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CULTIVATION OF THE FLOOR OF LAKE CHAD: A RESPONSE TO ENVIRONMENTAL HAZARD IN EASTERN BORNO, NIGERIA

ARE KOLAWOLE

This is a study of recent ecological changes associated with the shrinking of Lake Chad since 1970 and activities on the lake floor following the recession. The lake level in the southern basin fell from 283 m asl in 1962–3 to about 276.6 m asl in 1986 and the open water shrank from 25 000 square kilometres to about 3000 square kilometres. Whereas about 50 per cent of the lake floor was covered by vegetation in 1972–3, more than 90 per cent of it had been vegetated by 1984–5 and the lake floor was extensively utilized for both cultivation and grazing. Lake floor settlements have been identified and classified by tenure and occupation. Population movement both between and outside the settlements was relatively high and was determined by the size and distance of each settlement from the lake: the closer the settlement to the lake, the less the movement.

KEY WORDS: Nigeria, drought, agriculture, Lake Chad, river basin planning.

LAKE CHAD LIES between latitude 12° 30′N and 14° 30′N and longitude 13° 0′E and 15° 30′E (Fig. 1). The lake is shared between the Republics of Cameroon, Chad, Nigeria and Niger and has a basin area of approximately 2.5 million square kilometres normally. Lake Chad stands at an altitude of 282 m asl and has an area of 23 000 square kilometres with an estimated water recharge of 50 cubic kilometres depending primarily on the rainfall over its surface and the discharge from the Chari-Logone, its principal affluent (Grove, 1964, 1970, 1978, 1985; Sikes, 1972). Annual inflow of water into the lake varies between 20 and 85 per cent of its mean volume. In normal years, the inflow is made up of 40.4 cubic kilometres from Chari-Logone, 6.6 cubic kilometres from the El Beid (fed by bank overflow from the Logone), 0.5 cubic kilometres from the Yobe and 0.1 cubic kilometres from the Yedseram which together give rise to about 99 per cent of the run-off to the lake (Sikes, 1972). Of the total, the Chari-Logone contributes 94 per cent, El Beid, 5 per cent and Yedseram about 1 per cent. A high proportion of the lake water (2032 mm) is lost by evaporation, a small amount—about 10 per cent (228.6 mm), by infiltration, percolation and seepage losses (Grove, 1964). The size of the lake therefore depends on the balance between losses of water by surface evaporation and seepage as compared with the supply brought by rains.

Lake Chad is a mirror reflecting the climatic conditions in the Sudano-Sahelian zone and acts as 'an accumulator of positive departures from the mean Chari-Logone discharge, rising in response to runs of wet years, falling with successive years of drought' (Grove, 1985: 146). The lake, in response to environmental changes in this region, fluctuated between 283 m asl in 1963 to 276.6 in 1986; and the size from 25 000 to just 3000 square kilometres within the same period. The lake started the present century at an extremely low level, and the level was exceptionally low following the remarkably low rainfall of 1913. The lake rose in the period 1916–20s following good rains and was low in the 1940s as a result of low rainfall. The level rose in the 1950s and stood high in the 1960s. The level has been falling since 1969 with extreme lows in 1972–3 and 1983–5 responding to the Sudano-Sahelian drought.

The low level of the lake in 1984–5, quite unprecedented at least in this century, was a response to both low rainfall on the lake surface and the very low discharge of the Chari-Logone. The low discharge from the Chari-Logone was the effect of rainfall deficiency in the headwaters of the rivers in Adamawa Mountains and the Central African Republic. For some years the discharge of Chari-Logone had been remarkably

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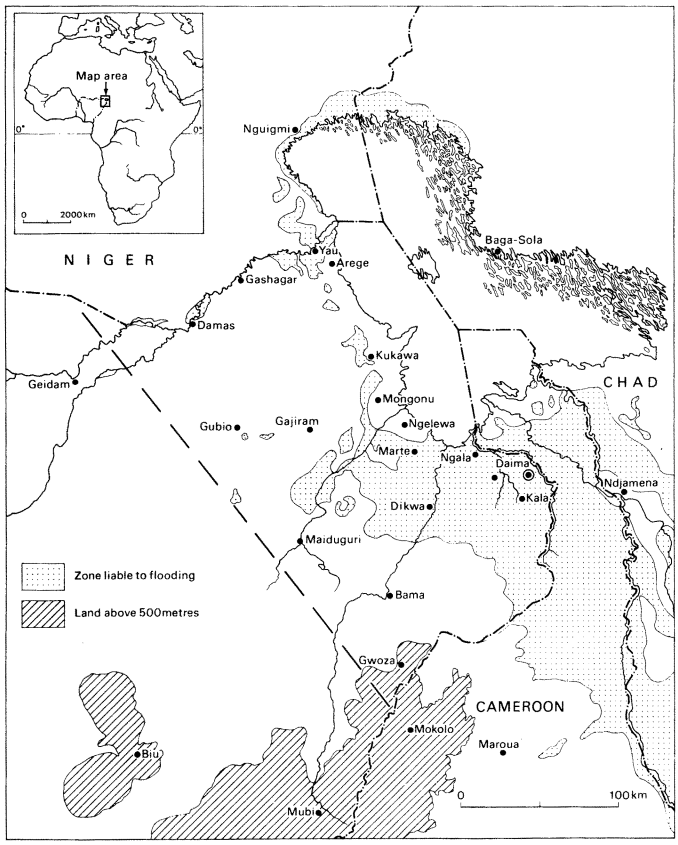

Fig. 1. Eastern Borno and Lake Chad

low, and in 1984 was the lowest within the period of instrumental record. In terms of rainfall deficiency, river discharges and lake levels, 1983–4 was the driest in Borno. All Borno rivers, the Yobe, Yedseram and the El Beid as well as Lake Alau, were virtually dry, leaving all the irrigation projects based on them stranded. The level of Lake Chad fell 3 metres below the critical level for the pumping station at Kirinowa and consequently the South Chad Irrigation Project could not irrigate any land during 1984–6. Whereas the lake edge lay 29 kilometres NE of Kirinowa in 1979, it was more than 100 kilometres away in April-June 1985 when the lake was confined to a pool immediately north of the Chari delta, around longitude 14° 50′–15° 0′E and latitude 12° 50′N–13°N.

The lake floor provides one of the traditional means of coping with drought in eastern Borno. The seasonal variations in the lake level determine the traditional farming patterns and the total area available for farming and grazing. The lake floor also serves as an essential grazing ground for livestock especially during the dry season and periods of drought. The open water provides fish, and the lake islands support mammals and wild plants such as dum and date palms which are useful famine food. The aquatic and semi-aquatic plants of the lake such as *Cyperus papyrus* are used for mat-making, fences, baskets and boats; *Typha australis, Aeschynomene elephroxylon* and *Phragmites australis* are also used as building materials.

Lakeshore farming and grazing have been common practices, but lake floor cultivation and settlement have greatly increased. The development and rapid

expansion of these settlements appear to be unprecedented, and this probably reflects the degree of current environmental crisis in eastern Borno. The areas with relatively fertile *firki* clay soils, on which the hardy dry season sorghum is traditionally cultivated west of the lake, were expropriated from the farmers for the development of the South Chad Irrigation Project. But the performance of this project has been poor; since the land was acquired in the early 1970s, the rates of land development and resettlement have fallen far below the target (Kolawole, 1985, also in press). By 1984–5, all irrigation activities had been crippled by the low lake level making it impossible for water to be abstracted. The inhabitants had to turn to the lake floor which offered them an opportunity to cultivate cowpeas and maize.

Field survey

Under somewhat difficult conditions an attempt has been made to assess the ecological changes associated with the receding lake and the extent of utilization of the lake floor for both farming and grazing. Settlements have been identified and classified according to the predominant occupation of the inhabitants and the way in which land was held. The village sample frame covered 87 lake floor settlements ENE and ESE of Kirinowa which lies south of the lake floor; Baranga and Doro Buhari villages were finally selected for detailed study. This research based on ground assessment, can be viewed in conjunction with imagery from NASA (Wells, 1985) and a study of LANDSAT and NOAA satellite data (Schneider, McGinnis and Stephens, 1985) thereby providing an overall appreciation of environmental changes in progress.

In this paper, the term 'lake floor' refers to that area between the high lake level of 1962–3 and the low lake level of 1986. It is the potential agricultural land; the actual area available for cultivation and grazing is dependent on the wet season, low water and the dry season high water. The total area in 1972–3 according to James (1977) was about 10 000 square kilometres and in 1984–5, 20 000 square kilometres. The lake recession has resulted in various ecological changes. The adjustments associated with the change from 'normal Chad' (1964–69) to 'lesser Chad' from 1970 have been given attention (Hepper, 1970; Grove, 1970; Iltis and Lemoalle, 1983). Fieldwork to determine the recent ecological changes on the lake floor was hindered by travelling difficulties and the problem of determining my position; the latter problem was partially resolved by making New Marte my reference point and taking the distance from the odometer of the Landrover and bearings with a prismatic compass. Although this was not entirely satisfactory, it does provide a rough guide. Figure 3 shows the approximate location of selected lake floor settlements.

Lake floor villages Whereas there were just 40 lake floor settlements in 1975, these had by 1985 increased to over 100 in Marte NE and SE alone. The settlements are located between the shallow water or temporary mud flats (limit of the lake in 1985) and the 1962–3 strandline. A number of them were established on sand islands covered with scrub and trees which had been left behind as sandy ridges by the shrinking lake. Prefixes such as Sabo, Naira, Gowon and Buhari show that these settlements were founded between General Yakubu Gowon's military rule in 1966 and that of General Buhari's administration in 1984–5. In fact more than 70 per cent of the sampled settlements were actually established in 1984–5 and a number of them took their names from more permanent, bigger and older towns such as Baga, Bama, Gogobirni, and Kangarawa. The settlements consist of isolated buildings or huts and compounds, some fairly permanent, others seasonal and temporary.

A higher proportion, about 76 per cent, in my sample, was semi-permanent; 14 per cent had already been deserted; 8 per cent, temporary or seasonal; and 2 per cent, permanent. Availability of water for irrigation and for animal and human consumption determines the tenure of a settlement. Deserted settlements were villages originally located on the old lakeshore line, from which the people moved owing to lack of water as Lake Chad receded. Baranga and Kuzuma are the only permanent settlements in the sample; they are regarded locally as big towns because they have a weekly market and the houses are built of mud bricks or cement blocks with corrugated iron roofs. Houses in the other settlements are makeshift, constructed of fences of straw matting (*zana*)

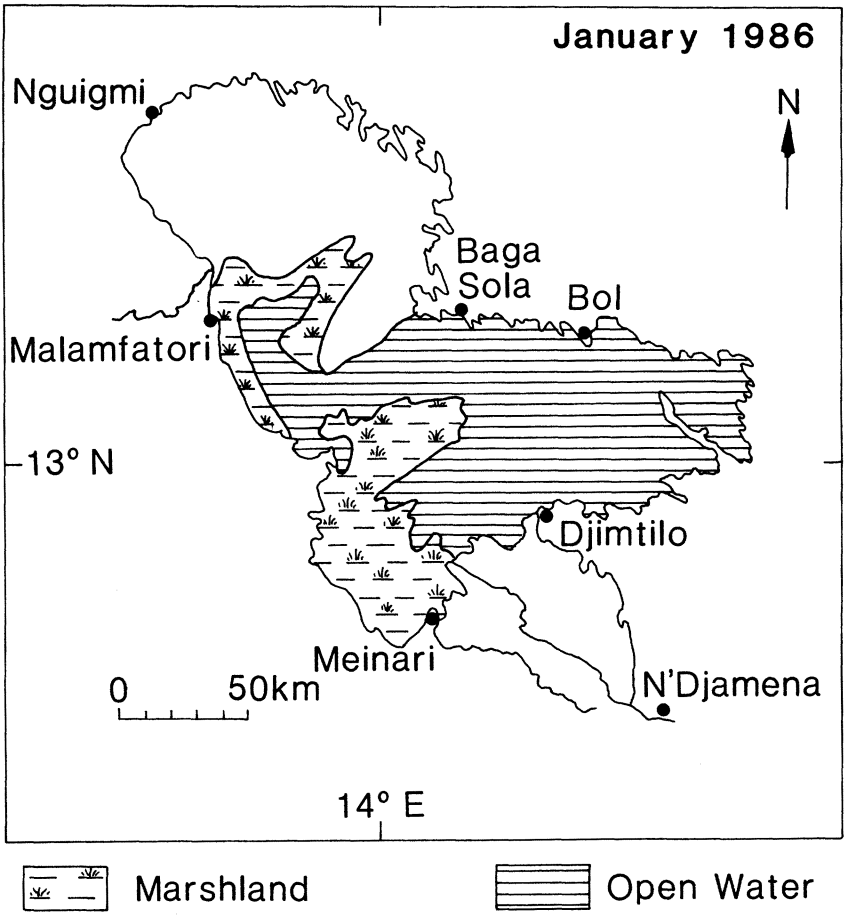

Fig. 2. The extent of Lake Chad following the 1985 rains

made from papyrus and typha, mixed with grasses or corn straws. Makeshift roofs are made of thatched straw supported by poles of marea (ambatch) trees.

Pastoral settlements formed 33 per cent of the sampled lake floor settlements, 40 per cent exclusively agro-pastoral, 19 per cent agricultural and 8 per cent fishing settlements. The system of animal husbandry involves seasonal and daily movements as dictated by the needs of animals for fodder. Animals move to the lake floor during the dry season and far away from the lake floor to an upland area during the rainy season. Livestock on the lake floor come not only from all parts of Borno State alone but also from the Republics of Cameroon, Chad and Niger. Disease and shortages of fodder and water constitute the greatest problems for animal husbandry on the lake floor and cattle mortality appears to be relatively high; every lake floor settlement has one or two local and traditional slaughter slabs.

The human population numbers about 25 000, with people living in 49 villages in the sample area. The largest settlements are those with good access to water; Baranga, Bama, Doro Buhari and Doro Kreta (Table I). Population movement varies according to distance from the lake edge; the closer a settlement to the lake edge, the lower the mobility of people living there.

Agricultural activities Agricultural activity is zoned according to the stage of lake recession, the level of the water table and the water requirements of the crops

TABLE I

Estimated human population of selected lake floor settlements

Name of settlement	*No. of households**	*Estimated population***
Bama 1–20	1050	4200
Baranga	751	4506
Doro Buhari	1227	6851
Faria 1–7	275	1100
Deserted	80	320
Kuzuma	200	1000
Doro Kreta 1–3	800	4000
Doro Dori 1–5	300	1500
Bukare Merembe	150	750
Metele 1–4	65	325
Tumbuma	60	300
Total	4958	24 852

* Estimated from the figures supplied by the village and ward heads and verified by house to house count.
** Estimated from the result of my socio-economic survey in Baranga and Doro Buhari.

Source: Fieldwork, April–June, 1985.

concerned. The oldest and highest of the lake floor settlements is located between the Faria group of villages and Bukare Merembe. Maize was cultivated here in 1984; agricultural activities in 1985 were restricted to crops with low water requirements such as water melon and cassava. The second zone is centred around Doro Buhari where, after the lake began to recede in December 1984, cowpea was planted. Cowpeas are normally planted in January/February and harvested from June to August. Production depends largely on soil moisture left behind by the receding lake and to a much lesser extent on the rainfall. Cowpeas are usually grown as a single crop but may sometimes be inter-cropped with vegetables, peppers, water melon, okra, tomatoes and cucumbers. The third zone, closest to the lake edge and centred around Doro Kreta, Doro Kpata and Doro Kirfi, was exclusively and intensively planted with maize in June/July, 1985. The soil here is somewhat heavier, alluvium rich in organic matter and with high water retention capacity. These qualities make it possible for maize to be planted from April to May and to be harvested from August to September, benefiting from both the soil moisture and rainfall.

The average farm size in Doro Buhari in 1985 was 11 hectares per household but this varied from 2 hectares among the local small-scale farmers to about 20 hectares among the Chad Basin and Rural Development Authority (CBRDA) employees. The farm size appears to be unusually large compared with other parts of northern Nigeria for a number of reasons. The first is the dual nature of Doro Buhari where subsistence farming co-exists with large-scale commercial farming. The disparity in land holding is magnified by the presence of employees of CBRDA, farmers whose mean holding size was 18 hectares. Second, this is a land surplus area where land availability does not appear to be a major constraint. Third, labour requirements are relatively low, being limited, according to the farmers, to one or two weedings and harvesting which could be met readily by family labour. However, commercial farmers rely heavily on hired labourers.

The production of cowpeas and maize is probably the most profitable farming enterprise in eastern Borno. The price of cowpeas rocketed from N900.0 per tonne in 1983 to N3000.0 in 1985, and that of maize from 300.0 to N840.0. Earnings of farmers in Doro Buhari ranged from about N2400.0 to N14 000.0 in 1984–5. Leaving room for domestic inflation, this income is a good rate of return since the production technique is essentially based on indigenous technical knowledge and requires little outside investment.

Lake floor cultivation and settlements may be regarded as a temporary expedient, a

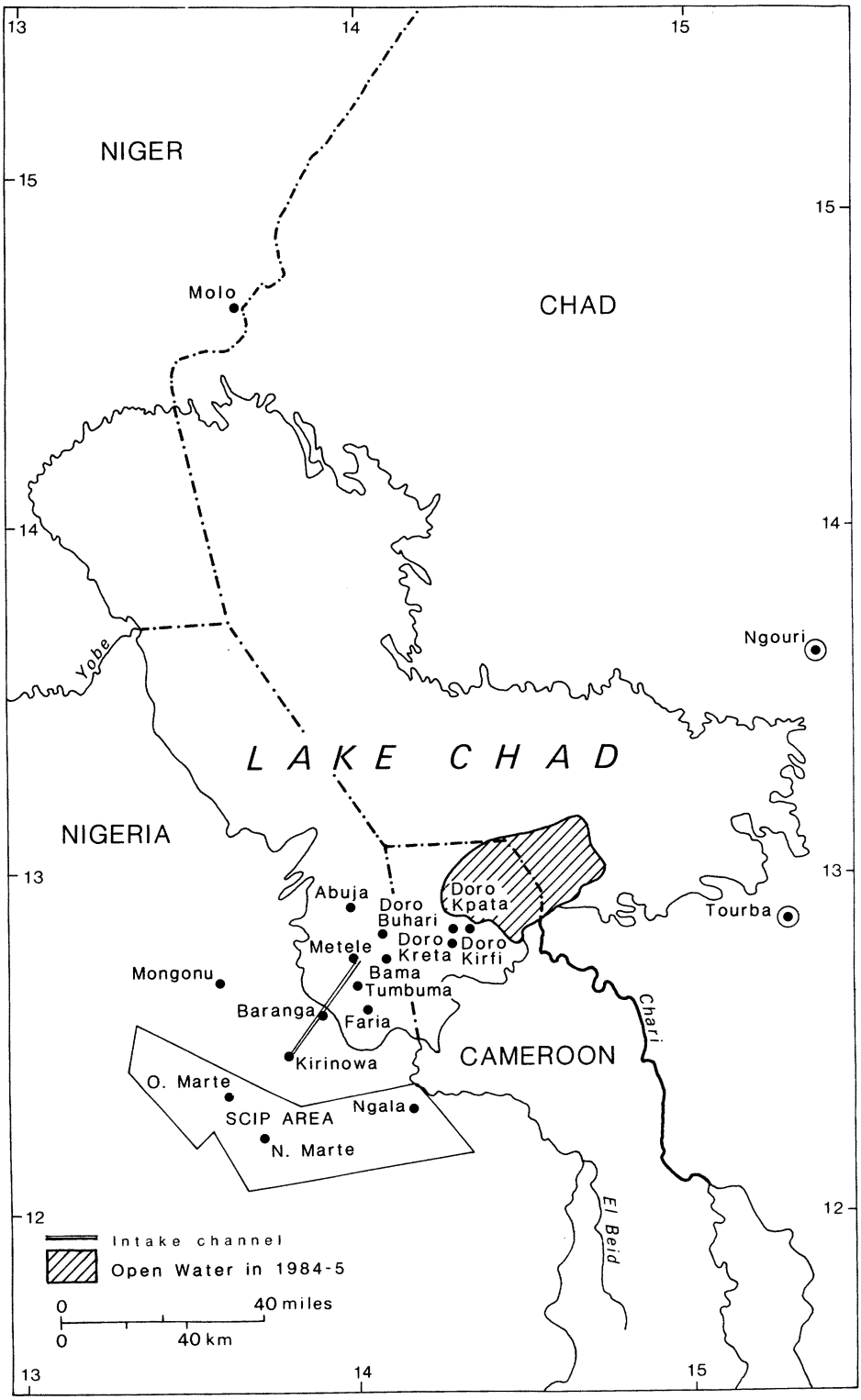

Fig. 3. The approximate locations of the selected survey villages

response to the early 1980s environmental situation in eastern Borno. But as long as the current environmental hazards persist, lake floor cultivation will continue to enjoy a prominent role. This is because lake floor cultivation means profitability, survival and autonomy from the regimental control of the CBRDA and its attendant risks of uncertainty.

The future of lake floor cultivation depends largely on what happens to the lake level and the size of the lake as determined by the rainfall in the Chari catchment area and other climatic conditions in that zone. If the lake level rises to the 1962–3 level, lake floor cultivation will have to cease but presumably there will be sufficient water for irrigation activities in the South Chad Basin area, in which case lake floor activities will be confined to the lake edge. This could be disastrous for the vast majority of the inhabitants who have no access to irrigation facilities. Latest reports on Lake Chad tend to point in this direction as the lake in the southern basin expanded somewhat following the 1985 rains (*New Nigeria* November, 1985; personal communication with Dr Wells, NASA, Feb. 1986 see Fig. 2). If and when the lake rises to the 1972–3 level, about 10 000 square kilometres would be available for lake-floor farming and grazing and this would also allow some irrigation on the South Chad Irrigation Project. On the other hand, should the lake return to the 1984–5 level, about 20 000 square kilometres will be available for lake-floor activities, but there could then be no irrigation.

Water for agronomic practices, and for animal and human consumption poses the major constraint on the use of the lake floor. The lake floor appears to have an enormous agricultural potentiality, but it is probably not possible for all the lake floor to be cultivated or grazed. Paradoxically the most intractable problem is lack of water; most of the uncultivated areas are too dry for farming and lack sufficient grasses to provide useful grazing. The farmers on the lake floor need assistance to reduce crop losses from water stress and pest attack. Mixed cropping might save labour, inhibit the spread of plant diseases and the nitrogen-additive properties of the legumes would maintain soil fertility. But there is a greater need for the improvement of other agronomic practices. First, planting dates can be adjusted and standard plant spacing introduced; second, herbicides, pesticides and fertilizers could be used and improved seed varieties, particularly drought-resistant, early maturing and high yielding varieties introduced. In addition better transport facilities are needed for the evacuation of farm produce from the lake floor to the markets. Improvement in farming practices calls for the provision of effective extension services which at present are lacking. Finally, perhaps, research is needed into suitable lake floor crops, notably hardy, drought-resistant early maturing varieties, under the prevailing climatic and hydrological conditions. It might be added that planning of lake floor activities could be assisted by statistics being made available of rainfall in the headwaters of Logone-Chari and predictions being made on that basis of the way in which the lake will behave in succeeding months. One hopes that such information might be made available by the Lake Chad Basin Commission.

The CBRDA involvement in lake floor cultivation dates back to November 1984 following a suggestion made by the Director of the African Studies Centre, Cambridge to the General Manager (CBRDA) on the agricultural potentiality of the lake floor and that cultivators should be assisted in the area by extension services and transport facilities to move their produce to the market. This recommendation was based on a similar scheme established by the UN and the Chadian Government to resettle some drought victims in Kraal village on the lake floor and encourage them to grow their own food (Diallo, 1984). By December 1984–January 1985, the CBRDA had cleared a total area of 4000 hectares in Doro Buhari for the production of cowpeas, and a Department for Lake Shore Activities created. This probably explains the reason why the then Head of State Major General Buhari visited Doro Buhari in January 1985 and the settlement was named after him. Thus far the extension services have been beyond the reach of the local farmers.

Conclusion

The lake floor has played a crucial role in ameliorating the effects of the current environmental hazards in eastern Borno, and it may possibly continue to play this role.

The lake floor has very great agricultural potential; the soil is rich and fertile, investment costs are low and rates of return high. It may be necessary for the government (both local, state and federal) to encourage and support cultivation in this area since it is not only better than relief measures taken during periods of environmental stress but also appears to offer a large contribution to Nigeria's drive for food sufficiency. It appears that the lake floor has very little potentiality for the development of shallow groundwater for pumps and shadufs owing to the tenuous nature of the settlements as well as the rapid fall in the water table. In Baranga, pumps have proved very useful in making use of the water from the intake channel which was too low for the SCIP operation. The land tenure is at present haphazard because of the international nature of the lake. Settlers have no regard for international boundaries, what matters to them is the location of the lake. Although the Doro Settlements (Buhari, Kpata, Kreta, Kirfi) are in the Republic of Cameroon the right of access to Nigerian settlers was granted by the Lawan (District heads) of Baderi and Kirinowa Districts of eastern Borno through their ward heads (bulama). CBRDA obtained their right of access directly from the district head of Baderi. As lake-floor use becomes institutionalized, Lake Chad, once the scene of international cooperation may become a scene of international conflict. This may, however, be prevented by the Lake Chad Basin Commission.

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