THE HISTORY AND FUTURE OF WATER MANAGEMENT OF THE LAKE CHAD BASIN IN NIGERIA

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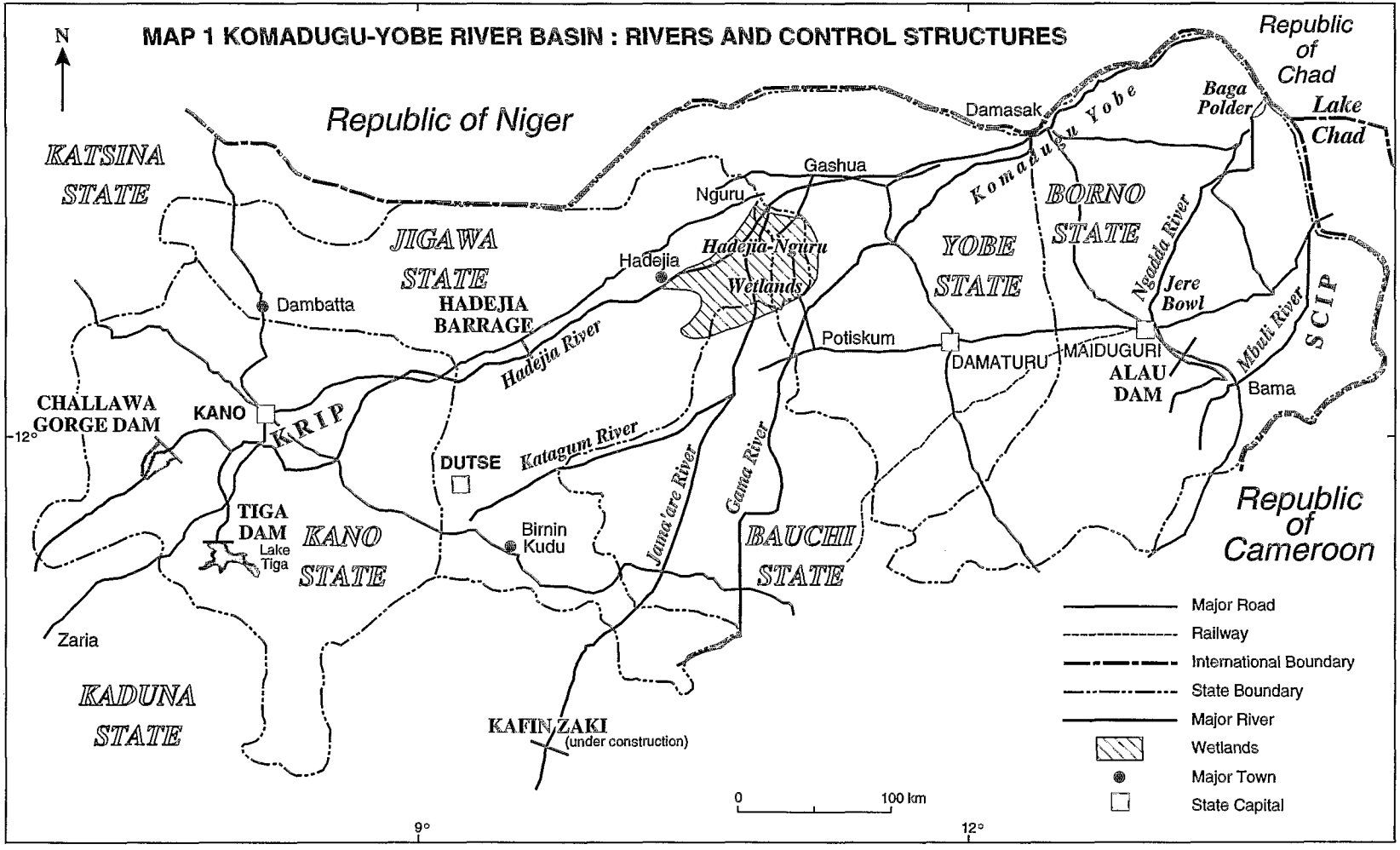
Abstract

The history of water management in Nigeria has been essentially a history of large capital projects, which have often been executed without comprehensive assessments of either the effects on downstream users or on the environment. In the case of the Chad basin, the principal river systems bringing water to the lake are the Komadugu Yobe and Ngadda systems. The Komadugu Yobe, in particular, has been impounded at various sites, notably Challawa Gorge and Tiga, and further dams are planned, notably at Kafin Zaki. These have reduced the flow to insignificant levels near the lake itself. On the Ngadda system, the Alau dam, intended for urban water supply, has meant the collapse of swamp farming systems in the Jere Bowl area northeast of Maiduguri without bringing any corresponding benefits. A recent government-sponsored workshop in Jos, whose resolutions are appended to the paper, has begun to call into question existing water-development strategies and to call for a more integrated approach to environmental impact assessment.

Keywords: water management, history, environment, Lake Chad Basin, Nigeria.


MAP 1 KOMADUGU-YOBE RIVER BASIN : RIVERS AND CONTROL STRUCTURES
N
Republic of Niger
Republic of Chad
Republic of Cameroon
Lake Chad
Baga Polder
Damasak
Komadugu Yobe
KATSINA STATE
JIGAWA STATE
KANO STATE
KADUNA STATE
BAUCHI STATE
BORNO STATE
YOBE STATE
Gashua
Nguru
Hadejia
Hadejia-Nguru Wetlands
HADEJIA BARRAGE
Hadejia River
Dambatta
Potiskum
DAMATURU
MAIDUGURI
Ngadda River
Jere Bowl
Mbuli River
SCIP
ALAU DAM
Bama
CHALLAWA GORGE DAM
KANO
KRIP
DUTSE
Katagum River
Jama'are River
Gama River
TIGA DAM
Lake Tiga
Birnin Kudu
Zaria
KAFIN ZAKI
(under construction)
12°
9°
0
100 km
Major Road
Railway
International Boundary
State Boundary
Major River
Wetlands
Major Town
State Capital

Acronyms

In a paper dealing with administrative history, acronyms are an unfortunate necessity if the text is not to be permanently larded with unwieldy titles of Ministries and Parastatals. The most important of those used in the text are below.

ADP	Agricultural Development Project
CBDA	Chad Basin Development Authority
DID	Department of Irrigation and Drainage
EIA	Environmental Impact Assessment
FAO/CP	FAO/World Bank Co-operative Programme
FEPA	Federal Environmental Protection Agency
FGN	Federal Government of Nigeria
FMA	Federal Ministry of Agriculture
HJRBDA	Hadejia Jama'are River Basin Development Authority
IBRD	International Bank for Reconstruction and Development
IIMI	International Irrigation Management Institute
IUCN	International Union for the Conservation of Nature
JICA	Japanese International Cooperation Agency
HJRB	Hadejia-Jama'are River Basin
KRIP	Kano River Irrigation Project
LCBC	Lake Chad Basin Commission
MCM	Million Cubic Metres
NCWR	National Council of Water Resources
NFDP	National Fadama Development Project
NWRI	National Water Resources Institute
RBDA	River Basin Development Authority
SCIP	South Chad Irrigation Project

Currency

Currency = Naira
US$ 1.00 = 25.00 (Central Bank Rate)
US$ 1.00 = 39.00 (Bureaux de Change)

Rates fluctuate substantially. These figures were recorded in April 1993.

Administrative boundaries

These change frequently in Nigeria. A "state creation exercise" took place in 1991 and the creation of further states has not been ruled out. The boundaries shown on the map apply to May 1993.

1. INTRODUCTION

Attitudes to water resource management in both the developed and developing world have undergone major reversals in the twentieth century. In the first half of the century, the construction of large dams, although apparently justifiable economically, was also seen as something of a challenge in engineering terms. Nature was subdued and human prosperity resulted. The environment had not yet become a millstone around the neck of those who approved large projects and the unfortunate downstream users whose way of life was radically altered without their permission were usually too dispersed and inarticulate to affect matters.

Unfortunately, the well-meaning but often damaging beneficence of first world planners in the 1950s was transferred all too effectively to their counterparts in the developing world. The consequence has been that dams and impoundments continue to be constructed, in spite of their now discredited reputation. Unfortunately, in contrast to other classes of useless monument, dams have all too visible effects on the populations on which they are inflicted. These have now been well-documented and dam projects have been the source of major social discord in many countries (ADAMS & HUGHES, 1986).

In view of this, for any particular region, it is crucial to understand both actual water control projects and the basis for decisions in water resource management that will affect people's lives in the future. The lake Chad basin makes a useful case study, because of the overall importance of the lake in the ecology of Central Africa and the scattered nature of the information. The history of water management in the Chad basin in Nigeria has essentially been a history of capital projects. A whole series of control works, dating from the 1930s, have been initiated either to serve the needs of urban populations through town water supply, hydropower or as a preliminary to irrigation schemes. Recent studies have suggested that major works, such the series of dams and barrages on the

Hadejia-Jama'are system, have disrupted the ecology of the wetlands and the intricate nexus of production systems which depend on these. Little account has been taken of the impact on either the environment or the peoples and economic life of the region.

This paper[1] reviews the history of these schemes and outlines projected future developments. It seeks to show that without much greater emphasis on environmental and social impact the proposed economic benefits will be largely wasted. It begins with an overview of the administrative history and current situation of water resource management in Nigeria. Then the Komadugu Yobe and Chad basin systems are described in some detail, focusing on both existing and projected developments. Finally, an extended reference list is appended to provide a way in to the complex and often inaccessible literature.

Descriptions of the various structures, planned and in progress, can be found in a number of sources. The most important are reports prepared for the IBRD, reviewing forestry and wildlands (FAO/CP, 1991), the irrigation subsector (FAO/CP, 1992) and four schemes proposed for further funding (FAO/CP, 1993). These provide a critical overview of both government policy, benefits and problems of existing schemes and insight into future projects. Another useful text is ADAMS and Grove (1986), which although notionally covering Africa has a whole, focuses largely on irrigation schemes in Nigeria.

2. MANAGEMENT OF WATER RESOURCES IN NIGERIA

2.1. Brief historical outline

The goals of water resource management in Nigeria have historically been three:

a) provision of urban water supply
b) generation of hydropower
c) development of large-scale surface irrigation

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[1] The data in this paper was collected in the course of a visit to Nigeria in March/April 1993. I would like to thank those Nigerian government officials who made available the documentation that made its preparation possible. I should emphasize, however, that this paper expresses my personal opinions and should not be taken as reflecting the views of any government body or international agency. A major source of data and documentation was the Kuru Workshop on the Hadejia-Nguru wetlands. I would like to thank Henry Thompson for making it possible for me to attend and for useful discussions on various matters.

They have been developed in approximately that order. Dam construction probably first began in the Sokoto-Rima basin during the first world war with the construction of low barrages. However, control works probably began in earnest with the construction of small dams for urban water supply in the south-west in the 1950s.

In 1949, an irrigation division was established within the Department of Agriculture in northern Nigeria. In the early 1950s, the Bagaji region of the Niger saw the beginning of rice schemes and simple flood control. In 1956, hydrological stations were set up in the lake Chad region, leading to pilot irrigation schemes on the Yobe and Ebeji rivers, and in 1959, Hydrology was also established as a division of Agriculture.

At the same time, a Niger Delta Development Authority was created, which later became a model for the River Basin Development Authority system. This was formally initiated in 1976, when eleven authorities were created covering the entire country. Pre-existing bodies, such as those responsible for lake Chad and the Sokoto-Rima basin were incorporated into the system. The RBDAs originally had substantial financial and administrative autonomy as well as large budget allocations. However, in 1987, they were stripped of any role in agricultural production and placed more firmly under central control.

The traditional sector

Nigeria has no long history of extensive surface irrigation, in contrast, for example, to Sudan. The majority of irrigation until recently was sited in naturally flooded swamplands, or *fadamas*, usually controlled with simple mud bunding. In some regions of Nigeria, especially on lake Chad, flood-retreat cultivation is possible, although it has never become widespread. Dry season cultivation, usually for vegetables to supply the urban market, has traditionally been dominated by lift systems. The most common system was the *shaduf*, but these have been largely displaced in recent years by small petrol-engine pumpsets. A combination of subsidised fuel, favourable pricing and high urban demand for food has made this type of small farmer enterprise very profitable up to the present.

2.2. Administrative responsibility

In Nigerian Government parlance, water resources are "concurrent', that is they are the responsibility of Federal, State and Local Government bodies. A Federal Ministry of Water Resources was first established in 1976. It had a somewhat chequered history and in 1992, was conjoined with Agriculture to form an expanded Federal Ministry of Agriculture (FMA). However, a merger

consistent with the civil service reforms has yet to take place, as there are still two Director-Generals within the Ministry. The future institutional structure is somewhat uncertain, especially in the light of current political developments. Apart from the service departments, such as Planning, Research and Statistics, there are four technical departments: Irrigation and Drainage, Water Supply and Water Quality, Hydrology and Hydrogeology, Dams and Reservoirs.

The main body making major policy decisions relating to water resource issues is the National Council of Water Resources (NCWR). The NCWR is chaired by the Federal Minister of Agriculture (previously by the Federal Minister of Water Resources), and its membership includes the 30 State Commissioners responsible for water resources development, and representatives of the major national institutions concerned with water use: National Electric Power Agency (NEPA), the Inland Waterways Department (IWD) and the Director-General for Agriculture in the Federal Ministry of Agriculture. The recommendations of this Committee and its sub-committees are binding on the technical departments.

Apart from the Ministry itself, other agencies have some responsibility for water resources. The National Water Resources Institute (NWRI) is an agency under FMA which was established in 1978 in Kaduna to provide training in water engineering. Although it has a brief to research the engineering aspects of major projects, its major task is to provide training for engineers and technicians on short courses and to maintain a water resources library and documentation centre.

Federal Environmental Protection Agency (FEPA) is a part of the Presidency, and was set up in 1989 on the model of the United States EPA to co-ordinate approaches to the environment across ministries and establish national standards for pollution. It has recently engulfed the Department of Soils and Erosion Control, previously within Water Resources. At present, it has no established mechanism for interacting with existing departments and sometimes proceeds along parallel tracks. For example, in 1991, FEPA published water quality standards without direct reference to the department within water resources responsible for water quality.

Before the establishment of the River Basin Development Authorities, irrigation development was handled by State Irrigation Departments (SIDs), under the State Ministries of Agriculture. When the Federal Government established a separate Ministry of Water Resources it also encouraged the states to follow. The advent of RBDAs eclipsed the role of SIDs, although many of them still have large staff numbers, despite limited funds rendering them virtually idle. The informal division of responsibility within a state is that larger irrigation projects (over 2000 ha) are handled by the RBDA. However, there is apparently

no forum within states for formal discussion and coordination of activities between the RBDA and SID.

Apart from the RBDA System, there are also the Agriculture Development Projects (ADPs) in each state, set up with IBRD funding. The ADPs, which formerly dealt mainly with rainfed agriculture, became involved in irrigation in the early 1980's. Their approach to irrigation concentrates on small systems - *fadama* development - and encouraging greater private participation. They have pioneered farmer-managed pumping systems with pumps owned by farmers, and drilling (for washbores and tubewells), done by the ADP. A World Bank assisted National Fadama Development Project has recently been launched, which intends to install 50,000 shallow tubewells to irrigate at least that many hectares.

Structured ambiguity

The practical consequence of this multiplicity of government and parastatals is that water resource management is in the hands of a plethora of institutions. This is not accidental. The development of duplicated and overlapping structures is essential to the diffusion of responsibility. This is intended to:

a. provide employment to excessive numbers of staff
b. justify the allocation of additional equipment and infrastructure
c. make goals unclear and thus provide a convenient explanation for lack of achievement.

This situation may be described as structured ambiguity - the intentional obfuscation of purposeful government for the benefit of those within it. Foreign donor agencies may also be victims of this system as the same project may be funded multiple times.

2.3. Impact studies

One of the unfortunate consequences of the traditional system of training and recruitment is that water resource administration is dominated by engineers. Developing countries want to develop, and this is all too frequently equated with construction. The goals of water departments are essentially constructional, getting large projects under way. Very few personnel have any training or interest in broader environmental or socio-economic issues, even in the case of irrigation, where these are essential to any significant plan to benefit farmers.

This is not to say that these types of study have no tradition in Nigeria. The Kainji dam, in northwest Nigeria is by far the largest-scale hydropower project in the country and its completion in 1968 was the culmination of a project that had been intensively studied in terms of biology, ecology and human impact. The

results of these studies, and in particular those concerned with downstream users (e.g. ADENIYI, 1973, 1975) were published well before major structures were put in place on the Hadejia-Jama'are system. However, the linkages between academic institutions and implementing agencies are predictably tenuous and no use has been made of this stored experience in planning new projects.

Environmental Impact Assessments (EIAs) are usually required by international agencies before funding large capital projects. This is particularly the case for large dams, as there has been considerable international concern in recent years about their deleterious effect on the environment. However, if EIAs are carried out honestly, they are very unlikely to take a positive view of dam and barrage projects, because of an already bad record in this area.

To meet the requirement for EIAs without their potentially fatal effect on capital projects, there are essentially two strategies. The task can be given either to a tame consultancy agency whose report will consist entirely of platitudes, or to the engineering firms bidding for the physical construction. Needless to say, this latter group are unlikely to highlight problems that would prevent an engineering project from going ahead.

In addition to this, a persistent feature of Nigerian administration is the tenuous relationship between reports and policy documents and actual executive action. This is because of the *ad hoc* nature of administrative decisions, which depend principally on political, religious and ethnic factors rather than economic or scientific rationales. The preliminary documentation then becomes a type of learned charter for action, irrespective of its content.

3. WATER RESOURCE MANAGEMENT IN THE CHAD BASIN

3.1. Administrative responsibility for the Chad basin

One of the more eccentric features of the system of RBDAs in Nigeria is that their boundaries reflect administrative and political decisions, rather than hydrological reality. The River basin system was established in 1976 outside the framework of international IBRD credits and no economic evaluation of the supposed benefits was ever undertaken. The actual number of RBDAs has risen and fallen over the years according to political influences.

Although the RBDAs are supposed to be federal and thus outside state interests, narrowly defined, there is little doubt that the siting of the Headquarters has a powerful influence on the activities of the authority. For example, the siting of the headquarters of the Hadejia-Jama'are RBDA in Kano town has led to the development of all the major control structures in the former Kano State, as well as the siting of the initial irrigation areas.

In the Nigerian administrative system, water resource development in rural areas is mandated to the RBDAs. There are eleven of these covering the whole of Nigeria, but the two affecting the lake Chad region are:

Name of development authority	Area	Headquarters
Hadejia-Jama'are River Basin (HJRBDA)	Kano, Jigawa states and the regions of Bauchi, Yobe and Borno drained by the Jama'are and Misau Rivers	Kano
Chad Basin (CBDA)	Borno, excluding the Komadugu Yobe system but including the Yedseram and Goma Rivers	Maiduguri

The Hadejia-Jama'are River Basin is not a hydrological unit, but simply a part of the Komadugu-Yobe system.

3.2. The Komadugu Yobe system

The Komadugu Yobe system is unusual among Nigerian river systems in that it flows northeast instead of south. The exact contribution of the Komadugu Yobe to lake Chad is uncertain. Although it must have been an important affluent of Mega-Chad, in historical times, the flow past Yau and into the lake seems to have been on a small-scale and probably insignificant in terms of the overall water budget. The Komadugu-Yobe falls within two RBDAs, the Hadejia-Jama'are and the Chad basin. In May, 1993 these encompassed five states (Kano, Jigawa, Bauchi, Yobe and Borno) although state boundaries often change at short notice.

Water resource development has been very extensive on this system, and the headings below outline these by type, divided into storage schemes, surface irrigation and groundwater schemes.

(a) Storage schemes

Large control structures for irrigation, domestic water supply, river regulation and flood control have been put in place by the HJRBDA and the Kano State government. There is no hydropower generation on any of the existing schemes in the basin and none is proposed. There are some thirty dams of varying sizes in the basin, in various stages of development. Most of these projects were intended

for irrigation or domestic water supply, although some are now actually used for recreation or aquaculture.

The major storage works in the upper catchment of the Hadejia river are the Tiga Rapids and the Challawa Dam. The Tiga Rapids dam is a 48 m high embankment dam, 6 km long, located about 60 km south of Kano with a catchment area of 6,600 km^2. The dam regulates the Kano river, the largest of the three upper tributaries and provides irrigation water to the Kano River Irrigation Project (KRIP), domestic water to Kano city and releases for downstream users.

The Challawa gorge dam was recently completed and impounding began in early 1992, but the first spilling has not yet occurred. It is a 42 m high embankment dam 7.8 km long with a total storage capacity of 930 MCM, a catchment area of 600 km^2 and a flooded reservoir area of 100 km^2. Releases from this reservoir are intended to irrigate land in the Hadejia Valley, KRIP (Phase II) and to supply Kano city and downstream settlements. There is no operating policy for Challawa dam and it has yet to produce any useful output.

The recently completed Hadejia barrage is located in the middle reach of this river and is intended to irrigate 12,500 ha of land in the Hadejia Valley Project (HVP) by diverting regulated releases from the upper reservoirs. The head pond of this barrage has a storage capacity of 34 MCM and irrigation and drainage infrastructure to serve a HVP Phase I area of 7,013 ha is presently under construction.

The Kafin Zaki dam has been planned for many years, but only in January 1993 did work begun in earnest with financing from the African Development Bank. The dam is being constructed on the Bunga river, the major upper tributary of the Jama'are river. It will be a 40 m high embankment dam, 11 km long, with a total storage capacity of 2,700 MCM and a flooded area of about 235 km^2. Releases from this dam will be re-regulated by the proposed Kawali Diversion dam on the Jama'are river about 60 km downstream of Kafin Zaki dam.

(b) Surface irrigation schemes

The main large-scale irrigation scheme in the Hadejia basin is the Kano River Irrigation Project (KRIP) (Phase I). Some 13,280 ha have so far been developed and are under agricultural production, with a cropping intensity of 150%. There is potential for a further 7,000 ha, provided additional water is available from Tiga Dam. However, the current development is plagued by institutional, operation and maintenance and water management problems. Congested natural

drainage ways, poor maintenance of internal drainage works and over-irrigation have caused waterlogging in parts of the command area.

Other surface irrigation projects in the basin are: Watari Irrigation Project (1,350 ha), Gari Irrigation Project (2,200 ha), Jakara Irrigation Project (200 ha), and Donbatta Irrigation Project (700 ha). The total irrigated area under existing large scale projects is about 18,000 ha. Large-scale irrigation projects planned by the HJRBDA include the following: KRIP(Phase I-7,000 ha), KRIP (Phase II-40,000 ha) from Challawa Gorge Dam, HVP (12,500 ha). Kafin Zaki dam has a highly complex proposed follow-up.

Proposed irrigation schemes following completion of Kafin Zaki dam

Name of scheme	hectares
Katagum Irrigation Project	8,700
Sakwa Irrigation Project	26,200
Lafia Walai Irrigation Project	11,000
K.D. Abonado Irrigation Project	60,600
Badeyeso Irrigation Project	14,000

Apart from this, the State Irrigation Department in Bauchi has plans for the development of 9,300 ha in four schemes using small dams and diversion weirs on four rivers. The total area to be developed would be 189,300 ha.

Most of the large-scale irrigation schemes have been developed by the HJRBDA under the FMA, while small-scale public and private sector irrigation schemes have been carried out under the State Ministry of Agriculture and the ADPs. The large schemes have so far fallen well short of their projected targets. Some of the reasons put forward include lack of experience with formal irrigation technology, poorly planned and designed projects, lack of farmer involvement in their planning and designs, and institutional and political constraints.

(c) Groundwater schemes (*fadamas*)

Most groundwater schemes that use either dug wells or handpumps to abstract water from the middle aquifer are for rural water supplies. However, in the *fadama* areas, which depend on traditional lifting devices such as the *shaduf* and calabash, small pumpsets are now being used to take out irrigation water. Alluvial deposits on the floodplain of the major rivers are the main source of groundwater. Water-bearing sand and gravel aquifers are within 15 m of the surface and water levels are generally less than 6 m below the surface. Recharge of this shallow aquifer is from rainfall and flood flows in the river. Groundwater irrigation in the *fadamas* is carried out by washbores (7 to 10 m deep) and

tubewells (15 to 25 m deep); in other cases irrigation water is diverted from small tributaries and streams by means of weirs and ditches.

The organised *fadama* irrigation has been operated since 1975 by the ADPs with financial assistance from the World Bank. The ADPs supply credit to small farmers to buy pumps and drill shallow wells. This technology introduced supplementary irrigation in the wet season and the potential for an irrigated dry season crop. The initial success rate for a sustained yield from the tubewells was less than 50 %, but this has improved substantially with the better understanding of the aquifers from hydro-geological surveys in the northern states between 1987 and 1990.

Existing *fadama* irrigation areas (using washbores, tubewells and direct pumping) in the states of Kano, Jigawa, Yobe and Borno total about 77,500 ha. The potential irrigation area is estimated to be 387,000 ha although this would depend largely on the groundwater potential, their exploitation practices and the aquifer recharge. Since they are hydraulically connected to the rivers, alteration in the floodplain hydrology will adversely affect their productivity and sustainability.

Impact on the regional ecology

Apart from problems within the irrigated area, notably waterlogging and salinity, the major effect has been on the downstream area, especially the Hadejia-Nguru wetlands and the Yobe proper. The Yobe is now virtually dry for most of the year, and the irrigation schemes, fisheries and pastoralists that used to depend on it have been forced out. The Hadejia-Nguru wetlands region of flooded swampland has been the focus of an RSPB/IUCN project for some years and so is relatively well studied. Its decline has been documented in a number of reports, especially BARBIER et al. (1991), KIMMAGE et al. (1991), THOMPSON (1992). The extent of the floodland varies from year to year, but a broad estimate of the impact suggests that the area flood has declined to one eighth of its previous size as a result of damming. The concerns raised by these findings are set out in more detail in Appendix 1.

3.3. The lake Chad basin

Nigeria controls a substantial geographical area of lake Chad, which it shares with the Chad Republic, and to a lesser extent Cameroon and Niger. The lake is overseen by a Lake Chad Basin Commission, formed by these countries, which Nigeria joined in 1962. The affluents of lake Chad within Nigeria consist of the Komadugu Yobe (see above) and the Ngadda and Yedseram systems. It is generally considered that Nigerian sources contribute less than 10% to the overall

waters of lake Chad. With the recent control works in Nigeria, this is presumably still less. BLENCH (1991) is a brief overview of the literature on the lake, its dessication during 1990 and the consequences for its inhabitants.

Water control within Nigeria can be divided into two distinct types: structures intended to draw off water from lake Chad, and those on the Ngadda and Yedseram systems that reduce the flow to the lake. Within Nigeria, the two most significant developments drawing water from the lake are the Baga polder and the South Chad Irrigation Project (SCIP). The Baga polder was constructed in the 1970s to irrigate a pilot scheme of 500 ha. This scheme has never been extended for lack of water. The first feasibility studies for SCIP were completed by 1973 and construction of Phase I began in 1975 and Phase II in 1979. The SCIP consists of a series of pumping stations with gravity distribution systems intended to divert international waters to Nigeria. The project has constructed headworks for 49,000 ha, but only 15,000 ha have ever been irrigated due to falling lake levels, in part because of the damming of the Chari river in Cameroon, but also reflecting a long-term decline in rainfall. By 1990, the lack of water in the lake meant that no irrigation was possible and the channels were completely dry. Indeed, farmers were using them as bunds for residual moisture agriculture, the traditional method for cultivating sorghum in this region.

The main structures reducing water flows into the lake are the Alau dam south-east of Maiduguri on the Ngadda river and the Lower Yedseram weir. The Alau dam was first investigated as early as 1963, but work began in 1986 and the back-up lake reached its full level in 1992. The live storage volume of this reservoir is about 106 MCM (million cubic meters). The mean annual rainfall over the drainage area is estimated to be 986 mm (ENPLAN, 1991) and the mean annual flow (MAF) for the Ngadda River is 345 MCM. The reservoir is intended to also supply the urban water needs of Maiduguri and annual commitments from its storage volume are 24 MCM and 48 MCM during phases I and II of the urban water scheme development. The drainage area of the Alau reservoir is 4,105 km^2 and includes part of the Sambisa swamp which detains inflows from the Ngadda River before these enter the downstream reservoir.

Although the Alau dam was notionally intended for irrigation, its enunciated purpose soon became urban water supply to Maiduguri, where the drying-up of conventional groundwater had made alternative water sources a priority. Flood control works are in progress on the Sambisa swamp and should be completed by the 1993 rainy season. Operations would need to be monitored over a water year to derive estimates of additional flow contributions to the Alau reservoir. OLOFIN (n.d.) who studied the Alau reservoir in detail, concluded that there is already severe siltation in the reservoir and that it is losing water through the

unconsolidated sands on its floor. It is therefore unlikely to fill to the projected levels and thus will not be able to fulfil its objectives.

The Jere Bowl was originally a region of swampland northeast of Maiduguri town fed by the Ngadda river. Like other wetlands, it had an integrated farming (rice), fishing and pastoral economy. Prior to the construction of the Alau Dam there was a thriving and extensive rice/wheat cropping pattern. Rice was produced in the depressions flooded by the rains and wheat was grown during the harmattan period from November to February. Besides the wheat, some irrigated vegetable crops were grown using tube-wells. Normal water flows into the Jere Bowl stopped in 1988 with the construction of the Alau dam and only in 1992 did the reservoir start to spill again. This situation has dramatically changed the cropping pattern within the Jere Bowl; wheat and rice now account for less than 2% of the cropped area. Rainfed cropping now dominates; about 40% of the area is planted to millet, followed by cowpea (18%) and groundnut (10%). Apart from the losses to farmers now compelled to return to rainfed subsistence cropping, pasture for livestock and fish stocks have been badly affected.

Using the topsy-turvy logic apparently characteristic of these developments, a Jere Bowl irrigation scheme has been proposed, drawing water from the Alau reservoir. The proposed area to be irrigated is about 15,000 ha, some 15 km northeast of Maiduguri. This will have the effect of first destroying a functioning system of flood-plain exploitation and then replacing it with a similar but vastly more expensive scheme whose effectiveness will depend heavily on high levels of management.

This interlinked series of works has yet more ramifications. The Sambisa swamp, 33 km upstream of the Alau dam, is the site of swamp flood control works in progress intended to enhance the water inflow to the Alau reservoir, thereby creating a water deficit further upstream. An interbasin water transfer scheme called the "Hawal Transfer Scheme" (HTS) has been proposed to overcome this deficit. Interbasin transfer is where water that is "not used" in one river system is led by a canal or pipe into another. Under the HTS, a dam would be constructed on the Hawal River, a tributary of the Gongola River. Diversion supplies would be delivered to the Alau dam via a 100 km closed conduit/open canal system. The HTS would make available an extra 127 MCM annually. Apart from the probable ecological effects on the Hawal system, the principle of creating water deficits by one expensive scheme and remedying the deficits by yet another seems to be of doubtful economic merit.

The Lower Yedseram scheme, which is still in the early stages of construction, is essentially a weir with diversion and gravity canals, planned to irrigate some 37,000 ha. The Yedseram drainage area is adjacent to the Ngadda River system and also enters the Sambisa swamp. Both rivers emerge from the

swamp to continue on their individual courses. An area of 200 km^2 is reportedly flooded for 8 months of the year in the Sambisa swamp; the control works would reduce this area but increase the ponded depth and permit regulated releases to both river channels.

4. CONCLUSION: THE FUTURE OF WATER MANAGEMENT

The history of water resource management in this region of Nigeria illustrates, with the benefit of hindsight, some worrying principles at work. The received wisdom which allowed some of the world's more notorious dam projects to go ahead has not been entirely extirpated from the decision-making process. This can be described as a concentration on upstream benefits, especially hydropower, irrigation and urban water supply, at the expense of downstream water users. Related to this is an adulation of large engineering projects for their own sake. Only this can explain dams and barrages which, although built under the rubric of development, actually have no function at all.

A realisation of all the negative aspects of large dams has now generally penetrated the international agencies and the adverse publicity they generate has meant that they are usually not willing to fund them. However, the case of Kafin Zaki dam shows that when the larger donors shy away, agencies with a lower profile and money to lend will take on the financing of projects of dubious desirability.

There is a series of further impoundments and other control structures planned for both the Komadugu Yobe and Ngadda systems. Unless the operating principles and maintenance schedules are radically revised, extreme environmental damage will result without any economic or agronomic benefits. The resolutions of the Kuru workshop on the Hadejia-Nguru wetlands, given in Appendix 1, indicate that there is a growing lobby within Nigeria concerned about the implanting of large control structures without impact assessments, rational operating policies or even economic justification.

The future of water resource management in the lake Chad basin seems to depend as much on the internal and international politics of Nigeria as upon objective development planning. If the ecological lobby gains the upper hand in the most senior echelons of the administration, and if their influence outlasts the transition to civilian power, then the wetlands and their associated productive systems may be saved. Otherwise, the outlook seems to be extremely bleak.

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APPENDIX
Workshop on the Management of the Water Resources of the Komadugu-Yobe basin

National Institute for Policy and Strategic Studies
& Hadejia-Nguru Wetlands Conservation Project
Kuru, Jos
1st - 2nd April, 1993

Preamble

A workshop was organised by the Hadejia-Nguru Wetlands Conservation Project in collaboration with the National Institute for Policy and Strategic Studies, at Kuru, Jos on 1st and 2nd April 1993, to address the issue of water management in the Komadugu-Yobe basin.

The Workshop drew a select group of participants representing various interest groups involved in the area such as the Federal Ministry of Agriculture, Water Resources and Rural Development, the River basin Development Authorities, State Governments, consultants on dams, conservation and development organisations as well as universities and research institutes.

The Workshop highlighted the serious problems being faced by the inhabitants of the basin in terms of water security and considered various strategies to ameliorate this condition.

Thorough discussions were held on water management, flooding and land utilisation in the area, and the following recommendations were unanimously adopted.

1. Water management and operating regimes of existing and planned dams

1.1. In order to meet the many water needs within the Komadugu-Yobe basin such as water supply, irrigation, groundwater recharge, flooding, it has been recommended that Tiga, Challawa and Kafin Zaki dams and the Hadejia Barrage should be operated to satisfy the downstream requirements.

1.2. The multiple contribution to the national economy of the wetlands (rice, dry season agriculture, fuelwood, timber, fish, grazing, wildlife, biodiversity and groundwater recharge) requires the maintenance of flooding which will require artificial flood releases from the dams in the wet season.

1.3. The existing facilities at Tiga dam that could be used for artificial flood releases need to be tested. The adequacy of outlets for releases from Challawa Gorge needs to be assessed. The detailed reassessment of the design of Kafin Zaki dam needs to incorporate the capacity for adequate artificial flood releases. The group notes that the contract for the construction of Kafin Zaki dam has

already been awarded. An environmental assessment and a cost benefit analysis should be undertaken as part of the execution of the Kafin Zaki dam "review and construct" process.

1.4. A plan for the integrated operation of the existing and planned dams should be formulated and implemented within the next 12 months. Test releases will be required to examine the interrelationship between surface and groundwater in both the wet and dry seasons in order to quantify the volume and timing of artificial flood releases. Flow depletion/conveyance studies should be undertaken to identify the appropriate level of releases from dams to maintain acceptable flows during the dry season throughout the basin.

2. Komadugu-Yobe Basin Co-ordinating Council

A Komadugu-Yobe Basin Co-ordinating Council consisting of the Minister in charge of Water Resources and Commissioners in charge of water resources from the States within the basin should be formed. The Council should have a permanent Secretariat within the basin. The Council should also be supported by an Advisory Technical Committee. This Council will formulate an integrated policy for the basin which will be implemented by the Hadejia-Jama'are River basin Development Authority, the Chad Basin Development Authority, ADPs, and other water users in the basin. The Komadugu-Yobe Council should set up a documentation centre which will hold a full set of all data, study reports and models. All material should be within the public domain and its contents widely advertised.

3. Water use decree

To enhance efficient and equitable distribution of water within the basin, a water use decree should be promulgated by the Federal Government. National and regional water resources policies must be consistent.

4. Hydrometeorological data

The importance of hydrometeorological data in the planning, design and operation of water resources systems is recognised. However, the collection of these data in the past and at present has been inadequate and has resulted in the employment of false data in water projects. The existing hydrometeorological network within the country, and especially in the Komadugu-Yobe basin, should be rehabilitated and extended. Facilities for data collection, data processing, storage and dissemination should be strengthened.

5. Topographical maps

A major impediment to planning and development of water resources in the Komadugu-Yobe basin is the non-availability of suitable topographic maps. It is strongly recommended that topographical maps at a scale of, at least, 1:50,000 with a contour interval of 1 metre be prepared. In addition, geological, structural and hydrogeological maps are desirable. Stereoscopic satellite images from the recently launched Japanese satellite may prove to be a rapid and effective basis for map derivation. It was appreciated that remotely sensed images could also provide data on the extent, volume and depth of flood water.

6. Inter-basin water transfer

The issue of inter-basin water transfer should be handled with caution. Potential areas of surplus water should be assessed critically from the perspectives of engineering and the local inhabitants of the exporting region.

7. Fisheries

The depletion of the existing fisheries of the Komadugu-Yobe basin has been caused by over-fishing and disruption to river flooding and flows. The Federal Government should enforce the existing legal limit to mesh sizes of fishing gear in order to safeguard fish stocks for the future.

8. Grazing

The existing grazing reserves are not being maintained and adequately managed. This is leading to an escalation of the conflicts between farmers and pastoralists. The Federal Department of Livestock should be mandated and required to re-organise, demarcate, and properly manage the grazing reserves and update the cattle routes.

9. Small-scale irrigation and fadama development

The small-scale irrigation sector under the Agricultural Development Projects and State Governments has been successful. The high economic return of small-scale irrigation requires that the Federal Government continue to promote these programmes whilst improving the water-use efficiency of the large-scale formal schemes and small-scale users. However, there is a need to quantify groundwater resources to facilitate safe abstraction levels for sustainable fadama development.

10. Sustaining agriculture

The present changes in demography, land-use and water use in the river basin have caused stress on rainfed and irrigated farming systems. A comprehensive programme of research into the integrated farming systems must be undertaken to ensure the sustainability of these indigenous agricultural producers. This will also reduce dependency on external inputs.

11. Protected areas

The internationally-recognised biological diversity and wealth of the central Komadugu-Yobe floodplain must be protected and conserved. The areas of special ecological value should be demarcated and afforded effective protection under the auspices of the Chad basin National Park.

12. Funding

New funding from Nigeria and overseas is needed for the priority projects identified above, which include production of topographic maps, formulation of reservoir operating rules, the Komadugu-Yobe basin Council documentation centre, the conveyance study, the improvement of the hydrometeorological network, protected areas and research on sustaining agriculture. Funding should normally involve collaboration between the public, private and voluntary sectors in Nigeria with international participation as appropriate. EC, Japanese Government, World Bank, FAO, ODA, UNEP, UNDP, and other funding agencies could be approached.

13. International dimensions

Water management decision in the Komadugu-Yobe basin have international dimensions for both surface and groundwater resources. This international implication should be considered in the management of water resources in the Komadugu-Yobe basin.