Early millet which breaks the hungry season can be harvested in August-September, while the late variety (maiwa) is ready in November-December. The cultivation of early millet, which is important in the Sokoto area, is not without risk; if the early rains prove premature, the crop may have to be replaced or abandoned. Some farmers actually plant millet in advance of the first rains—a practice known as binne—, which is a calculated risk. However it may not be more inconvenient than planting after the first showers, which may prove false, but if they succeed the hungry season is broken that much earlier. Many farmers interplant early and late millet with Guinea corn, as this spreads the risk of crop failure.

Interplanting is commonplace and the permutations of upland crops are many: up to forty-six combinations have been recorded (Norman, Fine & Goddard 1976). Intercropping allows the cultivation of two or more crops on the same piece of land in the same season, and planting and harvesting are either staggered or in succession (Fig. 3). Mixed cropping is essentially crop rotation within one growing season, as different crops with different nutrient crop requirements complement one another. Mixed cropping is an important technique for spreading risk and smoothing labour inputs. But it has been found that it also maximizes the returns to labour, which is frequently the scarcest factor, and therefore mixed cropping is economically advantageous. Norman, Fine and Goddard (ibid.) found that in three villages surveyed in the Sokoto close-settled zone in 1967-68, sole crops accounted for less than 10% of the cultivated area. The combination of legumes such as cowpeas (wake) and groundnuts (gujiya) with cereals is particularly important in this area of poor soil, as the former have nitrogen fixing properties.

Intercropping was certainly practised in the Sokoto-Rima basin during the 19th century, and Barth (1965: 570-571) writes of sorghum and cotton cultivated in the same fields near Gandi, while at Zurmi indigo and cotton were cultivated between rows of sorghum, and at Rubo indigo was grown between millet. It would seem that manuring, crop
rotation and mixed cropping were important techniques (albeit using different crop mixtures) for the management and improvement of this region during the 19th century.

Along with mixed cropping the use of ridges is another method whereby farmers minimize the physical constraints of climate, soil and biological factors. Ridging, when combined with the application of manure and ash, allows a concentration of soil and nutrients around plant roots, and increases the thickness of soil and its fertility. Also, it limits erosion, especially if ridges are built along contours, while ridges improve aeration of the soil as well as providing channels to either catch or drain water, depending on the crop planted. Ridges are constructed in several ways. If sufficient labour is available, they may be dug in advance of planting, after the land has been cleared and manured. On the other hand, millet and then Guinea corn may be planted on the flat and manure laid in lines between the rows. At the first weeding the young plants are ridged up and manure mixed around their roots. This method has the advantage of economizing on labour if it is in short supply, as weeding and ridging are done simultaneously. Another method is that whereby ridges are made and seeds planted along the furrow to catch the early rains; then the ridges are turned in and around the crops at first weeding. In this manner the crops begin in the furrow and end up on the ridges.

Crops such as cowpeas and groundnuts do not like too much moisture, and may be planted along ridge tops and sides (see Fig. 3) in June and July, and harvested in October and November respectively. On the other hand, where soils are especially light and rainfall variable, the furrows are a means of collecting rain, particularly the early showers, therefore early millet and sometimes Guinea corn are planted along the furrows. The amount of ridging and the disposition of crops depend on the labour available, together with local soil and rainfall conditions.

The inputs of labour on upland farms are relatively small and not continuous (between 150 and 200 man-hours per acre of mixed upland crops) but they are required in short intensive bursts, and timing can be critical if satisfactory harvests are to be achieved. With the high temperatures in this area, once there have been several rainshowers, the ground is quickly covered by grasses and weeds, with which young millet and Guinea corn have to compete. An excellent account of weeding is given by Imam Imoru (in Ferguson 1973: 59), who makes the point that 'weeding is farming'. The first weeding (noman furi) is necessary about ten to fourteen days after planting, and may be combined with ridging. Thirty days later weeding is repeated (mai mai) and then followed by turning the soil and keeping it around the base of the plant (fuda), followed in some cases—usually if labour is available—by a third weeding (sasarya). With crops such as groundnuts, yields can be reduced by as much as half if planting is delayed and weeding is inadequate.
Secondary canals

Figures show number of plots per row
Total cultivated area 714 m²

IRRIGATED ONION FARM
SPATIAL ARRANGEMENT OF SOME CROP MIXTURES

RAISED BEDS FOR CULTIVATION OF SWEET POTATOES

Fig. 3. Cultivation techniques.
The actual distribution of millet and Guinea-corn farms and their associated crops can be greatly influenced by local topography, soil type, drainage and ultimately population density and the pressure on land. Upland farming can be subdivided into several land-use elements, and these are illustrated in the two cross sections given in Fig. 4 for the villages of Gagi and Kwalkwalawa which are some 5 km east and north of Sokoto respectively.

Upland farms proper (A) are sited on the low plateau, but farms are also made on the upper valley or scarp slopes (B1), and on the basal or lower slopes (C1). In some situations, the upper slopes are left uncultivated as they are being degraded and comprise outcrops of ironstone or laterite, which is being exposed by headward steam erosion (B2). However, if land is scarce, then these upper slopes may be partially reclaimed by clearing away the blocks of loose laterite (B3). On the lower slopes, cultivation may be broken by gully ing which renders tracts of land unusable (C2).

If we look at the Gagi example, we find a shallow open valley cut into the plateau of Rima sandstones which give light yellow sandy soils, and local farmers use these primarily for millets, which are also grown on the upper valley slopes. But on the basal slope, soils are brown and have been altered by downwash and are subjected to occasional flooding. Here the water table is relatively close to the surface, and these slopes are planted with Guinea corn which benefits from residual soil moisture. As this zone is one which is flooded in wet years, it may be regarded as the upper slope of the fadama; alternatively, in drier years it forms the lower level of upland farming. But the crop mixture of Guinea corn and beans which is grown here suggests that it is more related to upland cultivation systems. In Nigeria there are seven races of Guinea corn, but there are many local varieties and forms. Farmers generally distinguish between red and white, the former being regarded as a food staple for poorer people and traditionally used for horses. Different varieties are planted according to palatability and suitable sites. In the vicinity of Sokoto one finds janjari, a red form of the Guinea race, and fara-fara, a white form, which is early maturing. Kaura is another race, found around Sokoto, which has a yellowish grain; along the wetter margins of streams and in the west of the Sokoto-Rima basin a form known as malle is grown. Because the close-settled zone is climatically marginal for Guinea corn, it tends to be grown on sites which are intermediate between upland and lowland cultivation.

Local farmers are certainly very responsive to soil conditions, which they recognize according to colour, texture and type of weeds growing.

3. To the south-east of Sokoto along the edges of the Sokoto river, Adams (1986) has recorded the cultivation of substantial amounts of Guinea corn during the wet season.
This kind of environmental perception was described by Imam Imoru (in Ferguson 1973: 51) in the late 19th century, when he also stressed the 'scientific' nature of farming around Kano and Sokoto and the use of manure and intercropping. Farmers' methods of classifying soils, land-use potential and farming technology have received only limited analysis by researchers, but are worthy of far more attention (Richards 1985). Similarly, methods of organizing space and time are of considerable interest. Hausa farmers have variable agricultural calendars, which divide the year into seasons and, while not necessarily deciding the exact dates of planting, do give general ground rules based on star sightings, which are known to village mallamai (Koranic teachers). Such astral calendars are intrinsic to Islamic areas and appear in different parts of the Sudan and Hausaland, with appropriate adjustments for local and regional conditions. In pagan Hausa areas, lunar calendars are sometimes used (Nicolas 1968).

If we turn to the Kwalkwalawa example, a rather different succession of land use obtains from the slope down to the valley bottom (see Fig. 4). The valley of the Shela is cut rather more deeply into the scarp overlooking the Rima, and the upland proper is developed on sandy limestones of the Kalambaina series. Here upland farms grow Guinea corn and millet, which are intercropped with beans and groundnuts. But the upper valley slope (B3) is badly degraded and there are numerous exposures of laterite, but such is the need for land in this village that blocks of laterite have been cleared away and used to form field boundaries (Ph. 1). These fields are considered to be marginal farmland, receive little manure and are planted chiefly with late millet after all the upland cereals have been sown. Further down slope (C2), millet with some Guinea corn is planted on an area which is intermittently gullied, and where contour ridging is used to limit erosion. Both of these marginal zones (see [B3] and [C2] on Fig. 4) are fallowed for one or two years, unlike the upland proper which is under annual cultivation.

In both villages, upland farms contain a variety of trees which are scattered across the upland and form part of the field boundaries. These trees have important uses apart from for fuel and construction; they are sources of food and medicine for humans and animals. The baobab (*Adansonia reticulata*) can be used in many ways: its leaves are used for soups, its bark for rope and net-making; the seeds and bark are also used for medicine. The seeds of the locust bean tree (*Parkia ClapPERTONIA*) are also used in soups mixed with millet, the fruit is used to sweeten fruit and drinks, and the bark is rich in tannin which is used for dying cloth and decorating pots. Winter thorn (*Acacia albida*) and black plum (*Vitex Cienkowski*) both provide leaves and fruits for animal fodder, especially during the dry season. The *fadama* also contains a variety of grasses and weeds which can be used as fodder, roofing materials, and medicines for humans and animals. For example,
LAND-USE TRANSECT KWALKW


development of floodland 1977 wet season

BAOBAB
(Adonsonia reticulata)

BLACK PLUM
(Vitex Cienkowskii)

Locust bean
(Parkia Clappertonii)

Thorn fence season

River

Dry-season wells

Dry-season wells

Millet

Gamba grass

field boundaries

Guinea corn

Bean

Rice

Rice

Onion

Cassava

Sweet potato

A mixture of dry-season grasses and herbs
for fodder, thatching and medicine

LAND-USE CROSS SECTION
Permanent fields under annual cultivation on low plateau
Gamba grass boundaries
Guinea-corn complex

Permanent fields with some fallowing on upper valley slopes of eroded duricrust
Stone boundaries. Millet complex

Permanent fields with some fallowing on gullied lower valley slopes

Lowland fadama, bunded plots, rice, sweet potato, onion, cassava, banana, papaya

Thorn-boundary fencing of fadama

Useful / economic trees

Gully

Settlement

Fig. 4. Agricultural land use near Sokoto.
a small shrub, known locally as *tataba* (*Clerodendrum capitatum*), grows on uncultivated *fadama* in the dry season, and the leaves are collected and mixed with milk and given to children with chest complaints. Therefore, seed and fruit collecting, which is one of the supposedly more primitive forms of agriculture, is an integral part of annual cultivation systems, and can be extremely important in times of drought when populations have to fall back on collecting leaves and seeds to supplement their diminished supplies of cereals. Animals such as cows, sheep and goats also become more reliant on these sources.

While some 90% of farmland is under annual cultivation in the Sokoto close-settled zone, on its margins where population densities are lower, fields may be fallowed for one or two years; thus short fallowing replaces annual cultivation. Similarly, the poorest land in intensively cultivated areas may be fallowed. Although one cultivation system is dominant in the Sokoto close-settled zone, it does not preclude the existence of other systems: in other words, there is not some unilinear development from extensive to intensive systems, but a considerable degree of overlap. As the Kwalkwalawa example shows (see Fig. 4), when population densities become very high, marginal land has to be used. Pressure on land is also brought about by the fragmentation of holdings due to partible inheritance. In such circumstances one has to question the proposition that increased population leads to intensification of agriculture and improvement of agricultural practice. Intensification may occur with population increase and be beneficial, but there may be a critical limit where it ceases to be so, given the type of agricultural techniques employed (Lagemann 1977). But it has long been the case that an alternative to technical change, and an accommodation to high population densities, is through off-farm work, which is used to generate income and purchase foodstuffs in the market place.

Throughout the close-settled zone the hoe is the basic agricultural tool, although in the south-eastern part of the Sokoto-Rima basin ox-ploughs have become widespread. But there are many different types of hoes which are fashioned to suit specific jobs and types of soils. A short-handled hoe with a straight blade (*kwasa*) is used to clear land before planting, and at harvest to cut Guinea corn at the base of the stem, which lays it on the ground ready for the heads to be cut. A long-handled hoe (*sungumi*, or *fartanya tsaye*) is used to plant millet on the flat, where the soil is broken to a depth of a few centimetres to receive the seed. Where ridging is required, a large-bladed curved hoe with a short handle (*galma*) is used, while weeding is done by a small hoe (*fartanya*). On *fadama* lands where soils may be heavy and raised beds are constructed, large-bladed hoes of the *galma* type are used, which are more like hand-ploughs.
Floodland Cultivation

*Fadama* is any low-lying land which is subject to seasonal flooding, or waterlogging, and includes the floodplains of streams and rivers which have been inundated, together with seasonal pools and depressions where land is moistened due to the rise in the water table. *Fadama* cultivation embraces a diverse range of farming methods and crops, which rely on farmers having a detailed knowledge of the extent of surface flooding, water-table levels, slopes, bunding and building raised beds, water-lifting, well-digging and the use of crop mixtures and relays. All of the 19th-century travellers who passed through Hausaland and the Sokoto region were impressed by both the techniques and the diverse range of crops they encountered on their journeys.

*Fadama* land may be cropped almost continuously, as swamp rice can be grown in the wet season and then followed by a variety of dry-season crops which rely on accumulated soil moisture or irrigation. Water is lifted from perennial streams by shadufs, or more frequently by buckets on poles from shallow wells; alternatively farmers use floodland retreat and sites where moisture is retained in the soil long enough during the dry season to grow a crop. *Fadama* farms which are irrigated are known as *lambuna* (sing. *lambu*) and are generally extremely small, ranging from 0.05 to 1.5 ha.

In the Sokoto close-settled zone, *fadama* land comprises the floodplains of the Sokoto-Rima basin and land along the tributaries, together with shallow depressions and valley heads which dissect the upland. Only a small percentage of the *fadama* is used on the Sokoto-Rima floodplain, as the area is vast, up to 5 km wide north of Sokoto; also, the amount of labour required for dry-season work is considerable, while the market for vegetables is more limited than that for cereals. During the dry season there is considerable competition for labour, as this is traditionally the time when men take non-farm work, in the towns or in commercial-crops zones further south. Cultivation along the main floodplain of the Sokoto and Rima rivers around Sokoto and below towards Birnin Kebbi is also limited by the erratic flooding which occurs in the wet season; the rivers are badly braided and the main channels divide and constantly shift across the floodplain. Swamp rice is restricted to selected patches along the margins, or to small islands, or tributary valleys.

From Sokoto to Birnin Kebbi some thirty varieties of rice are recognized, mainly of the indigenous species *Oryza glaberrima*, although there are some of the *Oryza sativa* species which were introduced between the 16th and 18th centuries by the Portuguese, and presumably diffused from the coast up the Niger river. The distinction between *glaberrima* and *sativa* is that the former is a round grain which is red- or brown-skinned, while the latter is a longer-grained white rice. Other more recent types of white rice have been introduced as part of irrigation
projects such as the one at Kware, north of Sokoto. But basically farmers use different rice species and varieties as part of their ecologically adaptive farming techniques, which requires that the type chosen be in accordance with the depth of flooding, the speed at which water rises and the rate at which the plant must grow. Transplanted rice under conditions of rapid and deep flooding is not possible, and therefore rice is broadcast onto ground which has been cleared and prepared. There is also a variety of wild rice (Oryza Barthii) known as bau which grows over large areas, and which will choke out other varieties, yet it does produce an edible seed and is used in times of scarcity.

Irrigated cultivation during the dry season tends also to occur along the margins of the floodplain, just below the lower terraces. Areas of broad and gently sloping floodplain, such as slip-off slopes, are restricted around Sokoto, although they do occur in the upper Sokoto and Rima valleys. On such land tobacco is an important commercial crop, and seedlings are planted in single stands as the flood water retreats. This is a low-density crop and needs fairly extensive areas where there is a regular fall in flood level. Apart from the upper Sokoto and Rima valleys, these kinds of conditions are also found in the shallow valley-head depressions around Bodinga and Gwandu at the western edge of the close-settled zone, and were much admired by Barth in the 19th century.

The most highly prized fadama land in the close-settled zone is not along the margins of the Sokoto and Rima rivers but in the lower and middle stretches of the tributaries and in certain shallow depressions which occur in some valley heads. Occasionally, as in the case of the river Shela near Kwakwalawa, there is a perennial water supply due to the presence of aquifers. The smaller valleys and depressions offer the possibility of continuous and controlled cultivation throughout both the wet and dry seasons, largely because flooding is less, or farming is adapted to the rise and fall in water tables. Rice can be cultivated from July until September on these fadama, and then the land can be cleared ready for the cultivation of onions, vegetables and fruits. This allows relay cropping, and the same piece of fadama may grow two or three crops in succession. In the middle Shela, farm plots have been observed where rice is succeeded by onions and then, after onions have been gathered, a crop of peppers or bitter tomatoes is sown; such relays contrast strongly with the farms along the main stream of the Rima where dry-season planting is delayed by the fall in flood water (Sutherland 1985).

The cultivation of onions, peppers, tomatoes, sugar cane and cassava is widespread on fadama land and requires specific techniques. The Sokoto area with its long dry season produces a very good type of red onion (Allium cepa, Hausa gudaji) which keeps well and is not only sold locally but taken to southern markets such as Ibadan. Onion farms comprise sets of small beds of about 6 m² (fangallai, sing. fangali) which are defined by earth bunds of some 150 mm in height. The fangallai
are linked by a network of secondary channels fed by a primary channel to which water is lifted from wells about 1 to 2 m depth using calabashes attached to poles (see Fig. 3). Since the waterflow depends on gravity, the farms have to be carefully engineered to assure the right amount of dip across the system of beds. Onions are grown from seed and transplanted into fangallai, which are frequently constructed on old rice farms, which have suitable dry-season water levels (see Fig. 4). The work on these farms is continuous from October to April as watering needs to be done daily, and at least two men or boys are needed, one to lift water and the other to break the bunds around the beds to let the water in. Planting is staggered to ensure a continuous supply of onions. Crop combinations are common and onions are frequently grown with spinach, while okra is grown with tomatoes, and carrots with spinach. Spices are grown on square bunded beds. If the average number of man-hours for an upland farm is 200 per acre, then for fadama cultivation it would average 500-870. Also, fadama land is sold at about three or four times the price of that of an upland farm.

The cultivation of crops such as tomatoes, either the local bitter variety (data) or introduced varieties, together with sweet potato (Ipomoea batatas, Hausa dankali) is restricted by their rather narrow tolerance of excess moisture, and therefore requires specific farming techniques. Raised beds (komi) of some 7 m long by 3 m wide are made by digging up the soil to a height of about 0.5 m to provide a deep tilth of loamy alluvial soil, which will retain moisture into the dry season, while lifting the sweet potato tubers clear of water which might accumulate at the base of the beds (see Fig. 2; Ph. 2). Sweet potatoes are planted as a single crop at the end of the rains on komi sited on the upper edges of the floodplain, and the tubers are harvested in February.

Cassava (Manihot palmata, Hausa rogo) is grown on upland farms from August to January, but its cultivation on fadama allows production to be extended into the dry season. Cassava is a particularly useful crop as it can be left in the ground until needed and has relatively low labour demands and no specific labour peaks. On fadama it is grown by protracting pieces of the tuber in flat beds in December, irrigated through the dry season and harvested in June. Fadama cassava conveniently breaks the hungry season (fasalin damina) while farmers wait for the early millet harvest. Sugar cane spans both seasons and is planted in sole stands on flat land which is flooded, after which the crop matures as the waters fall, and is harvested in October-December. Both sugar cane and cassava are more easily grown along tributary streams, or in shallow valleys and depressions, which have a more regular rise and fall of water and where they are not endangered by excessive floods, or land erosion by shifting stream channels and braiding.

Interspersed among lambuna are groves of fruit trees, such as papaya, banana and mango (Mangifera indica). Along the swamplier margins
of streams which may be left uncultivated there are grasses which have an economic value. Large numbers of domestic animals are kept in Sokoto and the villages, especially sheep which are required for Islamic festivals, and fodder is required throughout the dry season. In the peripheral valleys of Sokoto there is a brisk trade in bundles of cut grass, leaf residues of cowpeas and groundnuts, most of which are taken into the city.

The diversity of floodland cultivation adds enormously to the range of foodstuffs available within the Sokoto-Rima basin, and especially the close-settled zone where for over a hundred and fifty years the concentration of population has provided both the labour power and the market for an intensive agriculture. Sokoto farmers have in the past and present successfully combined many ecological niches and techniques to provide foodstuffs which are often absent from similar environments within the Sudan savanna. For example, the contrast between the Sokoto-Rima basin and the Gambia river and most of the Senegal river basin to the west is quite striking. At the time of the British conquest in the early 20th century, this was an area which not only had a flourishing agriculture supporting a large population, but also was part of a regional and inter-regional trading system which redistributed surplus foodstuffs and commercial crops such as cotton and tobacco.

The Colonial Period, 1903-1960

After the British occupied Sokoto, existing production and exchange relations were gradually altered. However, farming methods and techniques experienced only marginal changes, although these were greater in some areas than in others. In the 20th century, the colonial authorities encouraged specific crops for export, and the commercial emphasis of agriculture was shifted towards cotton and groundnut cultivation in the south-eastern part of the Sokoto-Rima basin. In this area, cotton and groundnuts grow relatively well as the rainfall is higher and cotton is suited to the heavier black-clay soils developed on the schists of the basement complex. The new commercial primacy of the south-east was underwritten when the railway from the south reached Gusau and Kaura Namoda in 1926-27. Sokoto never became part of the railway network, and under the British the former capital of the caliphate was a second-class provincial town. From the 1930s onwards, the close-settled zone increasingly began to assume the role of a labour reserve for migrant workers.

An important innovation in the cotton and groundnut areas was the ox-plough, which allowed more prosperous farmers to extend their cultivated area of cash crops, while cotton seed-cake from the ginneries was used for fodder. Agricultural officers encouraged farmers to grow cotton as a single-stand crop, which cut across traditional methods of
interplanting. Also, higher yields are achieved when old crop residues and weeds are cleared and burnt before mid-July when planting begins. For many small farmers, the optimum cultivation of cotton disrupts their farming schedules, as it interferes with the planting of millet and sorghum, the basic foodstaples. One advantage of groundnuts is that it can be integrated with other crops, as well as being a foodstaple.

In the early 20th century, cotton growing came under the control of the British Cotton Growers Association (BCGA), who were given monopoly buying rights in 1905. The BCGA's agents used a cash-advance system to encourage farmers to sell to them, and farmers responded as they wished to increase their cash incomes to purchase new types of imported consumer goods, and to acquire British currency to pay their taxes. The increased dependence on cotton and the cash-advance system exacerbated internal household crises in years of low rainfall and inadequate food production. Cash advances had to be repaid even if cotton or groundnuts failed, which could mean the sale of grain to meet the debt. Webs of indebtedness helped to undermine extended household units (gandaye) as their heads could not meet their responsibilities; on the other hand, some farmers managed to survive difficult periods, and became new hirers of labour. Under these conditions the market for hired labour and food prospered, together with increased economic differentiation among households (Shenton & Lennihan 1981). Today the advance-cash system has virtually disappeared for cotton cultivation, as loans are available from agricultural development banks. But it is apparent that cotton is now only grown by the larger and more prosperous farmers, as their households have succeeded in extending their farms, and they are the ones who can obtain loans when needed, as they are less of a risk for the banks.

The decline in the size of production units from complex to more simple ones has accentuated the impact of the family developmental cycle on producer-consumer ratios and household labour supply. But there were other factors at work in reducing the size of households and their flexibility. Farm production units were also reduced by the erosion of domestic slavery and agrestic servitude, which was assisted by colonial legislation. Increased personal mobility resulted, which combined with rising levels of taxation, and new job opportunities gradually swelled the number of men who migrated in search of work (Swindell 1984). Dry-season migration (cin rani) abstracted large numbers of people (up to 250,000 in the 1950s from Sokoto Province) as men left the Sokoto close-settled zone and the poorer north to take work in the south-east of the Sokoto-Rima basin, the Jos tin mines, or to work in southern Nigeria and the Gold Coast. Seasonal migration was also the means of reducing the effects of increased population pressure, and poor harvests, as men were not dependent on their home granaries for food in the dry season (Prothero 1957).
In the mid-1970s, the expansion of Sokoto town and the building of State infrastructures during the oil boom reduced the numbers involved in long-distance migration, as local opportunities became available (Abdu 1983). Non-farm work has now become an integral part of household reproduction, on a scale which exceeds that associated with the well-established Hausa system of crafts and trading. Dry-season migration does not of course actually hinder wet-season farming, if all or most men return in good time for the farming season. But it is difficult to know to what extent dry-season fadama farming was affected by, first, the decline of slavery and, second, the gradual build-up of cin rani during the 20th century. On the other hand, commercial tobacco production on fadama was encouraged during the 1950s. Like cotton, tobacco was an important crop during the 19th century and entered into regional trade, but production has now become concentrated in the middle Rima and Gagere valleys and new strains have been introduced. Two companies, the Nigerian Tobacco Company and Philip Morris, control the planting programmes and the buying through the agency of farmers’ co-operatives. Amounts of tobacco produced (and farm income) vary considerably from year to year, as the amount and distribution of rainfall affect the pulses of water coming downstream and its effectiveness in moistening the fadama.

The control of commercial cropping, and especially of prices received by farmers, has been in the hands of buying agents and marketing boards in many parts of West Africa, and this area is no exception. In the 1970s and afterwards, the prices offered for groundnuts became so low that the groundnut mills at Gusau now operate at a very low capacity and the crop is distributed primarily through local markets. This is a function of relatively low world prices compared with local prices, which improved during the mid-1970s as the Nigerian economy expanded with the oil boom.

It has been argued that the changes brought about during the period of British rule in northern Nigeria have had wide-ranging consequences, especially the ability of the population to feed itself and to cope with the impact of drought (see Watts 1983; Shenton & Watts 1979). Famine and food shortages due to weather and pestilence are well attested in the 19th century, but there were social mechanisms to deal with them to reduce the difficulties suffered by any one family. Systems of redistribution and reciprocity, together with larger joint-production units softened the effects on individual households, while taxes which in part were paid in grain were held in central granaries under the control of district heads for redistribution during times of shortage. Also, small farmers and herders were excused from taxes; farms producing less than 330 mudaye (one mudu being 500 gm) and herds of less than 30 were exempted in Sokoto (Tibenderana 1974). Although the raising of taxes and expropriation of surplus labour was a well-established feature of
19th-century Hausa-Fulani society, it was in the interests of the rulers to have enough safeguards to ensure the reproduction of the society on which they depended, even allowing for its partial replacement by slaves from outside.

British taxation in the 20th century comprised a land tax (haraj) based on the potential of each village and was fixed by the Residents and district heads. Payments after the early years of colonial rule were in the new British currency, and it is argued that as the economy and taxation became monetized, so commercial crops such as cotton and groundnuts, together with migrant wage-labour, became more attractive, or necessary. In the close-settled zone, unlike the Gusau-Kaura Namoda region, there was little potential for these crops, so the centre, west and north of the Sokoto-Rima basin became a source of migrant labour. In the Sokoto close-settled zone taxes appear to have become more excessive during the 1930s, at a time when village heads began to be more careful about the allocation of land to slaves and ex-slaves, as they became equal before the law. Also, there is some evidence that village and district heads continued to extract communal labour and taxes on traditional lines, so that some people were in effect being double-taxed (Swindell 1984). According to district officers' notebooks from the 1930s, the occurrence of adverse climatic conditions—drought or flood—tended to push men into seasonal migration in order to secure income for food and tax payment.

Shenton and Watts (1979) have argued that in some areas of Hausaland village granaries were gradually run down to find the currency to pay taxes, which were gradually increased even during times of famine. The famines of 1913 and 1926-27 were particularly bad and coincided with depressed commodity prices and outbreaks of influenza and cerebro-spinal meningitis. Amidst all of these events, the colonial authorities did not see fit to set up grain storage systems to replace the traditional ones that had been run down.

The droughts and food shortages experienced up to the 1920s and later the Sahelian droughts of 1968-1974 can be related to specific climatic events, but their effects were mediated through the prevailing social and economic structures, and the methods of farming employed. There seems to be a good deal of evidence that the pervasive systems of household production and long-established methods of farming—sophisticated as they are—have become vulnerable as some households have become smaller and reliant on either crops whose prices depend on national policies, international markets and buying agencies, or non-farm jobs which may be equally fragile and unstable. In the view of this author, the size of farming households is crucial because adequate and well-timed supplies of labour are an integral part of their successful exploitation of a wide range of crops in several ecological niches (Swindell 1985).

One of the facets of the colonial and post-colonial periods has been
the increased economic differentiation among peasant farmers, based on new parameters such as export-crop farming, non-farm work, clientage with modern political parties and the transformation of traditional authority to take advantage of new economic circumstances. There has also been a shift towards individualism away from communal and collective action at household and village level. In this context, the high levels of personal mobility associated with migrant labour and non-farm work in nearby towns are not entirely compatible with the demands of household production, based on a technology which requires adequate and well-timed labour inputs.

At a theoretical level, such developments have been couched in terms of the partial transformation of non-capitalist societies and the emergence of peripheral capitalism, where neither non-capitalist nor capitalist relations are dominant. Societies have thus been incorporated into a world capitalist system rather than being transformed into capitalist systems in their own right. Arguments about incorporation, dependency and partial transformation are far from being settled, but many households straddle different systems of production and exchange. Yet it may be unwise to draw a picture of total stagnation, and it is certainly necessary to recognize the geographic and historic specificity of structural change brought about by colonial rule.

In the Sokoto region, there are now heterogeneous rural populations who are part-peasants, part-proletarians, traders and artisans; there are also many small commodity producers and a few capitalist farmers. Many households are involved in non-capitalist and capitalist systems of production and exchange, neither of which singly, or in combination, can soften the worst consequences of environmental disturbance or disaster. On the one hand, traditional mechanisms of social control and labour organization have been eroded, while the dependence on imported foodstuffs, wages and crop prices tied to national and international economic systems offer limited alternatives. But what of the post-colonial period, and the rural development schemes aimed at improving farm outputs and incomes? What of the plans to transform peasant agriculture?

The Post-Colonial Period

The Sokoto-Rima basin is now one of three major irrigation schemes in northern Nigeria, the others being the Chad basin and the Kano river. The possibilities of extending irrigated farming through government initiative reach back to 1917 and 1918, when several small water-conservation projects were started within the floodplain to the north of Sokoto. Although these fell into disuse, interest persisted, and a pilot project was constructed at Kware in the mid-1920s. Eventually, the river
basin became the focus of an extensive study by the Food and Agriculture Organization (FAO) in the 1960s, which was stimulated by the government's fear of soil erosion and the 'advancing Sahara'. The FAO report of 1969 promoted the idea that irrigation should be central to the Nigerian agricultural economy, and that the Sokoto-Rima basin was an ideal area for introducing water control based on a series of dams. By smoothing the flow between wet and dry seasons, the area of dry-season irrigation could be extended, while this kind of scheme would also fit into national development objectives aimed at raising incomes, reducing seasonal migration and producing wheat and rice which are imported into Nigeria in large quantities.

At present two dams have been completed, one at Bakolori and the other at Goronyo (see Fig. 1). The Bakolori scheme was officially commissioned in 1978 and comprises some 30,000 ha of terrace and floodland irrigation, although it is still not fully operational. The irrigation project provides dry-season water for small farmers who have been reallocated land in blocks equivalent in area to their former holdings. However, the cropping programmes for the dry season are determined by the River Valley Authority which places an emphasis on wheat, rice and tomatoes. The scheme cuts across the traditional farming practices at two levels. It interferes with wet-season cultivation to the extent that Guinea corn is not encouraged as it interferes with wheat planting schedules in the dry season, while irrigated crops are no longer grown as mixtures. Also, wheat has hitherto only been grown by a minute fraction of farmers by indigenous methods of irrigation. Furthermore, there have been instances when, during the wet season when rainfall has been low, water has not been released to farmers for staples such as sorghum and millet.

The social problems of schemes such as Bakolori have been discussed by academics, if not the authorities (Wallace 1980). Problems have arisen over land compensation and the resettlement of those above the dam (some 14,000 people), while those on the scheme cannot always afford the necessary fertilizer inputs and have insufficient household labour for their new farms. Difficulties over marketing the produce, and producer prices, have not helped. The indication is that the scheme is biased towards larger farmers, and poorer ones may now sell, or rent, land.

But farmers not on the scheme who cultivate land downstream of Bakolori have also suffered disruption. As has been shown (Adams 1983; Adams & Grove 1984), farming has actually become more hazardous since Bakolori has been in operation. The dam has had the effect of slowing water coming down the Sokoto river, which means that fadama land downstream is no longer as extensively flooded; cultivation is inhibited, especially tobacco farming which uses floodland retreat. Also, the build-up of moisture in the soils of the floodplain has been less,
and onion farmers in some locations have had to dig deeper wells, which means more labour. During the 1980s the new and unpredictable river regime in the vicinity of Sokoto had begun to cause disruption and hardship. Farmers had to learn by trial and error that it was necessary to switch from rice to Guinea corn, as the fadama was subject to less flooding. Then, in 1982, water was released from the Bakolori reservoir to combat water shortage in the State, which caused an unanticipated flooding of Guinea corn grown along the margins of the fadama. Furthermore, water was trapped between riverside levées and road embankments, which delayed the preparation of dry-season farms (Sutherland 1985).

These incidents may be part of the inevitable teething problems of initiating such a huge scheme, but there is little doubt the building of some sixteen barrages and diversion dams will ultimately alter the hydrology, ecology and farming of the floodplains of the Sokoto-Rima basin, and represent an agricultural transformation on a scale hitherto unseen in this area since the Fulani jihad of the 19th century. The response of many farmers on and off the scheme has not been in accordance with the objectives of the planners. Some have left the land, others have turned to the traditional methods of finding off-farm and non-farm work to provide a hedge against the uncertainty associated with the irrigation scheme and its marketing policies. On the other hand there are some who have benefitted. In the 1980-1985 National Development Plan there was a shift in emphasis from the large-scale irrigation schemes such as Bakolori, but without abandoning a commitment to them. The new 'green revolution' programme puts the emphasis on integrated agricultural development projects and the provision of technical inputs for a large number of small farmers, spread over a wide area.

Whether integrated development schemes will assist the majority of farmers remains to be seen; alternatively, they may best serve the interests of the larger capitalist farmers whose numbers have increased in recent years. Compared with the early caliphate, the intervention of the modern State seems to have been less effective in transforming this region, and it is arguable that it may have increased its vulnerability to environmental hazard. Farming systems have been remarkably resilient to recent intervention, partly because they are geared to coping with the longer-term problems of the environment, rather than the short-term objectives of the State. The interaction between farmers and their natural environment is often subtle and complex, while the Sokoto case shows that the connection between population densities and agrarian change needs careful qualification.

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