Problems of the Natural Environment on the Kano Plains of Western Kenya.
Monsieur Roger Millman

Résumé

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This article discusses some of the environmental constraints affecting the development of the Kano Plains, East of Lake Victoria in Western Kenya. This small area, which suffers from alternating periods of drought and floods, is one of the populous districts of East Africa with a distinctive group of environmental problems relating to proposals for the rehabilitation of the agriculture and settlement of the resident population through a programme of comprehensive drainage and irrigation projects. As such, the Kano Plains are an interesting case study of the problems of rural development found within this type of tropical environment.

**INTRODUCTION**

The Kano Plains lie at the head of the Kavirondo Gulf near Kisumu, Western Kenya, over 300 km by tarmac road from Nairobi (see Fig. 1). The area is surrounded by a series of fault line escarpments that descend abruptly onto the Plains which lie between 1,160 metres and 1,300 metres above sea level. The area suffers from intractable, alluvial soils which have very poor drainage, together with years of drought and periodic flooding and local problems of overpopulation. Following disastrous floods in 1962, an irrigation scheme was started on the Plains, which is partly fulfilling a promise made by the Government of Kenya to do something to help the local people towards a higher standard of living. With Kenya’s population increasing at the rate of 3% per annum and with over half of the country classified as “semi-arid” it is very relevant that “problem areas” like the Kano Plains should come under close government scrutiny.

On the Plains, soil conditions and drainage and problems of custom and conservatism amongst the indigenous Luo people present serious obstacles to agricultural reforms.¹ Out-migration of the younger age

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FIGURE 1

KANO PLAINS IN THEIR REGIONAL SETTING

- Territorial Boundaries
- Provincial Boundaries
- Roads
- Railways

0 50 Miles
0 50 Kilometres

KANO PLAINS
groups, especially the men, to seek jobs in Nairobi and Mombasa is, in part, a consequence of the population pressure on the cultivated parts of the Kano Plains. In recent years, landholdings in the area have become excessively fragmented owing to the abuse, and virtual breakdown, of the traditional Luo systems of tenure. What is more, the soil and drainage conditions on the Plains seem to be ill-suited to substantial changes in farming techniques unless a great deal of irrigation, artificial drainage and soil conditioning is carried out alongside reforms in the system of land tenure. In this context, the latest schemes for large scale irrigation and resettlement in areas lying within and nearby the Plains are a bold attempt to give a better livelihood to a major source of Kenya’s underemployed population.

I. — The Physique of the Kano Plains

The Plains cover an area of approximately 430 square km. This tract lies South-East of Kisumu (population 30,000), which is the main commercial, cultural and administrative focus of Western Kenya. The relief of the Plains is very subdued ranging between 1,152 metres and 1,168 metres: the former is the mean level of Lake Victoria. The general slope of the land runs from East-North-East to West-South-West. Over the whole area the microrelief consists of broad swellings and troughs with meandering distributing channels crossing the lower areas. The three largest channels are the Nyando, Luanda and Kibos rivers.

To the South, the Miriu River has apparently captured the headwaters of a drainage system that once flowed down onto the Plains from the Kisii Highlands and this river has developed a prominent delta into the Kavirondo Gulf.

From map and field evidence the Plains can usefully be divided into four morphological sub-units:

1) The lowlying areas of permanent or seasonal swamps.
2) The slightly higher areas of West Kano location, consisting of swellings and troughs and fragments of old river levees.
3) The higher ridges, e.g. those of Rabour and East of Ahero, together with smaller eminences of higher ground. These stand out as islands in peak times of flooding.
4) The higher ridges rising northwards, eastwards and southwards towards the surrounding foothills and mountains.

On the macro-scale, from mapwork and field inspection, the wider area

3. Whisson.
including Plains can be subdivided into six contrasting zones, which have a much larger amplitude of relief, viz.:

1) The Kano Plains.
2) The scarp-foot zones of the Nandi and Nyabondo Escarpments.
3) The broken hill, and scarp-foot, zones East of Chemelil.
4) The lava plateaus East of the Kano Plains.
6) The Nandi Escarpment.

II. — THE SOLID GEOLOGY OF THE KANO PLAINS AND THE SURROUNDING DISTRICTS

The rocks of the hill country surrounding the Plains are mostly of pre-Cambrian age. This area is, however, complicated by the intrusion of granites and granitized rocks during subsequent geological periods. By contrast, many of the highest areas of the hill country lying North, South and East of the Plains have been developed upon great outpourings of volcanic material which accompanied the widespread rifting and faulting which occurred in East Africa during Tertiary and Quaternary times. Many layers of basic lavas and tuffs accumulated in the Tinderet Forest area (2,616 metres) East of the Plains, together with the lava plateaus on the Eastern edge of the Plains and over the area of the Nyabondo Plateau to the South.

It appears that the whole area was once part of a pre-Miocene peneplain which stretched far across Africa. Rivers drained westwards across this erosion surface through the present site of Lake Victoria: indeed, former river channels can still be traced down the Kavirondo Gulf and across the floor of Lake Victoria. According to Shackleton (1951)\(^2\) deformation and fracturing movements began in the study area in the lower Miocene period with gentle warping and the development of shallow lakes. The deposits which accumulated in the lakes consisted chiefly of diatomite, which forms a stratum underlying large parts of the Kano Plains at depth. More intense deformation of the Nyanza Rift zone was followed by the eruptions which gave rise to the tuffs and agglomerates which cover large areas on the landward sides of the Plains. At the same time rifts and fault scarps developed to the North and South of an area which was further downwarped to become the site of the Gulf and Kano Plains. The Kavirondo Gulf and Lake Victoria are recent geological features. It is evident, however, that a much larger lake existed in the pluvial periods of the Pleistocene age before the drainage outlet at the Owen Falls was eroded down. Field evidence (raised beach

THE KANO PLAINS OF WESTERN KENYA

deposits) suggests several shorelines from this phase, of which that 20 metres above present Lake level is most prominent. In the pluvial periods silt and clay sediments were deposited in the Lake and these became interbedded over the present Plains area with river and hill wash material brought down from the surrounding highlands. Since Pleistocene times, river and hill wash deposits have covered the whole of the Kano Plains to a considerable depth and hill wash material has further accumulated at the foot of the Nyabondo and Nandi escarpments.

In the most recent phase of landscape development the rivers crossing the Plains are eroding and reworking their own silt deposits whilst also bringing new material down from the surrounding hills. This causes river channels to block and there is a tendency for river outfalls to shift gradually southwards.

III. — THE CLIMATE OF THE KANO PLAINS

The climate and weather of the Plains and of the surrounding areas really merit a far more detailed treatment than can be given here. Despite the small number of recording stations in the area it is possible to offer the following summary and discussion of the most significant elements:

a) There is a marked contrast, in the average annual temperature, between the hot, dry plains at the head of the Kavirondo Gulf and the cooler, wetter highlands and plateaus to the North, South and East. The influence of Lake Victoria is reflected in the lower diurnal and annual temperature ranges recorded on the Plains, as compared with those observed further inland. Lake breezes make conditions more pleasant along the shorelands during the afternoons but they have little effect further inland.

b) The vast area of Lake Victoria (69,340 square km) immediately to the West has a marked effect on the humidity readings and on the clarity of the air over the Plains. Days are often hot and hazy and the weather in Kisumu can be particularly oppressive on occasions, despite the occurrence of Lake breezes.

c) Rainfall over this part of Kenya has some remarkable anomalies and, in any year, precipitation is one of the leading determinants of the success or failure of farming enterprises on the Plains. Various theories exist as to the sources of rainfall over the area but, broadly speaking, two main causes can be identified, viz.: — The equinoctial shift of the intertropical zone of convergence over this part of Kenya, together with:

The penetration of Atlantic airs, which are moist and humid, eastwards from the Congo basin—which are then re-charged in moisture content over Lake Victoria. A clear contrast is seen between the higher average rainfalls (of up to 2,000 mm) on the surrounding highlands and plateaus and the much lower totals (circa 875 mm) recorded on parts of the Plains and the Gulf lowlands. Moreover, the marked variability in annual rainfall totals renders average annual figures for precipitation quite meaningless on the Plains. This is also a problem which affects other parts of Kenya: the consequences upon agricultural production are not only to be seen in Kano. Even on the highlands a one in ten “low year” can be very noticeable in the records, but on the Plains such tendencies as this become exaggerated into erratic alternations of drought and floods. Not only do these erratic trends occur over shorter and longer periods of years, but they also occur seasonally, month by month. Consequently, the risk of crop failures on the Plains, in any given month or year, is quite high. Indeed, in the opinion of one writer on the area the risk of crop failure more than once in twenty years would be more than a peasant farmer could stand on the Kano Plains.

With these points in mind, it is useful to look at the rainfall probability figures for Kisumu, these being the most reliable figures for any station in the study area (see Table). According to Thornthwaite’s criteria Kisumu is classed as an “Equatorial sub-humid” station. It has an annual mean temperature of 24.5°C, an evaporation rate of 1,750 mm per annum and an average annual rainfall of 1,270 mm. The station is located at 0°05’ South of the Equator at an altitude of 1,300 metres. Being “sub-humid,” the climate conditions promote a net up-migration of water in the soils of the Plains which leads to a block-like structure and the formation of a “pan” in the soil—all of which exacerbate the problem of impeded drainage. The main rains in Kano extend from March into May but Kisumu has a “little rainy season” in August and September. In the Kano Plains the main rainy seasons is vital to crop growth: if these rains fail then the farmer’s chances of a fair yield from his crops are slim. In any case, his difficulties are increased by a need to plant when the first light showers are falling—before the soil matrix becomes saturated with moisture and the ground becomes intractable.

Soil-conditioners, containing gypsum, help to break up the cement-like soils but only if they are applied immediately after the showers which preceed the main rains. When they do come, the rains usually fall in thunderstorms. Sometimes these showers fall as hail, which can be very destructive to crops. This hail mainly occurs along the Northern (Nandi) Escarpment where the moist air from over Lake Victoria tends to be rapidly uplifted over the topography, which promotes turbulence and

The Erratic Nature of Rainfall during the Year

<table>
<thead>
<tr>
<th>Month</th>
<th>Mean Average</th>
<th>10%</th>
<th>30%</th>
<th>50%</th>
<th>90%</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>2.1</td>
<td>0.3</td>
<td>0.7</td>
<td>5.2</td>
<td></td>
</tr>
<tr>
<td>February</td>
<td>2.8</td>
<td>1.4</td>
<td>2.5</td>
<td>7.7</td>
<td></td>
</tr>
<tr>
<td>March</td>
<td>6.3</td>
<td>3.9</td>
<td>5.5</td>
<td>10.4</td>
<td></td>
</tr>
<tr>
<td>April</td>
<td>7.7</td>
<td>5.0</td>
<td>6.8</td>
<td>14.9</td>
<td></td>
</tr>
<tr>
<td>May</td>
<td>7.0</td>
<td>4.5</td>
<td>6.4</td>
<td>15.1</td>
<td></td>
</tr>
<tr>
<td>June</td>
<td>4.0</td>
<td>2.3</td>
<td>3.1</td>
<td>5.5</td>
<td></td>
</tr>
<tr>
<td>July</td>
<td>2.7</td>
<td>1.6</td>
<td>2.5</td>
<td>5.8</td>
<td></td>
</tr>
<tr>
<td>August</td>
<td>3.8</td>
<td>2.8</td>
<td>4.7</td>
<td>6.4</td>
<td></td>
</tr>
<tr>
<td>September</td>
<td>3.1</td>
<td>1.7</td>
<td>2.4</td>
<td>4.6</td>
<td></td>
</tr>
<tr>
<td>October</td>
<td>2.5</td>
<td>1.3</td>
<td>2.0</td>
<td>7.0</td>
<td></td>
</tr>
<tr>
<td>November</td>
<td>4.2</td>
<td>2.1</td>
<td>2.9</td>
<td>6.7</td>
<td></td>
</tr>
<tr>
<td>December</td>
<td>4.1</td>
<td>1.5</td>
<td>2.4</td>
<td>6.7</td>
<td></td>
</tr>
<tr>
<td>Total in year</td>
<td>50.3</td>
<td>32.5</td>
<td>38.4</td>
<td>42.0</td>
<td>54.4</td>
</tr>
</tbody>
</table>

This table shows the percent probability that rainfall in each month will be less than the figure stated for each month in each column, e.g., 10 years in 100 years the rainfall in June will be probably less than 1.2%, and 90 years in 100 years the rainfall in June will be probably less than 5.5%, etc. The aim of this table is to illustrate the erratic rate of precipitation at Kisumu (being representative of the Kano Plains).


fast ascending currents of air. In any event, however, proposals for increasing crop yields on the Plains cannot be considered without some effective form of irrigation.

IV. — Soil Conditions on the Kano Plains

The soils of the Kano Plains are developed upon the re-sorted lake and hill wash sediments and alluvial deposits which have been described earlier in the text (see Fig. 2). The effects of these fluvial and lacustrine agents are seen in the complicated areas of stratified soils and in the undulating topography of the area, which frequently includes "cut offs," terrace and levee fragments, marshy hollows and knolls. Also, a colluvial overburden covers the perimeter of the lake and river deposits at the base of the Nyabondo and Nandi escarpments which lie respectively to the South and North of the Kano Plains.

Although soils on the Plains consist predominantly of clays and clay loams there is a considerable range in both their physical and chemical
properties. Immediately to the North, South and East of the Plains, soils are formed from deep accumulations of hill wash that have been re-sorted by local flash floods and become mixed with lenses of alluvium. Dark-coloured clays and clay loams are the most widespread of the alluvial soil types found on the Plains. These occur in areas of gentler micro-relief and are found to be fairly well suited to irrigation development. Their colour varies from brown to a black, which corresponds to a variation in clay content of between 35% and 60% respectively in the topsoil and of between 40% and 70% in the subsoil. The silt content is usually more than 20% in the topsoil. When they are moistened these soils become plastic, slightly sticky and lose any semblance of structure. On drying they crack to form a weak, angular, blocky structure.

The blackness of these soils is not, however, due to large amounts of organic components. There is only a small proportion of organic nutrients in the topsoil and the characteristic blackness of the soils is due to the presence of unoxidised minerals in the soil-matrix which are the result of prolonged waterlogging on the Plains, during times of floods, when there is little free air in the soil. This perennial situation is exacerbated by the low amplitude of relief and by the braided and inefficient nature of the river outfalls. Furthermore, wherever clay soils are found in the area they are usually impervious at depth: consequently the topsoils soak up water like a sponge in the rainy season (March to May) until they are saturated, a fact which greatly assists the flash floods to race down from the hills after heavy rains. In just a few hours the rivers may rise 6 to 8 feet or more above their levels in the dry season and they soon overflow their natural banks and levees.

The floods of the 1961-62 season behaved in this way. As the braided "flash floods" abated over the gentle gradients of the Plains the local ponds, leads and marshes which are left behind remained for several weeks being only slowly evaporated away.

The soils described above are usually termed "Black Cotton" soils and they present considerable problems for agricultural development. They are generally found in depths ranging between 77 cm and 1.2 metres on the Plains and occasionally these soil conditions occur to a depth of 1.8 metres or more. Below them clay silt sediments with cement-like structures go down scores of feet. Owing to their high clay content, black cotton soils tend to become compacted and their structure is poor. The use of soil-conditioners, such as gypsum, already mentioned above, has only proved to be a partial remedy in agricultural experiments carried out on the Plains.
V. — The Development of Drainage on the Plains

All the rivers flowing across the Plains rise in mountain areas which have 1,500 to 2,000 mm of rainfall per year. Mention has already been made of the complexities in the drainage of the study area. It seems that the main river, the Nyando, once reached Lake Victoria by a more direct course than at present, flowing westwards through a series of swamps to share a common outfall with the Kibos River at a point South of Kisumu. Since that time, however, the streams flowing South from the Nandi Escarpment have accumulated large fans of detritus into this former river channel and the streams in this escarpment zone are now “auto-consequent” that is, flowing over, and re-working, deposits of their own creation. Because of this, the Nyando river, finding its course blocked by the detritus, forced an outlet southwards via a maze of distributaries which, one by one, became silted and finally abandoned except in times of flooding. Today the Nyando flows out into the Miruka swamp, South of the Plains, only to find its course hindered further by an ever growing area of papyrus reed, which promotes silting conditions and dams up a backlog of waters during flood times.

Efforts to control the erratic drainage system on the Plains have met with little success so far, although one consultant firm of engineers1 was invited to submit a scheme for the comprehensive drainage and irrigation of the Plains. The local people, however, are content to view the status quo philosophically and they continue to build their homes above the normal flood levels as far as possible. Knolls of raised beach and terrace fragments are topped with grazings and family compounds whilst cultivated lands are sited in hollows where the ground remains sufficiently moist during the dry months in order to guarantee some form of yield and return on the crops which are planted. Most of the local markets are discreetly sited above the normal flood levels and roads, as far as possible, on ridges of higher ground (see Fig. 3).

It is only since the disastrous floods of the 1961-62 season (which followed abnormally prolonged rains) that more drastic measures have been planned to control the drainage of the Plains. During part of the 1961-62 season the area was, in effect, a shallow extension of Lake Victoria and only the highest ridges remained as islands of dry ground (see Fig. 3).

In the latest proposals for the Plains it is planned that the areas under irrigation should have washlands lying between them, alongside a rationalized and canalized system of distributaries for drainage.

These washlands would be designed to contain the floodwaters during the wetter months and at other times they could be used for grazing. The ultimate plan is for some 13,200 hectares of the Plains to come under

irrigation but any solution to the social, as well as the physical, problems of the area is likely to be a long and painfall operation. One formidable challenge to any scheme for introducing irrigated farming to the Kano area is the need to eradicate malaria and bilharzia, both of which are at present endemic in this rather insalubrious part of Western Kenya. Certainly, it will require a considerable amount of money and technical expertise, together with a spirit of initiative and co-operation amongst the local farmers, in order to master the formidable constraints of natural environment which exist in this part of East Africa.