SYNTHESE AGROPASTORALE DU BASSIN DU LAC TCHAD

COMPLETION OF RANGE SURVEYS IN LAKE CHAD BASIN

RAPPORT

REPORT

DECEMBRE 1979

DECEMBER 1979

INSTITUT D'ELEVAGE ET DE MEDECINE VETERINAIRE DES PAYS TROPICAUX
10, rue Pierre-Curie - 94700 Maisons-Alfort
AGROPASTORAL SURVEY N° 53

AGROPASTORAL SYNTHESIS OF THE LAKE CHAD BASIN

A. GASTON, D. DULIEU, G. LAMARQUE
Agropastoralists and Ingenieur Cartographe IEMVT

Ch. BOUQUET, Ch. CLANET, Ch. SEIGNOBOS
Assistant-Professors of Geography - University of Chad

Institut d'Elevage et de Médecine Vétérinaire des Pays Tropicaux
Laboratoire de Farcha - B.P. 433 - N'DJAMENA (Rép. du Tchad)
CONTENTS

INTRODUCTORY NOTE

FIRST PART : The natural environment

Geology
Pedology
Climatology
Vegetation - Pastures
Productivity and carrying capacity
Forests

Cartographic exposition

SECOND PART : The human environment

Cattle movements

Map commentaries
Agropastoral situation on the shores and islands of Lake Chad
Agropastoral situation north and east of Lake Chad
Agropastoral situation in North Cameroon and South Chad

Park Landscapes

Park landscapes and their role in the Chadian basin

CONCLUSIONS

APPENDICES
INTRODUCTORY NOTE

The present compilation of range surveys about the Lake Chad Basin was undertaken in order to afford a synthetic view of pastures in that natural region of tropical Africa.

What made this study possible was the large number of range-surveys about the region. A global view was all the more necessary as those surveys varied in the scales used.

This document aims at offering, in a convenient format, the available data about the Lake Chad Basin as a whole. Its preparation has required additional surveys in North Cameroon and Niger (the region around Gouré and Meéné-Soroa).

The synthesis of range-surveys was supplemented by original research work about the agropastoral situation of stock-breeders and herds in the Lake Chad Basin.

This text as a whole - synthesis of range-surveys and original work about stock-breeder should be regarded only as a global representation of the Lake Chad Basin, making it possible to work up strategies. It cannot be a substitute for the local studies herein compiled that still remain valid for the regions they cover.

The local and regional surveys utilized in this synthesis are the following ones, in chronological order:

1. Peyre de Fabrègues (B.) - Etude des pâturages naturels sahéliens de la région Nord Gouré (Rép. du Niger)
   Maisons-Alfort IENVT : 163 p., 1 carte couleurs au 1/100 000 - Juin 1965

2. Peyre de Fabrègues (B.) - Etude agrostologique des pâturages de la zone nomade de Zinder (Rép. du Niger)
   Maisons-Alfort IENVT : 163 p., 1 carte couleurs au 1/400 000 - Janvier 1967

3. Ricostein (G.), Peyre de Fabrègues (B.) - Modernisation de la zone pastorale du Niger
SUMMARY MAP OF VARIOUS MAPS REVIEWED

I - "Etude des pâturages naturels sahéliens de la région de Nord-Gouré (Rép. du Nigé) « B. PEYRE DE FABREGUES » 1/100,000

II - "Etude agrométéorologique des pâturages de la zone pastorale du Zinder (Rép. du Nigé) « B. PEYRE DE FABREGUES » 1/400,000

III - "Modernisation de la zone pastorale du Nigé - Rép. du Nigé » (G. KOPPE - B. PEYRE DE FABREGUES) 1/100,000

IV - "Etude de la COUVERTURE Végétale du Tchad » 1/100,000

V - "The Land Resources of North-East Nigeria » P.K. de LEIUW, P. TULEY

VI - "Etude agrométéorologique des pâturages du Projet Assale-Sebouew (Rép. du Tchad - Rép. Tchad du Cameroun) » (A. GASTON) 1/200,000

VII - "Pâturages du Sud-Ouest du Tchad » (A. GASTON, B. PEYRE DE FABREGUES, H.D. KLEIN, D. DULIEU) 1/500,000

VIII - "Etude d'Assainissement Hydraulique Pastoral des Ouvres (Rép. Tchad du Cameroun) » (A. GASTON, D. DULIEU) 1/200,000

IX - "Effet de la sécheresse de 1973 sur les pâturages du Lac Tchad 

X - "Pâturage du Batha du Tchad » (A. GASTON, D. DULIEU) 1/500,000

XI - Cameroun (D. DULIEU, G. LAMARQUE)

XII - Nigé (D. DULIEU) 1/100,000

LÉGENDE

LEGEND
Maisons-Alfort IEMVT : 306 p., 1 carte en couleurs au 1/1 000 000 en deux feuilles - Janvier 1972

Paris ORSTOM, Traveux et documents n° 6 - 1970

5. Tuley (P.) Editor - The Land Resources of North East Nigeria Surbiton, Surrey, England, Land Resources division, Tolworth Tower, 4 vol., 13 color maps to the 1/1 000 000 - 1972

Maisons-Alfort - N'Djaména, IEMVT-CBLT : 144 p., 1 carte en couleurs au 1/200 000 - Octobre 1974

Maisons-Alfort IEMVT, 3 tomes, 2 cartes en couleurs au 1/500 000 - Décembre 1975.

8. Gaston (A.), Dulieu (D.) - Etude d'aménagement d'hydraulique pastorale des Yaéreré (Rép. Unie du Cameroun)
Maisons-Alfort - N'Djaména, IEMVT-CBLT : 50 p., 1 carte en couleurs au 1/200 000 - Juillet 1976

Maisons-Alfort IEMVT - 173 p., 1 carte en couleurs au 1/500 000 - 1976

To those published surveys should be added the unpublished studies by Dulieu in North Cameroon and Niger (region of Gouré and Maïna-Scroa).

For the present synthesis we have drawn from another document "Study of water resources in the Lake Chad Basin" Techn. Rpt/UNESCO/UNDP - Reg. 71, especially as regards geology, pedology, and climatology.

This compilation should therefore be regarded only as a convenient exposition whose aim is to propose an overview of agropastoral problems in the Lake Chad Basin before utilizing the basic regional surveys.
FIRST PART

THE NATURAL ENVIRONMENT
GEOLOGY

PEDOLOGY

CLIMATOLOGY
The recent geological history of the region under study is that of the Chadian depression since the end of the Tertiary. During the pluvial stages the lake was much wider than it is now. It is generally agreed that the region has undergone four important transgressions, broken by periods of severe drought. The last three periods have been accurately identified; the preceding ones are gathered under the general term of "first transgressions' before that time, the basement complex of the region has been locally covered by secondary deposits.

1. THE BASEMENT COMPLEX

It is to be found in the South-West of the Lake Chad Basin, in Nigeria, Cameroon and Chad, in the region of the Mandara Hills and Léré. It can also be seen inside the Chadian depression, in the form of outcropping rocks.

In the Biu area, in Nigeria, a basaltic zone dating from the Tertiary and Quaternary can be found.

11. MÉZOZOIC

The secondary formations are to be found in the South-West part of the Lake Chad Basin, and in the North-West, between Gouré and Tasker.

In the Léré region in Chad and in the Bénoué valley, from Garoua in

"Study of water resources in the Lake Chad Basin"

CARTE GEOLOGIQUE SIMPLIFIEE
MAP OF SIMPLIFIED GEOLOGY

Échelle : 1/5 000 000
Scale: 1/5,000,000

LEGENDE

QUATERNAIQUE - QUATERNARY

- Cordon dunaire lacustre
  Sand barrier of lake
- Alluvions inégalement déposés
  Undifferentiated alluvial deposits
- Delta IV recent
  Delta IV recent
- Delta III post-cordon 320 m et dépôts lacustres
  Delta III post-barrier: 320 m and lake deposits
- Alluvions contemporaines au cordon 320 m
  Contemporary barrier alluvial deposits
- Delta II pré-cordon de 330 à 330 m
  Delta II pre-barrier: 330 to 330 m
- Delta I pré-cordon de 400 à 330 m
  Delta I pre-barrier: 400 to 330 m
- Sables vifs, erg steppes
  Moving sands, recent erg, barchanes

TERTIAIRE - TERTIARY

- Sables fluviatiles avec remaniements deltaïques lacustres - Erg ancien
  Fluviatile sands reworked by lake delta and wind action - Old erg
- Plaines-forets de Pedoclaire
  Pedoclaire plains
- Continental terminal
  Continental terminal

SECONDAIRE - MESOZOIC

- Cambrien
  Cambrian
- Socle cristallin
  Basement complex

PRIMAIRE - PALAEOZOIC

- Carbonifère
  Carboniferous
- Basalte
  Basalt
Cameroon to Lao in Nigeria, we can observe undifferentiated cretaceous. In the Gombé region, in Nigeria, geologists distinguish a continental intercalaire, a marine cretaceous and a continental upper cretaceous. The last one is also present in the Koutous Massif, in Niger.

111. TERTIARY AND QUATERNARY

The change of eras took place between the first transgressions and the second one.

A) TERTIARY

At the end of the Tertiary, the first and oldest transgressions brought several hundred meters of sediments, from 300 to 700 meters or so. These deposits are called: "Continental Terminal".

In Chad they cover a very wide area, from Pala to Sahr; they are cut by the valleys of four rivers, the Cheri, the Mandoul, the West Logone, and the East Logone, flowing northwards.

In Nigeria these formations lie east of the Bauchi Plateau, where they cover a very extensive area too; this is cut by the valley of the Gongola River, flowing eastwards.

During the Tertiary era other deposits took place: those of the "piedmont flats", extensive in Ched around the Guera Massif, more scattered in Nigeria and Cameroon. They are found south of Damaturu and as a north piedmont of the Mandara Hills, as far as Maroua in Cameroon.

It was in the Tertiary too that occurred the deposits of fluviatile sands, reworked by the lake delta and wind action, that are known as "old erg". Those sands cover the whole northern part of the Lake Chad Basin.

B) QUATERNARY

During that era the 2nd, 3rd and 4th transgressions took place. They brought lacustrine deposits and the three successive Chari deltas.

Chronologically, we can observe:

- The first delta deposits, chiefly visible on either side of the Chari, upstream from Sahr. They can also be found in Cameroon, south-west of
SYNTHÈSE HYDROLOGIQUE DU BASIN DU LAC TCHAD

"Study of water resources in the Lake Chad Basin"

SCALE: 1/5,000,000

LEGEND

1. Highlands of basement complex
2. Ferrallitic surface
3. Pediment with compacted surface
4. Pediment with ironpan at surface
5. Not endurated pediment
6. Arenaceous pediment of great massifs
7. Old alluvial plains with ferruginous soils
8. Eolian formations with developed soils
9. Eolian formations with weakly differentiated soils
10. Old perialacustrine complex
11. Recent perialacustrine complex
12. Recent alluvial plains with clays, dolomites and salts
13. Major stream beds and actual shores of the lake
14. Actual extension of desert
15. Sand barrier of recent lake
16. Shore of lake at 130 m
17. Shore of lake at 130 m
18. Shore of lake at 320 m
19. Shore of lake at 400 m
Yagoua, and in Nigeria, north of Damba.

- the second delta deposits, found in Chad, on the right bank of the Chari, in the Guelangdeng area.

- the lagoon deposits, which constitute the Laï plain in Chad

- the contemporary alluvial deposits of the 320 meter barrier. This sand barrier, which forms one of the shores of the lake, is quite easily visible nowadays. In Chad, it makes up the Goz Kerki; then the dunes of Massenya and Bongor; in Cameroon the Limani barrier; in Nigeria the Bama barrier; in Niger the N'Guigmi dune.

The streams flowing into the lake have left alluvia at the foot of this barrier: in Chad, east of Goz Kerki, in Cameroon and Nigeria, against the "barriers" of "Limani" and "Bama"; in Nigeria along the Burum Gana valley.

- the third delta deposits lie in Chad in the Massenya region between Messeguet and the Fitri Lake, in the Bahr el Ghazal. In Nigeria, these deposits are found between Maidiguri and the lake and near the border dividing this country and Niger, between Mainé Sofoa and the lake.

- the fluvio-lagoon deposits of the Logone River. They have been laid in Chad and Cameroon, and in Nigeria as well. They spread over a wide area, from Bongor-Yagoua to Kousseri and Dikwa. In Chad and Cameroon, their area corresponds to the region known as the Yaérés.

- the deposits of the fourth Chari delta. They cover the region spreading from N'Djaména to Lake Chad.

Two shores of Lake Chad are still visible on the terrain:

- the first one corresponds to the 320 meter elevation. It is made up by the Bama and Limani barriers, the Bongor and Massenya dunes, the Goz Kerki, the Tal dune.

the second one corresponds to the 287 meter elevation. Vestiges of it can be seen in Chad (south of Hadjer and Hamis), Cameroon (Makari region) and Niger (N'Guigmi dune).
Pedology reflects the main lines of the geological history of the Lake Chad Basin. A variety of soils can be found there, ranging from desert soils to hydromorphic ones.

1. DESERT SOILS

These solian soils occur north of the Lake Chad Basin, in the 16th parallel area.

11. LITHOSOILS

These are found on crystalline rocks, especially on granite, in the Béibokoum region, in Chad, and in the Mandara Hills between Nigeria and Cameroon.

111. SOILS OF STONY DESERT

These soils having a ferruginous facies occur in Chad in the Guera Massif, in Nigeria-Cameroon in the region of the Mandara Hills and south of Damaturu.

They can develop:

- on sands derived from weathered granites, with a toposquence of hydromorphic or brown facies soils and a toposquence of leached halomorphic soils.

- on kaolinic and ferruginous sandstone.
IV. WEAKLY DEVELOPED SOILS FORMED BY DEPOSITION OR HYDROMORPHIC SOILS

These are the alluvia of the large rivers flowing into Lake Chad: the Chari and its tributaries (Mandoul, Bahr-Gara, Bahr Salamat) the Logone (western and eastern).

V. WEAKLY DEVELOPED SOILS FORMED BY DEPOSITION INTERGRADE TOWARDS HALOMORPHIC SOILS

These are few and far between. They occur only in Cameroon, between Yagoua and Limeni, behind the dune barrier.

VI. TOPO MORPHIC VERTISOILS AND SOILS WITH VERTIC GLEY

These are widespread, constituting most of the Yaérs in Chad, Cameroon and Nigeria. They can also be found between N'Djaména and the lake, and in the region of Lake Fitri.

They develop on clayey alluvia and brown sunken soils.

VII. LITHOMORPHIC AND TOPOLITHOMORPHIC VERTISOILS, SOILS WITH VERTIC ALKALI

They develop on sandy clays derived from weathering (granite) or argilites. Not common in the Lake Chad Basin, they occur in Nigeria north of Biu and south of Bama; in Chad, in the Guera Massif.

VIII. BROWN SOILS, WEAKLY DEVELOPED SOILS WITH A REDDISSH-BROWN FACIES, WITH A WEAKLY LEACHED FERRUGINOUS FACIES

These are widespread in the whole northern area of the Lake Chad Basin. They develop on siliceous sands.

Pedologists distinguish six types:
- soils on siliceous sands in the North of the Chadian depression
- soils of the perilacustrine barrier
- soils of the riverine complex
- sunken soils of fine lacustrine or fluvio-lacustrine alluvia
- toposequence with deep calcareous accumulation
- dune soils on siliceous sands

IX. BROWN AND REDDISH BROWN SEMI-ARID SOILS ON PIEDMONT SLOPES

They develop on sandy clays derived from weathered metamorphic rocks.

X. REDDISH BROWN SEMI-ARID SOILS, WEAKLY LEACHED FERRUGINOUS SOILS

They develop on siliceous sands (dunes) or on sand covering altered substratum (soft limestone, granite, ironpans, and ferruginated limestone).

They occur in Nigeria, in the area around Potiskum and Damaturu; in Chad, east of the Goz Kerki.

XI. UNCOMpletely DRAINED FERRUGINOUS SOILS

They are found on siliceous sands, localized in Nigeria and Cameroon, around Bama and Waza.

XII. LEACHED AND WEAKLY LEACHED FERRUGINOUS SOILS

They develop on siliceous sands and clayey sands. They can be divided into:

- toposequence with hydromorphic soils
- toposequence with leached hydromorphic soils
- toposequence with leached hydromorphic and halomorphic soils, and soils with calcareous nodules

They are widespread in Chad, Cameroon and Nigeria.

XIII. LEACHED FERRUGINOUS SOILS WITHOUT CONCRETIONS

They develop on limestone and granite; then we can observe some toposequences with hydromorphic soils and others with halomorphic soils and vertisols.
LÉGENDE

1. - Sol des déserts, sols éoliens
   Desert soils, eolian soils

2. - Lithosols
   Lithosols

3. - Solos résiduals à taches ferrugineuses
   Soils of residual desert with ferruginous patches

4. - Solos peu évolués d'appartement ou hydromorphes
   Weakly developed soils formed by deposition or hydromorphic soils

5. - Solos peu évolués d'appartement intermédiaires vers les sols halomorphes lessivés
   Weakly developed soils formed by deposition intermediate towards leached halomorphic soils

6. - Vertisols lithomorphes et sols à gleys vertiques
   Topomorphic vertisols and soils with vertic gleys

7. - Vertisols, lithosols, sols à gleys, sols à gleys vertiques
   Vertisols, lithosols, gleys, topomorphic gleys

8. - Solos bruns, sols peu évolués à taches bruns, épaisses taches brunes, des taches ferrugineuses peu lessivées
   Brown soils, weakly developed soils with brown patches, thick brown patches, thin ferruginous patches

9. - Solos bruns, sols à gleys vertiques
   Brown soils, with vertic gleys

10. - Solos bruns, sols à gleys vertiques
    Brown soils, with vertic gleys

11. - Solos bruns, sols à gleys vertiques
    Brown soils, with vertic gleys

12. - Solos bruns, sols à gleys vertiques
    Brown soils, with vertic gleys

13. - Solos bruns, sols à gleys vertiques
    Brown soils, with vertic gleys

14. - Solos bruns, sols à gleys vertiques
    Brown soils, with vertic gleys

15. - Solos bruns, sols à gleys vertiques
    Brown soils, with vertic gleys

16. - Solos bruns, sols à gleys vertiques
    Brown soils, with vertic gleys

17. - Solos bruns, sols à gleys vertiques
    Brown soils, with vertic gleys

18. - Solos bruns, sols à gleys vertiques
    Brown soils, with vertic gleys

19. - Solos bruns, sols à gleys vertiques
    Brown soils, with vertic gleys

20. - Solos bruns, sols à gleys vertiques
    Brown soils, with vertic gleys
This type of soil occurs in Chad, as a piedmont of the Cameroonian Massif of Adamawa.

XIV. FERRUGINOUS SOILS WITH OBLIQUE LEACHING

The soils develop on granite or clayey sands; they occur in Chad in the Lafi plain, on sand strips oriented South-North.

XV. LEACHED FERRUGINOUS SOILS WITH CONCRETIONS AND/OR IRONPANS

They develop on various rocks (limestone, granite, metamorphic rocks). Pedologists divide them into:
- soils with concretions predominant
- ironpan soils predominant
- toposequence with vertic soil
- soils with eroded ironpans
- alumina pans

These various types of soils can be found in Nigeria (north north-east of Biu); Cameroon (south of Maroua; Chad (Pala area, Bahr el Ghazal, south of the Guere Massif); and Niger (Koutous Massif).

XVI. WEAKLY FERRALITIC SOILS AND FERRUGINOUS TROPICAL SOILS ON OLD FERRALITIC SOILS

These develop on various rocks (sand, limestone, granite) and cover a wide area in the South of Chad and South of Potiskum.

XVII. HALOMorphic SOILS DUE TO WATERatable

They occur on alluvia (saline soils, alkali soils, soils with gley) and on the complex on the shores of Lake Chad.

They can be found in Niger, Nigeria (region of the Kumadugu) and Chad (Sahr el Ghazal).
XVIII. LEACHED ALKALI SOILS

These are either solaodised solonetz on sandy clays derived from weathering, or hydromorphic solaodised solonetz.

They occur in Nigeria, Chad (N'Djaména and Massenya regions).

XIX. HYDROMORPHIC MINERAL SOILS WITH SUPERFICIAL OR DEEP PSEUDO-GLEY.

These soils are generally acid, sometimes leached, on alluvia and limestone, occasionally neutral with alkalines.

They occur in Nigeria, north of Maiguri, in Chad, east of Massaguet and east of Goz Kerki.
Climatology

The climate of the Lake Chad Basin is of the tropical type, characterized by a wet season that can last from 1 month to 6 according to the latitude.

The map of isoyets drawn by the LCBC from the homogenized means for the 1940-1963 period shows a rainfall ranging from 100 mm on the 16th parallel latitude to 1100 mm on the 9th parallel.

The various types of climates, according to d'Aubréville's classification, are:

- Saharian: less than 200 mm
- Sahelo-Saharian: between 200 and 500 mm
- Sahelo-Sudanian: between 500 and 1100 mm
- Sudano-Guinean: more than 1100 mm.

To a large extent the pastures of the Lake Basin reflect the wide range of rainfall from North to South.

In this exposition, which is not a climatological survey, we give as a guideline the mean rainfalls drawn from the LCBC map for the stations in each of the 4 countries bordering Lake Chad. These data are not quite comparable, as they are not based on the same number of years analyzed.

**Niger**

<table>
<thead>
<tr>
<th>Station</th>
<th>Rainfall (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N’Guigni</td>
<td>241</td>
</tr>
<tr>
<td>Goudoumeria</td>
<td>436</td>
</tr>
<tr>
<td>Souré</td>
<td>406</td>
</tr>
</tbody>
</table>

**Nigeria**

<table>
<thead>
<tr>
<th>Station</th>
<th>Rainfall (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Damasek</td>
<td>415</td>
</tr>
<tr>
<td>Madejia</td>
<td>815</td>
</tr>
<tr>
<td>Dametura</td>
<td>710</td>
</tr>
<tr>
<td>Potiskum</td>
<td>808</td>
</tr>
<tr>
<td>Yusufari</td>
<td>471</td>
</tr>
<tr>
<td>Maidiguri</td>
<td>660</td>
</tr>
<tr>
<td>Azeré</td>
<td>755</td>
</tr>
<tr>
<td>Yola</td>
<td>960</td>
</tr>
</tbody>
</table>
MAP OF MEAN ANNUAL RAINFALL

**LEGEND**

- Zone inondable
- Zone liable to flooding
- Pluviométrie moyenne annuelle
- Mean annual rainfall

**Synthèse hydrologique du Bassin du Lac Tchad**

PNUD – FS – UNESCO – LCST
1966 – 1968

"Study of water resources in the Lake Chad Basin"

UNDP – ST – UNESCO – LCBC
1966 – 1968
### CAMEROON

<table>
<thead>
<tr>
<th>Town</th>
<th>Rainfall (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kousseri</td>
<td>543</td>
</tr>
<tr>
<td>Yagoua</td>
<td>822</td>
</tr>
<tr>
<td>Kaele</td>
<td>929</td>
</tr>
<tr>
<td>Mokolo</td>
<td>1103</td>
</tr>
<tr>
<td>Mora</td>
<td>764</td>
</tr>
<tr>
<td>Maroua</td>
<td>824</td>
</tr>
<tr>
<td>Garoua</td>
<td>961</td>
</tr>
</tbody>
</table>

### CHAD

<table>
<thead>
<tr>
<th>Town</th>
<th>Rainfall (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sol</td>
<td>279</td>
</tr>
<tr>
<td>Mao</td>
<td>330</td>
</tr>
<tr>
<td>Maoussouro</td>
<td>350</td>
</tr>
<tr>
<td>Bokoro</td>
<td>385</td>
</tr>
<tr>
<td>N'Djamena</td>
<td>635</td>
</tr>
<tr>
<td>Massenya</td>
<td>725</td>
</tr>
<tr>
<td>Lare</td>
<td>815</td>
</tr>
<tr>
<td>Bongor</td>
<td>850</td>
</tr>
<tr>
<td>Bousso</td>
<td>921</td>
</tr>
<tr>
<td>Pala</td>
<td>1011</td>
</tr>
<tr>
<td>Leï</td>
<td>1053</td>
</tr>
<tr>
<td>Kelo</td>
<td>1065</td>
</tr>
<tr>
<td>Bebedjia</td>
<td>1173</td>
</tr>
<tr>
<td>Sehr</td>
<td>1126</td>
</tr>
</tbody>
</table>
In order to make the text more readable, the part about vegetation and range-lands has been abridged. The detailed description is given in appendix.
VEGETATION OF THE SAHELO-SUDANIAN ZONE

It is characterized by four vegetal formations linked to the topography and climatic zone, and by other formations caused by special conditions. In broad terms, we can distinguish the following, from North to South:

- on steep dunes and more or less coarse sands:
  - a formation with Panicum turgidum.
- on dune undulations and sand plateaus:
  - a formation with Cyperus jeminicus and Aristida pallida
  - a formation with Acacia senegal and Aristida longiflora
  - a grassy formation with Hyperthelia dissoluta
- the special cases (fossil valleys, Bahr el Ghazal)

The species of the first three formations are accompanied by various woody and herbaceous species forming the common stock of Sahelian vegetation. These are: Acacia raddiana, Balanites aegyptiaca, Commiphora africana, Leptadenia pyrotechnica and Aristida funiculata, A. mutabilis.

In the fourth formation, Hyperthelia dissoluta is accompanied by Andropogon gayanus.

1. FORMATION ON STEEP DUNES WITH PANICUM TURGIDUM

It appears as a shrub steppe constituted by the common stock of Sahelian vegetation.

The woody stratum occurs mainly on lower slopes and between dunes.

The perennial herbaceous stratum, besides the species that characterize this formation, includes: Aristida pallida, A. papposa, Cyperus jeminicus, and more rarely Cymbopogon proximus. Panicum turgidum tends to
grow more freely on dune tops and upper slopes.

The annual herbaceous stratum is thin on dune tops, but thicker on lower slopes and in interdunes. It chiefly includes Aristida mutabilis, A. funiculata with some other less frequent gramineae: Cenchrus biflorus, Schoenefeldia gracilis, Dactyloctenium aegyptium, and Eragrostis tremula.

We can also find some species common in Sahelian regions and belonging to various families: Fimbristylis exilis, Alyssocarpus ovalifolius, Indigofera sessiliflora, Gisekia pharnacioides, Polycarpea corymbosa.

The formation with Panicum turgidum can occur in slightly differing variants: according to the geographical situation some accompanying species can be relatively more common than others.

This formation spreads from Niger to Chad, that is farther north than the 15th parallel, being linked with the large geomorphological unit of the Manga. A smaller isolated instance can be found east of the Koutous Massif in Niger.

- in the steep dune region of the Manga, the woody stratum is supplemented by a shrub: Commiphora quadricincta. This Manga vegetation constitutes a large homogeneous unit.

- It also develops west of the Dillia valley with two weekly shrubby variants.

- East of the Koutous Massif a variant can be found: the dunes are more regular, with Cymbopogon proximus in the perennial herbaceous stratum.

11. FORMATIONS ON DUNE UNDULATIONS AND SAND PLATEAUS

A) With Cyperus jeminicus and Aristida pallida

It has the same shrub-steppe appearance typical of Sahelian regions.

The shrub stratum is evenly distributed. There is almost no diffe-
rence between the top and the bottom of sand undulations. This stratum is homogeneous on plateaus.

The perennial herbaceous stratum, in addition to the characteristic species, includes Cymbopogon proximus. The presence of the latter species makes it possible to distinguish several variants.

The annual herbaceous stratum is constituted by the same species as the preceding formation: Aristida mutabilis, A. funiculata, Eragrostis tremula, Schoenfeldia gracilis as well as the common accompanying species.

The formation with Cyperus jeminicus can show slight variations according to the geological situation and the geomorphological pattern.

It extends from Niger to Chad, roughly between 14° and 15° North.

- from Chad to Niger (N'Guigmi), we find a large unit, typical of this formation.

- in the region south-east of Tasker, on either side of the 15th parallel, Commiphora quadricincta grows as an addition to the shrub stratum; the sand undulations are steeper.

- in the region east of Oualeram, North-east of the Koutous Massif, on regular dune undulations, Cymbopogon giganteus is added to the characteristic perennial species.

- in the Gagandi area, Salvadora persica supplements the shrub stratum species.

- around the Koutous Massif some variants with Cymbopogon giganteus and C. proximus can be found.

B) With Acacia senegal

This is again a shrub steppe on sand plateaus, more southern than the preceding two, which accounts for the presence of A. senegal.
The shrub stratum is homogeneous and evenly distributed.

The perennial herbaceous stratum is again constituted by Andropogon gayanus (in Nigeria), Cymbopogon proximus, Aristida longiflora, but these species appear as isolated individuals.

The annual herbaceous stratum is composed of Aristida mutabilis, Eragrostis tremula (more common than in the preceding cases), Ctenium elegans, Schoenefeldia gracilis, Cenchrus biflorus.

This formation with Acacia senegal shows slight variations in Niger and Nigeria.

. south of Bosso, Acacia seyal complements the woody species. There is no perennial herbaceous stratum except in depressions where Sporobolus helvolus grows.

. between N'Guigmi and Diffa, Ziziphus mauritania and Sporobus helvolus also occur in depressions. This variant develops on silty and clayey sands.

. in the Kadzell region, we can find a variant on silty substratum with Boscia senegalensis, Salvadora persica and Panicum laetum.

C) With Hyperthelia dissoluta

This is a thinnish grass savanna, growing on the edge of the 13th parallel on a sand plateau.

The shrub stratum is non-existent, except a few isolated shoots of Leptadenia pyrotechnica.

The perennial herbaceous stratum, besides H. dissoluta, includes Andropogon gayanus, Aristida longiflora and a few shoots of Cymbopogon proximus.

The annual herbaceous stratum is constituted by Aristida mutabilis, and sometimes Ctenium elegans and Schizachyrium exile.
This quite homogeneous formation occurs only in Chad where it makes up two large units, one south of Mao, the other south of Moussoro.

111. FOSSIL VALLEYS AND LARGE DEPRESSIONS

The sahelo-saharian zone is cut across by two large depression systems: the valley of the Dillia in Niger and the Bahr el Ghazal flowing down from lake Chad in Chad.

Interdunes and plateaus are interspersed by clayey hollows called "wadis".

A) Valley of the Dillia

The fossil valleys of Niger as a whole are oriented NW-SE and in recent quaternary were connected to Lake Chad.

The shrub stratum is constituted by the common Sahel species with the addition of Acacia ehrenbergiana and A. Laeta.

There are no perennial gramineae and the annual gramineae are characteristic of compact soils: Aristida funiculata and Schoenefeldia gracilis.

B) The Bahr el Ghazal

This defluent flows to the North-East when Lake Chad waters are high.

In addition to the ligneous species of the Sahelian zone we find Hyphaene thebaica, Piliostigma reticulatum, Acacia seyal, A. Laeta, A. nilotica.

Perennial species are almost non-existent. Long flood periods favor the growth of such species as Scirpus prelongatus, Heteranthera callifolia. On wind-blown sand layers we find the same annual gramineae as in the neighbouring steppe.

C) The wadis

They vary according to the geographical situation:
- **Interdune wadis**: they bear the same vegetation as the plateau or dune. The annual gramineae typical of the steppe develop on wind-blown sand layers.

- **Wadis of South Kanem and North of Lake Chad**: they are often covered by a thick vegetation with *Hyphaene thebaica*. Near Lake Chad there is no longer any woody stratum. Shallow depressions are covered by *Sporobolus helvolus*.

**IV. FORMATION ON MAJOR RELIEFS**

There are only two examples, both in Niger:

- the **Termit Massif**, characterized by *Chrysopogon aucheri*, *Stipa-grostis uniglumis*.

- the **Koutous Massif** characterized by *Lannea fruticosa*, *Boswellia odorata*. 
VEGETATION OF THE SAHELO-SUDANIAN SECTOR

It is characterized by three main vegetal formations, dependent on the nature of the soil and on the climatic zone.

- a formation on sands with Acacia senegal, Guiera senegalensis, Combretum glutinosum

- a formation on silty sands with Anogeissus leiocarpus, Sclero crya birrea

- a formation on silty sands farther south with Anogeissus leiocarpus, Terminalia avicennioides.

In addition to these largely dominant formations some special cases are found, those of edaphic and anthropogenic vegetation.

1. FORMATIONS ON SANDS WITH ACACIA SENEGAL - GUIERA SENEGALENSIS

It appears as a relatively dense shrub steppe, where thorny species are dominant, with A. seyal, A. ataxacantha and a few individuals of Balanites aegyptiaca. A Combretaceae occurs: Combretum glutinosum.

The perennial herbaceous stratum does not exist.

The annual herbaceous stratum is constituted by Schizachyrium exile, Schoenefeldia gracilis, Aristida mutabilis.

This formation, that can take a few variant forms, spreads from Nigeria to Chad, between 12° and 13°.

It is often overgrown by some ligneous species that testify to overgrazing: Guiera senegalensis, Balanites aegyptiaca and Acacia seyal.
There are some park-savannas with Acacia albida.

These alterations of the natural environment have made it possible to distinguish several local variants. In the Karal region in Chad, a formation with A. senegal has been replaced by a secondary formation with Salvadora persica.

11. FORMATIONS ON SILTY SANDS

A) With Anogeissus leiocarpus and Sclerocarya birrea

This is again a shrub steppe but consisting of thornless ligneous species growing on sandy-silty soils.

In the shrub stratum we find Piliostigma reticulata, Stereospermum kunthianum, Combretum glutinosum.

A few thorny shrubs are however found in this formation: Balanites aegyptiaca as a secondary species and Acacia seyal in depressions.

This formation is found in Chad in the same area as the preceding one with Acacia senegal.

There is no perennial herbaceous stratum but an annual one: Aristida mutabilis, Schoenefeldia gracilis, Chloris pilosa, Brachiaria xantholeuca.

B) With Anogeissus leiocarpus, Terminalia avicennioides

It is a dense shrub steppe, sometimes a tree steppe complemented by Combretum glutinosum.

The herbaceous stratum is annual, with Eragrostis tremula and Hyparrhenia begirmica.

This formation occurs in Chad, east of N'Djamena, part of it south of the 12th parallel.

111. FORMATIONS ON HALOMORPHIC SANDS

A) Formation with Acacia spp., Lannea humilis

It is a shrub steppe where thorny species are largely dominant.
We can also find Ziziphus mauritiana, Balanites aegyptiaca.

There is no perennial herbaceous stratum. The annual species are Aristida mutabilis, Schoenefeldia gracilis, Schizachyrium exile, Loudetia togoensis and Panicum laetum in low-lying areas.

These formations, that can also very according to their floristic composition, occur in Nigeria, chiefly in the Kumadugu area. One can also find a few patches of steppe with Lannea humilis in Chad, north of N'Djamé-na.

B) Formation with Acacia nilotica, A. seyal

It is a shrub steppe with thorny species growing on a hydromorphic substratum.

We may also observe other thorny species: Ziziphus mauritiana and more rarely Balanites aegyptiaca, but also Crateva adansonii, Diospyros mespiliformia and Mimosa pigra.

The herbaceous stratum is constituted by Oryza barthii, Echinochloa stagnina, E. colona.

IV. ANTHROPOGENIC FORMATIONS

Formation with Balanites aegyptiaca and Acacia seyal

This formation is a more or less dense shrub steppe; ligneous species may occur as small isolated individuals on a compacted and sterile substratum.

In addition to these two species we find Ziziphus mauritiana, Bauhinia rufescens, Capparis spp.

The herbaceous stratum includes Panicum laetum, Echinochloa colona.

This formation chiefly occurs in Chad.
It is in this sector that shrub and tree steppes with Combretaceae grow at their best. This vegetation is often referred to by foresters as "woodland with Anogeissus".

The formation grows on sand substrata, some of those with concretions, and on hydromorphic soils.

We can also find some formations with Terminalia laxiflora, others with Boswellia, and secondary vegetations of park-savannas with Adansonia digitata, Parkia africana, Acacia albida.

1. FORMATIONS ON SANDS AND CONCRETIONARY SANDS WITH ANOGEISSUS LEIOCARPUS

They occur as tree savannas more or less overgrown by secondary species, and develop on sandy soils and soils with concretions.

A) Formations with Anogeissus leiocarpus on sands also include Detarium microcarpum, and Guiera senegalensis, Combretum spp., Acacia ataxacantha. There are some facies with Sterculia setigera, others with Afrormosia sp.

The herbaceous stratum mainly includes Hyparrhenia spp., (among which H. bagirmica), Pennisetum pedicellatum, Loutetia sp.

B) Formations with Anogeissus leiocarpus on concretions also include Detarium microcarpum, Combretum spp., and a herbaceous stratum with Andropogon gayanus and Loutetia togoensis.

C) Formations with Anogeissus leiocarpus and Boswellia dalzielli; formations with Anogeissus leiocarpus and Terminalia spp.

They are found in Nigeria on relatively small and scattered areas.
In addition to the characteristic species, the first formation includes Lannea schimperi, Acacia spp., Combretum glutinosum.

The second one is constituted by Terminalia laxiflora, T. avicennioides, Combretum glutinosum, C. ghazalense.

In both cases the herbaceous stratum is composed of Pennisetum pedicellatum, Schizachyrium exile.

These formations with Anogeissus leiocarpus are found in Nigeria south of the 12th parallel. They cover very wide areas and are typical of the Sudano-Sahelian sector.

11. FORMATIONS ON HYDROMORPHIC SANDY SOILS WITH TERMINALIA LAXIFLORA

They develop on hydromorphic soils near flood zones.

The shrub/tree stratum also includes Pseudocedrela kotschyi, Prosopis africana, Terminalia avicennioides, Piliostigma spp., Parkia africana, Gardenia spp.

The herbaceous stratum is dominated by Andropogon gayanus and Diheteropogon amplectens.

These formations are found in Chad and Cameroon on the latitude of Bangor and between the Logone and the Chari.

111. THE PARK-SAVANNAS

These are man-made, and can be divided into several types of savanna:

- with Adansonia digitata
  - Parkia sp.
  - Faidherbia albida
  - Borassus aethiopum
  - Hyphaene thebaica

These savannas can be found south of the 12th parallel, in the whole Sudano-Sahelian sector, in Nigeria as well as in Chad and Cameroon.
In the latter country the park-savanna with Faidherbia albida covers a very wide area.

IV. THE FORMATIONS ON HYDROMORPHIC SOILS

They are numerous and varied. In broad terms we can state that:

- the ligneous stratum is constituted by Acacia spp., Combretum spp., Piliostigma spp., then, as soils get more hydromorphic, by Pseudocedrela kotschyi and Terminalia macroptera with Gardenia spp.

- the herbaceous stratum is composed of Andropogons (A. pseudapricus, A. amplectens, A. schirensis) and Hyparrhenia (H. bagirmica, H. involucrata, H. soluta) and, as soils get more hydromorphic, H. Eragrostis atrovirens, H. rufa, Setaria anceps). The ultimate state is a grass savanna with H. rufa.

These formations occur in Nigeria, Cameroon and Chad.
VEGETATION OF THE SUDANO-GUINEAN SECTOR

It is characterized by savanna woodland and woodland. According to the topography we find:

- a formation with Isoberlinia doka
- a formation with Daniellia oliveri

and a formation with Afrormosia laxiflora. We may observe also some formations on ironpans.

1. FORMATION ON FERRALLITIC SANDS WITH ISOBERLINIA DOKA

It is a savanna woodland changing into woodland, where legumes abound, developing on ferrellitic sands or Koros.

The tree stratum also includes Burkea africana, Tetrapleura tetraptera, Prosopis africana, Afzelia africana, Pterocarpus lucens.

The shrub stratum is constituted by Combretum nigricans, Detarium microcarpum, Hymenocardia acida.

The herbaceous stratum is formed by Andropogon gayanus, the dominant species.

This formation with Isoberlinia doka is found in Chad, south of the 9°30' parallel.

11. FORMATION ON TROPICAL FERRUGINOUS SANDS

A) With Daniellia oliveri

This is a savanna woodland developing on tropical ferruginous
sands in the valleys that cut across the sand massifs of the koros.

The tree stratum includes Burkea africana, Prosopis africana, Butyrospermum paradoxum, Terminalia laxiflora.

The shrub stratum is quite similar to that of the preceding formation

The herbaceous stratum is constituted by Andropogon gayanus, Hyparrhenia spp., and Ctenium newtonii.

The woodland savanna with Daniellia oliveri is found in Chad south of the 9°30' parallel.

B) With Afrormosia laxiflora

This woodland develops on sands west of Gombé.

The woody stratum is composed by Isoberlinia doka, Anogeissus leiocarpus, Detarium microcarpum, Combretum spp.

The herbaceous stratum is dominated by Hyparrhenia involucrata.

III. FORMATIONS ON IRONPANS

They develop on ironpans that occur on ferrallitic soils as well as ferruginous ones.

The ligneous stratum includes approximately the same species as the preceding formations, but it has the appearance of a shrub savanna.

The herbaceous stratum is constituted by Loudetia togoensis, Oryza sp. and various Cyperaceae.

IV. VEGETATION OF THE GUERA MASSIF

This massif is found in Chad; its vegetation is characterized by:

- a tree savanna with Anogeissus leiocarpus, Boswellia dalzielli
- a tree savanna on ferruginous hardpans.
VEGETATION OF RIVERS

According to their sizes, we can distinguish:
- the vegetation of large rivers with major beds
- the vegetation of narrow streams

1. VEGETATION OF LARGE RIVERS WITH MAJOR BEDS

The major bed is a grass savanna with Vetiveria nigritana, Hyparrhenia exarmata and H. rufa.

The minor bed is covered by Loudetia simplex, Setaria anceps, Sorghastrum trichapus, H. rufa.

The part that remains flooded longest has Echinocloa stagnina, Vossia cuspidata.

11. VEGETATION OF NARROW STREAMS

It is often limited to a few species.

- in the South, the bed of the stream is covered by Hyparrhenia rufa, Panicum anabaptistum, Jardinea congoensis; the banks bear woodland vegetation.

- to the North, we can find in stream beds: Mimosa pigra, Salix ledermenii, Phyllanthus reticulatus. The banks bear the same species as the neighboring shrub/tree savanna.
The Logone, a tributary of the Chari, flows every year over a wide plain bearing a grass savanna known as "yaéres". This can be divided into:

- the fringe of the yaéres covered by a shrub formation - flooded at more or less regular intervals - with Acacia spp., Mitragyna inermis.
- the yaéres proper, with Hyparrhenia rufa.

The vegetation of Lake Chad is dependent on the rise and fall of its waters.

1. FORMATION WITH ACACIA SPP., MITRAGYNA INERMIS, ON THE FRINGE OF THE YAERES

This can be found in Nigeria as well as Cameroon and Chad.

The shrub stratum includes Acacia seyal, A. sieberana, A. campylacantha, Ziziphus mauritiana, in varying proportions. In addition to these species we can find Pseudocedrela kotschyi and Mitragyna inermis. Single-species populations of A. seyal can occur locally.

The herbaceous stratum consists mainly of a tall annual graminea, Sorghum lanceolatum, often appearing in single-species populations. Eriochloa fatmensis can also be found.

11. FORMATION OF GRASS SAVANNA WITH HYPARRHENIA RUFA

On the fringe of the grass plain, the dominant species is Eriochloa fatmensis, then we find Sorghastrum trichopus, Setaria anceps and finally Hyparrhenia rufa, the characteristic species of typical yaéres.
III. LAKE CHAD VEGETATION

On the banks of the lake, the vegetation is that of the neighboring steppe, but on the South shore we find formations with Acacia nilotica var. nilotica.

The recent drought has caused the growth of pioneer formations with Calotropis procera and Sesbania sesban, and the dramatic development of Aeschynomene elaphrozyon.

The water-lapped fringe is covered by Cyperaceae and Gramineae (Eragrostis atrovirens, Paspalum conjugatum, etc...).

The floating edge includes Vossia cuspidata and Cyperus papyrus that can break off into floating islands.

Shallow parts bear a vegetation with Phragmites australis, Typha domingensis. We can also observe grass ponds with Potamogeton and Vallisneria.
VEGETATION OF MOUNTAIN ZONES AND REGS

The vegetation in these zones consists of:
- tree to shrub savannas with Isoberlinia doka
- tree savannas with Afromosia laxiflora
- tree savannas with Boswellia dalzielli
- tree savannas with Anogeissus leiocarpus
- shrub savannas with Acacia hoockii

1. TREE TO SHRUB SAVANNAS WITH ISOBERLINIA DOKA

They are found in Cameroon, on the Nigerian border. The ligneous stratum, often destroyed, is characterized by Isoberlinia doka. The herbaceous stratum includes Andropogon tectorum and Diheteropogon amplexans.

11. TREE SAVANNAS WITH AFROMOSSIA LAXIFLORA

These savannas are found in Nigeria south of the Benue, and in the Koboktina region.

In addition to the characteristic species the ligneous stratum includes Detarium microcarpum, Boswellia spp., Anogeissus leiocarpus.

The herbaceous stratum is composed of Andropogon spp., Hyparrhenia spp., Loudetia spp., Aristida spp.
1. Végétation à espèces annuelles
   (annual species vegetation)

2. Steppe arbustive à (shrub steppe with...)
   Acacia nilotica, A. seyal, Balanites aegyptiaca, Aristida mutabilis, Aristida funiculara

3. Steppe et sauvages arbustives à (shrub steppes and savannas...)
   Acacia longeacarpa, Combretum spp., Acacia seyal, Hyparrhenia biflora

4. Domaine saharien - Saharan Zone

5. Domaine sahelien - Sahelian Zone

6. Domaine soudanien - Soudanian Zones

7. Zone de régions montagnes - Mountain and reg zones

8. Zone d'inondation - Flooded zone

LEGENDE

PAR : A. GASTON
III. TREE SAVANNAS WITH BOSWELLIA SPP.

They occur mainly on either side of the border between Cameroon and Nigeria.

The ligneous stratum, in addition to the characteristic species, includes Acacia spp., Combretum sp.

The herbaceous stratum is composed of Aristida spp., Loudetia spp.

IV. TREE SAVANNA WITH ANOGEISSUS AND BOSWELLIA SPP.

This formation covers a wide area in Nigeria, Cameroon and Chad.

The ligneous stratum, in addition to the characteristic species, includes Acacia spp. (A. dudgeoni and A. hockii).

The herbaceous stratum is constituted by Loudetia spp., Aristida spp., Schizachyrium exile.

V. SHRUB SAVANNA WITH ACACIA HOCKII

It is found in Cameroon and Chad around Maroua and Léré; in Nigeria around Biu.

In addition to the characteristic species the ligneous stratum may include Albizia chevalieri, Boswellia dalzielii.

The herbaceous stratum is composed of Aristida kerstingii, Loudetia togoensis in Cameroon and Chad; Andropogon spp. in Nigeria.
PRODUCTIVITY AND

CARRYING CAPACITY
The productivity of pastures in the Lake Chad Basin has not been appraised for the special purpose of this compilation. The figures given are those published in the various basic surveys.

As the methods used may have varied according to the authors, and the yields according to the years, the following data should be considered only as an indication affording a general view of fodder production in the Lake Chad Basin.

Following the same order as in the chapter about vegetation, we shall study in succession:

- the Sahelo-Saharan sector
- the Sahelo-Sudanian sector
- the Sudano-Sahelian sector
- the Yaeres range-lands
- the Sudano-Guinean sector

To make for easier reading yields and carrying capacities are tabulated for each sector.

Capacities for the Nigerian area are measured for an animal weighing 272 kg (600 lb), whereas for the other countries they apply to a 250 kg animal (UBT : Unité Bovin Tropical - Tropical Bovine Unit).

In order to identify the Nigerian pastures, the initials that characterize its type are followed by the letters GC and a number corresponding to the gramineous group (e.g. GC2 = Grassland Communities : Aristida)

The gramineous groups for Nigeria are the following:

1 - Aristida/Andropogon
2 - Aristida
3 - Cenchrus
4 - Brachiaria
5 - Schizachyrium exile
6 - Loudetia togoensis
7 - Pennisetum pedicellatum/Loudetia togoensis
<table>
<thead>
<tr>
<th>No.</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>P. oedicellatum/ S. exile</td>
</tr>
<tr>
<td>9</td>
<td>Hyparrhenia spp.</td>
</tr>
<tr>
<td>10</td>
<td>Hyparrhenia involucrata</td>
</tr>
<tr>
<td>11</td>
<td>Andropogon spp.</td>
</tr>
<tr>
<td>12</td>
<td>Loudetia / Aristida</td>
</tr>
<tr>
<td>13</td>
<td>Hyparrhenia soluta</td>
</tr>
<tr>
<td>14</td>
<td>Andropogon geyanus / Diheteropogon</td>
</tr>
<tr>
<td>15</td>
<td>A. geyanus / Hyparrhenia</td>
</tr>
<tr>
<td>16</td>
<td>Sporobulus helvolus</td>
</tr>
<tr>
<td>17</td>
<td>Schoenefeldia / Panicum</td>
</tr>
<tr>
<td>18</td>
<td>Schoenefeldia / Loudetia</td>
</tr>
<tr>
<td>19</td>
<td>Sorghum spp.</td>
</tr>
<tr>
<td>20</td>
<td>Alluvial complex</td>
</tr>
</tbody>
</table>

The second column shows yields according to the various authors; the third one carrying charges according to the same sources; the last one a general appreciation of the pasture, after the various survey that have been compiled.

Note: For the Nigerian area, "Yields and Quality of Grassland Communities" and carrying capacities are given in Appendix 11.
SAHEL - SAHARIAN SECTOR

STEEP DUNES

On these dunes pastures have low yields, from 250 kg to 500 kg/ha. Their optimum utilization period takes place during the wet season.

In fact they are utilized during that period, with the livestock drinking from temporary ponds.

The Sd/RP formation, found in Nigeria, is an exception: because of its better geographical situation it has a higher yield: 1500 kg/ha.

These pastures should be regarded only as wet season grazing lands, whose yields may vary in substantial proportion from one year to the next. The proposed carrying capacity is about 3 ha per head in the wet season.

The Sd/RA pasture in Chad has a high value, for the numerous wadis of the Mang a make it more impervious to irregular rainfall.

DUNE UNDULATIONS

They bear pastures whose yields range from 600 to 1000 kg/ha, and that can be utilized all the year round, with carrying capacities varying from 8 ha to 11/15 ha per head.

Because of climatic hazards, it seems reasonable to keep the mean figure above 10 ha, that is 12 to 14 ha.

SAND PLATEAUS

They form most of the sahelian pastures of the Lake Chad Basin.

Some of them, such as Sp/LP, Sp/RL, located in the North East have a low yield. Therefore, they are classified as wet season grazing lands; 2 to 4 ha per head during that period.

The others, further south, are usable all the year round. Their yields vary from 450 to 1 200 kg/ha, consequently the carrying capacity varies between 6 and 10 ha per head.

PASTURES ON CLAY-LOAM SUBSTRATUM

They develop on a very favorable substratum, west of Lake Chad. The yield reaches 1250 kg/ha, making for a year-round capacity of 5-8 ha.
<table>
<thead>
<tr>
<th>TYPE OF PASTURE</th>
<th>YIELD kg/DM/ha</th>
<th>CAPACITY</th>
<th>QUALITY AND CONSTRAINTS</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steep Dunes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sd/RA</td>
<td>250</td>
<td>2-3 ha/WS</td>
<td>20 ha/TCC</td>
<td>Wet season pastures. Excellent in years when rainfall is evenly distributed. The Manga (Sd/RA) can be utilised all year because of numerous wadis.</td>
</tr>
<tr>
<td>Sr/PL</td>
<td>400</td>
<td>2 ha/WS</td>
<td>15 ha/TCC</td>
<td></td>
</tr>
<tr>
<td>Sd/CA</td>
<td>500</td>
<td>2-3 ha/WS</td>
<td>15-20 ha/TCC</td>
<td></td>
</tr>
<tr>
<td>SD/LP</td>
<td>400</td>
<td>5 ha/TC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sd/RP</td>
<td>1 500</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sd/CP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dune undulations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>So/SA</td>
<td>1 000</td>
<td>8 ha/TCC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>So/RC</td>
<td>600</td>
<td>11-15 ha/TCC</td>
<td></td>
<td>More southern than the preceding ones, can be used all year but high risks.</td>
</tr>
<tr>
<td>Sand plateaus</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sp/LP</td>
<td>250</td>
<td>4 ha/WS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sp/RC</td>
<td>700</td>
<td>1-2 ha/WS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sp/RL</td>
<td>500</td>
<td>2 ha/WS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sp/SC</td>
<td>700</td>
<td>11 ha/TCC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sp/RA</td>
<td>1 000</td>
<td>7 ha/TCC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sp/RS</td>
<td>1 200</td>
<td>6 ha/TCC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sp/LH</td>
<td>450</td>
<td>10 ha/TCC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sp/A</td>
<td>650</td>
<td>7 ha/TCC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sh/R (GC 2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S/R (GC 2)</td>
<td>550</td>
<td>4.0 ha/WS; 7.0 ha/DS; 12.1 TCC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sp/PL</td>
<td>1 200</td>
<td>6 ha/TCC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sg/LS</td>
<td>700</td>
<td>11 ha/TCC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Po/RC</td>
<td>650</td>
<td>11 ha/TCC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M/SP</td>
<td>1 250</td>
<td>5-8 ha/TCC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kn/PA</td>
<td>1 250</td>
<td>5-8 ha/TCC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fossil valleys and depressions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vn/RA</td>
<td>300</td>
<td>20 ha/TCC</td>
<td></td>
<td>Good pastures utilizable year round (except fossil valley in the North); especially in dry season for livestock get a substantial ligneous complement.</td>
</tr>
<tr>
<td>Vc/SA</td>
<td>1 200</td>
<td>6 ha/TCC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vo/RS</td>
<td>900</td>
<td>8 ha/TCC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NB/spp</td>
<td>1 000</td>
<td>7 ha/TCC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

GC Grassland communities

MM/MM 1st letter: Quality in wet season;
2nd letter: Quality in dry season;
3rd letter: Constraint in wet season;
4th letter: Constraint in dry season

W = Medium  H = High  L = Low

Abbreaviations:

WM = Dry Matter
WS = Wet Season
D = Dry Season

TCC = Total Carrying Capacity (year round)
FOSSIL VALLEYS AND DEPRESSIONS

The most northerly one has a weak yield: 300 kg/ha, allowing a carrying capacity of 20 ha per head.

The Vo/SA and Vo/AS group yields 900 to 1200 kg. The pastures can be grazed all the year round, with a capacity of 6 to 8 ha per head.

In Chad the Bahr el Ghazal (HB/spp) gives a mean estimated yield of 1000 kg/ha, which allows a carrying capacity of 7 ha per head.

CONCLUSIONS

Pastures in the Sahelo-Saharan sector, that represent the perfect example of an extensive-breeding zone, are especially productive south of the 15th parallel, where capacity varies from 6 to 11 ha per head. Locally, some favorable edaphic conditions may improve the quality of grazing lands.

North of the 15th parallel, the weak yields and wide variations in rainfall from one year to the next enable grazing in the wet season only.
FORMATIONS ON SANDS

The palatable vegetal production consists of annual gramineae: Schizachyrium exile, Brachiaria xantholeuca in Nigeria; Aristida mutabilis in Cameroon; and over the whole area Schoenefeldia gracilis with Chloris pilosa found locally.

Yield varies from 550 to 100 kg of D.M. per hectare, which makes for an annual capacity of 6 to 8 ha per head.

These pastures can be grazed all the year round, the wet season capacity being 3 ha per head, the dry season one 4 ha.

FORMATIONS ON SILTY SANDS

Vegetal production comes from annual gramineae: Schoenefeldia gracilis, Aristida mutabilis, Brachiaria xantholeuca, Chloris pilosa, and for the S/AT formation Hyparrhenia bagirmica.

Yields vary from 100 to 1900 kg of DM per ha. Grazing is possible in the wet season with a capacity of about 2 ha per head, and in the early dry season from July to December with about 2 ha per head. Hyparrhenia bagirmica is virtually unpalatable in the dry season.

When Schoenefeldia gracilis and Aristida mutabilis are dominant (S/AP), the pasture can be grazed for the 9 months of the dry season.
FORMATIONS ON HALOMORPHIC SANDS

The pastures are composed of annual graminæ: Aristida spp. and Schizachyrium exile, with Schoenefeldia gracilis, Panicum laetum, Loudetia togoensis.

Yield varies from 550 to 1000 DM per ha, and grazing is possible all round the year.

For the formation with Aristida spp, the capacity is 4.0 ha in the wet season, 7.0 ha in the dry season, 12.1 ha for the whole year.

For the formation with Schizachyrium exile the capacity is 3.3 ha in the wet season, 4.3 ha in the dry season, 8.4 ha for the whole year.

FORMATIONS ON HYDROMORPHIC SUBSTRATUM

Pastures are always made up of annuals: Schoenefeldia gracilis, Loudetia togoensis and, in larger depressions, Echinocloa colonae.

Yield varies from 100 to 2230 kg of DM per hectare, grazing being possible mainly in the dry season with a capacity of 2 to 3 ha per head.

ANTHROPOGENIC FORMATIONS

These pastures are composed of annuals: Panicum laetum, Echinochloa colonae, Loudetia togoensis, Chloris pilosa.

They can be grazed all year, with a capacity ranging from 3.3 to 4.6 ha per head.
<table>
<thead>
<tr>
<th>TYPE OF PASTURE</th>
<th>YIELD kg/DM/ha</th>
<th>CAPACITY</th>
<th>QUALITY AND CONSTRAINTS</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fossil dune barriers</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sd/GR, Sd/TP, S/S</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Formations on sands</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S/GS (GC 5)</td>
<td>550 - 1 100 kg</td>
<td>3.3 ha WD; 4.3 ha DS; 8.4 ha TCC</td>
<td>MM/MM</td>
<td>These pastures can be grazed all year, annual gramineae being fine and consumable on the spot in full dry season. These pastures are rather independent from climatic hazards, due to their latitude</td>
</tr>
<tr>
<td>S/GR (GC 5)</td>
<td>550 - 1 100 kg</td>
<td>3.3 ha WS; 4.3 ha DS; 8.4 ha TCC</td>
<td>MM/MM</td>
<td>Same as above, except for S/AT, for H. gagirica being too hard in the dry season cannot be grazed during that period</td>
</tr>
<tr>
<td>S/GR (GC 4)</td>
<td>550 - 1 100 kg</td>
<td>3.3 ha WS; 4.3 ha DS; 8.4 ha TCC</td>
<td>MM/MM</td>
<td>Same as above, except for S/AT, for H. gagirica being too hard in the dry season cannot be grazed during that period</td>
</tr>
<tr>
<td>S/S</td>
<td>(1 000 kg)</td>
<td>1.8 ha from Oct. to Feb.</td>
<td>MM/MM</td>
<td>Grazing possible all year, gramineae being fine. These ranges are rather impervious to climatic hazards, owing to their latitude</td>
</tr>
<tr>
<td>S/SS</td>
<td>(1 000 kg)</td>
<td>2.7 ha from Feb. to Jul.</td>
<td>MM/MM</td>
<td>Good pastures, to be utilized mainly in early dry season</td>
</tr>
<tr>
<td>S/AA</td>
<td></td>
<td>2.5 ha June/Dec/S-6 ha TCC</td>
<td>MM/MM</td>
<td>Good pastures with fine gramineae on moderately degraded facies, to be utilized in wet season and early dry season</td>
</tr>
<tr>
<td><strong>Formations on silty sands</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S/AP</td>
<td>1 450 - 1 900 kg</td>
<td>2.3 ha 9 months DS/1.3 ha Jul. to Dec.</td>
<td>MM/MM</td>
<td></td>
</tr>
<tr>
<td>S/PS</td>
<td>1 100 kg</td>
<td>2 ha Sept. to Jan.</td>
<td>MM/MM</td>
<td></td>
</tr>
<tr>
<td>S/AB</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S/AT</td>
<td>1 600 - 1 900 kg</td>
<td>2.0 ha 9 months DS/2 ha Jul. to Dec.</td>
<td>MM/MM</td>
<td></td>
</tr>
<tr>
<td><strong>Formations on halomorphic sands</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sh/GR (GC 2)</td>
<td>&lt; 550 KG</td>
<td>4.0 ha WS; 7.0 ha DS; 12.1 ha TCC</td>
<td>MM/MM</td>
<td></td>
</tr>
<tr>
<td>Sh/GA (GC 5)</td>
<td>550 - 1 100 kg</td>
<td>3.3 ha WS; 4.3 ha DS; 8.4 ha TCC</td>
<td>MM/MM</td>
<td></td>
</tr>
<tr>
<td>Sh/GC (GC 5)</td>
<td>550 - 1 100 kg</td>
<td>3.3 ha WS; 4.3 ha DS; 8.4 ha TCC</td>
<td>MM/MM</td>
<td></td>
</tr>
<tr>
<td>Sh/DS (GC 5)</td>
<td>550 - 1 100 kg</td>
<td>3.3 ha WS; 4.3 ha DS; 8.4 ha TCC</td>
<td>MM/MM</td>
<td></td>
</tr>
<tr>
<td><strong>Formations on hydromorphic substratum</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H/LS (GC 18)</td>
<td>11PP - 2 230 kg</td>
<td>2.0 ha WS; 1.9 ha DS; 4.3 ha TCC</td>
<td>MM/MM</td>
<td></td>
</tr>
<tr>
<td>H/N</td>
<td>1 300</td>
<td>1.2 WS; 2.7 DS; 3.8 AY</td>
<td>MM/MM</td>
<td></td>
</tr>
<tr>
<td><strong>Anthropogenic formations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M/BK</td>
<td>1 000 kg</td>
<td>3.3 ha TCC</td>
<td>MM/MM</td>
<td></td>
</tr>
<tr>
<td>M/SE</td>
<td>720 kg</td>
<td>4.6 ha TCC</td>
<td>MM/MM</td>
<td></td>
</tr>
<tr>
<td>M/BL</td>
<td>1 200 kg</td>
<td>4.6 ha TCC</td>
<td>MM/MM</td>
<td></td>
</tr>
<tr>
<td>M/K</td>
<td>720 kg</td>
<td>4.6 ha TCC</td>
<td>MM/MM</td>
<td></td>
</tr>
</tbody>
</table>

**Legend:** See preceding table p. 41
The herbaceous vegetation is dominated by annuals: Schizachyrium exile, Pennisetum pedicellatum, Loudetia sp., Aristida sp., Hyparrhenia spp. A few perennial species, such as Andropogon gayanus, may be found.

Yields vary from 550 to 3350 kg of DM per hectare; on the average it can be estimated at 1500 kg.

These pastures are utilizable all the year round with a capacity ranging from 2.7 to 8.4 ha per head.

Wet season utilization implies a mean capacity of 2 ha per head; dry season grazing a mean capacity of 2 to 4 ha per head.

However, of the pasture is dominated by annual Hyparrhenia, it is more advisable to use it in the wet season only.

The pasture is made up of annual gramineae: Loudetia togoensis, Pennisetum pedicellatum, Schizachyrium exile; and one perennial graminea, Andropogon gayanus.

Yield varies from 1100 to 2230 kg of DM per hectare. They can be grazed all year, with a capacity of over 4 ha per head. In the wet season it is 2 to 2.3 ha, in the dry season 1.8 to 1.9 ha.
FORMATIONS ON HYDROMORPHIC SANDY SOILS

Forage is provided by mostly annual gramineae: Andropogon amplexus, A. pseudapricus, Diheteropogon amplexus, Hyperthelia dissolutes.

Yield is over 3000 kg of DM per hectare, but straw, being too hard, is seldom eaten in the dry season.

These pastures can be utilized in the wet season if they are not exceedingly flooded, with a capacity of 2 or 3 ha per head.

In the dry season, the main forage is regrowth after burning; from December to June one can expect a capacity of 5 ha per head.

FORMATIONS ON HYDROMORPHIC SOILS

This category brings together a number of formations scattered over Chad, Cameroon and Nigeria.

In a few instances the pasture is made up of annuals: Pennisetum pedicellatum, Schizachyrium exile, Loudetia togoensis, Aristida kerstingii.

In most cases it is constituted by perennial gramineae: Andropogon spp., Hyparrhenia spp.

These pastures are reported to be utilizable all the year round, with the following carrying capacities for Nigeria: 2.0 to 3.3 ha per head in the wet season; 1.1 to 4.3 ha in the dry season; 4.3 to 8.4 ha yeard round. Yet one of them (H/CH) can be grazed only in the dry season.

In Chad pastures on hydromorphic soils are chiefly utilizable as regrowth after burning in the second half of the dry season with a capacity of 4 to 9 ha per head. This is the optimum period for grazing. If we compute the year-round capacity we have a total of 3 to 6 ha per head, but this includes some forage that is not eaten because it is too hard.

ANTHROPOGENIC FORMATIONS

In this sector we find parks with Acacia albida, with annual gramineae: Schonefeldia gracilis, Panicum laetum, Pennisetum pedicellatum.
<table>
<thead>
<tr>
<th>TYPE OF PASTURE</th>
<th>YIELD kg/DM/ha</th>
<th>CAPACITY</th>
<th>QUALITY AND CONSTRAINTS</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formations on sands</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sf/AC (GC 5 and 8)</td>
<td>550 - 1 100</td>
<td>3.3 WS; 4.3 D5; 8.4 TCC</td>
<td>(MV/MM)</td>
<td>Can be grazed all year with a capacity varying from 2.7 to 8.4 ha per head. In some cases, when dominated by Aristida and Indigofera, it is preferable to utilize them in wet season, as these grasses are hard in dry season.</td>
</tr>
<tr>
<td>Sh/AN (GC 9)</td>
<td>2 230 - 3 350</td>
<td>2.3 WS; 1.8 D5; 4.5 TCC</td>
<td>(MV/MM)</td>
<td></td>
</tr>
<tr>
<td>Sf/CA (GC 12)</td>
<td>1 100 - 2 230</td>
<td>2.3 WS; 1.8 D5; 4.5 TCC</td>
<td>(MV/MM)</td>
<td></td>
</tr>
<tr>
<td>Sf/AS (GC 6)</td>
<td>550 - 1 100</td>
<td>3.3 WS; 4.3 D5; 8.4 TCC</td>
<td>(MV/MM)</td>
<td></td>
</tr>
<tr>
<td>Sf/CP (GC 8)</td>
<td>1 100 - 2 230</td>
<td>2.3 WS; 1.8 D5; 4.5 TCC</td>
<td>(MV/MM)</td>
<td></td>
</tr>
<tr>
<td>Sf/PH (GC 10)</td>
<td>2 230 - 3 350</td>
<td>1.4 WS; 1.1 D5; 2.7 TCC</td>
<td>(MV/MM)</td>
<td></td>
</tr>
<tr>
<td>Sf/AN (GC 8)</td>
<td>1 100 - 2 230</td>
<td>2.3 WS; 1.8 D5; 4.5 TCC</td>
<td>(MV/MM)</td>
<td></td>
</tr>
<tr>
<td>S/AD</td>
<td>700 to 1 600</td>
<td>2.2 to 3.4 D5; 3 to 6 TCC</td>
<td>(MV/MM)</td>
<td></td>
</tr>
<tr>
<td>S/CL (GC 9-12)</td>
<td>2 230 - 3 350</td>
<td>1.4 WS; 1.1 D5; 2.7 TCC</td>
<td>(MV/MM)</td>
<td></td>
</tr>
<tr>
<td>S/AS</td>
<td>2 200</td>
<td>1 from June 15 to November 15</td>
<td>(MV/MM)</td>
<td></td>
</tr>
<tr>
<td>Formations on sands with concretions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sc/MA (GC 11)</td>
<td>1 100 - 2 230</td>
<td>2.3 WS; 1.8 D5; 4.5 TCC</td>
<td>(MV/MM)</td>
<td>These pastures can be utilized all year with a capacity of 4.5 ha per head.</td>
</tr>
<tr>
<td>Sc/CA (GC 6)</td>
<td>1 100 - 2 230</td>
<td>2.0 WS; 1.9 D5; 4.3 TCC</td>
<td>(MV/MM)</td>
<td></td>
</tr>
<tr>
<td>Sc/PP (GC 8)</td>
<td>1 100 - 2 230</td>
<td>2.3 WS; 1.8 D5; 4.5 TCC</td>
<td>(MV/MM)</td>
<td></td>
</tr>
<tr>
<td>Sc/SP (GC 8)</td>
<td>1 100 - 2 230</td>
<td>2.3 WS; 1.8 D5; 4.5 TCC</td>
<td>(MV/MM)</td>
<td></td>
</tr>
<tr>
<td>Formations on hydromorphic sandy soils</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sl/AT</td>
<td>3 000</td>
<td>3.1 TCC</td>
<td>(MV/MM)</td>
<td>These pastures can be grazed in early wet season if not too much flooded. Difficult to utilize in dry season as straws are too hard. Utilization as regrowth after burning preferable.</td>
</tr>
<tr>
<td>Sl/IS</td>
<td>3 700</td>
<td>2.4 to 6.4 TCC</td>
<td>(MV/MM)</td>
<td></td>
</tr>
<tr>
<td>Sl/TP</td>
<td></td>
<td>2 TCC; 5 TCC</td>
<td>(MV/MM)</td>
<td></td>
</tr>
<tr>
<td>Formations on hydromorphic soils</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hv/AK</td>
<td>After PIA5, no agropastoral results</td>
<td>1.4 WS; 1.1 D5; 2.7 TCC</td>
<td>(MV/MM)</td>
<td>Can be grazed either all year (2.7 to 8.4 ha) in Nigeria, or as regrowth after burning in Chad (4 to 9 ha per head). In Chad these are excellent pastures when utilized in 2nd half of dry season.</td>
</tr>
<tr>
<td>Hv/CM</td>
<td></td>
<td>3.3 WS; 4.3 D5; 8.4 TCC</td>
<td>(MV/MM)</td>
<td></td>
</tr>
<tr>
<td>V/BA (GC 13)</td>
<td>2 230 - 3 350</td>
<td>1.4 WS; 1.1 D5; 2.7 TCC</td>
<td>(MV/MM)</td>
<td></td>
</tr>
<tr>
<td>Ho/AB (GC 17)</td>
<td>550 - 1 100</td>
<td>3.3 WS; 4.3 D5; 8.4 TCC</td>
<td>(MV/MM)</td>
<td></td>
</tr>
<tr>
<td>H/AN (GC 18)</td>
<td>1 100 - 2 230</td>
<td>2.0 WS; 1.9 D5; 4.3 TCC</td>
<td>(MV/MM)</td>
<td></td>
</tr>
<tr>
<td>H/CH (GC 20)</td>
<td>&gt; 4 450</td>
<td>0.6 D5</td>
<td>(MV/MM)</td>
<td></td>
</tr>
<tr>
<td>H/CP (GC 8)</td>
<td>1 100 - 2 230</td>
<td>2.3 WS; 1.8 D5; 4.5 TCC</td>
<td>(MV/MM)</td>
<td></td>
</tr>
<tr>
<td>SA/TL</td>
<td>1 500 to Reg. 400</td>
<td>6 TCC; 4 regrowths</td>
<td>(MV/MM)</td>
<td></td>
</tr>
<tr>
<td>H/TX</td>
<td>2 800 to 5 500</td>
<td>1.2 to 2.4 D5</td>
<td>(MV/MM)</td>
<td></td>
</tr>
<tr>
<td>H/TC</td>
<td>1 000</td>
<td>6.6 TCC</td>
<td>(MV/MM)</td>
<td></td>
</tr>
<tr>
<td>H/H</td>
<td>4 500</td>
<td>1.5 D5; 5 regrowths</td>
<td>(MV/MM)</td>
<td></td>
</tr>
<tr>
<td>H/PE</td>
<td>2 600</td>
<td>3 TCC; 3 regrowths</td>
<td>(MV/MM)</td>
<td></td>
</tr>
<tr>
<td>Hs/C (GC 10)</td>
<td>2 230 - 3 350</td>
<td>1.4 WS; 1.1 D5; 2.7 TCC</td>
<td>(MV/MM)</td>
<td></td>
</tr>
<tr>
<td>Hv/AP (GC 19)</td>
<td>4 450</td>
<td>0.6 D5</td>
<td>(MV/MM)</td>
<td></td>
</tr>
<tr>
<td>Anthropogenic formations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hv/AA</td>
<td>1 000</td>
<td>4. WS</td>
<td>(MV/MM)</td>
<td></td>
</tr>
</tbody>
</table>

**LEGEND:** See preceding table p. 41.
Yield is 1000 kg of DM per hectare; the pasture can be grazed all year, but on account of its fragility, it is preferable to utilize it in the wet season only with a capacity of 4 ha per head.
FORMATION ON FERRALLITIC SANDS

Forage consists of tall perennial gramineae: Andropogon gayanus, Brachiaria brizantha, Beckeropsis uniseta; and an annual, Hyparrhenia bagirmica.

Yield is 1550 kg of DM per hectare, plus 130 kg of regrowth after burning.

This formation is an excellent pasture for the wet season (3 ha per head) and at the beginning of the dry season. In the full dry season it is difficult to utilize but regrowth after burning, added to wet season grazing, makes for an annual capacity of 7 to 10 ha per head.

FORMATION ON TROPICAL FERRUGINOUS SANDS

Fodder is provided by Andropogon gayanus, A. schirensis, Hyparrhenia involucrata, H. barteri.

Yield is 1450 kg of DM per hectare, plus 150 kg of regrowth after burning.

This pasture is chiefly utilizable in the wet season with a capacity of 1.4 to 2.5 ha per head. It can be grazed in the dry season as regrowth after burning.

The optimum capacity is from 3 to 12 ha year round combining wet season grazing and regrowth after burning.
FORMATION ON IRONPANS

The gramineous cover consists of annuals: Loudetia annua, L. togoensis, Aristida kerstingii; and a few perennials.

It can be grazed in the wet season with a capacity ranging from 2.5 to 2.9 per head. In the dry season, some of these pastures may grow again after burning.

FORMATION OF RIVERS

Yield varies from 2000 to 3000 kg of DMD per hectare. These pastures are grazed in the dry season (2.4 ha per head) or better as regrowth after burning (3 to 4 ha per head).
<table>
<thead>
<tr>
<th>TYPE OF PASTURE</th>
<th>YIELD kg/DM/ha</th>
<th>CAPACITY</th>
<th>QUALITY AND CONSTRAINTS</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formation on Ferrallitic sands</td>
<td>1650 - 130 reg.</td>
<td>3 WS; 4.2 DS; 7 to 10 TCC</td>
<td>LL/WH</td>
<td>Excellent wet season pastures but insects a problem; little usable in dry season (hard straws), but utilisable on regrowth after burning (10 to 12 ha per head)</td>
</tr>
<tr>
<td>Formation on Tropical ferruginous soils</td>
<td>1450 - 190 reg.</td>
<td>2.5 WS; 3.6 DS; 6 to 12 TCC</td>
<td></td>
<td>Can be grazed chiefly in wet season; little or not at all in dry season</td>
</tr>
<tr>
<td>Formation on Ironpans</td>
<td>2230 - 3390</td>
<td>1.4 WS; 1.1 DS; 2.7 TCC</td>
<td></td>
<td>Can be grazed in late dry season on regrowth after burning</td>
</tr>
<tr>
<td>Rivers</td>
<td>2000 - 3000</td>
<td>2.4 DS; 3 to 4 reg.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

LEGEND: See preceding table p. 41
The composition of the gramineous cover will vary according to the extent of flooding.

When it consists of annuals – Schonefeldia gracilis, Pennisetum pedicellatum – the yield is 1100 to 1500 kg of DM per hectare, making for a capacity of 4 to 8 ha per head all the year round, except in times of exceptional flooding.

When consisting of spontaneous sorghum, the yield is 4000 to 4450 kg. Because of flooding this species cannot be grazed in the wet season, but in the dry season it affords a capacity of 0.6 ha per head. Livestock also graze the green regrowth after burning and browsing.

When consisting mainly of Eriochloa fatmensis, the yield is 3000 kg of DM per hectare and the pasture can be used in the dry season when the waters begin to subside, that is in early January. The production is almost entirely grazed and some aftermath may occur. For the 5 dry season months the capacity is 0.6 ha per head.

The grass savanna of the Yaérés, consisting of Hyparrhenia rufa, yields 4000 kg of DM per hectare making for a capacity of 1.7 to 2.5 ha per head in the dry season if we assume the straw to be palatable. Actually it seems wiser to take into account the regrowth after burning that yields 350 kg of DM per hectare, giving a capacity of 2.1 ha per head in the period of utilization, that is the 4 dry season months.
The various species (gramineae-cyperaceae) growing on the fringe of the lake yield between 1500 and 3000 kg of OM per hectare.

This pasture can be grazed all the year round, for the green fringe follows the rise and fall of the water. We can settle on a capacity of 3.5 ha per head.
<table>
<thead>
<tr>
<th>TYPE OF PASTURE</th>
<th>YIELD kg/DM/ha</th>
<th>CAPACITY</th>
<th>QUALITY AND CONSTRAINTS</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formation of the Yaeres fringe</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H/AC</td>
<td>4000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H/AS (GC 19)</td>
<td>&gt; 4450</td>
<td>0.6 D5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H/ME (GC 19)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H/ME (GC 20)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H/V/AS (GC 20)</td>
<td>&gt; 4450</td>
<td>0.6 D5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H/S</td>
<td>4000</td>
<td>1 to 2 D5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H/ME</td>
<td>3000</td>
<td>4 TCC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H/PK</td>
<td>1500</td>
<td>8 TCC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hs/AB (GC 17)</td>
<td>550 - 1100</td>
<td>3.3 Ws; 4.3 D5; 8.4 TCC</td>
<td>ML/IM</td>
<td>Some little-flooded pastures can be grazed virtually all year, with 4 ha per head. Those with annual wild sorghum are utilizable in dry season with 0.6 to 2 ha per head. Some capacity for those with Eriochloa fatimensis</td>
</tr>
<tr>
<td>Hs/AS (GC 20)</td>
<td>&gt; 4450</td>
<td>0.6 D5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formation of the Yaeres</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hy/EN</td>
<td>3000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hy/EP</td>
<td>2600 to 4000</td>
<td>1.7 to 2.5 D5 (straws)</td>
<td></td>
<td>Very good dry season pastures, as regrowth after burning, with a capacity of 2.1 ha per head during 4 months.</td>
</tr>
<tr>
<td>Hy/HE</td>
<td>350 regrowths</td>
<td>2.1 for 4 months D5 (reg.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formation on the Fringes of Lake Chad</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H/L</td>
<td>1500 - 3000</td>
<td>1 Ws; 2 D5; 3.5 TCC</td>
<td></td>
<td>Can be grazed most of the year following the subsiding water fringe of Lake Chad.</td>
</tr>
</tbody>
</table>

LEGEND: See preceding table p. 41
1. TREE AND SHRUB SAVANNA WITH ISOBERLINIA

Grass production consists of Andropogon tectorum and Diheteropogon amplexans.

The pasture yields 2000 kg of DM per hectare, and is in theory utilizable all the year round, but it seems preferable to exploit it in the wet season with a capacity of 2 ha per head.

11. TREE SAVANNA WITH AFROMOSIA

Pasture is provided by Andropogons and Hyparrheniae, with a yield ranging between 1100 and 2230 kg (in one case 3350 kg) of DM per hectare.

It can be grazed all the year round with the following capacities: 2.3 ha in the wet season, 1.8 in the dry season and 4.5 year round.

111. TREE SAVANNA WITH BOSWELLIA

Grass production consists of annuals: Aristida and Loudetia.

Yield is between 1000 and 2230 kg of DM per hectare. These pastures could in theory be grazed all the year round, with the following capacities: 2.3 ha in the wet season, 1.8 in the dry season, 4.5 ha year round.

But the optimum period of utilization is still the wet season, with a capacity ranging from 2 to 3 ha per head.

IV. SAVANNA WITH ANOEISSUS AND BOSWELLIA

As in the preceding case, the pasture consists of annuals
<table>
<thead>
<tr>
<th>TYPE OF PASTURE</th>
<th>YIELD</th>
<th>MOUNTAINS AND REGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savanna with Isoberlinia</td>
<td>100 - 2 230</td>
<td>Suitable for wet season (2.3 to 3 ha per head)</td>
</tr>
<tr>
<td>Savanna with Acacia</td>
<td>100 - 2 230</td>
<td>Suitable for wet season (2.3 to 3 ha per head)</td>
</tr>
<tr>
<td>Savanna with Boswellia</td>
<td>100 - 2 230</td>
<td>Suitable for wet season (2.3 to 3 ha per head)</td>
</tr>
<tr>
<td>Savanna with Anogeissus</td>
<td>100 - 2 230</td>
<td>Suitable for wet season (2.3 to 3 ha per head)</td>
</tr>
<tr>
<td>Savanna with A. hockii</td>
<td>100 - 2 230</td>
<td>Suitable for wet season (2.3 to 3 ha per head)</td>
</tr>
</tbody>
</table>

**LEGEND:** See preceding table p. 41.

**COMMENTS:**

- Preferably utilizable in wet season with a capacity of 2 ha per head.
- Can be grazed all year with a capacity of 2.7 to 4.5 ha per head.
- Because of their composition, it is better to utilize them in wet season (2.3 to 3 ha per head).
- Also to be used preferably in wet season (2.3 to 3 ha per head).
- Also to be used preferably in wet season (2.3 to 3 ha per head).
(Loudetia-Aristida), with the same yield and the same grazing conditions.

V. SAVANNA WITH ACACIA MOCKII

This pasture also consists of annuals (in Chad and Cameroon). Yield is the same with the same grazing conditions.
NOTE CONCERNING THE FORESTRY MAP

The forestry map included in this report is based on the detailed cartography of vegetation.

From North to South we can distinguish three great ecological zones corresponding to three climatic zones and three well-defined types of vegetation.

1. Sahelian zone, Sahelo-Saharian climate, thorn steppe (mainly Mimoseae)
2. North Sudanian zone, Sahelo-Sudanian climate, tree savanna with Combretaceae
3. South Sudanian zone, Sudano-Guinean climate, woodland with leguminosae

Within those zones we thought it necessary to mention the areas that prove unsuitable to any kind of forest exploitation because of:
- climate (North zone, desert)
- soils
- farming

Those zones must be clearly pointed out so that no forest activity should be tried there whatever the reason.

1. THE SAHELIAN ZONE

The tree vegetation in this zone generally appears as a thorn steppe with the following main species:

Acacia raddiana
Acacia seyal
Acacia senegal
Balanites aegyptiaca
Commiphora africana
On stream banks, the formations are closed, especially those based on Acacia nilotica.

Forest utilization in this zone takes the following forms:
- dead wood picking by nomadic populations (firewood)
- harvesting the gum (Acacia senegal)
and a few minor products (bark used as tan, fruit of the Belanites and doom-palm, products for pharmaceutical use etc...).
- tree and shrub browsing by livestock, either in the late dry season (cattle, sheep) or all the year round (goats, camels).
- exploiting the natural forest for supplying human concentrations (large towns) with firewood is by no means ruled out, but this should be planned. Forest developments should provide for a fencing-off period enabling the vegetation to regenerate.
- afforestation should not be contemplated, except in special cases (within towns or in zones where the water table is very close to the surface).
- Creating gum-tree groves by direct sowing, while technically feasible, involves a permanent settling of the population (an association of cultivated lands and gum-tree groves).

2. THE NORTH SUDANIAN ZONE

This zone is more distinctly a forest one. Forest utilization is more varied:
- Forest development in order to supply urban centers with firewood and charcoal
- Development of palmyra groves for the supply of rot-proof slats
- Protection and regeneration of Acacia albida in agricultural areas (natural fertilization)
- Production and regeneration of Butyrospermum paradoxum (karité) and Parkia biglobosa (nééré) in farmers' fields
- Village plantations of neem (Azadirachta indica) for embellishing the villages and supplying them with wood
- From the 800 mm isoyet downwards, industrial plantations of Eucalyptus (mainly E. camaldulensis)
- In more Southerly zones, where the harmattan gets much weaker, plantation of cashews (Anacardium occidentale) for the supply of nuts and apples
- Building of break-winds in agricultural areas

3. THE SOUTH SUDANIAN ZONE

In addition to the forest utilizations mentioned above, new possibilities appear:

- exploiting trees of the species that are likely to yield wood for carpentry and house-building. Small sawmills could be established in this area.

- in addition to the plantations of Eucalyptus, others could be created: plantations of Gmelina arborea (around the 1300 mm isoyet) and teak - Tectona grandis - (near the 1500 mm isoyet).
CARTOGRAPHIC EXPOSITION

NOTE ON THE CARTOGRAPHIC METHOD USED

Map 1: Synthesis of range-surveys

G. LAMARQUE

December 1979
JUSTIFICATION OF THE PROJECT

A cartographic synthesis of the various range-surveys done in the Lake Chad Basin was necessary in order to give a global picture of pastures in that area. What made it possible was the publication, in 1976, of a 1/500,000th cartographic cover mapping 250,000 km² of Chadian territory, thus supplementing the cartographic work done in Nigeria, Niger, and Cameroon.

The synthesis was based on 12 agropastoral surveys containing maps (some of which unpublished):

1. Sahelian pastures in the North-Gouré region (Rep. of Niger) - map to the 1/100,000th
2. Pastures of the Zinder nomadic zone (Rep. of Niger) - map to the 1/400,000th
3. Modernization of the pastoral zone in Niger (Rep. of Niger) - map to the 1/100,000th
4. Outline of the vegetal cover in Chad - map to the 1/500,000th
5. The Land Resources of North-East Nigeria - map to the 1/100,000th
6. Pastures of the Assalé-Serbewel Project (United Rep. of Cameroon) - map to the 1/200,000th
7. Pastures in South-West Chad map to the 1/100,000th
8. Hydraulic pastoral development in the Yaérs (United Rep. of Cameroon) - map to the 1/200,000th
9. Impact of drought on the Kanem - Lake pastures (Rep. of Chad) - map to the 1/500,000th
10. Agrostologic survey of the Batha (Rep. of Chad) - map to the 1/500,000th
11. Survey of the Garoua-Maroua region (United Rep. of Cameroon) - model to the 1/1,000,000th
12. Survey of the Maïné Soroa-Gouré region (Rep. of Niger) - model to the 1/1,000,000th

The various origins and authors of those documents are given in the summary folder of reviewed maps attached to this report.

THE CHOICE OF A SCALE

The nine maps already published used quite various scales, ranging from 1/200,000th to 1/1,000,000th.
A few local 1/50,000th surveys had even been done in some areas.

Bearing in mind the disparate character of the information given by aerial photographs taken in different periods and the varying degree of precision of these elements, we have chosen the 1/1,000,000th as the best mean scale possible and the most economical one for publishing.

The basic directly visible metric unit on this scale represents a 20 km by 20 km square (2 mm £ 2 mm on the map).

This allows a sufficiently precise generalization to meet the required conditions for representing the various themes of this study.

A PLURI-DISCIPLINARY APPROACH

The general agropastoral study includes various themes that had to be translated into cartographic language for publishing.

The technician then had to choose between two possible approaches:

1) make the documents more readable by publishing one map for each theme (with the same topographic background and scale)

2) avoid publishing several documents at the risk of overloading the main theme.

Taking into account the cost/quality ratio we have chosen the first course. Thus we have been led to publish four documents with the following titles:

Map 1 : Agropastoral map of the Lake Chad Basin
" 1 bis: Summary forestry map of the Lake Chad Basin
" 2 : Major migration routes of breeders
" 3 : Mobility and pastoralism gradient of breeders
" 4 : Outline of a cartography of park landscapes in the conventional Lake Chad Basin

METHOD USED FOR DRAFTING THE AGROPASTORAL MAP

At the initial stage we decided to draft a first model on a 1/1,000,000 color background derived from maps published to the same scale by IGN (Institut Géographique National - National Geographic Institute of France). This preliminary document was used to make a selection among the
various vegetal formations identified in the already published maps.

This operation enabled us to prepare a homogeneous document to the chosen scale showing all formations that could be represented in metric units. Individualization by hand-coloring of the various vegetal groups represented made that working document extremely useful to the agropastoralists who, being well-acquainted with the terrain, could integrate the necessary data for the document to be really synthetic.

Then, after extensive analysis, a classification of the represented formations was worked out, and the map legend drafted.

Through studying, then compiling in detail the factors that condition the environment (geology, pedology, rainfall, human influence etc... the authors were then able to harmonize the classification of the vegetal formations described in the previous publications. A second model was necessary for working out a final picture that served as the basis for the main color map.

THE CHOICE OF COLORS

In order to observe the coloration principles recommended by UNESCO and originating in Prof. H. GAUSSEN's works, we had to prepare a synthetic document individualizing the great climatic zones in the Lake Chad Basin. Their boundaries were drawn on a previously made model taking into account the data about rainfall and the distribution of characteristic vegetal species.

On the basis of those data the final choice of colors took place with the authors' cooperation; the color disposition brings out the main zones defined by their climatic gradient and edaphic character. Thus we have distinguished five regions:

1. Sahélo-Saharian
   - red to pink
2. Sahelo-Sudanian
   - red to orange
3. Dominant edaphism
   - orange and mauve
4. Sudano-Sahelian
   - orange to bistre
5. Sudano-Guinean
   - bistre to marron

- The 300 mm isoyet corresponds roughly to the 15th parallel (Sahelo-Saharian sector). So the main vegetal formations on sandy soils occurring north of that
line get less than 300 mm of rain a year. Therefore the base color chosen for that region is a more or less deep red, with of course a pink undertint in various percentages obtained by screening or by superimposing a net made up of a graphic pattern ("pontific").

- South of that limit we find formations on silty-sandy soils (Sahelo-Sudanian sector). Rainfall in this zone ranges from 300 to 400 mm. The base color is orange (from 100% to orange-yellow).

- Then comes a third region, in the center of the map, occupied by formations on hydromorphic soils (yaérés, Logone-Charî interfluve). Most of them have a more or less marked hydromorphism, that has been identified by a coloration based on blue, superimposed on the tints of neighboring formations.

- South of that zone, rainfall ranges from 400 to 1,000 mm and we find formations with higher densities of ligneous species represented by tints varying from light bistre to dark bistre (Sudano-Sahelina).

- Finally the South of the map is occupied by the Sudano-Guinean zone that gets more than 1,000 mm of rain a year. This is represented by tints ranging from dark bistre to marron.

We must bear in mind that some steep reliefs (often higher than 1,000 m) are subject to a particular rainfall system. This feature of the ecology is shown by a special screen with a criss-cross pattern.

It is worth pointing out, too, that this individualization according to zones does not rule out the possibility of representing some localized elements based on edaphic conditions, such as Tropical red soils south of the map, Hydromorphic soils south of Lake Chad or in the Lâl plain.

This color arrangement enables users to see things from a general stand-point, to evaluate the extent of some exploited areas compared to others, to grasp their geographical distribution.

EXPLANATION OF THE LEGEND

The published agropastoral map uses seven colors to distinguish nearly 130 formations distributed according to the six climatic sectors.
reviewed, with the following indications:

1. pedologic or geomorphologic nature
2. name of the most common woody species, followed by the most common graminea. The ligneous species is always mentioned before the graminea, except in some cases where the graminea alone is mentioned.

Each formation, in addition to its characteristic color, is symbolized by initials made up of 4 letters at most.

The first one indicates the nature of the soil (capital); the second one the geomorphology (small letter).

A bar separates those from the initials standing for the most common vegetal species, tree or shrub being given first.

Example: So/SA =
Sable des ondulations du Koutous à / Acacia senegal et Aristida mutabilis (Sand of the Undulations of the Koutous with Acacia senegal and Aristida mutabilis).

The various vegetation groups have been arranged in chapters according to a classification based on the great climatic zones from the driest to the dampest one.

CONCLUSIONS

This document is also intended for planners to whom it offers general information about the distribution of pastoral resources.

It also enables to put in a general perspective the local surveys already published, while gathering the necessary data for determining the impact of new factors if any.

This map can also give precise quantitative information on the size of the represented areas and may thus be of some help to statisticians.

The forestry map

This document has been produced by the specialists of the Centre Forestier Tropical (Tropical Forestry Center) on the background previously drafted for the agrostological map of the I.E.M.V.T. (Institute of Stock-breeding and Veterinary Medicine in Tropical Countries).
It brings out the main forest utilizations according to the great climatic zones, and appears as a first step towards an inventory of forests within the Lake Chad Basin.

The map has been produced in two colors.

The agrostological legend has been retained in order to remind users of the meaning of the initials standing for non-ligneous vegetation. A second legend specifically concerning forestry should enable them to identify the various forest formations together with their gramineous environment.
SECOND PART

THE HUMAN ENVIRONMENT
AGROPASTORAL SYNTHESIS OF THE LAKE CHAD BASIN

PASTORAL MAPS

MAP COMMENTARIES

11 "MAJOR MIGRATION ROUTES OF BREEDERS"

111 "MOBILITY AND PASTORALISM GRADIENTS OF BREEDERS"

by JC. CLANET with the collaboration of CH. BOUQUET and CH. SEIGNOBOS
MAP OF THE REGIONS COVERED IN THE AUTHORS' COMMENTARIES

Ch. Bouquet
J.C. Clenet
Ch. Seignobos

1. NIGER
2. LAKE CHAD
3. CAMEROON
The purpose of the two maps which accompany the agrostological analysis of the conventional Basin of Lake Chad is to indicate the dynamics of the present-day utilization of the grazing lands in those regions.

Map 11, entitled "Major Migration Routes of Breeders" illustrates the mobility of pastoralists at the administrative area, county, division or sub-county level, or even at the district level as the case may be. The itineraries indicated on the map by means of arrows do not represent a synthesis of the regional movements as a whole but, instead, a precise localizing of the range as well as the direction of the annual movements of herds belonging to the human groups which we deemed the most representative for that purpose. In addition, the signs included in the legend of the map provide indications on the duration of camp at the outermost limits of the camp-site areas, the time of year during which movements take place, the agricultural occupations of the migrating group if appropriate, and the type of habitat used.

Map 111 combines two kinds of information: firstly, the half-tone screened background indicates once again the mobility of stock-men by classifying them into four different categories: "fully-nomadic pastoralists", "semi-nomadic pastoralists", "partially settled pastoralists", and "sedentary pastoralists". Secondly, the cartogram, based on the administrative divisions, presents the various groups involved according to the extent of their pastoral activities. The circular diagrams used for that purpose indicate here again the existence of four different types of agro-pastoral situations, as follows: "Pastoralists", "Stock-Breeders", "Breeder-Cultivators", and "Cultivator-Breeders". This classification system has been established according to the importance of breeding activities in each case, therefore, all other subsidiary activities, if any, were not, voluntarily, taken into account.

The boundaries of the Conventional Lake Chad Basin happened to match those of our scholarly research project in Chad, Niger and Cameroon. The summary presented here is the result of long years of observation, whereas this is not the case as far as Nigeria is concerned; there, we have had to be content with the material available.

---

Users of these maps must also bear in mind that the 1/1 000 000 scale does not allow for the representation of all regional complexities. Major features alone are indicated.

Lastly, the commentaries accompanying these maps attempt to report on specific facts, observed at first-hand, rather than give a general overview of the various regions of the Lake Chad Basin.

The maps have been drawn by Jean-Charles CLANET, at the Farcha Laboratory in N'Djaména. All necessary data concerning the peripheral area of Lake Chad and its archipelago were provided by Christian BOUQUET who kindly consented to present them and to bring them up-to-date in the form which we specified. Christian SEIGNOBOS undertook the task of covering the entire south-western quarter of Chad involved in the project, in addition to practically the whole of Northern Cameroon, where he agreed to carry out numerous assignments. The remaining area of the conventional Basin was covered by Jean-Charles CLANET.

It must be added that much information concerning Nigeria was not available. In particular, none, or almost none, of the numerical data or of the percentages of population in each district were obtained. This serves to explain that the cartography for this part of the conventional Basin merely constitutes an indication and cannot be considered as anything more than a very approximate estimation.
AGROPASTORAL GROUPS ON THE SHORES OF LAKE CHAD

AND ON ITS ISLANDS

CONTRIBUTION TO THE AGROPASTORAL REVIEW OF THE LAKE CHAD BASIN

by Christian BOUQUET

Assistant Professor of
Geography

University of Chad

N'Djéma - June 1978
In 1975, the population inhabiting the area corresponding to the Lake Chad Basin stricto sensu (fig. 1) numbered approximately 850,000 persons, nearly 600,000 of whom were located on the Nigerian side of the lake alone. This initial figure draws attention to the diversity of forms which spatial occupation of the land can take when analysed from the point of view of agro-pastoral situations.

The highest density of population is found in the southwest of Lake Chad, in the Nigerian province of Bornu, where it corresponds to the lowest density of live-stock. The reverse takes place on the north-eastern bank of the lake, in southern-Kanem and more particularly so on the islands where a number of typical pastoralist situations may be found. Further South, the lower-Chari region, peopled with Choa Arabs, may be qualified as an area of seasonal mobility even if it does not present the same aspects altogether, having been created by stock-breeders only recently sedentarized.

We have based our description of the pastoral situations in the various rural societies concerned on J. GALLAIS' mobility and pastoralism scale (1) and we have selected the ethnic group as our unit of investigation. The general approach we have taken follows that of "the geography of the actual" (2) (Géographie du vécu) in as much as no one may be in a better position than the shepherd himself to describe his movements or better motivated than the live-stock owner to indicate the importance of breeding in relation to his other activities. Accordingly, we have classified the island Buduma among the breeders and, by the same token, have situated the Suhurti group on the fringes of the Kanembu population.

The table below shows the numerical data derived from the surveys which we have conducted in all of the counties, sultanates, lawanates and administrative districts of the four countries in our research area (table 1) between 1972 and 1978. We have averaged out all of these data to the year 1975 by means of a system of estimates, projections, and random checks. We have not indicated the ethnic distribution in the Ngubio, Nganzie or Ran district on this table as we considered the results of our research on these groups to differ too widely from the truth. The various Fulbe groups which move around Lake Chad are also partially represented only, in the last column of the table, as they are either registered outside this particular zone or not registered at all.
While the Gallais double-scale, typological system may be represented perfectly well on a single map through a judicious combination of its symbols, it was nevertheless preferable to select one or the other of these criteria to prepare the explanatory notes. We have therefore conceived these notes around the primary activity (agriculture, live-stock breeding), it being understood that this activity is seldom an exclusive one and that the mobility of the live-stock (and, all the more so, of the populations involved) remains a very limited one.
Fig. 1

AREA OF STUDY

0 30 60 90 km

Limits of the study area
Bouquet May 1978
<table>
<thead>
<tr>
<th>S/P</th>
<th>Population 1975</th>
<th>Kanuri</th>
<th>Kanembu</th>
<th>Arabs</th>
<th>Buduma Kuri</th>
<th>Mobber</th>
<th>Kotoko</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nguigmi</td>
<td>18 890</td>
<td>1 858</td>
<td>9,8%</td>
<td>4 631</td>
<td>24,5%</td>
<td>8 671</td>
<td>45,9%</td>
<td>3 730</td>
</tr>
<tr>
<td>NOBBER (Damasak)</td>
<td>92 534</td>
<td>4 400</td>
<td>4,8%</td>
<td>37 900</td>
<td>40,9%</td>
<td>50 234</td>
<td>54,3%</td>
<td></td>
</tr>
<tr>
<td>District</td>
<td></td>
<td>92 534</td>
<td>4 400</td>
<td>37 900</td>
<td>50 234</td>
<td>74,6%</td>
<td>6,8%</td>
<td>3,3%</td>
</tr>
<tr>
<td>KANEMBU (Kuka)</td>
<td>103 755</td>
<td>31 777</td>
<td>29,8%</td>
<td>63 313</td>
<td>62,1%</td>
<td>3 000</td>
<td>2,8%</td>
<td>2 500</td>
</tr>
<tr>
<td>District</td>
<td></td>
<td>103 755</td>
<td>31 777</td>
<td>63 313</td>
<td>2 500</td>
<td>72,3%</td>
<td>8,1%</td>
<td>2,0%</td>
</tr>
<tr>
<td>MONGUNO District</td>
<td>104 541</td>
<td>78 005</td>
<td>74,6%</td>
<td>26 536</td>
<td>25,4%</td>
<td>676</td>
<td>1,3%</td>
<td>3,2%</td>
</tr>
<tr>
<td>MARTE District</td>
<td>33 187</td>
<td>458</td>
<td>1,4%</td>
<td>25 435</td>
<td>76,6%</td>
<td>3 124</td>
<td>9,4%</td>
<td>4 170</td>
</tr>
<tr>
<td>NGALA District</td>
<td>53 626</td>
<td>41 701</td>
<td>77,8%</td>
<td>460</td>
<td>0,9%</td>
<td>8 999</td>
<td>16,8%</td>
<td>676</td>
</tr>
<tr>
<td>S/P MAKARI</td>
<td>87 636</td>
<td>7 299</td>
<td>8,3%</td>
<td>45 391</td>
<td>51,8%</td>
<td>179</td>
<td>0,2%</td>
<td>3 028</td>
</tr>
<tr>
<td>S/P NDJAMENA (3 cantons)</td>
<td>33 187</td>
<td>458</td>
<td>1,4%</td>
<td>25 435</td>
<td>76,6%</td>
<td>3 124</td>
<td>9,4%</td>
<td>4 170</td>
</tr>
<tr>
<td>S/P N'GOURI</td>
<td>50 360</td>
<td>135</td>
<td>0,3%</td>
<td>32 540</td>
<td>64,6%</td>
<td>199</td>
<td>0,4%</td>
<td>7 802</td>
</tr>
<tr>
<td>S/P BOL</td>
<td>60 442</td>
<td>607</td>
<td>1,0%</td>
<td>22 922</td>
<td>37,9%</td>
<td>146</td>
<td>0,2%</td>
<td>35 387</td>
</tr>
<tr>
<td>SUB-TOTAL</td>
<td>689 248</td>
<td>226 014</td>
<td>32,8%</td>
<td>167 720</td>
<td>24,3%</td>
<td>120 624</td>
<td>17,5%</td>
<td>50 999</td>
</tr>
</tbody>
</table>

**Table 1:** Ethno-demographic distribution in survey area
1. PASTORALISTS

In the hinterland of Lake Chad, except for occasional incursions in the northernmost tip of our survey area on the part of Arab or Goran populations, only few people are found who rely for their subsistence on their herds alone. The Fulbé, those "thin-legged migrants" of whom SENGHOR speaks, are the only true fully-nomadic pastoralists in the area. They are difficult to sight and difficult to approach. Further research will have to be undertaken if their movements are to be better known; for our part we are able to supply indications only concerning their movements in the Bornu region, plus a case-study on the subject in the lower-Chari district.

The Fulbé populations of the Bornu have never been registered. They do not appear on the 1963 census, neither were they accounted for separately during the 1973 national survey whose figures, obviously inflated, have not been published. Their movements may be traced, however, along a North-South axis, west of the Kuka-Nonguno meridian. Their passage can be ascertained most notably through the land-fires which they set during the November-December months in order to stimulate a regrowth of green grasses. They roam far away from busy routes and have little contact with the Kanuri. Occasionally, they are forced to come down all the way to Owoza at the peak of the dry-season subsequently to return to Komadugu Yobe during the rains. The range of their movements may at times extend over 300 kilometers.

They stop for rest camps in numerous places in the course of an annual cycle; at such times, their habitat is a very light one, often made up of simple, wood-sticks shelters which protect their bed.

Their herds are very important in size, exceeding 60 heads per family-chief and being solely made-up of Bororo Zebus, recognizable by their red coat and lyre-shaped horns. However, it constitutes a non-productive wealth as the Fulbé heads are very seldom used for the supply of meat to the Bornu townships.
- The example of the Hadidé' camp sites, located at the mouth of the Chari river, corresponds to a westerly-easterly movement but with rather long stops in between (fig. 2). Here we have pastoralists of the Fellata Gesutji group where each family-head possesses approximately 50 heads of cattle. For the last eight years, they have been moving between Karmé and Hadide. During the rainy season, they camp down near Karmé, then move camp small distances until they reach the mouth of the Chari river where they are certain of finding grass even at the height of the dry season. As soon as the rains threaten to flood the banks where they have set up camp, they move back along the eastern route, occasionally descending first toward Dugia. Like the Choa Arabs, they have tents made out of matting; they engage exclusively in breeding activities, feeding on milk and exchanging their butter and oil against millet when they encounter other groups.
Fig. 2

MOVEMENTS OF THE HADIDE FULBE
(camp-sites)

Bouquet June 1978

University of Chad Drawn by Hienmouya K. Labo Carto 9/8/78
Faculty of Letters and Social Sciences
These small Fulbé groups have more frequent contacts with the sedentary villagers. Violent quarrels occasionally arise on account of grazing rights. The Fulbé are also much sought after by the cattle merchants from N'Djaména or from Maiduguri, so that they succeed rather easily in disposing of their unhealthy animals, whether in Chad or in Cameroon.

The majority of the Lake Chad Basin Fulbé "follow the grass" year round. Their long migrations are difficult to follow and their itineraries are not readily divulged, either because in their wanderings they find themselves crisscrossing political boundaries or because they are passing through territories inhabited by ethnic groups who do not look favorably upon their moving through. Every year since 1969, we have met the same members of a Peul tribal group who practice nomadism between the regions of Rig-Rig, Liwa, Bega-Sola, Bol and Isseiroum; and yet they are never to be found at the same place at the same time of year, are very evasive when questioned about the area they have just traveled through, and do not seem to have a clear idea as to the direction they will take next. "Peuls are proud...as soon as they rise, picking up their sticks, they go watch their herds..." (3).

11. BREEDER-CULTIVATORS

We have included in this category the rural societies which consider live-stock rearing as their chief activity. Much less mobile than the Fulbé but as much attached to their herds are the Buduma of the islands of Lake Chad and the Choa Arabs of the lower Chari river. Neither the Buduma nor the Arabs engage exclusively in breeding (pastoralists) but this particular activity does leave an important mark on their socio-economic environment. In former times, they were most probably true pastoralists who settled down progressively as a result of the type of evolution which may be observed at present in the Fulbé populations of Tumur.

- The Buduma constitute the only ethnic group whose entire territory is contained within the area under study. One is reduced to conjecture as to the origins of the Buduma; however, it is at least certain that they
used to inhabit the islands of the lake before the arrival of the Kanembu, whose language they have not adopted. Fiercely opposed to any sort of influences, they embraced the Moslem religion less than a century ago and that very superficially so to this date. They are generally little known by research scholars.

For a long time, it was believed that the Buduma were primarily fishermen because one could observe them in their dugouts, plying the open waters of the lake, and selling dried fish on the Kotoko markets. On the other hand, the size of their herds, in former times essentially 'made-up of Kuri bullocks, suggested a certain form of boomania; after all, a number of Buduma claim to be of Peul origin... (4)

As a matter of fact, these islanders are at once fishermen, livestock breeders, and even cultivators, particularly on the fringes of the islands where the waters have receded. Each of these activities is, however, assigned to a specific age group to carry out, as the age-pyramid established by a recent study on the villages of Kóremiron and Gambaru clearly demonstrates (5) through a strongly accentuated dip which may be seen for men between 10 and 35 years of age. From the age of 10 to 12 years to that of 18 to 20 years, young men watch over the family herds in the southernmost islands, which are the most verdant ones as they have been more or less completely flooded by the annual rise of the waters. After that period, they become autonomous and throw themselves into extensive fishing expeditions whose product will serve to purchase cattle for the constitution of a dowry. More often than not, they must wait until thirty years of age to obtain satisfaction, that is, a wife and the first elements of a herd. They then settle down in their native village where they devote their time to agricultural pursuits, entrusting the younger men with the task of guiding the herds from island to island in search of pastures.

The average size of Buduma herds is from five to eight heads of cattle per chief of a family, i.e. restricted to immediate relatives. However, fifty-year old men married to several wives frequently own from 25 to 30 animals. The Gambary village herds are kept on the island of Yakoura itself (fig. 3) during the rainy season. They do not return to the village and they are kept away from the millet plantations. After having grazed "fresh
grass", during the September-October period, they graze "dry grass" or millet stubble. Subsequently, they slowly make their way down under the guidance of young herdsmen towards the Kaya Peninsula, crossing the lake's arm to reach Ngouya, and arriving on the Island of Ngara, which the Yakoua and Koremirom clans share between them, at the peak of the hot season. The first rain showers subsequently cause rather meagre grass coverage to appear on the sands of the islands and the herds are driven back in the space of a few days to Yakoua where all hands are needed to carry out the sowing of millet.

The Gambaru and Koremirom cases constitute fairly good examples of what is happening in the Sol archipelago as far as agro-pastoral activities are concerned: during the dry season, fairly sizeable herds move over distances of between twenty to twenty-five kilometers, along a Northerly-Southerly route; these movements take them from one island to the other within the territory controlled by the clan. The main village is generally located on the island nearest to the shore of the lake. The animals, which belong to the Kuri race but are heavily cross-bred with Bos Indicus, are well-fed, thanks to pastures from which flood-waters have receded, and they show good resistance to parasites and insects. They are nevertheless susceptible to diseases such as peripneumonia, as they are not often reached by the inoculation campaigns undertaken.

- The Choa Arabs occupy the whole of the region located South of Lake Chad, from the Southern-Oriental horn of the lake to Monguno, in the Bornu area. They dwell in circular villages (6) whose round, straw-huts cannot be mistaken for those of the Kotoko, of the Chari river, or for those of the Kanuri who inhabit the back-country of Maidiguri.

They are the most recent inhabitants of the region: the earliest ones arrived less than 3 centuries ago (7) and live in the Bornu area, in the Kotoko sultanates of Serbewel where, even though they constitute the majority, they do not hold the chieftaincy. The subsequent ones arrived little by little while the last ones did so at the beginning of the century. They primarily inhabit the right bank of the Chari River. The Choa Arabs are divided into multiple fractions but retain a very homogeneous way of life based on live-stock rearing.
OPEN WATERS
LAKE CHAD

Villages of Gambaru and Koremiron
Cattle movements during the hot season

Faculty of Letters
University of Chad - and Social Sciences

Bouquet April 1978 Fig 3

drawn by HIENMOUYA K.
Nowadays, Arab village sites are permanently settled: in 1975 we counted 135 permanent installations east of the El-Seid River and on either side of the Chari River, inside the perimeter of the research area; these villages numbered approximately 10,000 inhabitants in all. These sedentarized Arab populations devote part of their time to agriculture. They chiefly grow sorghum on flood-retreat vertisols during the cooler season. They have not as yet fully mastered this particular activity and a large number of them continue to store the grain after harvesting in silos dug out of the earth, near their dwellings, as if the threat of pillaging invaders still existed. Nevertheless, they remain breeders before anything else and the more nomadic among them may own herds numbering 10 to 15 heads per family chief.

During the rains and the cooler season, the herds, which are essentially made up of Arab zebus are driven back to the village every night. They are kept together in a central pen, blanketing it with a thick layer of dejections which remain unused for fertilization. They are given shelter in huts whenever there are too many insects or whenever it rains. However, as soon as the harvest of the flood-retreat sorghum crop is gathered, the villages are abandoned and the entire population moves off to areas richer in pastures, that is, either the areas subject to flooding which are not occupied by others or the prairies from which Lake Chad has withdrawn (fig. 4). There they find not only herbage but also water at a lower depth. A number of them, most notably within the Asalé group, the Missirié and the Ulâd-Himet, take up nomadic habits again such as the erection of straw-matting tents. Others content themselves with improvised shelters made out of straw and imitating the shape of a round hut. Practically all of the furniture is taken along on the trip.

Dry-season camp sites are not assigned in any permanent fashion but villagers usually come back to the same dried-up pond or backwaters of the lake or of the river. Those who possess tents may shift camp sites two to three times during the dry-season, especially when a climatic crisis occurs.

Not all Choa Arabs of that region are involved in this type of movement with temporary dwellings. It is mainly prevalent East of the Chari River, among those who have recently become sedentarized and who have only the poorest lands at their disposal. The others have the use of the better plots which supply them with nearby pastures, so that their herds come back
to the village every night.

- **Tumur** (Fig. 5) is a large pond whose circumference exceeds five kilometers. For many years now, it has been filled by rains only. In former times, it was connected to the Komadugu-Yobé which supplied it with a certain amount of water.

At the time of colonisation, the village of Tumur, situated on the dune at the South-Western edge of the pond, was peopled with former captives from Kanuri. It was turned into a central gathering point for the Fulbé and several elderly men, more or less tribal chiefs, settled down there. The same is true of the Koala well area, 30 kilometers north-west of Tumur.

Approximately 4,000 Fulbé belonging to the Behaye, Abalankwe, Tuntumenko and Bibedenke clans are included in the Tumur census but in reality very few of them live there permanently. The whole of the Fulbé population is perpetually on the move; they travel by small groups comprising five to eight families each within a radius of 15 to 30 kilometers around the pond. Since the recent drought, they possess less cattle than goats but the average cattle herd may still number up to 20 heads per family chief.

The 1969-73 drought has, in fact, noticeably modified the Fulbé way-of-life in this region of the Kadzel. A number of them have tried to graze their herds on the Nigerian pastures of the South but the obstacle constituted by the Mobber gardens next to the Komadugu-Yobé River has frequently repelled them. Taking advantage of the ancient relations of dominânce which they enjoyed over the sedentary populations of Tumur and of the neighboring villages, they progressively took up dune cultivation which they practice during the rainy season and even more flood-retreat cultivation which they carry-out at the edge of Lake Chad during the cool season. For the cultivation of rain millet, adults alone remain behind in one of the settled villages; children, a few old men, and the majority of women continue to drive the herds about in the vicinity. At the time of the flood-retreat cultivation of sorghum, the entire Fulbé population gathers on the shores of the lake. At the height of the dry season, many live-stock men return once again to the Kadzel or make their way to Nigeria. However, some of them are beginning to appreciate the permanently green pastures of Lake Chad over which their new status as cultivators has given them certain rights.
MOVEMENTS OF THE ARABS OF THE LOWER-CHARI

Legend:
- Flood-prone zones
- Trails

Bouquet May 1978 Fig 4
Fig. 5

MOVEMENTS OF THE SUHURTI AND OF THE FULBE

- Lake pastures
- Flood-retreat fields
- Trails

Bouquet May 78
Can we infer a hypothesis on the sedentarization process undergone by the nomadic societies of Pastoralists out of these three examples? A number of the responses which the recent climatic crisis has given rise to would seem to go against the theory according to which this type of natural catastrophe causes the abrupt sedentarization of nomadic populations. In fact, some Budumas undertook the crossing of Lake Chad — partially dried out in its entirety, to provide their herds with sufficient pastures. Certain Choa families did not leave their tents for two whole years. The evolution towards settlement seems nevertheless as highly irreversible as the political and economic authorities of the countries concerned consider it desirable.

III. THE CULTIVATOR-BREEDERS

Traveling all around Lake Chad along the shores and beginning on the north side, one primarily encounters Kanembu villages; they are easily identified by the shape of their straw-huts which resemble a hooped skirt (crinoline). Between Kuka and Kouloudi, and except for the Mobber barrier of the Komadugu-Yobé River, the Kanembu population numbers nearly 170,000 (not including the Kanem prefecture). South of the River Komadugu, the Kanembu may be assimilated with the Kanuki because of their similar language and way-of-life. On the contrary, to the north and all along the shores of the Lake, they constitute an example of agro-pastoral situation rather infrequently encountered in the region: they are cultivator-breeders.

On the average, the Kanembus possess 2 or 3 heads of live-stock per family chief; however, the last drought has resulted in a high number of losses. The Kanembu are interested in animal rearing in so far as it is beneficial to their agriculture; indeed, they fertilize their dune plots with the manure. To accomplish this, they simply drive the herds back to the villages every night. The cattle is then gathered in small groups around open fires whose smoke repels insects. Goats are tethered to sticks or penned in a zeriba, (or pen fenced-in with thorny shrubs). The association between animal husbandry and agriculture stops here; there is no animal-drawn cultivation. However, the abundance of manure at the end of the dry season makes possible the avoidance of fallowing in a region where annual rainfall measures less than 30 mm. Those Kanembu who do not own any live-stock occasionally enter into manuring agreements with their neighbors.
After crops have been harvested, the animals are left to graze out in the fields where they chew on the millet stalks, to be taken afterwards to more remote spots, some five to eight kilometers away. If there is a wadi in the village, its moisture serves to maintain a sufficient herbaceous cover along the edges of the crop area. If not, the cattle is driven to the shores of the lake during the dry season. However, such movements never exceed 10 kilometers in length and they are undertaken on a daily basis: every night, the herd is taken back to the village.

Even though there are several dozens of natron-containing wadis along the South-Kanem shore, the live-stock is never taken to one of these for its salt cure; the water from the village wells is completely suitable for that purpose and, if need be, several pieces of natron, the purchase of which is an easy matter here, may be dissolved in the cattle's drinking-trough.

While the mobility of these populations appears to be very limited, there does exist a constant factor which we have been able to observe, and that is that the villagers remove their herds from the shores of the lake during the rainy season, if possible, to protect them from insect bites. A large proportion of their cattle is composed of Arab Zebus, much less resistant than the Kuri bullocks of the Budumas. During the drought years, many animals died because of disease rather than from hunger or thirst, because they had been driven up to the lake-side at the wrong season.

The Kanembus might be considered occasional breeders as they doggedly cultivate their dune plots and keep up their wadi-fed gardens. In fact, this is not the case at all: the smallest profit derived from their wheat or wadi-irrigated millet crops is reinvested in the herd. In the course of a survey on income, it became apparent that to increase the size of their herds in order to better manure their fields is the utmost desire of the great majority of the Kanembus (8).

The Suhurti constitute a fractional Kanembu group whose way-of-life differs significantly from that which we have just described. Imitating in that the Kanembu Kuki of the northern horn of the lake, they take their
herds of cattle on true, seasonal-transhumance trips. After the harvest of the dune-grown millet, the villagers of Ali-Kukuri (fig. 5) allow the herds to graze on the stubble. They then entrust the cattle to young herdsmen who take them along the backwaters of Lake Chad where it seems that they possess reserved sites: Gadeirom, Djara, Dandalla, Kumudo-Kurerom, Kanu-Ngurbu, etc ...(9). When the rains come, they come through the village again on their way away from the lake shores towards the wadi and ponds of Tchunkaori, Bula-Kru, Ouerram-Djeguli, Yila, Choe, etc. This system is not exactly identical with that practiced by the Burumas who move off continuously from the village. With the Suhurti instead, herds remain away during a great number of weeks but contacts with the shepherds guarding them are frequent, if only to collect the milk, butter, and oil which will later be sold on the markets of the shore.

In this case, the mobility of the herds does not permit the manuring of fields and millet yields are lowered in proportion. The deficit is compensated in part by the harvest of flood-retreat crops, and especially by the sale of animal husbandry products.

IV. THE CULTIVATORS

It is between Monguno and the Komadugu-Yobe river that the large agricultural area where live-stock breeding activities take on a definitely separate character, is situated in Northeastern Bornu. There, herds are in the hands of the Fulbé who move along migration corridors usually well delimited by the Kanuri.

The Kanuri are the dominant ethnic group. They are relayed to the North of Kuka by Kanembu, who form the majority in the two districts of Northern Nigeria, but whose way-of-life is much more akin to that of their Kanuri neighbors in Bornu than to that of their Kanembu kinsmen of Niger and Chad.

Indeed, neither the Kanuri nor the Kanembu of the Bornu region have
practically any cattle to speak of. They possess only a few sheep and goats. The lack of manure does not seem to affect them as they enjoy the most favorable climatic conditions, with an average annual rainfall measuring between 500 and 600 mm, and with their clayey-sandy soils being richer than those of the Kanem on the Southern-Manga dunes. As a result, they prefer to cultivate sorghum rather than millet but they also grow corn, ground-nuts, beans, and occasionally cotton.

These rural societies are made up of true cultivators, whose exclusive activity is an agricultural one. Their sedentarization dates back a considerable time; they inhabit villages where their dwellings are made out of banco. According to the scale devised by J. GALLAIS, they are situated at the very opposite of the Fulbé pastoralists, as can be seen from table n° 2 below.

<table>
<thead>
<tr>
<th>Pastoralists</th>
<th>Full-time Nomads.</th>
<th>Semi-Nomads</th>
<th>Partially Sedentarized</th>
<th>Sedentary</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bornu Fulbé</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hadidé Fulbé</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Live-stock Breeders</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breeder - Cultivators</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Choa Arabs</td>
<td></td>
<td>Buduma of the</td>
<td></td>
</tr>
<tr>
<td></td>
<td>of the lower</td>
<td></td>
<td>lake’s islands</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chari River</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultivator - Breeders</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nigerian Suhurti</td>
<td></td>
<td>Kanembu of</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lake Chad</td>
<td></td>
</tr>
<tr>
<td>Cultivators</td>
<td></td>
<td></td>
<td></td>
<td>Bornu Kanuri</td>
</tr>
</tbody>
</table>

Table n° 2 : mobility and pastoralism scale
- The Mobber and the Kotoko's choice of habitat is their conspicuous common feature: they inhabit the banks of the Chari and of the Komadugu Yobé Rivers. As far as the rest, the resemblance between the two groups does not go any further; the Kotoko are most probably the oldest occupants of the Chadian basin, indeed they are thought to descend from the legendary Sao. For a long time they specialized in fishing activities, however, at present, they primarily occupy themselves with the flood-retreat cultivation of sorghum. The Mobber on the other hand can probably claim a very distant relationship with the Kanuki captives, even though this hypothesis has been contested. They cultivate their gardens in the valley of the Komadugu river where they have contributed to the development of rice-growing.

There does exist, however, another common point between the Mobber and the Kotoko: they rather like to invest part of their monetary income in cattle buying. They then entrust their herds to their neighboring herds- men: Choa Arabs in the case of the Kotoko, Fulbés in that of the Mobber.

In this manner the Kotoko of the Wulki region enter into agreements with the Arabs of the neighboring villages, the keeper retaining the milk for himself while the owner enjoys the natural increase in stock. The Kotoko tend to divide their herds among several keepers in order to increase the possibilities of avoiding both taxes and epizootic incidents.

This type of agro-pastoral situation, the fourth we have examined, introduces a nuance in the evolutionary pattern previously sketched out. Although it is true that the general tendency for the nomadic, full-time breeders is to sedentarize and to begin to cultivate on a small scale, a revival of interest in herding has nevertheless been observed among the rural societies most anchored to agriculture. The motivations involved may have to do with a spirit of "revenge" on the part of the former Mobber captives or yet again with the necessity of producing a dowry in kind for cross-ethnic marriages, notably with the Arabs. To be able to manage this development, one should focus on the possibility it affords to compensate for the decline of the pastoralists' way of life by integrating animal husbandry with agriculture, as the experiments with live-stock fattening conducted in Bol and in the Chari river delta encourage us to do.
If we have, on the whole, concentrated our paper on the category of Breeder-Cultivators (Buduma, Arabs, a few Felbé groups) even though they represent only 25% of the populations involved, it has been because they are the ones who possess the major part of the live-stock in the area under study and because, as a consequence, each village unit carries out its activities over a greater domain than do cultivators. By travelling episodically through spots which show-up as "holes" on the map of spatial occupation, they provide justification for the present coverage of the area.
(1) GALLAIS (J.), Pasteurs et paysans du Gourma, CEGET-CNRS Paris 1975: 240 p., pp. 188-189
(2) On this subject, see the RCP "Espace Vécu" and number 1 of the periodical L'Espace Géographique
(3) GRENIER (Ph.), Les Paul du Ferlo, Cah. d'Outre-Mer n° 49, juv. mars 1960, pp. 28-58
(4) BOUQUET (Ch.), Îles et rives du sud-Kanem, CEGET-CNRS Bordeaux 1974, 200 p., p. 43
(5) BOUQUET (Ch.), Étude de factibilité du polder de Tandal, CH2M Hill, Portland, Oregon, mai 1978, rapport non publié.
(6) BOUQUET (Ch.), Genèse et évolution de l'habitat rural dans le bas-cheri-tchadien, Études Rurales n° 70, avril-juin 1978
(8) BOUQUET (Ch.), op. cité en (4), p. 79.
(9) These particular movements will be indicated in a more precise fashion on one of the 1/50,000 scale sheets being presently prepared by the IGN on the basis of the aerial photographic coverage carried out in 1975 (75 ND), etc.
AGRO-PASTORAL SITUATIONS NORTH AND EAST OF LAKE CHAD

CONTRIBUTION TO THE AGRO-PASTORAL SURVEY OF LAKE CHAD

by Jean-Charles CLANET

Assistant-Professor
of Geography

University of Chad

N'Djaména - June 1978 - July 1979
1. THE SEMI-NOMADIC PASTORALISTS OF KANEM

The breeders of the Kanem area surveyed under the CBLT project, practice two different types of breeding according to the region they traverse in the course of their movements. In the West, the area extending from the Nigerian border to the Mao meridian is the domain of the Daza pastoralists who graze their cattle on the Manga dunes, where numerous depressions cut deeply into the fossil erg. To the East, there is a vast, sandy plateau where the former valley of the Bahr-el-Ghazal forms a clayey furrow running for more than 200 kilometers along a south-westerly-north-westerly line. This natural channel where ponds fill-up rapidly during the rainy season attracts all the Kreda and Kéchercha herdsmen of the area.

- **The Kreda**

All year long the Kreda dwell in encampments made out of straw-mat tents; only exceptionally to they inhabit villages where cultivation takes place. During the dry season, they camp along the Moussoro latitude which is a crossing point for all their routes.

They begin to cover their longest routes in May and June. At that time of year, young cattlemen drive the Zebu herds to the south to encounter the first rains. Very few families only take advantage of their having moved away to begin cultivating fields of dry grown millet. The termination of these limited agricultural activities coincides with the return of the herds. Where such cultivated fields do exist, the old and the aged are left to watch over them, while the camp-dwellers begin the nomadic movements which will take them to the natron-containing ponds and the rainy-season pastures of the Bahr-el-Ghazal. If rainfall is particularly heavy throughout the season, groups of them continue on to the very edge of the Sahara. While the "upwards" movement to the North is carried out at a fairly rapid pace, the speed of the return is dictated by the progressive drying-out of the ponds along the route. Only in January will the tents be pitched again on the sites of the dry-season encampments. The rehabilitation of herds in briny areas, which takes place at the onset and at the close of the hibernating season does not necessitate any particular movement as a sufficiently
MAP LEGEND

1. Movements without tents; 2. Nomadic group movements towards the dry-cultivation areas; 3. Return towards the dry-season sites; 4. Location of the group during the dry-season months; 5. Natron-containing wells; 6. Steeply sloped ridge of the clayey valley of the Bahr-el-Ghazal; 7. Main routes; 8. Representational curves of the depressions between dunes.
MOVEMENTS OF THE KREDA SOUND
large number of natron-containing ponds and wells are found all along the regular itineraries of transhumance.

The cycle of Kreda nomadic movements comprises three different stages which may be seen clearly on the diagram indicating the axis along which the movements of the Sounda populations take place:

- from January to May, a prolonged stay in order to take advantage of the pastures lying between the 13th and the 14th parallels. Migrations between the five or six spots used as camp-sites do not exceed 20 kilometers in length.

- from June to July, the herds make use of the extra-regional resources of the Chari-Baguirmi while waiting for the onset of rainfall over the septentrional areas.

- from July to December, the herds are kept grazing on pastures found on the clayey hollows of the Bahr-el-Ghazal River furrow.

This extreme mobility of the Kreda pastoralists, unique in Western Chad under those latitudes, rests on the uniformity of their herds which are made up of animals sufficiently hardy to be able to put up with long, daily moves and with a light habitat. It is precisely to this easy manoeuvrability that minimized cattle losses of the 1969-1973 drought may be ascribed.

11. THE DAZA, SEMI-NOMADIC BREEDER - CULTIVATORS

The configuration of the Manga and of the two areas lying south of it, the Chitati and the Liloa, enable Daza stockmen to avoid long hibernating migrations; there, sandy plateaus and clayey hollows alternate, thereby offering within a restricted space, various type of pastures.

The Daza encampments are scattered between RigRig, Noku, and Mato, near the most deeply sunken-in wadis. During the dry season, their herds composed of half-bred cattle descended from crossings between Kuri bullocks and Arab-type Zebus graze the circular sides of the shallow basins into which the

+ Within the boundaries of the conventional basin, on the other hand, to the East, the Missirlé Arabs, for example, travel over distances four to five times more extensive in latitude.
abundant summer showers have rained. When grass becomes sparse, camp is lifted and moved over a very short distance—no more than a few kilometers—to another site or near another wadi. In June, when rains begin to fall, the population leaves its straw-mat tents to take-up residence in agricultural villages. Cultivation is invariably carried-out at the foot of the dunes running along the edge of the clayey basins. Under the guidance of young shepherds, the herds then move off at will to wherever they encounter the first green pastures. Before coming back in September at harvest time, the animals take one or two rehabilitation salt cures at the natron-containing well of Leschur which is located north of Noku. Once the harvest has been gathered, the Daza put up their tents once again and the cycle begins anew.

Unlike the Kreda, the populations of stock-breeders in these regions were unable to prevent the nearly total destruction of their herds during the last drought. Their lesser mobility and the fact that their cattle was unused to frequent migrations contributed to their being unable to devise a strategy for the salvation of their animals. At the present time, most of the families who have not emigrated have abandoned the rearing of Zebu cattle and invested the little they had left into the constitution of small herds of young camels and goats.

111. THE NOMADIC PASTORALISTS OF THE CONVENTIONAL BASIN'S NORTHERN BOUNDARIES

Included in this particular category are the pastoralists, or breeders, who are located north of the rain-millet cultivation line which we have traced on map 11 ("Major Migration Routes of Breeders"). Since the climatic crisis of 1969-73, practically no animals other than camels have been bred in this particular region, which is situated at the highest latitudinal point. The populations inhabiting the Kecherda districts of Salal, a number of the Arab groups from the EgueI and some Gorane to the North of Gouré, in Niger, all situated well above the 14th parallel, used to own a great number of herds made up of Zebu cattle of the so-called Arab breed.

The pastoral life of the two groups mentioned above may be divided into two major periods: the one during which wells are used as watering-
places for their herds, the other -- which lasts as long as possible -- during which they rely on available surface waters for that purpose. Other complementary activities, such as gathering, cultivation, or harvesting are not carried out at all, during any of the various seasons of the year.

- The Sakerda Kécherda of the western Soulies (West of Salal)

Only recently have the Kécherda taken their herds of she-camels to graze exclusively along the banks of the Soro (Bahr-el-Ghezal), during the rainy season. Before then, when the rains came, the animals were driven to the Égueï, away from the stinging insects found in the vicinity of the seasonal ponds of the Bahr valley which were a serious nuisance to them. However, after 1973, the Égueï pastures did not grow back and the Sakerda Kécherda were forced to drive their herds towards the valley of the Soro where pastures become verdant as soon as the first rains fell. Unlike cattle, however, the she-camels of those regions cannot take full advantage of the pastures because they are unable to stand-up for long in the mud and because, in addition, horse-flies, which arrive early on, drive them away. Towards the end of July or the beginning of August, all Kécherda tent sites are struck and their inhabitants leave the region to proceed towards the Northern Soulies and the vicinity of the Égueï, beyond the tent sites of the dry season. These pastoralists will then follow a course dictated by the presence of summer ponds whose location varies from year to year but whose waters are always heavily natronized. They attempt to stretch this northward migration over the longest period so as to find themselves as late as possible in the season in the dry-herbage areas lying between Bir Tchao Téfouna, Salal, and Koal which they reserve, as much as they can, for the dry months.

These rainy-season nomadic movements do not cover the wide areas of old. Then, all ethnic groups, all tribes (Sanakora, Médéma, Sakerda, some Yries) met and remained together in the Égueï for three or four months. To the type of movement in existence then during which took place first a brief stay on the banks of the Bahr River followed by a longer one in the Égueï, has been substituted a type of nomadism where the pastoralists groups remain at length on the banks of the Bahr-el-Ghezal when the rains begin, to break up later on into small groups traveling on the fringes of the Égueï.
without ever penetrating deep into it. The intense social life of those old days — weddings, celebrations of all kinds, drum-beating, etc — is gone. Now, the meager potentialities of each pond make it imperative for groups to separate and go their own way. They need to disperse themselves into almost as many fractions as during the dry-season. The inhabitants of each encampment devise their own itinerary, at times under the utmost secrecy, so as to be able to use to their greatest advantage the ponds with which they might come across along the way. Social cohesion has disappeared and conflicts have multiplied.

To this "shrinking" of winter nomadism corresponds an increase in dry-season mobility. Although pastures* have recovered, they are not yet able, to support the stocking rates of the past. Tents are now struck often to move from well to well. In 1971, families camping at a spot called goz Bila** had moved seven times. In January 1978, or not even four months after the end of the rains, they were already preparing for their ninth move.

- The Ouled Sliman Arabs of North-Kanem

The movements of these populations do not differ in their principle and in their range from those of the neighboring Tubus or the Goranes of eastern Niger, nor from those of the families and groups of Tuaregs from Gouré*** Few among these travel over distances of more than 100 kilometers, or over a little less than one degree of latitude. This distance is nevertheless sufficient to come across a variety of pastures ranging from shrub cover to graminaceous grass-lands composed of a relatively varied number of species. Dromedaries are found here again grazing the pastures at the bottom of the fossil, honeycomb-like ergs during each rainy season; there, for a

* Work undertaken by D. DULIEU and GASTON, IEMVT, 1975, and observations made by D. DULIEU, jan. 1978

** In the Northeastern fringe of the Manga. There is another place of the same name, South of Moussoro.

*** Here, the sinking of six wells has considerably reduced the number and range of movements.
month or two, usually July and August, they are provided with fresh, green herbage. This period begins and ends with a rehabilitation cure at the natronized wells of Dira and Nira, which are located well inside the Sahars.

Their nomadism does not have a cyclical character; it is exceptional for them to go through the same spots two years in a row. It cannot, however, be considered as aimless wanderings, as has too often been supposed. Rainfall being unreliable, both spatially and temporally, the Ouled Sliman Arabs must of necessity spend the entire year within that area of their wide-ranging travel routes which has received the highest level or rain water, even if it entails moving the following year to a neighboring region having had a greater amount of rain. This mobility, broader in its range than that of the Sahel Breeders has remained the same since the end of the 19th century.

To illustrate it, let us take the example of the Djebelirt fraction of the Ouled Sliman; they are located to the North of Liloa and possess tent sites in four main wadi zones, respectively named, from west to east, Bir Afit, Bir Teleni, Bir Am Hadid, and Bir Ghodum. Coming back in September of 1977 after the ponds near the northern wells had become dry, they did not move camp sites again before January 1978. In February, the families migrated toward the nearest wadis, located immediately south of their point of departure, taking with them only the pack-animals and a few she-camels for milk. At the same time, the herds of she-camels and young males were undertaking a wide-ranging, slow migration in the direction of the natronized wells of Leschur and Tidé, under the guidance of the shepherds. The travels of the herds continued throughout the entire dry-season or approximately five months. Only in July 1978 did people and animals find themselves together again to begin a new migration on a northerly direction in search of low-lands where some degree of humidity might still remain.

----------

* At that time, G. NACHTIGAL has already observed it.

** These are circular depressions between dunes and not thalwegs.
MOVEMENTS OF THE OULED SLIMAN DJEBAIRT

**Dry season movements from Oct., 77 to June, 78**

- Movements involving the entire group and its herd
- Movements involving herds driven by shepherds towards southern, natron-containing wells
- Successive family camp-sites

**Wet season movements, 1978**

- Nomadic movements involving the whole group towards wintering-sites
- Brief movements (not exceeding 15 days) towards natron-containing Saharian wells before the height of the wet season
- New camp-site in 1978

* Natron-containing well

**Topography**

- **Trail**
- **Sub-prefecture**
- **Administrative station**
- **Prefecture**
- **Intermediary depression**

scale: 1/1,000,000
IV. PARTIALLY SETTLED BREEDER - CULTIVATORS

(Arab group of the Chari-Baguirmi and of the Aka regions; Kutus populations of eastern Niger; Kanembus inhabiting South Mussoro).

These live-stock men have a life-style akin to that of the breeders who inhabit the areas situated on either side of the Chari River which C. Bouquet has described in his work. Differences do exist however: the former carry out the cultivation of a smaller number of varieties, not being able to make use of the flood-retreat lands similar to those in the regions bordering Lake Chad in the South and constrained, therefore, to adapt themselves to an environment more lacking in surface waters by undertaking dry-season movements covering a much wider range.

Another case in point is that of the Arabs who people the northern part of the Chari-Baguirmi. These villages are spread out over an area lying between the road leading from Massaguet to Ati through N’Goura, the Bokoro meridian, and the Chari River. During the dry season, they make use of the only bridge available, which is situated near N’Djaména, to take their, Zebu herds across the river and lead them on to the Tandjilé prairies, or, but that rather exceptionnally, toward the two Logone. Alone among them, the oriental group who dwell near the administrative sub-district of Bokoro do not cross the Chari; pastoral movements are the same as those described by Ch. Seignobos in the third chapter of this section. This agro-pastoral situation is certainly the most prevalent one in the South of the Chadian Sahel.

The village of Bouta-al-Bagara, between Bokoro and N’Djaména, constitutes a truly typical example of this type of situation. The pastoral year is divided into three, clearly delineated periods: a period of far-ranging nomadism during the dry-season, one of forced "stalling" during the winter months, and one of sedentary breeding for a short duration.

The herds of Zebu cattle come back from the South with the families who accompanied them on the journey after most of the plots of millet have
been tilled and fenced-in. Cattle-pens are repaired while waiting for the rains to come so as to be ready to spend the heart of winter on the spot. From July to mid-October, the cultivated plots require only little attention and children usually take on this task. During the ripening of the crops, all cares are centered on the cattle which must be protected from biting insects and penned in dry spots. So as to allow them to sleep on dry, unmuddied ground, manure produced during the night is removed daily and replaced by a mixture of dried dung powder and sand. The work is carried out beginning at dawn and continuing through midmorning. When that has been accomplished, logs are set around the stalls to smoke out insects after the animals return in the evening. Once all cattle are back, the fires are set and a layer of green grass is thrown over the logs to produce thick bellows of smoke. Armed with fans, children scurry through the animals' legs to chase the gad-flies out of the opening of the stall. When these are all gone, the door of the stall-hut is carefully stopped-up and the whole structure, the walls and roof of which are made-up of millet stalks or of dried-up mud as in Ab Deddi for instance, becomes impervious to insects. These activities last until October at which time, the harvest of dry-crops having been gathered, simple enclosures ringed with thorny shrubs are sufficient for the animals.

This particular period, when all agricultural tasks have been performed and when the herds graze in the vicinity of the village under minimum watch, is of short duration. The daily movements of the herd are conducted under the leadership of an old cow who is perfectly familiar with the rhythm of the comings and goings. At the end of approximately two months, the neighboring pastures are showing signs of exhaustion; the daily travels therefore stretch over longer distances and the amount of feeding time is reduced accordingly. New grazing spots must be found. Full-scale nomadism begins either towards the end of December or the beginning of January, according to the abundance of rain fall each year.

Whenever families move off towards the South, in the direction of the Tandjilé, they gather their small herds together and entrust them to one of their members. One or two men lead and watch over the herd while a young woman attends to the cooking and to the sale of the dairy products. These two or three persons who accompany the animals will spend the entire six-months-long dry-season (January to June) in the most complete autarcy.
This form of nomadism practiced in the village of Bouta-el-Bagara is indeed the most representative one but it is far from being in general use. In several regions, the winter form of nomadism alone is practiced along northerly, easterly, or westerly routes oriented towards the potential water resources which polarize all regional movements. Seasonal movements are useless in certain areas, notably between Bokoko and Ab Gourda, as the population density and stocking rates of the land are low enough and as local pastures are of unusual quality.

V. SEDENTARY BREEDERS

The south-eastern prefectoral limit of Tanut, in Niger, marks the beginning, at the 14th parallel level, of a zone extending as far as the Noko meridian where one encounters villages inhabited by sedentary breeders with a frequency unusual in the Sahel. The highest concentration of such populations is found within a perimeter located between Gouré, Diffa, and N'Guigmi in Niger, and between Rig-Rig, Liwa, and the shores of the lake in Chad. These live-stock breeders are Peuls. Unlike the Hannagenba and Bororo Peuls who have retained their traditional dress and their herds of Bororodji Zebus, these Peuls do not differ from their Gorané, Tubu, or Arab neighbors.

Yet the sedentary Peul breeders of Rig-Rig have only recently immigrated to that location. Only in 1937 did the military outpost of the area, located in Kouloulou chi, registered them in its log. Forced to settle in a spot south of the present Rig-Rig district, they had no trouble assimilating with the Gadoue Tubu and the Kédéléa of the same administrative district and in becoming perfectly integrated with them. Outwardly, nothing would seem to distinguish them from their neighbors if it weren't for their language. Analysing the pastoral occupations which constitute the greater part of their activity alone reveals their specific character as breeders: they take advantage of their geographical situation, of their membership in an ethnic group, and of their particular breeding techniques to refine their economic situation into a specialization.

Young bull calves, one to three-years old, (sometimes older but in small proportion to the rest) compose the greater
part of their cattle herds. These young animals were acquired in the majority from the sahelian markets situated along the Peul's latitude, most notably those of Mao, Méchiméré, Moussoro, Djedaa and Oum-Hadjer. The animals are purchased in December and January when the Arab Tubu shepherds bring in large numbers of Zebu calves to market in order to be able to meet their annual expenses (personal income tax, purchase of finished-products and cereals) with the cash they derive from their sales. The Rig-Rig Peul breeders need not fear competition during those cattle fairs. Other Peuls only purchase young bull calves, thus they have easily been able to establish a veritable monopoly on this type of operation. The cattle merchants, usually Kanembu, who also frequent the same market places, are not likely to mind this state of affairs as they require older, fatter animals which will eventually be slaughtered for meat.

The ready-purchased young Zebus are immediately integrated into the herd and sent out daily to graze alongside it in the immediate vicinity of the villages. However, contrary to their native neighbors' usual practice, Peul breeders assign two or three shepherds to keep permanent watch over their cattle. These men lead the herd to the greenest pastures, bringing back the stray animals, moving on to new grazing spots when grass is getting scarce on the old ones, and generally being very attentive to the welfare of the herds in their charge. These daily excursions, which take place within a radius not exceeding 20 kilometers in diameter, constitute the total extent of the Peul cattle's annual movements. It is a reduced mobility but of superior quality, at the opposite of the simple watch kept by the Tubu or Arab breeders or Pastoralists over their herds. In the same way, herds are not taken to the salt cure stations at all. Whenever one of the breeders feels that his animals need natron, he simply goes and purchases some in Bagasola. The villagers who make use of the natronized wells of Talégu and Ouydé found west of Rig-Rig, only do so because they happen to be nearby.

No specific economic study having been undertaken on the subject, it is difficult to make a correct estimate of the value of this type of livestock fattening compared to the breeding of the neighboring populations. The herds appear to be more handsome but, obviously, the homogeneity of the cattle and the taller frame of the males are factors which contribute to this favorable judgment.
After three rainy seasons, which occasionally correspond to four calendar years, the Peul breeders take the young bulls back to market for resale to cattle merchants whenever they feel the animals have been brought to the best possible fattening point. Their geographic situation is particularly well suited for that purpose as many of the commercial distribution networks, be they the official or, on the contrary the officious ones, go through their region. This is especially true of Niger and of Nigeria, distant by only a two to three-day's walk, where the sale of cattle commands the highest prices. There again, the Peul's belonging to an ethnic group plays in their favor as the nomadic Peul breeders who work their way round Lake Chad at the end of the rainy-season "willingly" take charge of animals intended for sale; if the owner wishes to conduct the sale himself, he will be allowed to feed his animals on their relay sites where he will be provided with shelter, advice and help of all sorts, in a family-like spirit, until he is safely delivered to the gates of the big market places, in North-Cameroon, Nigeria, or Niger.
AGRO-PASTORAL GROUPS IN NORTH CAMEROON AND SOUTH CHAD

(CONVENTIONAL LAKE CHAD BASIN)

CONTRIBUTION TO THE AGROPASTORAL REVIEW OF THE LAKE CHAD BASIN

by Christian SEIGNOBOS

Assistant-Professor of Geography

University of Chad

N'Djaména - July 1978
A BRIEF INTRODUCTION INTO THE HISTORY OF LIVE-STOCK REARING FROM THE MANDARA HILLS (CAMEROON) TO THE CHARI RIVER (CHAD)

In the 16th and 17th centuries, the populations inhabiting the banks of the rivers Chari, Mayo Danay, and Guerleo, the shores of the Lake of Lere, and the slopes of the Mandara Hills attempted to introduce a form of sedentary breeding into their agro-systems. These populations had already for the most part been driven back from more northerly regions lying on the fringes of the great Sahelian Empires; they eventually abandoned live-stock rearing which subsequently disappeared from the banks of the Chari (1), from the interfluve of the Chari-Logone, from the Diamaré . . . concentrating itself in the end between the Logone river and the Lake of Fianga, and persisting in the Mandara Hills.

Concurrently, the Fulbe already present in the area who had come from the West and whose sole activity was live-stock rearing, increased their hold on the pastures and, as early as the beginning of the 19th century, materialized it into a political one.

The Peul populations settled according to a different pattern depending on the breeds and size of their herds. The Fulbe, who possessed large herds, , established themselves in the North, in Marva, Bogo, Pette, and in the vicinity of the flood-water prairies of the Logone, the Yaere. The Yllaga, who were warriors, opted instead for the South, across from the potential labor sources there.

The migrations of their herds, smaller in scale than nowadays, followed the same rhythm: to the Yaere prairies during the dry-season and in the neighborhood of villages or on appropriate, free grazing lands during the winter.

The supremacy exercised by the Peul Lamidat Chiefs and the very high density of the Habe population (i.e., non-moslem) had turned North Cameroon into a closed-off area for the great southerly migrations, blocking the Chowar Arabs to the north of Mayo Mangafe (border area between the Peul and Wandala populations) and preventing the crossing of the Mbororo herds (2).

The beginning of the colonial period helped to open up much more extensive travel routes. Live-stock men occupied all of the former "no man's land" areas, thereby creating a veritable jumble of migration routes, difficult to unravel. It is also at that time that the great epizootic diseases made their appearance.

(1) The Niellim only lost their herds at the end of the 19th century.
(2) It has been one generation only since the Chowa Arabs of Nigeria have infiltrated themselves down to Mindif to spend the rainy season there,
AREA OF STUDY

Scale: 1/5,000,000

Drawn by HIENMOUYA Koudoul
The excess numbers of breeders in the Diamare emigrated to the vicinity of the Chari river, where the Baguirmi Chieftaincy which had always held the Fulbe in suspicion had collapsed and where population density was very low. In that way, the Chari river from its distributary to its junction with the Bahr Ergig practically became a Peul territory (1). The Chowa Arabs withdrew to the north of the Bahr Ergig river; the Fulbe inhabiting the banks of the Chari were thus able to make use of the pastures situated along the main bed of the river and on the flood-water Yaere, or prairies, of the Logone, in the west and south-west.

After World War II, the situation slowly deteriorated for the North-Cameroon stockmen. They had been the first to occupy empty areas but they were now being imitated by cultivators who had caught up with them; the first to arrive were the Mouzouk, who were cultivator-breeders, followed by the Toupouri who settled in the interior of the Diamare and, finally, after 1960, by the mountaineers who came down in droves from their hills to the lower piedmonts.

In addition, the cultivation of a type of sorghum, the mouskouari, which is becoming wide-spread in North-Cameroon, constitutes an agrarian revolution of sorts which further impedes live-stock rearing.

Mouskouari sorghum grows on vertisols not previously cultivated from which all vegetation, including shrubs and other woody plants is torn out, eradicating in the process vast grazing expenses which could have been used in the dry months. The resulting lack of firewood leaves no choice but to use the sorghum stalks for that purpose, thereby doing away with the stubble pastures as well.

That the Mouskouari sorghum is being more extensively cultivated is manifest in as much as the Fulbe tend to develop the agricultural side of their economy.

(2, suite) and less than 40 years since the Mbororo have slipped in through the same "burtol", a sort of transhumance channel leading from the Yaere prairies to the Torok desert.

(3) They took over by force the districts of Malboum and of Bogo Moro, which subsequently became a revolving door through which all Peul herds in the region passed on their migrations.
The 1969-73 drought brought about the displacement of a large number of stock rearers—notably Arab groups—from Nigeria who settled in the area of the Mangafe as well as in others, thereby causing strong demographic pressures which continue to be felt to this day, if to a lesser extent (1).

The danger today for the live-stock herder's way of life lies in the number of development projects being undertaken. The small Yaere prairies of the Moulvouday region are scheduled to be turned into cultivation zones for rain-grown rice. The SEMRY project is to be extended beyond the north-west of Pouss to a strategic spot on the migratory routes of the North-Cameroon stockmen; if carried out, this extension may imperil the grazing lands downstream, the "bourgoutieres", or flood-water pastures, and the Vetiveria nigritana prairies as well.

More than a fifth of the Peul herds of the Diamare region remains in Chad throughout the year as a preliminary to new departures for the East.

Along the Chari river, the drought has accentuated the flow of stockmen from the north and from Niger and Nigeria. It has become necessary, temporarily at least, to give up land north of the Chari, lengthen the southerly routes, especially in the outer Logone, and to keep a large part of the herd within the interfluve area during the rainy season.

The all too frequent and, what's more, unpredictable migrations of the Uda'en and of the Mbororo, who travel outside the transhumance corridors, are regarded as an additional nuisance.

To these difficulties is added another threat from the south which chiefly concerns the Peul settlements along the fringes of the Yaere, north of the administrative districts of Bongor and up to Mito, as they are located precisely on the upwards migration route of the Logone Massa making their way to the Chari and on that of the true cultivators leaving the South by way of the left-bank of the Chari river.

(1) In 1975 for example, the Fulbe stockmen had to lobby the administrative authorities to get them to drive back the Arab breeders of the Mayo Danay.
These problems are all the more acute as the chiefhoods are held by cultivators.

I - CULTIVATOR-BREEDERS

The sedentary rearing of cattle is still practiced among two, important population groups: the central and northern highlanders of the Mandara Hills and the Massa Toupouri group which dwells on either side of the Chad-Cameroon border.

The type of breeding practiced in the Mandara Hills is of a very specific nature as the animals are kept in confinement. Young calves purchased down in the plains are walled-in inside huts and fattened for slaughter, which takes place on the occasion of the Mandara Hills celebration observed every two, three or four years. This type of cattle rearing, very fluid in nature, nevertheless allows for the fairly rapid renewal of the herd; however, its practice is followed in varying degrees according to local hill customs.

A number of population groups have kept up a more traditional way of breeding cattle, the Podokwo for one, whose herds browse freely on the terraced lands; the Kapsiki, who inhabit a plateau where the organisation of soils and the extensive savanna point out to long-established cattle-rearing practices; and the Glavda who dwell along the Nigerian border.

Down in the plains, the Massa Toupouri ethnic group, to which must be added the Mouzouk and Mousgoum to the north and the Kera to the south, possess very large herds which are constantly on the increase (1).

These herds are made-up of a number of mixed breeds balanced with Zebu cattle and cross-bred with the Arab and Fulbe Zebu.

The animals rarely go out of the village area (2). The Toupouri, who occupy the now stabilized erg of Kalfu where each village tends to carve out its own individual territory on top of a dune, make clever use of the various

(1) The Massa and Toupouri lands carry an average of 2 to 2.5 heads of cattle per land grant. In Mafa country, the average is 0.5 heads per land grant.

Figures supplied by J. BOULER in Definition des potentialites agro-pastorales ORSTOM Problemes Humains

(2) Those in the Ndoukoula region did not begin to leave the area in significant numbers until the 1973 drought; they left for Lake Fang, much too late unfortunately, and many of them perished on the way.
types of grazing land at their disposal, whether they are flooded or flood-
retreat stubble pastures, low-land pastures between the dunes, or shrub
pastures.

The herds follow the rhythm of the various harvests performed during
the year.

After the harvest of early sorghum has been gathered, the dry, loose
hedges fencing in the plots are dismembered and the cattle is left to browse
around the dwellings, under the shade of the Acacia albida trees.

In January, the animals move down to the fields planted with Babai,
a variety of sorghum whose seedlings are transplanted out onto water-logged,
sandy-clayey soils.

In February, they reach the vertisols where the Mouskouari variety
of sorghum is cultivated, ending their journey in the lowlands where they find
a regrowth of vegetation which has sprung up after the fires and the last wells
still with water.

During the wintering season, they return to what remains of the
fallow lands while the low-lands fill-up with rain water.

The Acacia albida park constitutes a forage reserve in the heart of
the village lands. At times, its trees are systematically stripped to provide
forage for large and small cattle.

During the rainy months, the routes followed by the herds are
marked with "zeriba" and with hedges of Jatropha curcas which run perpendicular
to the dunes. To complete this network of routes, a lateral passageway is
opened along the bottom between dunes, on the "harde" (1). There, ponds to
water the animals are found which are all the more beneficial because of the
alkaline environment in which they are situated.

Occasionally, a kind of cattle corridor, the "plamna" (in Mouzouk
country) is opened between the Mayo Guerleo and the Mayo Danay pastures.

(1) Harde: term used in North-Cameroon to designate halomorphic aridosols.
This particular ecosystem, which includes extensive, sedentary breeding and a certain amount of spatial organization, such as dispersed habitat, Acacia albida parks, etc., is expansionist in nature. It accompanies the Toupouri demographic push to the North, of course, in the Kalfu region towards Kore, and progresses towards the north-eastern Chari, along with the Massa populations.

It exerts a certain influence over the neighboring populations as well, whose economy was based on the river, in the old days, and who are adopting the type of livestock rearing practiced by the Massa. These populations are the Ham in the South and the Moloui in the North.

As for the other agricultural groups who inhabit the southern part of the Lake Chad Basin, the Moundangs alone among them increase the size of their herds; indeed, their tradition has always been to include heads of cattle as part of their dowries.

The herds of the Marba-Moussey, who are established south of the Massa, were composed of "Kirdi poneys" which fulfilled a socio-economic role similar to that of the cow for the Massa. In spite of the development of animal-drawn cultivation and of the relative loss of interest in horses, it is too early as yet to see a trend towards the constitution of horned-cattle herds.

Among the populations along the banks of the interfluve and of the Logone, only the Kim, who find themselves in close proximity to Arab breeders during the entire dry season, have acquired cattle herds.

II - BREEDER-CULTIVATORS

Most of the breeders living in the southern part of the Lake Chad Basin fall into the above category, and most of them are Peul.

They are breeder-cultivators established in permanent villages; their economy continues more often than not to show a deficit in cereal production.
The main crops are Mouskouari sorghum, several varieties of short millet in North-Cameroon, and short millet on the banks of the Chari river. The present tendency is towards self-subsistence and even excess yields as far as millet crops are concerned, thanks to the Mouskouari sorghum variety.

Breeding practices are similar from North-Cameroon to the Chari as these areas are on the whole largely populated with related ethnic groups such as the Ngara Fulbe for instance.

The bulk of the herd—the cedoje—is led out at the beginning of the dry season by shepherds who are accompanied by a few women and by the Kaydal.

The herd may be subdivided into "saurus", or approximately 100 heads. Departures towards the Yaere are spaced out along the period preceding and succeeding the Mouskouari harvest, which signals the close of the agricultural season.

Approximately a fifth of the herd—the cureeje—is composed of diseased or pregnant animals, of young calves and of milking cows of the Chowa Zebu race primarily which produce more milk (1).

The return journey to the village takes place as soon as the first rains arrive, so that the owners may evaluate the state of the herd—which is the misurtan—and decide which animals are to be sold, which restituted to their owners or, instead, taken back if they had been on "govalge", or loan.

The major part of the herd—the duumooje—is subsequently withdrawn from the village to spend the rainy season in a favorable, uncultivated spot, thoroughly dry and free of flies (2).

In North-Cameroon, departures towards the northern or southern Yeare prairies are spread out along the dry-season, with one return trip taking place during the winter months towards flood-retreat pastures situated more or less near the village.

(1) The herds have become more and more mixed. Groups whose members have remained true breeders alone have kept up a dominant breed: red bulls (bodeeji) in Pette, white ones (dereej i) in Fulbe country (Kalfou Fulbe and Baguirmi Fulbe).

(2) The duumooje part of the herd is usually to be found closer to the village than the cedoje, save in villages such as Haissa Harde, Guider, and others.
The southerly direction taken by the herds is due to the obstacle which the Mandara Hills constitute to the north and to the high densities of cultivator-breeder populations present in the west, all along the banks of the Logone, whose territory is difficult to cross.

Cattle routes are roughly drawn across the Diamare region, from Mindif to Kalfou. The northerly route towards the Yaere prairies in Chad and in Cameroon goes through Pouss, Katoa, Mazera, Logone Birni, etc. . . . The southerly one leading to the Mayo Kelbi pastures and, more importantly, to the Yaere of the Logone's overflow basin, is situated within the triangle formed by Laf, GounouGaya, and Ham.

Movements are traditionally more important towards the north and primarily involve settlements of true breeders. The 1969-73 period had caused an inversion in the direction of movements which, however, rapidly reverted to the old traditional patterns after the end of the drought, save for a few exceptions, the extent of which is difficult to evaluate.

During the rainy season, when herds fall back towards the villages, they go through a privileged area of the Diamare spreading across the Torok Desert to Mindif which is scantily populated and free of marshes and insects.

There, grazing the Diamare between Bogo, Maroua, Mindif and Goudoum Goudoum, several duumooje—main bodies of the herds—are found congregated together; included are cattle owned by nomadic Arab groups coming from as far away as Nigeria.

Along the Chari river, movements follow a double pattern: one route, to the north of Guelendeng, leads to the north-western Yaere prairies; the other, to the south, takes the herds to the flood-water pastures of the Logone river.

At first, movements cover short distances only; the herds graze on pastures lying close to the villages or to the islands of the Chari, which they cross at the end of the dry-season on their way to meet the rains.

Other movements, covering a much wider range, reach the Logone Yaere or further south even, the grazing lands of the Beinamar arboreal savanna.
Each such migration is merely a component in a much larger system of movements which involves great numbers of stockmen, one group advancing and the other retreating, according to a sort of linear flow on the banks of the Chari and to a wavy circular one in the Diamare. The Bogo or Goudoum Goudoum breeders for example, move away to leave room for the Maroua, Yoldeo, or Mindif herdsmen who come from farther away and who subsequently continue on towards the fringes of the Yaere prairies.

**MOVEMENTS OF THE NORTH-CAMEROON BREEDERS ALONG THE FRINGES OF THE YAERE**

In the Diamare, Fette and Bogo are the areas in which live-stock rearing is the main activity. It is there that cattle migrations take on the most complex character and cover the widest range.

In October, the herds(1) move off towards the northern Yaere: Katoa, Zina, and all the way to Logone Biri, large numbers of animals being concentrated at a spot named Kazire.

The herds which return directly to their respective villages leave the Yaere in June, at the time of the first heavy rains. Instead, those which travel south to encounter the rains leave in April or May by way of Bogo, to the east, between Goudoum Goudoum and Moulvouday, crossing the Chad-Cameroon border at Mbrodom and the Mayo Kebbi at Mbourao; from there they proceed further to Pala, where a certain number of heads will remain until they are replaced by others every two, three, or four years. What is left of the herd—approximately a third of the animals—makes its return journey upwards to spend the rainy season within the triangle formed by Guidiguis, Doumrou, and Kobo.

Throughout the Yaere grazing period as well as during the rainy season, when herds remain relatively stable, shepherds maintain permanent contact with the families left behind in the villages and transfers of cattle heads take place on a constant basis. The state of the herd as a whole is evaluated at the beginning of the dry-season before it is led off to the Yaere.

The Fulbe pastoralists from the regions of Mayo Mangafe, Meme, and Haissa Harde take their herds to the Yaere of the North in October. They go through Kossa, splitting up into smaller groups to the west of Waza, in the low-lying plains of Malingo and on either sides of the Nigerian border.

(1) The veterinary section of Bogo numbers 60,000 heads
MOVEMENTS OF FULBE CATTLE FROM BOGO
North Cameroon
MOVEMENTS OF FULBE CATTLE FROM THE AREA OF HAIXSA HARDE (North Cameroon)

Yaere

Dry-season movements

Wet-season movements

Map drawn by HENMHOYA Koudoul

scale: 1/1,000,000
After their return to the village, they will keep part of the herd there throughout the wintering period, following in that the customary procedure of their long-standing neighbors, the Chowa Arabs.

During the day, the animals are kept inside large-size huts filled with light smoke against insects, then they are taken out at night.

The bulk of the herd will "spend the duumooje" in the highlands south of Mokolo in the Wandy region; this is a free zone, sparsely inhabited, which used to be a Peul migration corridor linking Madagali to the plains of the Diamare. The herd will make its way to the duumooje taking the route lying between the island-like, solitary hills and the piedmonts, to the north-west of Maroua.

The inhabitants of the Kalfou region and especially those of Moulyouday send part of their herds to graze out on the northern Yaere. Departures take place throughout September and November. The animals are first taken out to graze onto the small depressions of Bizili, climbing next up to the northern Yaere of Hinale. The Logone river is crossed at the Yagoua latitude. The way to the South lies through Guissey and Bougoudoum and the herds set off in that direction in November, to arrive there in May. The choice of directions is made according to the animals' physical condition: the strong ones are sent off to the northern Yaere and calves are directed to the South. The bulk of the herd, or duumooje, will find itself gathered together again between Gadjia, Guidiguis, Kolara and Gaban.

MOVEMENTS IN THE INTERIOR

The Mayo Louti stockmen, most notably the ones from Gawar, climb up with their herds to the plateau lying in Kapsiki country where they meet up with those of Madagali. Others, instead, climb down towards the Mayo Kebbi region.

The Mindif herds reach the northern Yaere going through Kore, Dangalia, Lamoudou, Kadéy, Goudoum Goudoum, etc. The majority remains there but a certain number of the animals continue on towards the Mazera Yaere.

In March, some of the herdsmen take their cattle to the South, in the direction of Moutouroua, Figuil, or Guider; others go as far as north-western Benoue, coming back in June to spend the rainy season in Yode, west of Mindif.
The herds in Guidiguis and Binder set off towards the South via Kalfou and Guissey, skirting Ker country in Chad or making their descent towards Golenguini, Mbourao, Domo Dambali, and Kolon, to return to their point of departure in June.

From Binder, the animals are sent off towards Lere, whose lake constitutes a border point for the herds coming from the Benoue on their way towards Pala and Gounou Gaya. The duumooje gathers together in the region of Mayo Ladde.

THE FULBE BREEDER-CULTIVATORS OF THE CHARI RIVER

In the counties of Malboum, Mandjafe, and Toufra, and to the north of the Bongor and Mito counties, the tendency of the stockmen is to undertake short-distance migrations only, along the Yaere.

The Malboum herds set off towards the nearby Yaere of Morno Mirmir and settle down along the area bordering on the Katoa and Mogroum counties in three principal locations: the Katchala, Baska, and Djampadam Yaere, where they meet up with the Fulbe from the Mandjafa and Mito counties and with the Mbororo (Alidjam Wewebe, Anagamba, Djapto'en . . .). The Tourfa Fulbe take their herds out to graze on the Yaere lying near Mogay, the Bongor Fulbe going to Tougoudeo.

As for the other Fulbe of the Chari, their routes follow a constant direction but the range of their movements is extremely varied.

A certain number of Fulbe herds remain on the same spot throughout the year, making use of the pastures growing along the main arm of the Chari river, thereby appropriating the area de facto.

Whenever pressure from northern stockmen (from Mito, from Dourbali) becomes more acute or pastures are depleted, the Chari is crossed to reach more southerly regions.

It is possible to take such measures because a number of heads from the same village or from neighboring settlements have already left for the Logone river, and because there exist, within the county, small settlements of true breeders who can take charge of the animals. The right bank of the Chari is a traditional stopping point for such specialists, most notably for the Mbororo, who take over the animals, usually on behalf of small-owners.
MOVEMENTS OF THE BOGO MORE FULBE HERDS (Chad)

- Yaere
- Dry-season movements
- Duumoodje

Bouam

Baleniere
Bogomoro

Ngam
Ishagdo

Kim
Goundel

Bere
Gabri Ngolo

Krim Krim

Chari
Bousso

Doba

1/1000 000
Departures take place late in the season, as it is necessary to wait for the waters of the Chari to recede to a suitable crossing level. The herds belonging to the stockmen from the North concentrate at that time on the right bank; outside pressures, i.e., from other stockmen, are evaluated, the state of pastures is reviewed, and the descent towards grazing lands is mapped out. The flexibility of this type of organization enabled stockmen to move their animals en masse towards the South during the 1969-73 drought, along a route passing through Ngam, Deressia, Lai, Krim Krim, and Beinamar.

At the time, these migrations involved stockmen from Deredia county who are usually content to use dry-season wells and to rely on the proximity of the Bahr Ergig river, as well as stockmen who customarily went to the Baska Yaere.

Itineraries follow a sort of common route from the Chari to the Logone at Doba, and along the outer-Logone towards Beinamar...

The herds belonging to the Bogo Moro county (1), for example, cross the Chari river at Baleniere or at Malounri, descending next towards Ngam and Deressia. The Logone is crossed upstream beyond Lai, at Goundo, the herds going then towards Bere from which a number of animals may continue on to reach Krim Krim and Beinamar, integrating themselves on their way with the Peul herds coming from the Benoue area.

This type of migrating course became in general use in 1970. During "normal" years, the great bulk of the herds remains along the Logone, which it crosses again at Gabri Ngolo to reach the Doba hinterland of Gore.

The Logone, where the Fulbe meet up with Arabs coming from the north of Massenya, is the dispersion point for the various groups. Each one has its own, radically different way of installing its camp site. The Arab groups

(1) State of the herds belonging to the Bogo Moro county during the 1970-75 dry seasons, from personal observation:

<table>
<thead>
<tr>
<th></th>
<th>1970</th>
<th>1975</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the villages of the county</td>
<td>26%</td>
<td>42%</td>
</tr>
<tr>
<td>Chari islands</td>
<td>9%</td>
<td>12%</td>
</tr>
<tr>
<td>Ngam</td>
<td>-</td>
<td>3%</td>
</tr>
<tr>
<td>Lai-Deressia</td>
<td>30%</td>
<td>10%</td>
</tr>
<tr>
<td>Doba</td>
<td>20%</td>
<td>12%</td>
</tr>
<tr>
<td>Beinamar</td>
<td>11%</td>
<td>19%</td>
</tr>
<tr>
<td>Others</td>
<td>4%</td>
<td>2%</td>
</tr>
</tbody>
</table>
settle down in a fixed ferik, installing their straw-mat tents or straw huts on sand shoals, whereas the Fulbe, always on the move, are in the habit of stopping inland.

The return trip takes herds across the interfluve as soon as the first rains appear and before millet shoots come out.

Later, they join up with the herds which had left the Chari river in search of the rains in the vicinity of Tchaguin or sometimes a little more to the south, where a certain number of the animals will remain together to "spend the duumooje" in the region of Ngam.

The districts of Bousso and of Milton are inhabited by a population of stock-breeders recently arrived who have mixed with the last of the populations originally driven back from Moyto and Ngama. There, one finds Bibe Wayla, Baylao and Chowa Arab groups living side by side.

During the dry-season, the breeder-cultivators of Bousso spread themselves out onto a fan-shaped territory towards Lai, Dono Manga, Goundi, or even Sahr. Part of the duumooje remains close to the interfluve, in Ndam or in Kimreo.

The Chari is a sensitive area, where the relative and absolute pulsations of pastoral movements may be registered with accuracy.

The Chari stockmen put their herds through three major grazing stages, i.e. in Deressia, Doba, Beinamar, to which the three stages of the northern breeders roughly correspond, i.e. Bahr Ergir, Chari, Deressia.

It is too early yet to tell whether the trend is towards a stabilizing of the grazing circuits used by the Chari stockmen on the Logone pastures during the dry season, with the Beinamar arboreal savannas as the ultimate recourse in grazing lands whenever necessary.

Small nomads leave their rainy-season villages where they cultivate their crops to travel over a few kilometers only. Each family goes out to a "dor" which they put together near watering spots or on the river shoals. Returning, they bring back with them the entire herd.
Both the type of habitat and of terrain are well adapted to the cohabitation of men and animals: the villages are nicely situated on top of a dune, in an airy spot; the enclosures are centrally located within a circle of huts; there are large stables where animals are kept during the day, especially young calves, and huts are placed according to a petal-like pattern hermetically closed-off by dry brush hedges.

There are few such breeders present within the limits of our study area (1); the Chowa Salamat and the Mbarkoud Arabs are the only ones. They migrate from areas from which waters have withdrawn such as the Limani dunes in Magdeme to low-lying plains, towards Bounderi. The Djoubour and the Chiderat go from their villages behind the rim of the Chari's banks to the shoals of the Chari's backwaters (Mandjafa and Mogroum counties).

The existence of a group of blacksmith-breeders must be reported; they are the Baylao who live on the Chari as well, downstream from Niellim. The canal reach to the north is held by Baguirmi Fulbe originally from the region of Ngama, who have begun to settle down around that spot (they are Abdala'en and Ellere'en). They have the same sort of breeding practices than do the Arab stockmen with whom they used to migrate.

In order to appropriate for themselves the use of southerly pastures, the Chowa Arabs have initiated a process—now in full swing—which tends towards the transfer of their controlling system to the Chari area or to more southerly regions of the Logone or the Mandoul. To achieve their aim, they build-up temporary settlements on the river shoals, use flood-water pastures and, during the rainy season, cultivate the areas from which waters have receded, in the hinterland of permanent villages.

Both the cattle and sheep herders, who may be considered part of the Peul group as a whole, also cut across some of the migratory circuits established by the Arabs.

The Kessou Fulbe moved away from the Bornou to the area north of Baguirmi. In former times, they practiced a type of Arab-style breeding, their cattle being kept indoors for two to three months during the rainy

(1) We have been less strict in delineating the limits of our study area when it came to deal with Peul breeders.
season, after which the animals were taken for an outing—the loutchi—on nearby bushland pastures, before being sent on to the Yaere...

The size of their herds having constantly increased after they had found themselves in Chad, they gave up this particular type of breeding and took up the practice of driving their animals from Maswa-Biram and Dagana to Linia and Mandelia during the dry-season months.

However, the high concentration of stockmen on the Yaere, particularly of Arab ones, led them to shift their migratory course to go through Maswa-Biram, Yerwa, Kili-kili, Fatchetchou, and the Kouri islands. At the present time, they are in the process of developing the cross-breeding of their type of cattle with Kuri bulls.

During the dry season, various members of the Peul community—Bibe Wayla, Mare'en, Diadia'en, Ontorbe, Alidjam (Mbororo), and Uda'en—may be found scattered over vast areas, from the southern pastures of the shores of the lake, the eastern bank of the lower-Chari and the Madiagho Yaere to the latitude of Goulfey.

These stockmen make the return trip for the wet season in disparate but consolidated groups. In some cases, a number of them are left behind in the fields of short millet which are situated within the Karal-N'Djamena-Massakori triangle.

The Kreda stockmen have already moved off to make way for the Peul herdsmen, leaving behind pastures which are indeed rather mediocre by then but also ponds which are at least natronized. Other Uda'en and Bibe-Wayla Peul groups of horned-cattle herdsmen (there are no true sheep raisers among them), coming from the southermmost area of Chad, join up with them in Kokorde. Life is not always easy around the natronized ponds which were "conquered" at the beginning of the colonial period by the Bibe-Wayla who literally imposed their presence on the Gorane.

Kokorde functions as a ceremonial center for the Peuls: weddings are celebrated there, names are selected, cattle is sold, etc... These herdsmen have kept up the Peul traditions and, before the 1969-73 drought, each of their groups could be distinguished from the next by the type of herd it possessed.
Their habitat reflects this diversity: the Bibe-Wayla align their open sheds or mat-tents; the Mare'en arrange theirs in a circle or, else, in no particular order, while the Diadia'en dispose theirs according to a very strict pattern. As for the Uda'en, they merely erect simple "zeribas".

The second basic migrating route of the Bibe-Wayla is a southerly one. It runs from Ati, during the wet season, to the Camerooneses border.

Travel along the route proceeds in fits and starts as it is dependent on the search for the rains. There are two itineraries in fact, the first one being a fast one and the second a slow one, which enables the herdsmen to adapt their rhythm to the abundance or lack of rainfall. Herdsmen follow the right bank of the Chari, thereby turning this particular route into the most heavily frequented "burtol", until such time as the ponds in the interior fill up again.

Crossing the Bahr Ergig at Bodor, they subsequently go through Ngama Moito, where a number of them may possess agricultural fields. After that point, the group is sub-divided into smaller units, some of which go in the direction of Kolkorde, the bulk of them returning to the area north of Ati.

Before the drought, the itinerary ran through the following localities: Ati, Fitri, Ngama, Bodor and Korbol, ending at the Chari river. After 1973, they too were forced to prolong their route to Kyabe and the Cameroon border, or to cross the Chari at Deressia, Doba or Beinamar.

The Uda'en sheep raisers(1) are for the most part absent from North-Cameroon, with the exception of a small number of them from Nigeria who cross the border between Limani and Bounderi, skirt the big Yaere to the south and occasionally reach all the way to Chad. The return route follows the same course.

During the dry months, the various Uda'en groups (Kabinko'en, Balinko'en, Koninko'en) spread out on both sides of the Chari river which they cross by way of the N'Djamena bridge at Linia, or else further south, at Mossio, Mafaling, or other points.

(1) The Uda'en raise two types of sheep: the bounodji (white sheep) and the koraodji (black and white sheep)
These pastoralists drive their flocks in search of arboreal pastures with Acacia groves, carrying an ax on their shoulders to strip branches if necessary. As soon as the first rains fall, they return north, taking advantage of the grass yet short enough not to bother the large animals, and of the relatively dry ground still free of mud. The return route goes through Moito, Ati, Am Kaleb and the Haddah Wadi; however, a steadily decreasing number of herdsmen follows a different return course which takes them through the Kanem at Mayo Salafou and to the Guetty.

The Uda'en from the Bousso area spend the dry-season months in Sahr. For their return trip, they leave their cattle herd behind for the duration of the rainy period, while members of the group take the sheep flock to Ati to remain there for the same length of time.

Whenever the Bousso Uda'en raise bulls, their way-of-life becomes entirely similar to that of the Mbororo, for whom they are often mistaken. They remain in Bokoro during the rainy months but the dry season finds them on the Baska Yaere of the Logone, where their herds graze in company with other cattle which will later spend the winter in Dourbali.

Other Dourbali groups come down to Doba and occasionally as far as the R.C.A. border. A small group, the ultimate one, migrates from Ngama (wet months) to Doba (dry months).

The transhumance movements undertaken by a number of Mbororo fractions remain little known. Settled down for the rainy season in the region of Dourbali and Bokoro, they subsequently spend the dry months on the Yaere of the Chari-Logone interfluve, sometimes going as far as the R.C.A. border; however, it is possible that some movements take place along a more southerly route, for instance those which go through the Mayo Kebbi during the rainy season and which involve population groups coming from as far as the confines of the R.C.A.
PARK LANDSCAPES
PARK LANDSCAPES AND THEIR ROLE IN THE CHADIAN BASIN

A CONTRIBUTION TO THE AGROPASTORAL SYNTHESIS OF THE LAKE CHAD BASIN

by Christian SEIGNOBOS

Assistant-Professor of Geography

University of Chad

N'Djaména - August 1978
This rather sketchy map should be regarded as an attempt and an excuse for commenting and classifying the various types of vegetation that have been promoted by anthropogenic action in the conventional basin of Lake Chad.

Emphasizing landscapes that have been developed on improved areas makes the geographer's approach entirely different from the botanist's or agrologist's.

1. SOME BASES FOR A CLASSIFICATION

A park is a more or less conscious selection of some tree species by a village society, with the purpose of promoting the production of foodstuffs, wood, etc., maintaining livestock, and preserving soil fertility.

With due reference to the climatic and edaphic influences that may set precise limits to the development of some tree species, it is the power of adaptation of these vegetations, their man-made, planned character that stand out.

The concept of a park retains a subjective element. What minimum density of trees, what minimum surface are required for a park to deserve the name? What proportion of dominant and accompanying species can serve as a criterion for defining that park?

In fact the ligneous element is the most conspicuous; it stands out because of its repeated occurrences, in a landscape transformed by man.

In a park the various species develop some sort of spatial hierarchy in relation to their habitat: one species is often predominant, but seldom to the point of exclusiveness.

Yet it is this dominant species that we have tried to plot on our map, for its presence implies some well-defined types of traditional economies, especially as regards the relation between cultivation and stock-breeding.

P. PELISSIER(1) has proposed a genetic classification of parks:

- vestigial parks composed of heterogeneous species, whose trees have not been grubbed because they looked too big for felling.

- parks selected for food purposes, whose trees are present in the natural vegetation: Vitellaria paradoxa, Parkia biglobosa.

- homogeneous afforestations that spontaneously take the place of climatic associations thanks to the favorable ecological conditions created by clearing: heliophilic species or those that reproduce by suckers.

- a variant of the preceding type: parks whose composition "is due to the presence of man and to his role as a disseminating agent": Adansonia digitata, Boerassus aethiopum.

- parks that have been substituted to spontaneous vegetation, and whose elements are not involved in any climax of the natural environment: Acacia albida, that has necessarily been developed by cattle-breeding agricultural communities.

- finally landscaped parks with planted trees

Only Acacia albida refers explicitly to a specific agro-system.

We propose to extend to other species this essential relationship that links one tree to one type of agrarian civilization, making it the characteristic feature of a landscape. This will be the basis of our classification.

Such a typology enables us to establish "automatic" associations:
Acacia albida/cattle/farming communities/intensive agriculture/strong density.
Vitellaria paradoxa/no cattle/extensive agriculture/medium density
Boerassus aethiopium/insecurity/small territory/rudimentary agriculture.

We shall cut the classification down to three categories:
- parks composed of species that reflect one agro-system
- occasional parks, to which we may add some zones dominated by useful trees that have been selected without "physically" creating a park.
- complex parks without a dominant species

11. VALUE AND ROLE OF PARKS IN THE CHADIAN BASIN

2.1 - GROVES OF USEFUL TREES AS DISTINCT FROM PARKS
All useful trees do not inevitably turn into a park. We shall exclude the Kanem groves (1) of palm-trees and jujubes (Ziziphus spina christi) whose development, being part of a pseudo-arboriculture, is totally different from that of a park.

The fact that some species are present in all tree selections - Tamarindus indica, Acacia nilotica - or on the contrary localized in too restricted an area - Ceiba pentandra in Kimré for instance - makes them valueless as references. Moreover those trees have never constituted real parks; at the very best they have grown into a dominant species, as in the case of Tamarindus indica (Nigeria).

We have not plotted on our map some selections such as those of Daniellia oliveri and Khaya senegalensis (2) that may point to a secondary vegetal formation too directly produced by clearing. Their presence seems linked to that of fallow lands, in a kind of "pre-park".

Ziziphus mauritiana (3) too seems a part of a dynamic process rather than the constituent of a stabilized park. It is found - often pruned - on fallow lands, before the development of a more thorough tree selection. It is the most common companion species of Acacia albida, as is evidenced in the history of many parks: South of Mokolo, pioneer fringes of the Massa country ...

For three Sahelian trees - Hyphaene thebaica, Balanites aegyptiaca and Sclerocarya birrea - difficulties arise as to their constituting parks.

-----------------
(1) J. CLANET in: "La culture des jujubiers au Liloa (Kanem)". Annales de l'Université du Tchad.

(2) The pods of Tamarindus indica are used for preparing a porridge and a drink; Acacia nilotica for tannin. As for Ceiba pentandra, its young leaves and fruit are edible, and its very important height made it part of a defence system. The exact role of Daniellia oliveri is unclear, but Khaya senegalensis played an important one: the oil of its seeds was used for protection against the cold, body adornment and skin-treatment, by a population that did not practice weaving. This partly explains its presence in almost every park.

(3) The fruit of Ziziphus spp. is consumed just as it is, in the form of polenta or "bread" that can be stored for a very long time when mixed with ground-nuts and cooked in the earth (Batha, Guerra).
They often appear in populations over wide areas, *Balanites aegyptiaca* north of the Bahr Ergig, *Sclerocarya birrea* south-east of Lake Chad, west of Maza...

This substantial spreading — as is the case for *Balanites aegyptiaca* — follows an alteration of the climate resulting in increased aridity, and a degradation of the environment by man. The sturdiness of that tree and its rooting system enable it to endure as the only seed-bearer.

Yet the anthropophilic character of those species is patent. *Balanites aegyptiaca* is the typical tree in the villages of Chowa Arab breeders who carry it to the South with them. Its presence is systematically reported in their former settlements between the Chari and the Logone.

The doom palm-trees too has spread southwards thanks to the breeders, and it has then been adopted by cultivators in times of want.

South of N'Djaména, it is both useful and noxious. Its stump is difficult to tear out, it can withstand burning, and its tuft-like habit enables it to encroach on other species, pushing fields farther off, choking the remnants of former parks on the Chari at Baigane, Mafaling...Tchagin, Maseke...in the interfluve.

So the rings that those trees make round villages should not be regarded as parks.

The confusion between a natural stand and a park comes from the fact that those trees, being especially useful, are really exploited. Yet neither their selection process nor their relationship with the land can put them in the park category.

North of the N'Djaména latitude, the selection of *Balanites aegyptiaca* and *Hyphaene thebaica* especially by breeders, is done in such a way that man's action seems less planned and is therefore less conspicuous. Their exploitation does not entail any specific right. It takes place among a "natural" vegetation and seems to have been carried out as it were from within, whereas in more southerly zones parks and pseudo-climatic vegetations are more sharply contrasted. Those formations are too marginal in relation to

---

(1) North of the N'Djamena latitude, the fruit of *Hyphaene thebaica* gives a meal that serves as a basis for foodstuffs, and this not only in periods of gaps between crops. In the South, its wood is used for salt, its palms for grasswork. *Balanites aegyptiaca* is an all-purpose tree: leaves for sauces, kernels for oil, wood for carpentry or charcoal... The edible fruit of *Sclerocarya birrea* is used for making a drink, its kernel is roasted, but its utilization cannot be compared to what it is in some regions of West Africa.
the habitat and improved zones, while a park is linked both to the habitat and to the tilled lands, that is to the "terroir". It means the selection of a tree in the field.

Though their utilization is waning in southern zones, those trees appear either inside the park, near the habitat (*Hygrophane thebaica*), or on the fringe of the park (*Sclerocarya birrea*), and often on termite mounds whose pedoclimmate is drier (*Balanites aegyptiaca*).

2.2 - PARKS REFLECTING AN AGRO-SYSTEM

**Acacia albida**

The park with *Acacia albida* is one of the most interesting to map and the most representative of an agro-system.

It seems to care very little for latitude and edaphic conditions: indeed we find it on the summits of the northern Mandara Hills (*Podokwa*), on the piedmonts of island-massifs - not only on the outer edges of thalwegs - on the fossil erg of Kalfou, in the periodically flooded basin of the Logone (*Katoa*).

We do not wish to dwell here on the advantages of *Acacia albida*, as they have been analyzed in detail, not least by P. GIFFARD (1)

Thanks to its inverted cycle, it generates a true micro-climate favorable to cultivation; its litter fertilizes the soil, multiplying the yields of millets and sorghums. The nutritional value of its leaves and above all of its pods is all the more welcome as they are available from February to May, in a critical period for livestock. Moreover it is not affected by pruning.

We wish now, after P. PELISSIER, to stress the role of a sedentary bovine-breeding system in the development of *Acacia albida* parks.

Cattle contribute to the germination of *Acacia albida*, by dissolving in their digestive tract the waxy cuticle of its seeds (2). The part played by bovines in the propagation of *Acacia albida* is clearly perceived by the communities of breeder-cultivators. Yet the tree would never outgrow its

---

(1) P.L. GIFFARD. *L'arbre dans la paysage sénégalais (sylviculture en zone tropicale sèche)*, CTFT, Dakar, 1974.

(2) See following page.
shrubby appearance and develop a crown without the help of man, who prunes it. So the formation of a park necessarily implies a planned action by breeders who keep cattle permanently (1).

The same processes that result in the constitution of a park have led to the presence of similar landscapes among communities that live very far from one another, being scattered over the whole Sudano-Sahelian zone. In the Lake Chad Basin we can mention the Masse, Mouzouk, Kera, Toupouri, Glayde on the Nigerian border.

If the cattle-Acacia albida association can be demonstrated by the negative - that is, no economy without bovines has ever generated a park of Acacia albida - the existence of Acacia albida parks should not be systematically regarded as evidence of the simultaneous presence of cultivation and stock-breeding.

The "cattle + agriculture + Acacia albida" formula does not apply automatically. The population density plays a part in the presence or absence of a park. The Boudouma, for instance, who live on the islands of Lake Chad, have never felt the need to create parks. Neither have the Sounay Masse, that have emigrated from the Logone, where they had developed parks, to the Chari. They have not felt that need because of their great mobility and small densities.

It is the cultivation element of an economy that inspires the constitution of a park, even though cattle are the physical agents.

Cultivator-breeder do not urge the development of parks. In the case of the Diamaré, for instance, Acacia albida is not found in Kalfou, though this place is situated between the two largest park groupings in the region. Some remnants still exist in parks dating from the pre-Paul period, between

---

(1) See preceding page: We do not deny the role that smaller livestock can play in the maintenance of a park.

(2) There is an intermediate formula that makes it possible to utilize some of the qualities of Acacia albida without leading to the constitution of a park. Hundreds of hectares can be left to a shrubby vegetation of Acacia albida, thus creating a pasture which affords a double advantage: being accessible to small livestock, and allowing shorter fallow periods (Gazawa, Binder...).
This situation is not so much due to the fact that few heads of cattle remain all the year round in Peul villages (1), as to a scant interest for cultivation. (2).

Parks now tend to be revived because of increased population densities, a stronger interest for agriculture, and a corresponding decrease in herd sizes.

Parks may sometimes be developed through an association of pure cultivators and of breeders who leave their cattle on stubbly fields where some remnants of former parks are still to be found, as between the Mandara Hills and the island-massifs of the North-East, and in part of Haoussa country.

Acacia albida parks occur either in broken rings or in continuous ones, as in some areas of Toupouri country.

Densities may vary from between eight and ten trees per hectare north of Yagoua to thirty or even thirty-five in the region of Kay Hay, Wini...

The proportions of Acacia albida and associated species may also fluctuate widely. Some parks are quite homogeneous - 90% A. albida and more - in others on the contrary the share of A. albida falls to less than half of the selected tree species.

The present state of a park, its complexity or lack of variety reflect a long-standing or recent human settlement.

Vitellaria paradoxa

The map of karité parks does more than just record an ecological area whose North boundary would be around the 750 mm isoyet; it signals the passage to another agro-system, where cattle are absent.

On latitudes where they can exist side by side, Vitellaria paradoxa parks appear as the very opposite of Acacia albida ones. This reflects as it were an opposition in the two kinds of fats consumed by the two populations:

(1) These heads of cattle are less numerous than those of the Massa or Toupouri breeder-cultivators, which remain permanently on the land. They make up less than one-fifth of the herd that spends the dry season in the Yaeres and the wet season in favourable uncultivated zones, sometimes very far from the villages.

(2) Such little interest as they show has been focused at first on the mouskouari, a sorghum planted-out on vertic soils that do not need to be fertilized by Acacia albida - the latter would not thrive on them anyway.
karite butter on one side, animal fat on the other. The presence of either excludes the other one.

Yet the karité that develop from the existing vegetal stock may have encompassed some islands of Acacia albida along the Mandara (Nigeria) and in the southernmost part of the basin (Chad).

The karité seed is heavy, and man contributes to its propagation. Being pyrophylic, it can withstand bush-fires—except in the blossoming season—and thrives on burned lands.

Karité parks generally have smaller densities than Acacia albida ones and their boundaries are not so well-defined. The Vitellaria paradoxa park is seldom monospecific; it includes Parkia biglobosa, Khaya senegalensis, and in Nigeria Tamarindus indica.

The most northerly occurrences of karité in parks are in Chad the regions of Tie - N'ougar - Darbe - Ninge - Gounou Gaya... In Nigeria they are found farther North, higher than the eleventh parallel.

Its absence in the Diamaré and on the piedmonts of the eastern Mandara Hills cannot be accounted for by a mere southward incurvation of isoyets. It is due to the fact that past agrarian cultures, whose migrations followed a North-South axis, had preferred animal fat to karité butter.

The arrival of the Fulbé with their herds in the early 19th century did not help its development either. So there are no karité parks in that area, only a few rough attempts (Bateo).

On the contrary in Nigeria, South of the Bornou, and on the Mandara foothills, thanks to a higher rainfall and to the favorable economic systems of the past, parks are wide and dense.

**Borassus aethiopum**

Like Acacia albida and Vitellaria paradoxa, it exemplifies one specific type of economy.

Its fusiform gern that sprouts at its foot and in drupe-gardens at the back of the concessions makes it the right tree for female periods.

The point of storing gerns in the ground was to make up for rebeater- raids and the plunder of standing crops; thus the razzia was made part of an economic equilibrium.
The boundaries of palmyra groves follow the limits of the northern marches of Sahelian states south of the Bornou, for instance, the Wayo region in the South and in the South-West of the Baguirmi the Sarwa country, Ngam, Morno.

Palmyra regions spread over all the former buffer zones, from the vestigial groves of the Bahr el Ghazal west of Cheddra in lower Chari to the Logone area between Bornou and Baguirmi.

These palmyra groves act both as shelter-zones and as pivotal patches for redistribution in the course of migrations.

For the Kwang communities, in the interfluve between Chari and Logone, Borassus aethiopum is the key of the whole agro-system. The Kwang population does not extend farther than palmyra groves.

Besides the germ, a staple food, people use the pericarp, the albumen, the palms that serve for making salt and for grasswork...(1).

Borassus aethiopum is utilized by populations coming from the North. In the Lake Chad Basin it is not used for making palm-wine, because its strictly nutritional value has always been predominant.

The Ngam grove includes other useful species: Prosopis africana, Ficus spp., Khaya senegalensis...

All palmyra groves are not man-made parks, far from it: the largest one (Ngam) can be regarded as quasi-climatic.

Yet they are all tended by man who may even extend them farther out.

Palmyra drupes can be carried and planted; so this tree can be found in parks having a wide variety of species. Its first appearance in these parks, where it can grow to a dominant status, always corresponds to a period of insecurity, that compelled the people to reduce the surface of their lands, around the island-massifs of Midjiving, Kong Kong (North Cameroon), round the Logone cities in small groves (Gofa, Holom...).

---

(1) Interest for palmyra wood is quite recent. Formerly it was forbidden to fell palmyras, especially female shoots. Wood was then derived from Anogeissus leiocarpus, Prosopis africana...
Borassus aethiopum parks are fragile and may disappear quite suddenly. They were destroyed on Chari - Mefi, Bougoumon - when the river area was conquered by Massenya in the middle of the 18th century. More recently, some palmyra groves have been threatened by the growth of towns, which consume large quantities of timber.

Ficus gnaphalocarpa

Ficus gnaphalocarpa too is a tree for times of want that spreads in periods of chronic insecurity.

Traditionally the fruit, always plentiful, were dried for conservation. Crushed and mixed with groundnuts and millet bran, they were used for preparing the "boule" (a very thick porridge), gruel and even an alcoholic drink.

Like Parkia biglobosa, Ficus gnaphalocarpa is a melliferous tree (1).

Its protection and development were ensured by a true agrarian discipline, as strict as was the case for Borassus aethiopum.

Ficus gnaphalocarpa was most often a mere component of the selected vegetation and a tree for inhabited areas. It occurs as a dominant in some zones, in the Chari-Logone interfluve, especially in Soumray country, but this is at best an occasional park.

2.3 - OCCASIONAL PARKS

These parks have no reference value per se, but this does not make them unrepresentative. The very absence of the trees they have replaced on some latitudes gives a number of clues as to the prevailing economies.

Parkia biglobosa

It yields both a condiment (seed) and a basic ingredient for sauces (tegument).

(1) We can understand its value when we know that the most common tribute demanded by the Baguirmi, together with prisoners, was honey.
It is frequently associated with karité and its utilization conforms to a stricter code of rights than applies to the latter, because it is regarded as more valuable. In the concentric layout of parks, it appears in the inner circles, closer to the inhabited zone.

It can constitute a park only where karité disappears.

It is the single species on the central Mandara highlands and on banks of rivers such as the Logone, on the fringe of the zone under study, where the karité dwindles away, not so much because the water-table is too close to the surface as because the traditional fat utilized in this economic area comes from the river.

In Nigeria, between the tenth and eleventh parallel, parks are dominated by a trio: Parkia biglobosa, Vitellaria paradoxa, and Tamarindus indica.

It would be interesting to study whether the decreasing role of Karité in favor of néré is due to the massive Fulbe settlement, as in Gombe, or to purely edaphic conditions.

To be plotted on a map, the variations in the proportions of Vitellaria paradoxa and Parkia biglobosa would require a much more detailed investigation than can be afforded by a bird's-eye view; so we have chosen to map them together.

**Adansonia digitata**

Its numerous utilizations range from fresh leaves, dried ones (saucés), through fruit pulp (porridge), to fibers (ropes, ornament)...

Being nitrophilic, it grows better near human dwellings and is severely affected by bush-fires when young.

It is included in the range of park species, and its mere presence is enough to signal the place where a former village stood. High population densities and mobile settlements can lead to a park formation in some areas of the Bornou.

The baobab occurs in parks or as the dominant in a selection of useful species north of the eleventh parallel, then as it goes down South it becomes more integrated into inhabited zones or inner rings of parks, like the other anthropogenic Sahelian trees.
If Adansonia digitata is not characteristic of one economic type, it is nevertheless representative of a cultural area and of past, often remote migrations. Widespread in the West and South-West of the Chadian basin, it is not so common in the East where it appears in isolated patches, as in Goubara (North Cameroon), Holom (Chad).

**Prosopis africana**

The main advantage of *Prosopis africana* is its hard, rot-proof wood that in addition produces first-rate charcoal. Its leaves and dry pods are relished by livestock.

Though a legume like *Acacia albida*, *Prosopis africana* is not endowed with as many qualities as the former. It has ichthyotoxic and tanniferous properties. Difficult to fell, heliophilic, and furthermore reproducing itself easily by suckers, it shows a great encroachment capability. Thus it populates fallow lands in recent settlements and often occurs on the fringe of parks in the outer halo.

Yet it may constitute true parks with very high densities, in Mousey country, between Sika and Bogo. Sometimes it replaces quite suddenly the *Acacia albida* park of breeder-cultivators, as between Moulfouday and Bogo (Chad).

The population of *Prosopis africana* is supplemented by *Parkia biglobosa*, *Vitellaria paradoxa*, *Ziziphus mauritania*, *Bombax costatum*, and a few *Adansonia digitata* individuals near villages.

To the South, it gradually yields in percentage to *Parkia biglobosa*, *Ficus gnapholocarpa*, *Vitellaria paradoxa*; but, even in old parks, *Prosopis africana* is always present (1).

In Marba Mousey country it is park element characteristic of those ethnic groups whose socio-economic system was geared to the breeding of Kirdi poneys, which accounts for their population density and command system.

Other non-Muslim groups whose economic system also centered on the horse have not, however, selected *Prosopis africana* out of their national environment: bush Mousgoum, some Hadjeray groups.

(1) *Prosopis africana* is used everywhere for ostentatious graves made by sticking tree-trunks in the ground. Such tombs are common landmarks of Marba Mousey country.
Unlike *Acacia albida*, *Prosopis africana* is not linked to one specific agrarian culture.

*Andansonia digitata* reaches the park stage through the inhabited area, while *Prosopis africana* comes from the fallow lands. But they are both part of those Sudano-Sahelian species that can spread southwards because of their heliophilic nature and, like *Acacia spp.*, are helped in their development by clearing.

### 2.4 COMPLEX PARKS WITHOUT A DOMINANT SPECIES

These are parks in which some trees are co-dominant, with a very wide range of selected species.

This is generally due both to a long-standing settlement and to a high population density or compact territory.

**The case of the northern Mandara Hills**

Helped by exceptional densities and economies that used to be largely self-sufficient, tree parks are quite varied, without any true dominant except in Podokwa communities (agro-pastoralists) of the extreme North.

These parks are generally confined to mountain zones, which are the only cultivated ones, with the plains and piedmonts left to the bush. But the situation is precisely reversed on the piedmonts of the western Mandara (Nigeria): when mountain ranges are cultivated, piedmonts remain unplanted; when parks grow on piedmonts, then mountain zones are uncultivated.

The same tree selection is present on all massifs though densities and compositions vary from one place to another, reflecting the specific way of life of each ethnic group.

If we take as an example the various species used for firewood, the Mofou select *Ziziphus mauritania*, *Lannea microcarpa*; the Mada, *Anogeissus leiocarpus*; the Podokwo, *Terminalia brownii*...

On the Mafa massifs, as wood is scarce, all trees are pruned, *Ziziphus spp.* as coppices, the others as pollards: *Ficus spp.*, *Tamarindus indica*, *Khaya senegalensis*, and even *Vitex doniana*, *Acacia albida*, *Piliostigma reticulata*...
A complex park can be concentrated on a small area, in notches cutting into the massifs, ahead of the houses, as in Boudoum, south-west of Maroua. This park, formerly surrounded by a thick net of hedges, is very rich: Acacia albida, Borassus aethiopum, Adansonia digitata, Celtis integrifolia, Ziziphus spp, Vitex doniana, Diospyros mespiliformis, Ficus gnaphalocarpa, Khaya senegalensis, Acacia nilotica, Bombax costatum.

This phenomenon can be observed, too, on the shelter-zones of the Bauchi island-massifs (Nigeria). The selected species are generally: Khaya senegalensis, always used for its wood, Tamarindus indica, Ficus gnaphalocarpa, Vitex doniana...and above all Parkia biglobosa.

It is difficult to draw a map these zones, that have been much improved by man but occur in quite isolated patches amidst a secondarized or pseudo-climatic vegetation. It would cover the central and southern Mandara Hills, the island-massif zones, the Bauchi...

The case of the Kimré region

Parks do not always reflect a single agro-system, but deciphering the tree selections - always with the help of oral traditions - enables us to trace the succession of several agro-systems in the course of time.

The Kimré region lies on the edge of the Logone flood-plain east of Laï, at the meeting-point of the main migration flows.

On an earlier human stock, that had preserved or even developed Celtis integrifolia, Khaya senegalensis, Ceiba pentandra and perhaps Prosopis africana - owned by the ironsmiths that were then the dominant social category - groups of breeder-cultivators coming from the North-East of the Chari have superimposed their culture.

The late-comers' economy was based on red sorghums and the breeding of small bovines. At the time they developed a park of Acacia albida, rather in the same way as the Massa do nowadays.

From the middle of the 18th century, a feeling of insecurity grew because of the Baguirmi's action; the horse (Kirdi poney), better fitted to the situation, took the place of cattle, and thus the whole agro-system was altered. In the same process the cultivation of planted-out sorghums and eleusines expanded.
Chronic insecurity then favored the development of two famine-period trees: *Borassus aethiopum* and *Ficus gnaphalocarpa*.

In spite of multiplying raids, the 19th century was marked by a northward migration of southern, grain-growing populations that pushed the selection and development of *Vitellaria paradoxa*, as the basis of their staple fat, and of *Parkia biglobosa*.

Groups coming from the South generally show a greater regard for trees than those from the North; a "sealing-off" process actually took place, enabling some elements of pre-existent parks, such as *Acacia albida*, to persist though they are quite rare in the South.

In addition, the park includes *Hyphaene thebeica*—carefully controlled—*Ziziphus mauritania*, *Vitex doniana*, *Tamarindus indica*, *Acacia nilotica*, *Detarium microcarpum* (1).

So this park, that used to occupy territories characterized by a semi-scattered habitat, has no dominant species. It gives an accurate record of the successive layers of population with their main economic features. Such parks often occur as isolated examples, in favored regions, on long-inhabited and conservative terroirs.

### 2.5 FOSSIL PARKS

A park keeps its balance with the society of cultivators that has created it. Thus some parks could be referred to as climatic, others as nascent, still others as fossil.

A detailed map of fossil parks would yield valuable information. We have only outlined here some areas occupied by the most representative one, the park with *Acacia albida* and its accompanying species.

Some vestigial parks remain with the same selected stock on fragments of once-wide areas: the Chari, Koubar country...

Former parks can be traced through their substitutes. On the right bank of the Chari, *Ficus platophylla* has choked off *Acacia albida* that had

---

(1) *D. microcarpum* thrives in that area, and its fruit is used for making "sugar".
been left in the fields for shade and because of a traditional regard for this tree among the Barma.

It can be found only in fields, as a sort of loose park. Its frequency gives one of the most certain vegetal clues for tracing previous parks, and those clues are always confirmed by oral tradition.

Some others, more northerly, have completely lost their former structure, and can be perceived only through the persistence of some species that endure, sometimes dissociated from one another, in less hostile environments.

Such is the case in the Kanem for the Am Hadid, Faragoul, Goskrey, and Monou Wadis, or the region west of Mao where Acacia albida has persisted. The presence of Ziziphus spp. and some other trees such as Ficus gnaphalocarpa and even Bombax costatum, which are meaningful when found in southern regions, leads us to imagine several successive economic paleo-systems rather than just one.

These can be re-discovered only because we know about parks that are still "living" in southern areas and about local history.

111. THE DISTRIBUTION OF PARKS IN THE CONVENTIONAL LAKE CHAD BASIN

3.1 DRAWBACKS OF A SIMPLIFIED CARTOGRAPHY

The 1/1,000,000th scale does not allow a true cartography of parks. Their outlines are not well-defined enough, and the sprinkling of parks linked to inhabited areas cannot be made to stand out because they are intermingled with zones of secondary vegetation and fallow lands.

A more appropriate scale would be that of the terroir or group of terroirs, as it would show at the same time the densities, the proportions of dominant and other species, and the clear-cut or gradual limits of a park.

It would emphasize the three main parts of a park: the inhabited area, the park proper, and its fringe, bringing out the basic relationship that links the type of habitat, the population density, and the park.

The discrepancy that appears in the stratigraphy of parks according to latitude shows their limits as more arbitrary than those of non-anthropogenic
vegetations, and is due to the deliberate character of their implantation.

This map contrasts a relatively continuous zone of parks with an almost empty area, thus allowing to bring out the general processes whereby they appear, persist or disappear.

3.2 - CAUSES LEADING TO THE PRESENCE OF PARKS

Park landscapes follow a North-West to South-East line that cuts the latitude of Lake Chad south of the Basin.

This latitude does not affect some species: Adansonia digitata, Acacia albida, Borassus aethiopum, Ziziphus mauritiana... For some others on the contrary it is the limit of their existence: Parkia biglobosa, Vitellaria paradoxa.

Parks are found on populated zones from Haoussa country north-west of the Mandara hills to the Logone plains, more precisely in regions of contiguous terroirs and thorough vivification.

They are linked to socio-political groups of park-builders, to a city or ethnic group that creates its own landscape, each park being part of a specific agricultural "mix", even if it belongs to a well-defined agro-system.

The economic framework is that of more or less self-sufficient cultivators or breeder-cultivators. Human densities are the determining element in the density and complexity of these tree selections.

3.3. - CAUSES LEADING TO THEIR ABSENCE OR DESTRUCTION

We must account for the wide empty areas in the center and eastern parts of the map.

Parks do not seem to fit readily with some economic systems, such as that of the river people living in the Chari-Logone flood zone. Their economy, entirely centered on the river - fish, fish-oil, salt derived from aquatic grass - has not led them to select some tree species, which would have had a hard time anyway in this unfavorable, yet not entirely hostile environment.
Some economic systems of the past have not left any parks either: groups of hunters or those who, though they had a small taurine herd, have not made it a part of their agricultural mix and have moreover given prominence to gathering in their economy.

The existence of parks, and especially of those constituted by Acacia albida, seems hardly compatible with a massive presence of pure breeders, Chowa Arabs and Fulbé being a case in point. They are to be blamed for the destruction of most of the Chari parks, wherever cultivators had left temporarily and densities had plummeted. In the early 19th century, the conquest of the Diamaré by Paul breeders has led to a devastation of the parks left by the Zoumaya population of breeder-cultivators, through over-exploitation: forage for small livestock, fumigation, firewood...

Yet the disappearance of the Chadian Basin parks, that have suffered in the last centuries the same deterioration as the whole Sahelian vegetation, was essentially caused by historical and human factors (1).

Parks cannot thrive either in some politico-economic frameworks such as the centralized states of the Chadian depression: Kanem, Bornou, Baguirmi...

These Moslem states, that have united the pre-existent populations in one melting-pot, have expanded their territories by war, and each of them eventually created around itself, especially southwards, a vast, almost empty glacis.

But the disappearance of parks was mainly due to their devastation, in the Bornou under the various Mai, especially Idriss Alvama, and on the Chari by Mbang Hadji; it was the outcome of a complex network of causes.

The conquerors brought a way of life and an economy typical of cultivators from more northerly zones, where breeding, reserved for specific ethnic groups, was dissociated from cultivation.

Imitating the conquerors' economic model, and their mentality that was generally less favorable to tree-growing; planting new varieties of millet whose cycle was at times incompatible with a tree cover, for instance of

(1)There are numerous exceptions, however, such as the disappearance of palmyra-trees in the Massenya region, that was caused by a lowering of the water-table.
Acacia albida; settling in more concentrated villages, a typical feature of Moslem habitat; all these led to a decreasing control of space and parks.

The religious organization of indigenous populations was destroyed; formerly the "land-chiefs" acted as curators of parks and enforced a strict agrarian discipline in their maintenance, as was still being done in southern zones at the beginning of the colonial period. Some species could be allotted to them; others belonged to specific groups such as ironsmiths (1), and the whole selected vegetation might even be apportioned on a family basis.

The disappearance of some economic features that were essential but too much linked to the former pagan cults, as was the case for cattle-breeding, led inevitably to the demise of their tree-element (Chari, Bahr Ergig...).

Being enclosed in the boundaries of a large empire then meant a more open type of economy, often with actual markets, the development of new cultures such as the groundnut, and of new "vegetables" that made some "sauce-trees" no longer necessary.

The ending of chronic tensions that had been caused by the variety of small ethnic groups enabled communities to expand their lands and practice a more extensive kind of agriculture.

For all these reasons, the tree selection lost some of its importance and it disappeared all the more easily as the traditional agrarian discipline was no longer applied.

The mass arrival, just after the conquest, of pure breeders, who for safety reasons ranged only within the boundaries of large Moslem empires and seldom went farther than their southern marches, was instrumental in the disappearance of some parks.

On those latitudes, they were not replaced by a more intensive agriculture of the wadi type, with true plantations on the pattern of jujube and palm-tree groves; so these parks have never been restored.

\[(1)\] Khaya senegalensis among the Guiziga and Mofou. Prosopis africana among the Ngam ironsmiths.
CONCLUSION:

Parks first appear as creations of some agrarian ethnic communities that are deeply rooted in the land. High densities and a perennial agro-system are necessary for their maintenance. They chiefly thrive where human habitation is scattered and where a sedentary breeding system is associated with agriculture.

Whenever the human density falls, the park recedes towards the inhabited perimeter; conversely a higher density causes the park to spread out into pioneer fringes.

Changes in the agro-system produce a qualitative transformation of the park, sometimes a whole mutation, of course only as far as is permitted by the natural environment. Some communities, of a more conservative character, only record changes without altering the essential elements, which produces complex parks...

Parks are found on the outer circles of the Lake Chad Basin, in the West, South-West, and South; they contrast with empty zones formerly included within Sahelo-Sudanian empires, where parks mostly remain as vestiges nowadays.
BIBLIOGRAPHY

A. AUBREVILLE

Flore forestière soudano-quinéenne
1950

J. CABOT

Le bassin du Moyen Logone
Mémoires ORSTOM 1965

P. CREACH

Le Balanites aegyptiaca, ses multiples applications au Tchad
Rèvue de Botanique appliquée et d'Agriculture tropicale. 1940, p. 578-593.

J.M. DALZIEL

The useful plants of West Tropical Africa
1948

G. FOTIUS

Etude phytosociologique du triangle
Fort-Lamy - Bouso - Laï
ORSTOM Fort-Lamy 1963

P.L. GIFFARD

L'arbre dans le paysage sénégalais
(sylviculture en zone tropicale sèche)
C.T.F.T. - Dakar 1974

H. GILLET

Agriculture, végétation et sols du Centre et Sud Tchad (feuilles de Miltou, Dagela Koumra, Moussafoyo)
CRT ORSTOM 1963

A. GRONDARD

La végétation forestière au Tchad
R.B.F.T. 93 1964

H. JACQUES FELIX

Le Karité (Butyrospermum parkii) au Cameroun
Rèvue de Botanique appliquée et d'Agriculture tropicale. n° 279-80

R. LETOUZET

Etude phytogéographique du Cameroun
Encycl. Biol. LXIX Paris 1968
Types et genèse des paysages de parcs élaborés par l'agriculture africaine
20e congrès international de Géographie, Abstracts of papers London 1964
Les paysans du Sénégal 1966

La végétation du Tchad, ses rapports avec les sols, variations paléo-botaniques au quaternaire
Travaux et Documents de l'ORSTOM Paris 1970

Cartographie des parcs au sud du Chari
Projet pour la conservation d'un parc d'arbres sélectionnés et entretenus dans la région de Kimré
(Préfecture de la Tandjilé Tchad)
evr. 1978
Acacia albida et Vitellaria paradoxa témoins de deux agro-systèmes
Annales de l'Université du Tchad mai 1978

Végétation de clôture et systèmes de défense végétaux pré-coloniaux de la zone soudano-sahélienne
(Tchad et Nord-Cameroun)
Annales de l'Université du Tchad n° sept. 1978

Paysages de parc et civilisations agraires
Essai de typologie (Tchad et Nord-Cameroun)
Annales de l'Université du Tchad n° sept. 1978
CONCLUSIONS
Pastures found in the Lake Chad Basin may be used in a variety of complementary ways which make them more or less valuable as such.

North of the 15th parallel, pastures may be grazed during the rainy season whenever the rate of annual rain-fall is normal; the stocking rate on grazing lands more to the south may thus be reduced accordingly. The yield of these pastures is not reliable and cannot therefore be taken into account when considering the total yield of Sahelian pastures.

Between the 15th and 13th parallels, Sahelian pastures may be grazed all year, with carrying capacity something between seven to ten hectares per head. Pluviometric variations must not be overlooked. Alternate solutions must be built into the grazing schedule in case of drought - migrating south towards known pastures or using part of the fenced-in areas along the way as grazing spots.

In this particular region of the Sahelian Sahara, depressions and wadis constitute interesting sources of additional forage material.

Between the 13th and 11th parallels, pastures may be grazed year-round if the annual graminaceae of which they are made up are slender varieties such as Schoenfelda gracilis, Aristida mutabilis, Panicum sp., or Pennisetum pedicellatum. Capacity here is of six to eight hectares per head.

Some of these pastures should preferably be grazed during the rainy season; they are the ones where the annual Hyparrhenia bagirmita is found, as this particular grass becomes unpalatable with the advent of the dry season. Capacity here during the rainy months and at the beginning of the dry season is of two hectares per head.

Numerous ponds are to be found throughout the Sahelian region of the Sahara, contributing to the improved yield of its pastures.

Part of the area is under cultivation, which reduces the size of pastures accordingly. If the land is laid fallow for an appropriate period of time after crops have been harvested, animals will be able to graze slender grasses such as Schoenfeldia gracilis or Eragrostis tremula or to feed on crop residue. Unfortunately however, intensive cultivation often causes sterilization of the soils and promotes erosion in its early stages.
South of the 11th parallel, i.e. as far down as the 9th parallel, various types of pastures may be encountered. Herbaceous layers made up of graminae such as Aristida or Loudetia, which become unpalatable during the dry months, should be exploited during the rainy season. Pastures whose hydromorphy is too high can be but little used, whether during wet or dry months, as their grasses are coarse and tough; however, the regrowth which springs up after scorching is palatable. A case in point is the Lai plain, in Chad.

South of the 9th parallel, pastures could be exploited throughout the rainy season if it were not for insects which may bother the animals, even though the village herds do graze in this area, on the village plots laid fallow. Post-fire regrowth is poor but it is exploitable in the dry season, as are pastures found along the major rifts of the large depressions, such as that of Mandoul.

To these pastures above may be added the Yaere which are, for the most part, located in North Cameroon; they constitute excellent dry-season grazing lands, when covered with post-fire regrowth. Capacities at that time and for the four subsequent months are of two hectares per head.

In the Lake Chad Basin, the year-round exploitation of natural pastures is rarely possible; to remedy this situation, movements of men and animals must be undertaken over a wider or narrower range, as the case may be, even within the existing migratory routes of the Sahel. Yet, this mobility is not sufficient in itself to avoid the loss of animals during drought years, as was amply demonstrated in 1973 and in the following years.

Extensive live-stock rearing in the Lake Chad Basin must take into account the complementary of the various zones in the area and schedule migrations towards reserve pastures in case of drought in the Sahelian region.
APPENDIX I

DETAILED DESCRIPTION OF THE VEGETATION
Vegetation in the Sahelian zone is chiefly characterized by the predominance of plant formations located on sandy substrates. Sahelian sands present a variety of topographical aspects ranging from dunes to sandy plateaus, with numerous intermediate geological facies.

Dunes may be mobile or have become fixed because of vegetation; their curves may be more or less salient, turning almost imperceptibly from wide, undulating ones into flat, sandy plateaus.

The sands of these regions are pock-marked with clayey-bottomed depressions or wadis, and traversed by the wide valleys of the Bahr-el-Ghazal in Chad and of the Dillia in Niger.

As a result of this varied morphology, which is matched by different rates of precipitation in the Northern and Southern Sahel, various kinds of vegetational formations were able to develop in that area.

To begin our description of these formations, we will deal first with plants found in high-relief areas, which roughly correspond to the most arid ones. Specific cases will be examined afterwards.

I. FORMATIONS ON HIGH-RELIEF DUNES

This substrate is the prevalent one throughout the north-central part of the Sahel, the whole area being known under the name of Manga.

The Manga Dunes present a contrasting landscape of steep hills intersected with depressions, at times very deep, on which shrubs concentrate.

The floristic composition alone allows for the distinction to be made between the various vegetational formations.
A) Formations with Acacia raddiana, Balanites aegyptiaca, Leptadenia pyrotechnica and Aristida mutabilis on high dunes of the Manga

The shrubby layer is sparse on the summit of the dunes, becoming denser on the slopes and at the bottom. It is composed of Balanites aegyptiaca, Acacia raddiana and Leptadenia pyrotechnica.

In addition to these physiognomically prevalent species, a variety of short shrubs, Commiphora africana and especially Commiphora quadricincta, may also be found in this area of northern Sahel, which constitutes its sole habitat. A few specimens of Maerua crassifolia grow there as well.

The perennial herbaceous cover is limited to Panicum turgidum at the summit of the dunes, with occasionally some Cyperus Jeminicus and Aristida pallida as well.

Aristida mutabilis is the dominant species of the annual herbaceous growth whose coverage nevertheless remains rather thin. Alongside Aristida mutabilis, one finds the following species: Cenchrus biflorus, Dactyloctenium aegyptum, Fimbristylis exilis, Alysicarpus ovalifolius, Polycarpaea corymbosa and Gisekia pharnacioides.

This type of formation may be classified as an open shrub steppe.

B) Formations with Panicum turgidum and Leptadenia pyrotechnica on Manga dunes with contrasting relief

This formation is frequently found on top of the dunes and on the slopes, on coarse, sandy soils. It closely resembles the preceding one but for the relief of the terrain on which it grows. Its habitat is south of the Termit massif, in Niger.

The woody stratum is sparser, especially on top of the dunes where Leptadenia pyrotechnica predominates down to the bottom of the slopes, when Acacia raddiana grows alongside of it.
Panicum turgidum—the most common species here—grows in large, sand-retaining tufts. This perennial grass is mixed with Aristida pallida and Cyperus jemicinus.

Annual species are dominated by Aristida mutabilis, accompanied by Cenchrus biflorus, Gisekia pharnacioides and Indigofera sessiflora.

This type of vegetation may be described as an open shrub steppe occasionally becoming a grass steppe.

C) Formations with Commiphora quadricincta, Salvadora persica and Aristida spp. (Sd/CA)

This type of formation is found near the Chadian border, in Niger, and specifically between the 14th and 15th parallels, south of the Manga range.

The woody stratum is composed of Commiphora quadricincta and of Salvadora persica, with the addition of Leptadenia pyrotechnica, Commiphora africana, Acacia raddiana, Maerua crassifolia and Balanites aegyptiaca.

The perennial herbaceous cover is solely made up of Aristida pallida and of Cymbopogon proximus.

The annual herbaceous stratum is here as elsewhere dominated by Aristida mutabilis, Erugrostis tremula, Cenchrus biflorus and Schoenefeldia gracilis which grow on the slopes of the dunes. Together with them, one finds Dactyloctenium aegyptium and Aristida adscensionis.

This formation may be classified as a shrub steppe.

D) Formations with Leptadenia pyrotechnica and Panicum turgidum on dunes (Sd/LP)

The dunes on which this type of formation is found are situated north of the 15th parallel; they are frequently irregular in shape and very steep.

The woody stratum densely covers the depressions between dunes; Leptadenia pyrotechnica and Acacia raddiana are the dominant species.
The perennial herbaceous cover is important; its main components are Panicum turgidum, Aristida pallida, Cyperus jeminicus and Cymbopogon proximus.

This is a shrub steppe with thorny bushes.

E) Formations with Acacia Raddiana, Commiphora africana, Aristida pallida and Cyperus jeminicus, on dunes east of the Koutous, in Niger (Sd/RP)

This type of formation occupies the area east of the Koutous Massif and north of Kiriguim, in Niger. Dunes are interspersed with long, narrow wadis lying along a north-westerly-south-westerly line; it grows on the large, regularly-shaped dunes.

The shrub species are Acacia raddiana, Commiphora africana, Leptadenia pyrotechnica and Balanites aegyptiaca.

The perennial species are Aristida pallida, Cyperus jeminicus, Panicum turgidum, Aristida papposa and Cymbopogon proximus.

Aristida mutabilis is, as usual, the dominant species among annual ones; also found are Eragrostis tremula, Schoenefeldia gracilis, Dactyloctenium aegyptum, Cenchrus prieurii, Cenchrus biflorus.

F) Open shrub steppe with Leptadenia Pyrotechnica, Cymbopogon proximus and Aristida mutabilis (Sd/CP)

This type of shrub steppe is found in Niger, in the valleys adjacent to the Koutous Mountain range.

The woody stratum is characterized by Leptadenia pyrotechnica and Merua crassifolia mixed with some Acacia senegal and Balanites aegyptiaca.

The herbaceous cover is chiefly made-up of Cymbopogon proximus and Aristida mutabilis along with A. pallida and Schizachyrium exile.

II FORMATIONS ON DUNE UNDULATIONS

They are found in Niger, on the sandy terrains east of the Koutous Massif.
A) Formations with Acacia senegal, Acacia raddiana and Aristida mutabilis, on dune undulations of the northern Koutous (So/SA)

This type of vegetation occupies a fairly small proportion of the regularly-shaped and regularly-oriented dunes; instead, its chief habitat is located on the slopes of the dunes.

The woody stratum is dominated by Acacia senegal and Acacia raddiana, which are found together with Salvadora persica, Balanites aegyptiaca and Commiphora africana.

There are no perennial grasses. The main annual graminacea of the herbaceous cover is Aristida mutabilis; others are Aristida funiculata, Eragrostis tremula, Schoenefeldia gracilis and Cenchrus biflorus.

This type of formation may be called a shrub steppe.

B) Formations with Acacia raddiana, Commiphora africana, Cymbopogon proximus, Cyperus jeminicus and Aristida mutabilis, on dune undulations of the eastern Koutous Massif (So/RC)

This type of formation covers vast expanses in Niger; it reaches all the way to the fossil valley of the Dillia, in the East. It grows on the undulations of the regularly shaped dunes; its density varies according to its position, i.e. on the summit or on the slopes.

Acacia raddiana, Commiphora africana, Leptadenia pyrotechnica and Salvadora persica are the predominant shrub species.

The perennial herbaceous stratum contains a large number of species, Cymbopogon proximus being the dominant one among them, such as Cyperus jeminicus, Panicum turgidum, Aristida pallida, with Cymbopogon giganteus growing on the shoulders.

The annual herbaceous stratum is dominated by Aristida mutabilis, and Aristida adscensionis, along with Eragrostis tremula and Dactyloctenium aegyptium.

This type of formation may be qualified as an open shrub steppe.
III. FORMATIONS ON SANDY PLATEAUS

This is the type of formation most frequently encountered in Niger as well as in Chad. The plateaus themselves are not rigorously flat; small undulations occur here and there but they are negligible in relation to the strongly delineated relief of the dunes and of the dune ripples.

A) Formations with Leptadenia pyrotechnica and Panicum turgidum, on coarse, sandy plateaus of the northern boundary area (Sp/LP)

This type of vegetation grows at the northern limit of the Sahel, in a region where winds constantly shift the coarse surface sands of the area.

On the crests and slopes of the dunes the woody stratum is practically non-existent; instead it is found at the bottom of the dunes and in the southern part of the area. The most frequently occurring species is Leptadenia pyrotechnica, mixed with Acacia raddiana.

The perennial herbaceous cover is limited to a few, large tufts of Panicum turgidum which retain the sand at their base, and to even fewer tufts of Cyperus jeminius and Aristida papposa.

The annual herbaceous stratum is composed of Aristida mutabilis, which is the most prevalent species with Gisekia pharnacioides. This last species being present here is an indication of the irregularity of rain precipitations in North Sahel.

This type of vegetation cover may be qualified as an open shrub steppe becoming a grass steppe.

B) Formations with Acacia raddiana and Cymbopogon giganteus, on sandy, eroded plateaus of the Northern Koutous Massif (Sp/RC)

This is found to the north of the Koutous range, on thick, eroded sands which constitute a favorable terrain for shrubby growths.
The woody stratum is constituted by *Acacia raddiana* and *Salvadora persica*, with *Commiphora africana*, *Balanites aegyptiaca*, *Leptadenia pyrotechnica* and *Acacia senegal*.

The perennial herbaceous stratum is characterized by *Cymbopogon giganteus*, accompanied by *Cyperus jeminicus* and *Aristida pallida*, with a species seldom present in the Sahel, *Andropogon gayanus*.

*Aristida funiculata* and *Aristida mutabilis* are the most prevalent species in the annual herbaceous cover.

This formation may be classified as a shrub steppe.

C) **Formations with *Acacia raddiana*, *Leptadenia pyrotechnica*, and with *Cyperus jeminicus* and *Aristida pallida*, on sandy, eroded plateaus of the northernmost Koutous** (Sp/RL)

This type of formation is located to the north of the preceding one, i.e., to the north of the 15th parallel, on peneplaned, coarse-sand plateaus with dune formations.

The woody stratum is dominated by *Acacia raddiana* and *Leptadenia pyrotechnica*, mixed with *Commiphora africana* and *Balanites aegyptiaca*. *Commiphora quadricincta* occurs at the outer, northern limit of the growth area of this type of formation, while *Acacia senegal* is present on the southern one.

*Cyperus jeminicus*, *Aristida pallida* and *Aristida papposa* are the predominant species of the perennial herbaceous stratum.

The annual herbaceous stratum is composed of *Aristida funiculata* and *Aristida mutabilis*.

This type of formation is an open shrub steppe.

D) **Formations with *Salvadora persica* and *Cyperus jeminicus*, on sandy plateaus** (Sp/SC)

This type of formation covers a large area of Niger which is situated immediately south of the dune undulations and east of the Koutous range or, more precisely, east of Kiriguim, all the way up to Lake Chad (N'Guigmi).
The shrubby cover is characterized by Salvadora persica mixed with Leptadenia pyrotechnica, Acacia raddiana and Commiphora africana.

The perennial species growing there are primarily Cyperus jeminicus and Aristida pallida.

Annual species are dominated by Aristida mutabilis, Cenchrus biflorus and Schoenefeldia gracilis.

The Doum-palm, Hyphaene thebaica, grows on the clayey-loamy bottoms of the pan-like depressions which are found here and there on those plateaus. Graminaceae of the Schoenefeldia gracilis, Cenchrus biflorus, Chloris pilosa and Chloris prieurii species also occupy the bottom of these wadis.

The formation of these sandy plateaus is a shrub steppe.

E) Formations with Acacia raddiana, Balanites aegyptiaca, Leptadenia pyrotechnica and Aristida mutabilis and Aristida funiculata. (Sp/RA)

This type of formation occupies vast expanses situated in the Sahel part of the Lake Chad basin which spread from the east of N'Guigmi, in Niger, to the boundaries of the prefectures of Kanem and of Batha, in Chad. It lies between the 14th and the 15th parallel.

Occasionally, the shrubby stratum is rather dense for a Sahelian landscape; it is composed of Acacia raddiana, Balanites aegyptiaca, Leptadenia pyrotechnica and of a few specimens of Mareua crassifolia.

Cyperus jeminicus is the predominant species of the perennial herbaceous stratum.

Aristida mutabilis and Aristida funiculata are the predominant species of the annual herbaceous stratum; they are accompanied by Eragrostis tremula, Schoenefeldia gracilis, Dactyloctenium aegyptum and Gisekia pharmacioides.

This formation is a shrub steppe.
F) Formations with Acacia senegal, Acacia raddiana, Balanites aegyptiaca, Leptadenia pyrotechnica and Aristida mutabilis, on sandy plateaus (Sp/RS)

This type of formation, like the preceding one, occupies vast areas. It is divided into two sections, the one lying on either sides of the border between Niger and Nigeria, the other reaching up to the boundaries of the Kanem and Batha prefectures, in Chad.

The woody stratum is characterized by Acacia raddiana, Acacia senegal, Balanites aegyptiaca, Commiphora africana, Leptadenia pyrotechnica and with Salvadora persica as well, this last species being present primarily in Niger.

The herbaceous stratum is composed of Aristida mutabilis, Eragrostis tremula and Dactyloctenium aegyptum. One also finds Andropogon gayanus, Cymbopogon proximus, Diheteropogon hegerupii and Ctenium elegans, primarily in Nigeria.

At the edge of the depressions (pan-like depressions of the Manga, in Niger), one encounters Aristida mutabilis, Schoenefeldia gracilis, Chloris prieurii while the woody stratum is dominated by the Doum-palm Hyphaene thebaica, with Balanites aegyptiaca, Acacia albida, Acacia senegal and Acacia nilotica.

G) Formations with perennial graminaceae (Hyperthelia dissoluta) and Aristida mutabilis, on sandy plateaus (Sp/LH)

This shrubless formation occupies an important area in Chad, north of Bol and south of Moussoro.

The woody stratum is solely composed of Leptadenia pyrotechnica, growing in very open formations.

The perennial herbaceous stratum is with Hyperthelia dissoluta, Aristida longiflora and Andropogon gayanus. Its coverage is poor. These species appear to be regressing.

Aristida mutabilis and Fimbristylis are the predominant species of the annual herbaceous cover; they are mixed with Alysicarpus ovaliflorus and Borreria raddiata.

In spite of the rare occurrence of tall perennials, this type of formation may be qualified as a savanna; taking its latitude into account,
however, it is preferable to call it a shrubless steppe.

H) Formations with Leptadenia pyrotechnica and Aristida mutabilis, on sandy plateaus

This occurs south of Mao, in Chad, and covers a small area.

The shrubby stratum is limited to Leptadenia pyrotechnica.

There is no perennial herbaceous stratum to speak of, as in the preceding case. A few rare specimens of Cyperus jeminicus may occasionally be found together with some Tephrosia obcordata and Chrozophora senegalensis.

Aristida mutabilis is the predominant species of the annual herbaceous stratum; it grows alongside Eragrostis tremula, Dactyloctenium aegyptum, Alysicarpus ovalifolius and Fimbristylis exilis.

This formation is a shrubless steppe.

I) Formations with Acacia raddiana, Leptadenia pyrotechnica and Aristida spp., on sandy plateaus with temporarily hydromorphic depressions

This formation occurs in Nigeria, south of Bosso and north of Gashua, which means that it covers an area the shape of a narrow strip skirting the border.

Acacia raddiana and Acacia senegal are characteristic of the shrubby stratum, with stands of Acacia seyal and Balanites aegyptiaca.

Except in depressions where Sporobolus helvolus grows, there is no perennial herbaceous stratum to speak of.

The annual herbaceous stratum occupies sandy surfaces; it is composed of Aristida mutabilis and Aristida funiculata, with patches of Cenchrus biflorus. Also found among the annual species are Eragrostis tremula and Dactyloctenium aegyptum.

Echinochloa colona and Brachiaria xantholeuca grow alongside Sporobolus helvolus in the hydromorphic depressions mentioned above.
This type of formation is a shrub steppe, occasionally dense.

J) Formations with Acacia raddiana and Leptadenia pyrotechnica, on sandy plateaus (S/RL)

It is identical with the preceding one; however, there are no hydromorphic depressions present in its growth area, which is found in Nigeria, on the shores of Lake Chad and on the right bank of the Kumadugu river.

The woody stratum is composed of Acacia raddiana, Aqacia Senegal, Balanites aegyptiaca and Leptadenia pyrotechnica, with some Boscia senegalensis.

There is no perennial stratum; the annual cover is dominated by Aristida mutabilis, Aristida funiculata, Eragrostis tremula and Dactyloctenium aegyptum.

This type of formation, very close in nature to that of neighboring areas in Niger, may be classified as a shrub steppe.

K) Shrub steppe with Acacia raddiana, A. senegal and Balanites aegyptiaca, with depressions with Panicum laetum (Sp/PL)

The area involved here is located north of Maine-Soroa, in Niger. It consists in a plateau-like steppe interspersed with depressions, as previously described; these depressions may be observed in a highly developed stage in the region neighboring the Kadzell.

Panicum laetum, along with Schoenefeldia gracilis and Eragrostis tremula, forms the bulk of the shrubby stratum growing on these depressions.

L) Formations with Leptadenia pyrotechnica and Salvadora persica, and with Aristida mutabilis and Cenchrus biflorus, on coarse sands of the Mitimi Plateau (Sg/LS)

This formation begins in Niger, next to Lake Chad, and continues on towards the Chadian area.

In addition to characteristic species, the woody stratum is composed of the following ones: Acacia raddiana, Balanites aegyptiaca and Commiphora africana.
The perennial herbaceous stratum occurs primarily at the top of the small dunes found on this plateau; it is composed of Panicum turgidum, Cyperus jeminicus and Cymbopogon proximus.

The annual herbaceous growth is dominated by Aristida mutabilis and Cenchrus biflorus, with some Eragrostis tremula.

**M) Formations with Acacia raddiana, Cymbopogon giganteus on plateaus with undulations with Cymbopogon proximus** (Po/Re)

This occurs in an area of Niger which is geologically composed of a juxtaposition of two types of formations previously described under Sp/RC: the sandy plateaus of the northern Koutous, where Acacia raddiana and Cymbopogon giganteus grow, and the undulations of the eastern Koutous described under So/RC, where Acacia raddiana and Cymbopogon proximus are found.

### IV. FORMATIONS OCCURRING ON SILTY OR CLAYEY-SILTY SOILS

This type of soil is present in limited areas of the Sahelian part of the Lake Chad Basin, namely in fossil valleys and in the region of Kadzell, in Niger.

**A) Formations with Schoenefeldia gracilis and Panicum laetum, on sandy-silty soils of the Kadzell** (M/SP)

One encounters this type of vegetation in Niger, between NiGuigmi and Diffa. It occupies various types of soils, rather heterogeneous in nature, with a marked preference nevertheless for sandy-silty or sandy-clayey terrains and for clayey soils in the East.

The woody stratum is very dense; it is composed of thorny bushes such as Balanites aegyptiaca, Ziziphus mauritiana, Acacia senegal and Acacia raddiana.

The perennial herbaceous stratum is limited to Sporobolus spicatus which is always to be found in the water-filled depressions during the rainy season.
The annual herbaceous stratum is composed of Schoenefeldia gracilis and Panicum laetum, the predominant species, accompanied by Eragrostis tremula, Cenchrus biflorus and Aristida mutabilis.

This type of formation may be classified as an open to dense shrub steppe.

B) Formations with Panicum laetum on Kadzell silts and on pan-like depressions of the Manga

This occurs in Niger, near Lake Chad, in an area occupied by the silts of the Kadzell and by the pan-like depressions of the Manga.

Vegetation in the Kadzell is characterized by a woody stratum composed of Boscia senegalensis, Balanites aegyptiaca, and Salvadore persica. The herbaceous cover is dominated by Panicum laetum, Schoenefeldia gracilis and Eragrostis tremula.

Hyphaene thebaica and Balanites aegyptiaca are the predominant species growing in the pan-like depressions of the Manga, while the herbaceous cover is primarily composed of Eragrostis tremula, Aristida mutabilis and Schoenefeldia gracilis.

V. FOSSIL VALLEYS AND DEPRESSIONS

A) Formations on sandy-silty soils of the fossil valleys of Niger

These valleys are oriented along a north-westerly-south-westerly line; they were connected, in the recent quaternary, to Lake Chad. The most important among them is that of the Dillia.

The dense shrubby stratum is populated with the classic species of the Sahel: Acacia raddiana, Balanites aegyptiaca, Commiphora africana, and with two other ones which occur rather less frequently: Acacia ehrenbergiana and Acacia laeta.
The annual herbaceous cover is also composed of the usual species, namely Aristida funiculata and Schoenfeldia gracilis, these two electing to grow primarily on compact soils.

The vegetational cover of these fossil valleys is of the shrub steppe type which occasionally becomes denser if large amounts of rain water accumulate in the area.

B) Formations on the clayey-silty soils and on the sandy deposits of the Bahr-el-Ghazal (HB/spp)

The Bahr-el-Ghazal, located in Chad, is a distributary of Lake Chad which flows towards the north-east when the waters of the Lake are very high.

The shrubby stratum may be very dense in certain localized areas such as in the depressions which become veritable ponds filled by the rains during the wet season. It is less dense on the compact, silty substrate and on the existing or recent sand deposits resulting from aeolian action.

It is composed of Balanites aegyptiaca, Acacia raddiana, Maerua crassifolia, Salvadoria persica and Bosia senegalensis, this last species frequently occurring in the form of an impenetrable thicket.

Also found there are Hyphaene thebaica, Piliostigma reticulatum, Capparis decidua, Capparis corymbosa, Acacia laeta and Acacia seyal, as well as Acacia nilotica localized in depressions found in the Moussoro region of the Bahr-el-Ghazal which remain flooded for long periods of time.

In the Salal region of the Bahr-el-Ghazal, Commiphora makes its appearance.

The herbaceous cover is composed of Chloris prieurii, Schoenfeldia gracilis, Aristida funiculata, Aristida mutabilis, Scirpus praelongatus and Heteranthera callifolia.

In the northern part of this region of the Salal latitude, two perennial graminaceae, Sporobolus helvolus and Eleusine compressa, appear for the first time, alongside Panicum turgidum on sandy monticules.
C) Formations with Sesbania sp., Sorghum sp., Sporobolus helvolus and Hyphaene thebaica, on depressions

This type of formation occurs in Chad, south of Kanem, and in the North of Lake Chad. In the Harr region, vegetation is very dense; the predominant species is Hyphaene thebaica.

Further to the west, that is, around Lake Chad itself, the woody stratum becomes progressively less dense until it is reduced to a coverage of Sporobolus helvolus, in the region of Chad which borders on Niger.

D) Formations on depressions of the Sahelian zone

In Chad, north of Bol, there are wide, shallow depressions grown over with dense, shrubby thickets of Commiphora africana.

In Chad and in Niger, depressions lying between dunes are occupied by a woody stratum composed of the same species as those found on plateaus or dunes, but growing in denser formation. They are Acacia raddiana, Balanites aegyptiaca and Commiphora africana. Aristida funiculata, A. mutabilis, Schoenefeldia gracilis and Chloris spp. make up the herbaceous cover.

VI. VEGETATION OF MOUNTAINOUS AREAS

Mountainous areas in this part of the Sahelian-Sahara region are found in Niger; they are the massifs of Termit and of the Koutous.

A) The Termit Massif

On the plateau, vegetation is characterized by Commiphora quadricinota, Eleusine compressa, Chrysopogon aukeri and Panicum turgidum. In the valley it is composed of Maerua crassifolia, Balanites aegyptiaca, Commiphora africana, Stipagrostis uniglumis and Cymbopogon schoenanthus.

A) The Koutous Massif

There, vegetation is dominated by Commiphora africana and Combretum micranthum, with some Lannea fruticosa, Boswellia odorata and Euphorbia balsamifera. The herbaceous stratum is with Cymbopogon proximus and other annuals.
This sector, which lies between the 15th and 13th parallels, receives annually from 400 to 700 millimeters of rain. Its morphology presents a variety of substrates, ranging from sands to clayey vertisols.

The various formations present there will be examined in succession, according to the type of substrate on which they grow. The varieties which grow on sandy soils are closest in nature to those of the Sahel.

The order of their examination is as follows:
- on the sands of fossil dune ridges
- on sands
- on more or less silty sands
- on halomorphic sands
- on hydromorphic substrates
- on compact soils; vegetation due to anthropogenic action
- on river banks

I FORMATIONS ON THE SANDS OF FOSSIL DUNE RIDGES

The location of these sands corresponds to the area of the Lake up to the 320 m. elevation. Although their substrate is identical, they bear different types of vegetation according to the amount of anthropogenic influence.

Several dune ridges may be distinguished here: the Bama Ridge in Nigeria, the Limani Ridge in Cameroon, and the Massenya dune ridge in Chad, the latter extending as far as the 13th parallel in northern Chad and as far as the map's limits in the East.
A) Shrub steppe with Guiera senegalensis and Schizachyrium exile (Sd/GS)

This type of vegetation, which reflects anthropogenic influences, occurs on the Bama Ridge. Guiera senegalensis is the predominant species of the shrubby stratum, where Ziziphus mauritiana, Combretum glutinosum, Piliostigma reticulatum and Boscia senegalensis are also encountered.

The annual herbaceous cover is characterized by Schizachyrium exile and Brachiaria xantholeuca.

B) Tree savanna with Sclerocarya birrea, Terminalia avicennioides and Hyparrhenia bagirmica (Sd/PT)

This type of vegetation is localized on the Limani Ridge in Cameroon where it has been subjected to lesser human degradation. The woody stratum is characterized by Sclerocarya birrea, Terminalia avicennioides, Combretum glutinosum and Balanites aegyptiaca. Khaya senegalensis occurs near Yagoua.

There are no perennial grasses but annual ones abound, such as Hyparrhenia bagirmica and Pennisetum pedicellatum.

C) Shrub steppe with Acacia senegal (S/S)

This formation occupies the dune ridge lying west of Massenya, in Chad, known as the Massenya Dune. It will be described later on, together with the steppe-type formation growing on sands.

Also included in the present category for the sake of accuracy is the dune ridge of the southern shore of Lake Chad corresponding to the fourth transgression; it is not mapable, however, at the scale used here. The steppe formation which covers it reflects Sahelian influences; it is composed of Hyphaene thebaica, Commiphora africana and Hyperthelia dissoluta. It has been described in the agrostological study of the Assale Serbewel.

II. FORMATIONS ON SANDS

This type of formation occupies relatively large surfaces of land in Nigeria, in Cameroon, and most of all in Chad. Acacia senegal is its most characteristic element, although it is found in lesser quantities in Nigeria because of anthropogenic influences.
A) Shrub steppe with Guiera senegalensis, Acacia senegal, Combretum glutinosum and Schizachyrium exile (S/GS)

It is located in Nigeria, at the foot of the fossil dune ridge of Bama and extends from that point on to Gubio.

The shrubby stratum is dominated by Guiera senegalensis—the result of human influence—with some Acacia senegal and Combretum glutinosum. Also occurring are parkland forests with Acacia albida.

The herbaceous stratum is composed of annual grasses such as Schizachyrium exile with some Brachiaria xantholeuca.

B) Shrub steppe with Guiera senegalensis, Acacia spp., Lannea humilis, Schizachyrium exile and Schoenefeldia gracilis (S/GA)

This type of steppe occurs north-east of Maidiguri, in the piedmont plains lying at the foot of the fossil dune ridge.

Guiera senegalensis is the predominant species of the shrubby stratum; it is found alongside Acacia seyal, A. senegal and A. ataxacantha. Concentrated patches of Lannea humilis may also be observed there.

The annual herbaceous stratum comprises Schizachyrium exile as well as Schoenefeldia gracilis. Panicum laetum and Echinochloa sp. may also be found in depressions.

C) Shrub steppe with Guiera senegalensis, Acacia senegal, Combretum glutinosum and Brachiaria xantholeuca (Sf/GA)

This type of formation occupies vast expanses on either sides of the Kumadugu Gana, in Nigeria.

The shrubby stratum is dominated by Guiera senegalensis with here and there patches of Acacia senegal and Combretum glutinosum.

The herbaceous stratum is dominated by Brachiaria xantholeuca.

D) Shrub steppe with Acacia senegal and Aristida mutabilis (S/S)

Its habitat is plateau-like sandy stretches with brown, sub-arid soils. The morphology of its plants promotes the retention and fixing of sands; its floristic composition classifies it as similar to Sahel-type vegetation.
It is found in the northern part of Cameroon and of Chad as well as to the north and north-east of N'Djamena.

The shrubby stratum is made up of Acacia senegal, which may occasionally be the sole species present to the exclusion of other ones; however, other shrubs often add a certain amount of variety; they are Balanites aegyptiaca, Ziziphus mauritiana, Cadaba farinosa and Capparis corymbosa. These species grow here as the result of animal grazing and of its influence on the vegetation.

Occasionally, one encounters small, clayey depressions approximately one hectare in breadth and situated primarily to the south of Lake Chad on which Acacia nilotica var. adansonii and Acacia seyal are found.

Whenever Acacia senegal is abundant, the herbaceous cover underneath is composed of Aristida mutabilis; if instead the steppe is overgrown with thickets of secondary, thorny bushes, it is composed of Schoenefeldia gracilis, Aristida funiculata, Chloris pilosa and Pennisetum pedicellatum.

The small clayey depressions are covered with a dense layer of Panicum laetum and of Echinochloa colona.

E) Shrub steppe with Salvadora persica and Chloris pilosa
(S/SS)

Most probably of anthropogenic origin, this type of shrub steppe is primarily localized in the Chadian region of Karal but it may also be encountered in Cameroon, north of Makari. Its physiognomy is strongly characterized by Salvadora persica which grows on localized patches in the shape of large spheres remaining green even during the dry months; it clearly prevails over other species.

The shrubby stratum is primarily composed of Salvadora persica, with some Hyphaene thebaica, Cordia sinensis and Acacia senegal. The occurrence of this last species leads one to suppose that the present steppe is the result of the degradation of the previous formations.

The annual herbaceous stratum is made up of Chloris pilosa, Aristida mutabilis, Cenchrus biflorus, Brachiaria distichophylla and Dactyloctenium aegyptum.
F) Shrub steppe with Acacia senegal, with depressions with Acacia ataxacantha

This type of steppe is situated in Chad, at the back of the Massenya Dune Ridge. It is of the type with Acacia senegal and Aristida mutabilis previously described, with clayey-sandy depressions scattered here and there.

The vegetation which grows on those depressions consists in a variety of creeper Acacia, Acacia ataxacantha, which forms extremely dense thickets.

Mitragyna inermis and Tamarindus indica have also been observed on the depressions.

The herbaceous cover is composed of Pennisetum ramosum, Brachiaria ramosa and Sorghum lanceolatum.

III. FORMATIONS ON MORE OR LESS SILTY SANDS

This type of formation is found in Cameroon and in Chad, with certain forms of it extending over both countries.

A) Shrub to tree steppe with Anogeissus leiocarpus and Sclerocarya birrea and with Aristida mutabilis and Schoenefeldia gracilis.

In Chad, it occurs in the area lying north of the N'Djamena-Ati road, on substrates ranging from sandy to silty soils. In the latter case, patches of Lannea humilis may be observed.

The shrubby stratum is composed of Anogeissus leiocarpus and Sclerocarya birrea, with occasional clumps of Hyphaene thebaica if the nature of the soil is a sandy one. On silty soils, one encounters Dalbergia melanoxylon and Capparis decidua as well as patches of Lannea humilis. These shrubs have a characteristic bearing and way of growing in monospecific groups.

The herbaceous cover is composed of annual grasses; sandy soils bear Aristida mutabilis and Schoenefeldia gracilis. Whenever soils become siltier, the latter species predominates. Also found are Chloris pilosa, Eragrostis tremula, Brachiaria xantholeuca and Schizachyrium exile.
B) Shrub steppe with Anogeissus leiocarpus and Sclerocarya birrea, with depressions with Acacia seyal (S/PS)

This constitutes merely a variety of the previous one and it is similarly located north of the N'Djamena-Ati road. This steppe is interspersed with numerous depressions which are connected and form a relatively close pattern.

The shrubby stratum growing on these depressions, whose bottom is clayey to clayey-silty, is with Acacia seyal; the dense, annual herbaceous cover is dominated by Echinochloa colona.

C) Shrub to tree steppe with Anogeissus leiocarpus and Balanites aegyptiaca (S/AB)

This type of vegetation is localized in Cameroon and in Chad, on either sides of the Logone, at the edge of the Yaeres. It closely resembles that of the Anogeissus leiocarpus and Sclerocarya birrea steppe; however, it differs from it in its lack of Sclerocarya and by the presence of secondary species. The privileged geographical position of this steppe has led to extensive human occupation.

The woody stratum is dominated by Anogeissus leiocarpus, with numerous Balanites aegyptiaca. Also found are Piliostigma reticulata, Stereospermum kunthianum and Combretum glutinosum.

The annual herbaceous stratum is composed of Schoenefeldia gracilis, Chloris pilosa and Crachiaria xantholeuca.

D) Tree savanna with Anogeissus leiocarpus, Terminalia avicennioides and Hyparrhenia bagirmica (S/AT)

This type of formation covers vast expanses in Chad, east of N'Djamena and south of the N'Djamena-Ati road. The Bahr Ergdig constitutes the southern-most limit of its growth area.

The woody stratum is primarily composed of Anogeissus leiocarpus, Terminalia avicennioides. The latter species occasionally grows in mono-specific patches, as on the Moyto dune and on the large, parallel dunes which are lined-up along a south-western-north-western axis. Combretum glutinosum also occurs within this type of formation.
The herbaceous stratum is composed of Erugrostis tremula as well as of Hyparrhenia bagirmica. Andropogon makes its appearance further south.

IV. FORMATIONS ON HALOMORPHIC SANDS

This type of formation is located in Nigeria, in the area of the Kumadugu river and of its waterways, and on the outside piedmont plain of the Bama Ridge.

A) Shrub steppe with Guiera senegalensis, Ziziphus and Aristida spp.  
(Sh/GA)

This occurs on the banks of the Kumadugu. There, the shrubby stratum is characterized by Guiera senegalensis. There are large patches of Ziziphus mauritiana, Acacia senegal and Acacia nilotica var. nilotica.

The herbaceous stratum is composed of Aristida mutabilis, Aristida funiculata, Schizachyrium exile, Panicum laetum and Schoenefeldia gracilis.

In the West, this steppe tends to be replaced by Acacia albida parks.

B) Shrub steppe with Ziziphus, Acacia spp. and Acacia Albida parks  
(Sh/AA)

This type of formation is very similar to the preceding one but here the Acacia albida parks predominate. The herbaceous cover consists of Schoenefeldia gracilis and Panicum laetum.

C) Shrub steppe with Guiera senegalensis, Acacia spp., and Balanites aegyptiaca with Schizachyrium exile  
(Sh/DS)

It is located in the North-West area of Maidiguri, between Geidam and Magumeri, on the outside piedmont of the Bama ridge.

The shrub stratum is mainly composed of Guiera senegalensis, with patches of Acacia senegal, A. nilotica var. nilotica.

The herbaceous stratum consists of Schizachyrium exile, together with Loudetia togoensis and Schoenefeldia gracilis.

D) Shrub steppe with Adansonia, Acacia spp. and Balanites aegyptiaca with Schizachyrium exile

It occupies the piedmont of the Bama ridge, in the Maidiguri region. It is practically identical with the preceding one, save for the fact that Acacia albida parks are replaced with Adansonia digitata parks.
V. FORMATIONS ON HYDROMORPHIC SUBSTRATE

Here, only local edaphic growths which occur in temporarily flooded depressions will be examined. Those growing in depressions periodically flooded by the Logone overflow waters will be dealt with separately in a special chapter entitled "Edaphic Vegetational Formations". The vegetation of north-western Maidiguri will be treated within the same chapter so as to respect the geological unity of the flood-waters area.

A) Steppe with Acacia spp., Balanites aegyptiaca, Ziziphus mauritiana, Lannea humilis and Schoenefeldia gracilis  
(Hv/LS)

It is situated north-west of Bama, on the piedmont lying at the foot of the fossil dune ridge.

Thorny bushes are predominant in the shrubby stratum; they are Acacia seyal, A. nilotica var. nilotica, Balanites aegyptiaca and Ziziphus mauritiana as well as Lannea humilis.

The annual herbaceous stratum is dominated by Schoenefeldia gracilis and Loudetia togoensis.

B) Steppe with Acacia nilotica var. nilotica, Oryza barthii and Echinochloa colona  
(H/N)

In the flooded ponds, Acacia nilotica var. nilotica grows alongside Crateva adansonii and Diospyros mespiliformis. Mimosa pigra occasionally grows in the areas which remain under water for the longest periods of time.

The vegetation of the ponds has been classified together with that of the long, narrow depressions which are numerous in the N'Djamena region, as they have the same floristic composition; however, Diospyros mespiliformis is the more consistently found of the species on the banks of the narrow depressions.

In the areas remaining at length under flood waters, one encounters Oryza barthii and Echinochloa stagnina, along with numerous hydrophytes, among which the following may be mentioned: Schoenoplectus senegalensis, Heteranthera callifolia, Sphaenoclea zeylanica, Ipomoea aquatica, Pistia stratiotes and Limnophyton sp.
VI. FORMATIONS OF ANTHROPOGENIC ORIGIN

These may be observed most particularly around N'Djamena, but also in North Cameroon. The main causes of degradation are the following ones, in decreasing order of importance: the clearing of land for cultivation purposes; the gathering of fire-wood; the increase in cattle herds.

The three major types of vegetation which occur as a result of these factors are all thorny steppes, whatever their initial type may have been.

A) Shrub steppe with Balanites aegyptiaca and Panicum laetum

This type of vegetation occurs only on dry land, never subjected to flooding; it is frequently found in the Kalamaloue National Park of Cameroon, which was founded in 1946. The shrubby stratum is fairly dense with Balanites aegyptiaca as the predominant species, alongside Ziziphus mauritiana and Bauhinia rufescens. A few specimens of Acacia senegal and Acacia seyal may be observed in small depressions. These woody shrubs are mixed with shorter ones such as Cadaba farinosa, Capparis corymbosa and Boscia senegalensis.

The herbaceous stratum is composed of annual grasses, among which Panicum laetum and Chloris pilosa are the predominant species, with some Schoenfeldia gracilis and Panicum subalbidum.

Brachiaria ramosa, Panicum maximum, Pennisetum pedicellatum and Setaria pallide-fusca grow under the shrubby stratum.

Over-exploitation of this type of secondary steppe by man and his herds has led to an almost complete sterilization of the soil, heavy trampling having resulted in a superficial compaction which promotes water run-off and impedes the germination and root-taking of annual species. The physiognomy of the vegetational cover is thus reduced to a few woody shrubs, scantily distributed and scraggly in appearance.

B) Shrub steppe with Acacia seyal, Panicum laetum and Echinochloa colona

This is a steppe found on more or less hydromorphic soils in Cameroon and in Chad, more often than not overlapping the preceding type.
The shrubby stratum is primarily composed of Acacia seyal which develops into a take-over formation after the clearing of land for cultivation. It is accompanied by Ziziphus mauritiana, Balanites aegyptiaca and Acacia nilotica var. nilotica, as well as by short woody shrubs such as Cadaba farinosa, Capparis corymbosa and Bauhinia rufescens.

The herbaceous flora is not strongly characterized, indeed it comprises species which are common to many types of vegetational cover; they are, in particular, Panicum laetum, Echinochloa colona, Chloris pilosa, Setaria pallide-fusca and Panicum subalbidum.

Here again the excessive exploitation of the soils leads to extremely widely spaced growth patches, if not to bareness.

These two types of vegetation are extremely widespread, especially in Chad and in Cameroon, where they have been mapped. The natural environment being under intensive exploitation by man these secondary facies show a tendency to spread further south.

C) Shrub steppe with Balanites aegyptiaca and Loudetia togoensis (M/BL)

This type of steppe is located in the region of the Bahr-el-Erguig in Chad. Its anthropogenic origin is less obvious than in the two preceding cases. It grows on slopes with compact, sandy-clayey soils and denuded spots.

The woody stratum is made-up of Balanites aegyptiaca, Cassia sieberana and Piliostigma reticulata.

The herbaceous stratum is composed of Loudetia togoensis, Hyparrhenia bagirmica and Andropon gayanus.

D) Formations with Acacia sieberana and with Panicum maximum, P. laetum and Chloris pilosa (M/K)

This type of formation occurs along the banks of the Logone and of the Chari rivers, as well as on the shores of Lake Chad. In Cameroon and in Chad they are found on numerous former meanders of the deltaic system. Some stands may possibly have been flooded over by the waters of Lake Chad in former times.
The shrubby stratum is heterogeneous in nature and comprises a number of various species. The size of the shrubs ranges from two to five meters; they are Acacia sieberana, Acacia seyal, Acacia nilotica var, nilotica, and Acacia campylacantha. Also present is Faidherbia albida, with the occasional predominance of Ziziphus mauritiana in localized spots.

On alluvial deposits where the humidity level is rather high, woody shrubs of the following species are found in the most notable quantities: Mitragyna inermis, Crateva adansonii, Mimosa pigra and Securinega virosa.

There is no perennial herbaceous stratum although a few spots of Andropogon gayanus do grow near the river.

On the other hand, annual grasses are well represented with Brachiaria ramosa, Pennisetum pedicellatum and Panicum maximum.

VII. FORMATIONS ON THE NORTHERN BANKS OF THE LOGONE AND CHARI RIVERS

These formations always occupy small areas only; they are limited to the banks of the rivers or to the edges of their active distributaries in periods of heavy flooding. In Cameroon, they are also found on the banks of the Serbewel.

A) Forest gallery with Morelia senegalensis

This forest gallery rises to a height of seven meters and is shaped in the form of a long, narrow strip running along the river's edge. Vegetation cover is dense and the predominant species is Morelia senegalensis. Also found are some Diospyros mespiliformis and Crateva adansonii, with the creeper or bind-weed Paullinia pinnata and the frequent convolvulacea Merremia pinnata.

There is no herbaceous cover in the strict sense of the term; however, between two alignments of Morelia, one may observe patches of Vetiveria nigritana, Panicum anabaptistum and Andropogon gayanus.

B) Depressions and ridges with Mitragyna inermis

This is another type of formation found on recent river alluvia, which accumulate in the shape of lenticular, concentric interlayers on the concave banks of the Chari and of the Logone rivers. It occurs between these ridge-shaped lenticular interlayers and is characterized by Mitragyna inermis and Panicum anabaptistum as the predominant graminaceae. The most frequent companions to these species are Hyperthelia dissoluta and Andropogon gayanus which form a grass savanna.
C) **Shrubby ridges with Andropogon gayanus**

These shrubs grow in small patches on sandy humps. The heterogeneous stratum is primarily composed of Acacia seyal and Securinega virosa, while the herbaceous cover is basically dominated by Andropogon gayanus and Panicum anabaptistum.

D) **Formations with Aeschynomene sp. and Oryza barthii**

This type of formation, widespread throughout the northern parts of Cameroon and of Chad, is characterized by Oryza barthii, a most reliable species in as much as it occurs every year whereas Aeschynomene requires a normal amount of precipitation in order to develop, as has been confirmed by observation conducted on a pond of the Maltam area.

E) **Formations with Sorghum of canceolatum and Sesbania rostrata**

Situated north-east of N'Djamena, in the region of Moyto, this type of formation occupies shrubless areas dozens of square kilometers in breadth.

The most frequently occurring species is a type of Sorghum which may be classified with S. lanceolatum, although it has not been possible to determine its proper classification with precision. Sesbania rostrata makes its appearance after a good rainy season, while a Malvacea of the hibiscus gender becomes abundant instead if rain-fall is less heavy than usual.
THE SUDANESE DOMAIN: THE SUDANO-SAHELIAN SECTOR

This area lies between the 11th and the 9th parallels and has an annual rain-fall of 700 to 1000 millimeters. It is the domain of Anogeissus leiocarpus woodlands.

The following types of formations will be distinguished in the course of this chapter:

- formations on sandy soils
- formations on sandy soils with rocky concretions
- formations on sandy, hydromorphic soils
- formation on hydromorphic soils
- formations resulting from strong anthropogenic action
- formations of the Guera Massif

I. FORMATIONS ON SANDY SOILS WITH ANOGEISSUS LEIOCARPUS AS THE PREDOMINANT SPECIES

These formations occupy extensive areas on tropical, ferruginous soils in Chad, as well as in Nigeria. They occur in regions where annual rainfall measures between 600 and 900 millimeters.

A) Tree savanna with Anogeissus leiocarpus, Guiera senegalensis and Schizachyrium exile (SF/AC)

This type of formation is found in Nigeria, north of a line running between Azare, Potiskum, Damaturu and Maiduguri.

Anogeissus leiocarpus is characteristic of the arboreal stratum but there are patchy formations of Guiera senegalensis and of Acacia sp. as well.

Schizachyrium exile is the dominant species of the herbaceous cover with some stands of Brachiaria xantholeuca and Pennisetum pedicellatum also found.
B) **Tree savanna with Anogeissus leiocarpus and Acacia ataxacantha and with Hyparrhenia sp.** (Sh/AH)

This type of savanna is located in Nigeria, south-west of Maidiguri.

Here again, *Anogeissus leiocarpus* is the dominant species of the arboreal stratum but specimens of a bind-weed bush, *Acacia ataxacantha* are scattered throughout the savanna.

One may also encounter patches of steppe with *Acacia* spp., *Balanites aegyptiaca* and *Lannea humilis*.

Hyparrhenieae are the dominant species of the herbaceous layer; they are *H. bagirmica*, *H. barteri* and *H. involucrata*.

C) **Tree savanna with anogeissus leiocarpus and Acacia seyal, and with Combretum spp. and Hyparrhenia spp.** (Sf/CA)

This formation is found in the region of Girei, in Nigeria. The woody stratum is made-up of *Anogeissus leiocarpus*, *Sclerocarya birrea*, *Sterculia setigera*, *Prosopis africana*, *Entada africana*, *Combretum glutinosum*, *Combretum nigricans* and *Acacia seyal*.

The herbaceous stratum is dominated by *Hyparrhenia bagirmica*, *H. involucrata*, *H. barteri*, *Andropogon pseudapricus*, *Aristida kerstingii* and *Loudetia togoensis*.

D) **Parkland savanna with Adansonia digitata and Schizachyrium exile** (SL/AS)

This parkland savanna is localized in Nigeria, in the region of Chinade, Dambam and Potiskum. There are occasional stands of *Anogeissus leiocarpus* and *Detarium microcarpum*; whenever this is the case, the herbaceous layer underneath is composed of *Pennisetum pedicellatum* and of *Loudetia togoensis*.

E) **Steppe with Combretum spp. and with Pennisetum pedicellatum** (SL/CP)

This formation occurs in scattered patches and is a transitional one. The shrubby stratum is primarily composed of *Combretum nigricans*,

...
C. binderianum, C. molle, and C. glutinosum, with some Guiera senegalensis and Anogeissus leiocarpus.
The herbaceous cover is dominated by Pennisetum pedicellatum and Schizachyrium exile.

F) Parkland savanna with Parkia and tree savanna with Anogeissus leiocarpus, Prosopis africana and Combretum, and with Hyparrhenia involucrata (SL/PH)

The South of Nafada, in Nigeria, is the habitat of this type of formation. The area involved here is occupied by a parkland savanna with Parkia alternating with patches of tree savanna with Anogeissus leiocarpus, Prosopis africana, Lannea schimperi, Combretum glutinosum and C. nigricans.

The herbaceous cover is dominated by Hyparrhenia involucrata, with H. bagirmica, Andropogon gayanus, A. pseudapricus and Tristachya superbua.

G) Tree savanna with Anogeissus leiocarpus and Combretum, and with Afromorsia, Detarium and Pennisetum pedicellatum (SL/AH)

Found in Nigeria, this type of formation is located in the Dukku region, on either sides of the Gongola valley.

It is the same tree savanna as the one previously described and its species are also Anogeissus leiocarpus, Prosopis africana, Lannea schimperi, Combretum glutinosum and C. nigricans. There are occasional, localized patches of Afromorsia laxiflora and Detarium microcarpum, as well as of Burkea africana and, more rarely so, of Isoberlinia doka.

The herbaceous layer is dominated by Pennisetum pedicellatum with, locally, some Hyparrhenia involucrata, Loudetia and Aristida.

H) Tree savanna with Anogeissus leiocarpus, Detarium microcarpum, Hyparrhenia bagirmica and Andropogon gayanus (S/AD)

This type of savanna is extremely widespread in Chad and in Cameroon. In Chad, it extends from Guelengdeng to Miltou, on either sides of the Chari river; in Cameroon, it occurs on either sides of the Limani ridge.

The tall stratum is made up of Anogeissus leiocarpus, Terminalia avicennioides, Sclerocarya birrea, Detarium microcarpum, Albizzia chevalieri, and Cassia sieberiana, with Prosopis africana, Sterculia setigera and Lonchocarpus laxiflorus in the southern part.
The lower stratum is composed of Combretum glutinosum, Combretum collinum, Piliostigma reticulata, Hymenocardia acida, Strychnos spinosa and Guiera senegalensis.

The herbaceous layer comprises a majority of annual grasses of which a certain number belong to the Sahelian type; they are Hyparrhenia bagirmica, Eragrostis tremula, Pennisetum pedicellatum, Cenchrus biflorus, Brachiaria ramosa, Chloris pilosa, Schizachyrium exile, Aristida adscensionis, Pandakia heudelotii, Alysicarpus ovalifolius and Blepharis linearifolia. The only perennial is Andropogon gayanus.

Foresters designate this type of formation by the name of "combretaceous woodland"; it is a shrubby savanna, becoming a tree savanna whenever stands are apparently intact.

I) **Tree savanna with Anogeissus leiocarpus, Guiera senegalensis, Loudetia spp., and Hyparrhenia spp.** (S/CL)

This formation is found in Nigeria, north of the Benoue; its arboreal stratum is dominated by Anogeissus leiocarpus, Detarium microcarpum, Guiera senegalensis and Combretum glutinosum. The herbaceous layer is primarily composed of Loudetia spp. and Hyparrhenia spp.

J) **Tree savanna with Anogeissus leiocarpus and Sterculia setigera** (S/AS)

This formation occurs in Chad, between the rivers Bahr Erguig and Chari. The arboreal stratum is dominated by Anogeissus leiocarpus and Sterculia setigera, growing alongside some Combretum hypopilinum and Annona senegalensis.

The herbaceous layer is primarily composed of annual grasses such as Eragrostis tremula and Hyparrhenia bagirmica; however, a perennial graminacea is also present: Andropogon gayanus.

II. FORMATIONS ON NIGERIAN SANDY SOILS WITH ROCKY CONCRETIONS

These are Sudanian savannas with Anogeissus or with Combretum which occasionally become parkland savannas with Parkia.
A) Tree savanna with Anogeissus leiocarpus, Detarium microcarpum and Andropogon gayanus (Sc/AA)

This formation appears north of Uba, in the region of Lassa. Its woody stratum is composed of Anogeissus leiocarpus, Sterculia setigera, Combretum glutinosum, C. molle, Detarium microcarpum, Strychnos spinosa. Some patches of parkland savanna with Parkia and with Butyrospermum paradoxa and others are also present.

The perennial herbaceous layer is dominated by Andropogon gayanus, with some Brachiaria brizantha and Hyperthelia dissoluta; the annual species are Pennisetum pedicellatum and Schizachyrium exile.

B) Shrub savanna with Combretum spp and tree savanna with Anogeissus leiocarpus and Combretum (Sc/CA)

This type of vegetational formation occurs in several different areas surrounding the top part of Western Nigeria.

It is a savanna with Combretum glutinosum, C. molle, C. nigricans, Anogeissus leiocarpus and Commiphora pedunculata. There are also patches of the preceding type of savanna.

The herbaceous stratum of the Combretum savanna is dominated by Loudetia togoensis.

C) Parkia-Parkland savanna with Pennisetum pedicellatum (Sc/PP)

This formation occurs on a strip of land running roughly along a north-south axis, on either sides of Gombe.

The herbaceous layer is composed of Pennisetum pedicellatum and Schizachyrium exile.

D) Tree savanna with Boswellia dalzielii, Acacia spp., Acacia dudgeoni, Combretum glutinosum, Pennisetum pedicellatum and Schizachyrium exile (Sc/BP)

It is found in Nigeria, north of Kombo. Its arboreal stratum is composed of Boswellia dalzielii, Anogeissus leiocarpus, Lannea schimperi, Acacia dudgeoni, A. hookii and Combretum glutinosum.
The herbaceous layer is made up of annual species among which Pennisetum pedicellatum and Schizachyrium exile are the dominant ones.

E) Tree savanna with Terminalia spp., Combretum spp., Schizachyrium exile and Pennisetum pedicellatum (Sc/TP)

It is situated in Nigeria, on the right bank of the Benue river at Lau as well as to the north-east of Uba.

The shrubby stratum is composed of Terminalia laxiflora, T. avicennioides, Combretum glutinosum, C. ghasalense and Anogeissus leiocarpus.

The annual herbaceous stratum is made up of Pennisetum pedicellatum and Schizachyrium exile.

III. HYDROMORPHIC SANDY SOILS

A) Formations with Anogeissus leiocarpus, Terminalia laxiflora, Andropogon gayanus and Diheteropogon amplexensis (St/AT)

This type of formation occurs to the south of Miltou, between the town itself and the ferrallitic soils of the region of Goundi.

It is indicative of a substrate with deep, temporary hydromorphy, the existence of which is made even more obvious by the presence of Pseudocedrela. This species may also constitute an indication of the fact that in former times the level of the phreatic waters or of the flood waters may have been different as one frequently encounters Anogeissus leiocarpus both on old termitariums and on sandy substrates.

The tall stratum reaches to a height of eight to ten meters and is characterized by Anogeissus leiocarpus and Terminalia laxiflora, accompanied by Prosopis africana, Pseudocedrela kotschyi, Pericopsis laxiflora, Stereospermum kunthianum, Piliostigma thomningii, Piliostigma reticulata, Sterculia setigera, Detarium microcarpum, Combretum collinum and Gardenia sp. Together with these species, one may observe a few isolated specimens of Khaya senegalensis as well as of Tamarindus indica growing on termitariums.
The herbaceous stratum is based on Andropogon gayanus, Diheteropogon amplectens, Ctenium newtonii, Hyparrhenia bagirmica, and on stands of Andropogon pseudapricus and Pennisetum pedicellatum.

Because of the possibility of floods, a frequent occurrence in former days but most certainly a rare one now, the area occupied by this type of formation is practically uninhabited. The vegetation described is therefore homogeneous and intact.

Between Miltou and Niellim, one encounters a variant of the formation described in which Afzelia africana, a shrubby legume, makes its appearance. Also to be noted is a greater abundance of Terminalia avicennioides.

The shrubby stratum is based on Anogeissus leiocarpus, Terminalia avicennioides, Afzelia africana, Detarium microcarpum, Prosopis africana, Pericopsis laxiflora, Piliostigma reticulata, Combretum collinum, Entada africana and Sterculia setigera.

The herbaceous layer remains unchanged and is composed of the same species.

This type of formation may be designated as a shrub savanna occasionally evolving into an arboreal one in the most developed stands.

B) Formations with Terminalia avicennioides and Sclerocarya birrea on elongated ridges

This type of formation grows on sandy, elongated ridges running north-south over several dozen kilometers in length and over two to eight kilometers in width. They are parallel to each other and run across the interfluve between Logone and Ba-Ili. They are the vestigial traces of a delta of the Logone river formerly existing there.

Their geomorphologic characteristics has led one to classify its vegetation as an altogether separate formation but before human settlement took place it constituted, most probably, a transitional one between the Anogeissus formation in the north and the Daniellia formation in the south. At that time therefore, vegetation must have evolved progressively from a leguminous one to one dominated by Combretaceous species.
In stands which have been submitted to little or no destruction at the hands of man, one encounters the following shrub species:
Anogeissus leiocarpus, Terminalia avicennioides, Terminalia laxiflora, Sclerocarya birrea, Prosopis africana, Daniellia oliveri, Parkia africana, Piliostigma reticulata, Combretum collinum, Hymenocardia acida, Ziziphus mauritiana, Pseudodcrela kotschyi, Ximenia americana and Annona senegalensis.

Within this woody stratum, there exists a number of species closely affiliated to the Sahelo-Sudanese ones, such as Sclerocarya birrea, Terminalia avicennioides as well as legumes such as Prosopis africana and Daniellia oliveri and a species which farming practices do not eradicate, Parkia africana.

The herbaceous stratum is composed of Andropogon gayanus, Cymbopogon giantens, Ctenium newtonii and Eragrostis tremula, with a number of stands of Cenchrus biflorus and Hyperthelia dissoluta.

The presence of Hyperthelia dissoluta is due to the hydromorphy of the neighboring substrate, which is temporarily flooded by the Logone overflow waters.

This formation may present a number of very characteristic anthropogenic facies such as the parkland savanna with Faidherbia albida, the palmyra grove with Borassus aethiopum and the dum-palm grove with Hyphaene thebaica.

- The Faidherbia albida facies is extremely spectacular, its trees growing to a height of ten meters or more. There is a particularly beautiful example of it in Tchagin Golo. It is obviously the result of anthropogenic intervention and is due to a population of pastoralists. The dum-palm facies is more recent; it may have been brought in by emigrant populations from the north.

- The palmyra facies is also a very spectacular one. It seems equally ancient in origin and most likely anthropogenic as well. The dum-palm facies seems to be more recent; it may have been brought in by migrants.

C) Formations with Terminalia laxiflora and Prosopis africana and with Andropogon gayanus and Diheteropogon amplectens. (St/TP)

This formation occurs in the region of Lai, on either sides of the Logone where it occupies relatively confined areas. One encounters stands of Tamarindus indica, Anogeissus leiocarpus, Diospyros mespliformis and Balanites aegyptiaca densely growing on large, tumbled termite-mounds. Between termitariums, the shrubby stratum is composed of Terminalia laxiflora, Prosopis africana, Piliostigma thomningii, Piliostigma reticulatum, Combretum glutinosum, Gardenia aqualla, Vitellaria paradoxa and Parkia africana.
The herbaceous stratum is composed of Andropogon gayanus, Diheteropogon amplectens and Andropogon pseudapricus, with patches of Hyperthelia dissoluta.

This type of frequently heterogeneous formation is located in a cultivated zone; it is a shrub savanna.

D) Shrub savanna with Terminalia laxiflora, Combretum glutinosum, C. hypopilinum and Diectomis fastigiata (St/TC)

This type of savanna occurs in Chad, in the region of Pala. It occupies hydromorphic soils with an overall temporary hydromorphy which leads to the formation of pseudo-gley on clayey-sandy materials.

The shrubby stratum is composed of Terminalia laxiflora, Combretum glutinosum, C. hypopilium, Pseudocedrela kotschyi and Gardenia erubescens.

The herbaceous stratum is composed of Diectomis fastigiata, Andropogon gayanus and Hyperthelia dissoluta.

IV. FORMATIONS ON HYDROMORPHIC SOILS

A) Tree savanna with Combretum glutinosum, Anogeissus leiocarpus and Pseudocedrela kotschyi (Hv/AK)

It is found in Chad, south of Lake Fitri, on the western piedmont of the Guera Massif; it occurs on hydromorphic vertisols.

The woody stratum is based on Combretum glutinosum, Anogeissus leiocarpus, Pseudocedrela kotschyi, Piliostigma reticulata and Gardenia ternifolia.

The herbaceous stratum is with Hyparrhenia sp. and Andropogon sp.

B) Tree savanna with Combretum glutinosum, Gardenia ternifolia and Terminalia macroptera (H/CM)

It is found in the same region as the preceding one; it develops on mineral, hydromorphic soils with pseudo-gley.

The woody stratum is composed of Combretum glutinosum, Gardenia ternifolia, Terminalia macroptera and Piliostigma reticulata.

The herbaceous stratum is with Hyparrhenia sp. and Loudetia sp.
C) Shrub and tree steppe with Anogeissus leiocarpus and with
Combretum spp, Acacia seyal and Hyparrhenia soluta (Vf/BA)

This formation includes a mixture of savanna-type growth with
Anogeissus leiocarpus and a steppe-like growth with thorny shrubs. It is
localized east of Fika and Buni, in Nigeria.

It has also been observed growing in the shape of a narrow strip
roughly oriented along a northerly-easterly line, east of Gombe where its
shrubby savanna also includes Acacia polyacantha.

Its woody stratum is composed of Anogeissus leiocarpus, Sclerocarya
birrea, Sterculia setigera, Prosopis africana, Entada africana, Combretum molle,
C. glutinosum, Acacia seyal, A. sieberana and A. polyacantha.

The herbaceous stratum is dominated by Hyparrhenia soluta, accompanied
by Andropogon gayanus, Aristida kerstingii, Sehima ischaemoides, Andropogon
pseudapricus and Pennisetum pedicellatum.

D) Tree savanna with Anogeissus leiocarpus, Acacia seyal, Boswellia
dalzielli and Hyparrhenia soluta (Hv/AB)

This type of formation, very similar in nature to the preceding one,
is situated in Nigeria, east of the Buni-Biu road. It is characterized by the
same type of tree savanna with Anogeissus leiocarpus and Acacia seyal. The
other woody components are nearly the same and so is the herbaceous layer, which
is also dominated by Hyparrhenia soluta.

E) Tree savanna with Anogeissus leiocarpus, Acacia seyal, Hematostaphis,
Bombax, Schoenfeldia gracilis and Loudetia togoensis (H/AH)

It is found in Nigeria, in the region of Butuki. The woody stratum
is identical with that of the two preceding formations but, in addition, Hemato-
staphis and Bombax are also encountered.

The herbaceous layer differs markedly; it is dominated by annuals
such as Schoenfeldia gracilis and Loudetia togoensis.
F) Tree savanna with Anogeissus leiocarpus, Acacia seyal, Combretum spp., and Hyparrhenia spp. (H/CH)

It is situated in Nigeria, in the Malaba region north of Yola.

The woody stratum is identical to that of the preceding ones, with locally abundant Combretum glutinosum and C. ghasalense.

The herbaceous cover is composed of Hyparrhenia bagirica, H. involucrata and H. barteri.

G) Shrub savanna with Combretum spp., Acacia spp., Pennisetum pedicellatum and Schizachyrium exile (H1/CP)

This type of formation is found in Nigeria, north of Numana. The woody stratum is based on Combretum glutinosum, C. ghasalense, Acacia seyal and A. polyacantha.

The herbaceous cover is made up of annual grasses: Pennisetum pedicellatum and Schizachyrium exile.

H) Formations with Terminalia macroptera on hydromorphic, ferruginous soils (Sh/TL)

This type of formation develops near temporary waterways or in flood-prone areas where phreatic waters are close to the surface.

The shrubby stratum, dominated by Terminalia macroptera, is very evenly distributed. The regularity with which this particular plant occurs at times authorizes the use of the term "orchard-savanna" to qualify this type of formation.

It occasionally outgrows the combretaceous zone to make inroads into that of the legumes, following the course of the waterways or of the flood waters in the plains.

It can take on various aspects according to its geographical location but differences are minimal.

The shrubby vegetation is based on Terminalia macroptera, with a few specimens of Butyrospermum paradoxa, Gardenia erubescens and Vitex doniana.
The herbaceous layer provides very dense coverage; it is primarily composed of Loudetia simplex and Andropogon schirensis, along with Setaria anceps, Brachiaria jubata, Eragrostis turgida and Eragrostis gangetica.

In other stands, the shrubby stratum also includes Daniellia oliveri and Crossopteryx febrifuga and the herbaceous layer Sorghastrum trichopus, Hyparrhenia exarmata, Andropogon canaliculatus and Paspalum sp.

This formation presents a relatively homogeneous facies, from the West of the Logone river to Sahr, thanks to its being under little or no cultivation. It may be classified as an open shrub savanna.

1) Formations with Terminalia macroptera, Pseudocedrela kotschyi, Diheteropogon amplexens and Andropogon pseudapricus

This type of formation occupies clayey-sandy to clayey soils with temporary hydromorphy, whereas the preceding one is found on sandy soils. The temporary hydromorphy may be an overall or in-depth one, according to the extent of the Logone's floods.

It is primarily characterized by the presence of Terminalia macroptera, which is accompanied by Pseudocedrela kotschyi, Combretum glutinosum, Pilostigma thomningii, Pilostigma reticulata, and Gardenia aqualla, as well as by Tamarindus indica, Ziziphus mauritiana, Nauclea latifolia, Balanites aegyptiaca, Mitragyna inermis and Acacia sieberana which are found most particularly on termitariums.

The herbaceous stratum is based on Diheteropogon amplexens, Andropogon pseudapricus, Hyparrhenia rufa, Eragrostis atrovirens, Panicum aflatii and Panicum subalbidum, with stands of Vetiveria nigritana, Oryza sp., and Echinochloa obtusiflora. These stands are found on vertisol depressions.

It occupies very large surfaces on the flooded plain of the Logone and especially on the right bank of the river. One encounters it again in the form of small patches at the edge of the Cameroon Yaere. Pseudocedrela kotschyi occasionally becomes the dominant species over Terminalia macroptera in localized spots.

This type of formation is a shrub savanna.
J) **Formations with Terminalia macroptera, Combretum spp., Diheteropogon amplectens and Andropogon pseudapricus**

(H/TC)

The area of distribution of this type of formation is fragmented into stands, a few square kilometers in extent, which are situated between Lai and the Ba-illi, to the south of the Chari river.

It comprises a number of sterile, compacted spots, the cause of which cannot be ascribed to man as this is a sparsely inhabited area, with some totally uninhabited zones.

There are numerous termitariums taken over by colonies of Tamarindus indica, Anogeissus leiocarpus, Khaya senegalensis and Mitragyna inermis.

Between the termite-mounds the shrubby stratum is composed of Combretum glutinosum, Combretum collinum, Piliostigma thonningii, Balanites aegyptiaca, Acacia sieberana and Terminalia macroptera.

The herbaceous layer is patchy and heterogeneous; near the termitariums one encounters Andropogon gayanus and, between them, Andropogon pseudapricus and Diheteropogon amplectens.

A number of micro-depressions bear vegetation based on Panicum anabaptistum and Vetiveria nigritana.

K) **Shrubless formation with Hyparrhenia rufa**

(H/H)

It is situated in Chad, in the plain of Lai, where it occupies occasionally extensive surfaces at the foot of the sandy ridges lined along a northern-southern axis.

This type of formation is a true grass savanna, without either trees or shrubs; it is dominated by Hyparrhenia rufa, accompanied by Hydrolea floribunda, Ammania auriculata and Elytrophorus spicatus.

L) **Formations with Piliostigma thonningii, Piliostigma reticulata, Combretum collinum and Eragrostis atrovirens**

(H/PE)

This formation develops in a spotty pattern along the southern edge of the Yaere in Chad as well as in Cameroon. The substrate, clearly influenced by the degree of hydromorphy, has a sandy-clayey surface.

The shrubby stratum is dominated by Piliostigma reticulata, Piliostigma thonningii, and Combretum collinum, with Nauclea latifolia and...
The herbaceous cover is homogeneous; its species reflect the degree of hydromorphy. They are, 

- Eragrostis atrovirens, Panicum anabaptistum, 
- Hyparrhenia bagirmica, Vetiveria nigritana, Echinochloa obtusiflora, and 
- Elytrophorus spicatus with stands of Hyperthelia dissoluta and Andropogon pseudapricus.

M) Formation with Combretum spp., Acacia spp. and Hyparrhenia involucrata

This type of formation is localized in Nigeria, on either sides of the Hawal, a tributary of the Gongola.

The shrubby stratum is primarily composed of Combretum glutinosum, 
- C. ghasalense, C. molle, C. nigricans, Anogeissus leiocarpus and Acacia dudgeoni.

The herbaceous layer is characterized by Hyparrhenia involucrata, 
- H. bagirmica, Andropogon gayanus and A. pseudapricus.

N) Formation with Acacia spp., Anogeissus leiocarpus and Sorghum sp.

It is found in Nigeria, in the region of Numan. The shrubby stratum is based on Acacia seyal, A. campylacantha, Balanites aegyptiaca, Anogeissus leiocarpus and Entada africana.

The herbaceous stratum is dominated by Sorghum arundinaceum, S. aethiopicum, Echinochloa colona and Panicum laetum.

V. FORMATIONS OCCURRING AS A RESULT OF EXTENSIVE ANTHROPOGENIC ACTION

Shrub to tree steppe with Faidherbia albida

This formation is situated in the region of Bongor, in Chad, and in that of Maroua-Yagoua in Cameroon. There, it is found on silty soils with a compacted surface and it becomes an integral part of the vegetational landscape. One comes across Faidherbia albida again in Nigeria, on the Bama Ridge.
The woody stratum is dominated by Faidherbia albida, along with Balanites aegyptiaca, Ziziphus mauritiana, Hyphaene thebaica, Boscia senegalensis, Acacia seyal and Cadaba farinosa.

The herbaceous stratum is composed of annual species: Panicum laetum, Schoenefeldia gracilis, Chloris pilosa, Pennisetum pedicellatum and Cenchrus biflorus.

VI. FORMATIONS OF THE GUERA MASSIF

They are found west of the Guera Massif, in Chad. Two categories may be distinguished, that of the Massif itself and that of the piedmont iron pans.

A) Tree to shrub savanna of the Guera Massif with Anogeissus leiocarpus and Boswellia dalzielli

On arenaceous sands, one encounters a savanna with tall trees and sparse undergrowth. The species present are Anogeissus leiocarpus, Albizia chevalieri, Combretum glutinosum, Sclerocarya birrea and Terminalia laxiflora.

Around villages, cultivation has modified the woody stratum which is primarily composed of the following species: Balanites aegyptiaca, Faidherba albida, Ziziphus mauritiana, Guiera senegalensis, Piliostigma spp. Concurrently, the herbaceous layer is made up of Pennisetum pedicellatum, with Aristida stipoides, Chloris sp. and Schizachyrium exile.

As soon as rocky outcrops appear, the tree savanna becomes a more open woodland and there are populations of Boswellia dalzielli accompanied by Sterculia setigera and Gardenia sp.

Whenever soils are of the reg-type, the woody stratum becomes a thorny steppe with Balanites aegyptiaca, Acacia seyal and Capparis decidua. The herbaceous layer is based on Schoenefeldia gracilis and Aristida funiculata.

B) Tree savanna with "densely populated islands" of growth with Anogeissus leiocarpus, Sclerocarya birrea, Acacia ctaxacantha, on ferruginous hard-pan

It is situated in the piedmont zones of the western part of the Guera Massif.
The arboreal vegetation grows in densely populated "islands"; it is composed of Anogeissus leiocarpus, Sclerocarya birrea, Balanites aegyptiaca, Tamrindus indica, Dalbergia melanoxylon, Dichrostachys cinerea, Albizia chevalieri, and Acacia ataxacantha.

This type of formation occurs on hard-pan soils, on ferruginous soils with rocky concretions and on hydromorphic soils over ferruginous hard-pan.
This sector is situated to the South of the 1000 mm isohet; it is a region of tree savannas and woodlands with legumes. Three types of vegetational formations will be examined as follows:

- vegetation of the Koros with Isoberlinia doka
- vegetation of the great valleys with Daniellia oliveri
- vegetation of the waterways and of the galleries

1. VEGETATION OF THE KOROS (Ge/IB)

This type of vegetational cover is composed of tree savannas and of woodlands where legumes, in particular Isoberlinia doka, abund.

The tree savannas and woodlands with Isoberlinia are here greatly more developed than the various formations previously examined. Trees reach a height of 12 to 15 meters while graminaceae are up to 2 meters tall during the growth season.

Their floristic composition, a classical one, is primarily composed of Isoberlinia doka, Burkea africana, Tetrapleura tetraptera with Andropogon gayanus, Beckeropsis uniseta, Brachiaria brizantha, and Hypparhenia bagirmica.

A greater development of the trees and shrubs is observed under such favorable hydrologic conditions. The physiognomy of this type of formation is that of an "open forest"; one encounters it near the Central African Republic's border, in the region of Siagon or again in the classified forest of Djoli Kera, North-West of Sahr.
In addition to the species mentioned above, the following ones are also to be found in the arboreal stratum: Terminalia laxoflora, Anogeissus leiocarpus, Pterocarpus lucens, Prosopis africana, and Afzelia africana.

The shrubby stratum is composed of Combretum nigricans, Psorospermum febrifugum, Crossopteryx febrifuga, Strychnos spinosa, Detarium microcarpum, and Hymenocardia acida.

There is a low stratum as well which is composed of short, woody shrubs and of perennial grasses ranging between 50 centimeters and 1.5 meters in size. They are: Grewia mollis, Bridelia scleroneura, Securinea longepunctulata, Securinega virosa, Adenolichos paniculatus, and Ectadiopsis oblongifolia.

Perennial graminaceae predominate; they are: Andropogon gayanus, Beckeropsis uniseta, Brachiaria brizantha, Dicheteropogon amplectens; also present is the annual Hyparrhenia bagirmica.

11. VEGETATION OF THE GREAT VALLEYS

This type of formation occurs on tropical, weakly leached, ferruginous soils. As with the preceding types, the presence of an underlying hard-pan provokes modifications in the floristic composition. The topographical position promotes the occurrence of hydromorphic phenomena.

Similarly, two types of formation are described here, the one occurring on hard-panes being dealt with separately.

A) TREE SAVANNA WITH DANIELLIA OLIVERI, BURKEA AFRICANA, AND PARKIA AFRICANA AND WITH ANDROPOGON GAYANUS, HYPARRHENIA INVOLUCRATA, AND HYPARRHENIA BARTERI ON DEEP, TROPICAL, FERRUGINOUS SOILS

As in savannas with Isoberlinia doka, in savannas with Daniellia oliveri, trees reach up to a height of between 12 and 15 meters while perennial grasses grow to a height of 2 meters.

These three savannas have been cleared, and continue to be cleared for cultivation purposes. Stands which appear to be intact are rare.

The floristic composition differs slightly from that of the Koros
savannas; Isoberlinia doka has disappeared to be replaced by Daniellia oliveri.

The arboreal stratum is thus composed of Daniellia oliveri, Burkea africana, Prosopis africana, as well as of Butyrospermum paradoxum, Terminalia laxiflora, and Anogeissus leiocarpus.

The shrubby stratum is Combretum collinum, Pericopsis laxiflora, Entada africana, Crossopteryx febrifuga, Strychnos spinosa, Detarium microcarpum, and Hymenocardia acida.

A lower woody stratum of short shrubs is also present; its composition is very similar, if not identical: Grewia mollis, Bridelia scleroneura, Securidaca longipedunculata, Ectadiopsis oblongifolia, and Maytenus senegalensis.

The graminaceous cover is based on perennial species: Andropogon gayanus, Hyparrhenia involucrata, H. barteri, and Ctenium newtonii.

B) **TREE SAVANNA WITH DANIELLIA OLIVERI, TERMINALIA MACROPTERA ON TROPICAL, FERRUGINOUS SOILS WITH HYDROMORPHIC TENDENCIES**

The hydromorphy, due to the proximity of waterways, modifies the florestic composition of the tree savanna in which Terminalia macroptera and Vitex doniana appear.

The other species of the shrub and tree savannas are those of the preceding tree savanna, the relative proportion of each being nearly identical as well.

At the herbaceous level, hydromorphic influence is more deeply felt and the differences in floristic composition are more clearly delineated. The species present are Andropogon schirensis, Hyperthelia dissolute, and Sporobolus festivus.

C) **TREE SAVANNA WITH AFROMOSIA LAXIFLORA, DETARIUM MICROCARPUM, AND HYPARRHENIA INVOLUCRATA**

This formation occurs on sands, in Nigeria. The arboreal stratum is characterized by Afromosia laxiflora, Isoberlinia doka, Anogeissus leiocarpus, Detarium microcarpum, and Combretum spp.
The herbaceous layer is dominated by Hyparrhenia involucrata, accompanied by Andropogon spp., Loudetia sp., and Aristida sp.

111. VEGETATION OF THE HARD-PANS

The hard-pan coverage area is the same as that of the tree savannas and open woodlands with legumes found south of the 9th parallel.

The hard-pan vegetation is in the form of shrub or tree savannas, occurring on both ferrallitic soils (in the Koros) and tropical ferruginous ones (vegetation of the great valleys).

A) SHRUB AND GRASS SAVANNA OF THE HARD-PANS

The most frequently encountered aspect of this type of formation is that of a grass savanna sprinkled with termitariums on which shrubs develop.

The herbaceous cover is almost exclusively composed of Loudetia annua var. annua. Gramineae, cyperaceae, as well as specimens of various other species inhabit the small depressions which remain flooded over long periods of time.

Among gramineae, Oryza spp., Brachiaria stipitata, and Sporobus piliferus are the most characteristic.

Cyperaceae are also present with Ascolepis protea, Pycreus spp., and Scleria melanotricha.

Other families are represented notably the Lamiaceae with Dyssophila tisserantii, the Aponogetonaceae with Aponogeton vallisnerioides, and the Eriocaulonaceae with Eriocaulon cinereum.

The termitariums found scattered over hard-pans support "islands" of shrubby vegetation with Hexalobus monopetalus, Combretym spp., Strychnos spp., and Acacia macrostachya.

The hard-pan outliers of Begamber, South of Moundou, and of Koro Karmona, North of Laï and Guideri, bear a formation of tree savanna even though the hard-pan practically form outcroppings. The arboreal stratum is composed of Tetrapleura tetraptera, Burkea africana, Pterocarpus lucens, and Monostes kerstingii. The herbaceous layer is based on an annual species, Hyparrhenia begirmica, and on a perennial one, Andropogon schirensis.
B) TREE SAVANNA ON HARD-PANS WITH BOSWELLIA ODORATA AND STERCULIA SETIGERA

This type of formation occurs in Chad, on Reg-type soils which have undergone very little evolution. The woody stratum is characterized by Boswellia odorata, Sterculia setigera, Isoberlinia doka, and Anogeissus leiocarpus with, in the undergrowth, Strychnos spinosa, and Bridelia scleroneura.

The rather sparse herbaceous layer is composed of Aristida kerstingii, Loudetia togoensis, Schizachyrium exile, and Andropogon gayanus.

IV. FORMATIONS ON THE WATERWAYS AND ON THEIR MAJOR BEDS; FORMATIONS IN FOREST-GALLERIES

The present paragraph deals with the great depression of the Mandoul, that of the major beds of the Logone and of the Chari Rivers, of the Bahr Sara, the Sido and the Nana Barya.

The Mandoul sector, South of Koumra, constitutes a formation typical of the major river beds because of the extensive area it covers and because the successive waves of vegetation are better delineated there than anywhere else. This particular depression will serve as an example of vegetational pattern for the great river beds.

A) VEGETATIONAL FORMATIONS OF THE SAVANNAS OF THE GREAT RIVERS, ON HYDROMORPHIC ALLUVIAL SOILS

The physiognomy of this formation is that of a non-shrubby savanna, except for a few "islands" which occur on termitariums and which bear the following species: Mitragyna inermis, Terminalia macroptera, and Vitex doniana.

At the edge of the flooded areas, one may observe three species: Vetiveria nigritana, Hyparrhenia exarmata and Hyparrhenia rufa.

The flooded zone itself is with Loudetia simplex accompanied by Setaria anceps, Sorghastrum trichopus, Brachiaria jubata, and Hyparrhenia
rufa; it is not possible, however, to distinguish clearly which of these facies might be the dominant one.

At the edge of the medium bed, the differences are more clearly delineated with Eragrostis barteri, Paspalum scrobiculatum, and Panicum fluvicola; this strip of flooded land being under-water for a longer period of time than others, it enjoys deep, underground hydromorphy after draining.

The open-waters area which, generally speaking, is never permanent is with Echinochloa pyramidalis, Echinochloa stagnina, Voscia cuspidata, and Jardinea congoensis, as well as with Sesbania sp., Mimosa pigra, Aldrovanda vesiculosa, and Nymphaea lotus.

These successive formations are encountered again in the area of the backwaters of secondary water courses, but in a more or less telescopic form. In the rivers' overflow, one also notes the following species: Panicum sublaetum, Panicum anabaptistum, Eragrostis barberi, Paspalum orbiculare, as well as the others which we have already indicated; Loudetia sp. is rarer, however, and when it is present, it never occupies extensive areas.

B) VEGETATION OF THE RIVER MAAIGOTS FLOODED FOR VARYING LENGTHS OF TIME OR PERMANENTLY FLOODED

In this particular case, the vegetation growing on the areas subject to flooding is of a limited nature, most of it being more specifically aquatic in character.

In the areas subject to the greatest amount of flooding, one finds the following species: Ottelia ulvifolia, Nymphaea rufescens, Nymphoides indica along with some Cyperaceae such as Rhynchospora candida, Kyllinga erecta, Heleocharis acutangula, and Fuirena umbellata; and with graminaceae such as Sacciolepis africana, Leersia hexandra, and Setaria restioidea.

These species are accompanied by Hygrophila senegalensis, Sauvagesia erecta, Melastomastrum segregatum, Clapertonia ficifolia, and Buchnera capitata.
C) VEGETATION OF RIVER BANKS

The banks of large waterways bear a type of vegetation which differs from that of the neighboring savanna.

One may observe the following species: Mitragyna inermis, Morelia senegalensis, Diospyros mespiliformis, Celtis integrifolia, and Kugelia africana with some Acacia ataxacantha and Paullinia pinnata. In Southern Chad, the vegetation is enriched by the addition of Syzygium guineense.

The shoals on the sandy bottom of river banks are inhabited by populations of small shrubs, characteristic of flood-prone areas, such as the following ones: Mimosa pigra, Sesbania sesban, Salix ledermanii; gramineae are also found in such spots: Echinochloa stagnina, Panicum anabaptistum, Jardinea congoensis, Chloris robusta, and Eragrostis atrovirens.

D) VEGETATION ON BANKS AND MAJOR BEDS OF MEDIUM-SIZE RIVERS

It differs from North to South, according to its geographical situation.

The southern-most type of vegetation — that of the Nana Barya — is made up at the edges of species from the neighboring woodland forest whereas the major bed of the river itself is invaded by Loudetia annua, Hyparrhenia rufa, Hyperthelia dissoluta, Eragrostis barteri, Sporobolus sanguineus, Brachiaria jubata, Panicum anabaptistum, Paspalum orbiculare, Jardinea congoensis, Echinochloa stagnina which form a grassy savanna with a few islands of Mitragyna inermis.

On the banks and shoals from which the Logone waters have receded and upstream from the rivers' meeting point at Laï, one finds the following species: Phyllantus reticulatus, Sesbania rostrata, Salix ledermanii, and Mimosa pigra accompanied by Phragmites australis, Chloris robusta, Saccharum spontaneum, and Polygonum senegalense.

E) VEGETATION OF GALLERY FORESTS

The term of "gallery forest" embodies the concept of riparian forest as well. It is precisely in those riparian forests that the most interesting
species from the botanical point of view are found; They are located in the southernmost area of Chad and can be penetrated with extreme difficulty only as they often grow solidly on either side of the river.

The woody stratum is composed of a mixture of various species which, nevertheless, is dominated by sudano-guinean types, many of them being in this particular case at the northernmost limit of their area of growth. They are Oncoba spinosa, Caloncoba schweinfurthii, Oncocalamus acanthonecmis, Psychotria vogeliana, Psychotria psychotrioides, Opilia celtidifolia, Hallea stipulosa, and Eriocoelum kerstingii.

In addition, various species, such as the following ones, are found in the undergrowth: Cyrtosema senegalense, Paulinia pinnata, Raphia sp., Entolasia olivacea, Smilax kraussiana, Scleria iostephana, Impatiens irvingii, Cremaspora triflora, Oxyanthus unilocularis, and Trachyphrynium braunianum, along with other ones, more specifically aquatic in nature, notably Otellia ulvifolia and Eichornia diversifolia, and with ferns such as Nephrolepis undulata, and Cyclosorus elatus.
This type of vegetation encompasses the various formations whose development is conditioned by the amount of flood and other waters.

The overflow waters of the Logone and Chari rivers flood vast plain areas in northern Cameroon as well as in Nigeria. These plains, which do not bear any shrubs, are called "yaéres".

The shores of Lake Chad as well as the Lake itself support a special type of vegetation.

1. FORMATIONS ON HYDROMORPHIC SOILS IN THE NORTHERN PART OF THE YAÉRES

This type of formation occupies areas of Cameroon (East of Kousseri) and of Nigeria (region of Dikwa); the development of its vegetation is regulated by the heavy floods of the Logone and by the filling waters of the rainy season.

A) Formation with Acacia seyal, Acacia campylacantha, Sorghum lanceolatum (H/AC)

The shrubby stratum is low; it is extremely dense in spots and impenetrable. Its most characteristic species are Acacia seyal, Acacia campylacantha and Ziziphus mauritania. The herbaceous cover is almost solely composed of Sorghum lanceolatum.

B) Shrub steppe with Acacia spp, Balanites aegyptiaca; Parklands with Acacia albida, and Sorghum aethiopicum (H/AS)

This formation is found in Nigeria, East of Dikwa. The shrubby stratum is based on thorny bushes such as Acacia seyal, A. nilotica var. nilotica, A. senegal and Balanites aegyptiaca. There are parklands with Acacia albida as well.
The herbaceous stratum is dominated by Sorghum aethiopicum, a tall, annual sorghum variety.

C) Grass steppe with Sorghum aethiopicum

This formation is localized north-west of Dikwa, between the town itself and Lake Chad. In spite of this geographical situation, one may observe a few thorny species such as Acacia seyal, A. nilotica var. nilotica, A. senegal and Balanites aegyptiaca; however, the dominant formation is a grass steppe with Sorghum aethiopicum.

D) Shrub steppe with Acacia spp., Balanites aegyptiaca and flooded area formations

This is found in the easternmost area of Nigeria, along the border with Cameroon and to the South of Sama, on the piedmont of the fossil ridge.

The shrubby stratum is composed of the thorny species already mentioned, that is, Acacia seyal, A. nilotica var. nilotica, A. senegal, Balanites aegyptiaca.

The herbaceous cover is composed of Schoenefeldia gracilis in the flooded parts, of Sorghum aethiopium, Eriochloa nubica, Oryza sp. in the flood-prone areas.

E) Flood-prone grass steppe of the northern alluvial system

This particular steppe occupies a vast area North of Maidiguri, in northern Nigeria.

Its vegetation is composed of Echinochloa obtusiflora, E. stagnina as well as of other herbaceous hydrophyllaceae.

F) Shrub formation with Acacia seyal and Sorghum lanceolatum

This kind of formation does not wholly belong to the Yaéré type as it is composed of differing species; instead, it might be associated with the thorny species which make up the transitional formation occurring between the hydromorphic areas and those from which flood-waters have receded. It is situated in Cameroon, on the western and south-western fringes of the Yaéré.
It occupies a sizable area of the Waza National Park.

The shrubby stratum is dense and regular; it is based on Acacia seyal, seemingly in its natural habitat here, accompanied by Sorghum lancelotum, the dominant graminaceous species, and by Echinochloa obtusiflora.

G) Formation with Mitragyna inermis and Eriochloa fatmensis on clayey-soils with water-retreat cracks

(H/M/E)

With this type of formation, the transitional ones which occur towards the yeârês disappear giving way to a formation very close in nature to that of the Yeârês. The shrub component, Mitragyna inermis, is not a thorny species. The aspect of the formation is that of a vast extent of short grasses with Mitragyna growing in clumps of five to six specimens, the tops of which always grow freely, without being entangled with one another. The herbaceous stratum is almost completely monospecific with Eriochloa nubica, a species which may behave as if it were perennial whenever long-lasting floods take place.

The vegetational formation here is a grassland.

H) Shrub formation with Acacia sieberana and Pseudocedrela kotschyi

(H/PK)

This formation, like the preceding one, does not altogether belong to the typical yeârê one; instead, it represents a transitional one following the formations on floodretreat areas. It constitutes an intermediary formation which is flooded during heavy flood years only. Its shrubby stratum is heterogeneous; it is made up of Acacia sieberana, Acacia seyal, Acacia etacea canthavera, camyacantha, Acacia nilotica, Crateva adensonii and Pseudocedrela kotschyi, this last species frequently growing in monospecific clumps.

The herbaceous stratum is composed of Pennisetum pedicellatum, Brachiaria ramosa, Panicum maximum, Echinochloa colona.

This type of formation is a shrub steppe. The presence of Pseudocedrela kotschyi announces the formations on hydromorphic soils with Terminalia macroptera which are characteristic of the Lef plain.
1) **Steppe with Acacia spp, Balanites aegyptiaca, Ziziphus, Schoenefeldia gracilis, Panicum sp.**

(Hs/AB)

This is situated north-west of the Maidiguri-Bama ridge, in Nigeria. The shrubby stratum is composed of Acacia seyal, A. nilotica var. nilotica, Balanites aegyptiaca, Ziziphus mauritiana.

The herbaceous cover is annual; it is based on Schoenefeldia gracilis, Panicum laetum, Chloris spp.

**J) Shrub steppe of the alluvial system with Acacia spp, Balanites aegyptiaca, and with Sorghum sp., and Eriochloa sp.**

(Hv/AG)

This type of formation occurs east of Maidiguri, near the Cameroonian border. In flood-retreat areas, the woody stratum is characterized by Acacia spp., and Balanites aegyptiaca; the herbaceous cover by Sorghum sp., and Eriochloa sp.

11. **VEGETATIONAL FORMATIONS ON FLOOD-PRONE HYDROMORPHIC SOILS, THE SO-CALLED YAERES**

These formations are located to the South of the 12th parallel putting them beyond the framework of the present chapter, which is devoted to the northern part of the Sudanese zone whose vegetation shows a certain affinity with that of the Sahel.

Their development taking place independently of climatic factors, these formations, which are conditioned by the Logone floods, can with difficulty only be ascribed to one or the other categories. They should have been dealt within a separate chapter.

The study of the transitional formations previously mentioned leads, nevertheless, directly to the Yaere-type if one follows the logical course of the catena; these particular formations will therefore be examined here.

**A) Non-shrubby formation with Eriochloa fatmensis**

(Hy/EN)

This type of formation is found at the 12th parallel level and constitutes the least flooded one of the Yaéré system, as it is generally defined, that is, a grassy plain without shrubs.
The herbaceous stratum is almost completely monospecific, i.e. made up of Eriochloa fatmensis. Echinochloa stagnina is found in the long, shallow depressions which constitute the water drainage channels.

This formation is of the aquatic grassland type.

B) Non-shrubby, flooded formations with Eragrostis atrovirens and Panicum anabaptistum

(Hy/EP)

It is periodically flooded by the Logone waters during the months of October and November.

At the edge of the flood-prone areas, the most frequently encountered species are Vetiveria nigritena, Sorghastrum trichopus, Setaria anceps, and Brachytrachium jubata. In the more water-logged zone, one finds Eragrostis atrovirens, Eragrostis barberi, Panicum anabaptistum, and Hyparrhenia rufa.

This type of formation is a grass savanna.

C) Non-shrubby formation with Hyparrhenia rufa and Echinochloa stagnina

(Hy/HE)

This formation constitutes a Yaérf in the true sense of the word for it is very regularly flooded, even during light flood years. The herbaceous cover is homogeneous and evenly distributed, Hyparrhenia rufa being the predominant species.

The drainage channels, which are lower, support vegetation based on Echinochloa colone and Vossia cuspidata.

This type of formation is a grass savanna.

III. FORMATIONS TYPICAL OF LAKE CHAD (H/L)

As for the formations occurring in the areas subject to flooding by the Logone water system, i.e. the Yaérs, Lake Chad should have been the subject of a separate chapter, the edaphic factor being of the first importance in the climatic influence which is preponderant here. In that case, however, the line of separation between formations dependent on edaphic conditions and independent of them would have been a very delicate one to situate and would have broken a catena. It would seem more logical therefore, to describe the Lake Chad system at this point, by the same reasoning which allowed the integration of the Yaérf system into the northern Sahelo-Sudanese category.
These Lake-Chad types of formation are more or less extensive, according to the flood level. During a high flood-mark year, the dividing line between the waters and the shore is sharp and "terra firma" vegetation stops very close to the water's edge. Vegetation, strictly dependent on the waters for its development is limited to a narrow strip, a few dozen meters in width, with a floating Cyperus papyrus fringe, especially on the north shore.

During low flood-mark years instead, extensive areas are above water and according to the texture of their soils and the time at which flood-waters recede, they can bear a type of vegetation which differs markedly from that found on firm ground. These formations are difficult to describe as they undergo constant evolution. Nevertheless, two major groups may be distinguished in the areas from which waters have recently withdrawn (two to eight years ago); one, the shrub group, is characterized by very dense growth of Acacia nilotica, var. adansonii, the other, non shrubby, by creeping Leptadenia hastata.

The formations described below are indicated on the map by means of the initials H/L.

A) Formation with Acacia nilotica var. Adansonii, Pennisetum pedicellatum and Cenchrus biflorus, on organic, sandy soils

This type of formation has been in existence for a number of years which we can estimate, even if such dating is difficult to establish, to be between three and eight.

The shrubby stratum measures two to four meters in height. It is extremely dense, often impenetrable, and is dominated in the microdepressions forming on compacted sands by Acacia nilotica var. adansonii, previously mentioned. Other woody shrubs, Acacia sieberiana, Acacia seyal, Calotropis procera, Hyphaene thebaica, and Piliostigma reticulatum grow in isolated specimens.

There are also some perennial species belonging to various families such as Leptadenia hastata, Indigofera oblongifolia, Waltheria indica, Cynodon dactylon and Pulchea ovalis, a shrubby composite.

The annual herbaceous layer is abundant in clearings; it is dominated by Pennisetum pedicellatum and Cenchrus biflorus, accompanied by Chloris pilosa.
Brachiaria ramosa, Panicum maximum and Lactyloctenium aegyptium.

In its most typical aspect, this formation may be classified as a shrub steppe with dense, thorny, closed shrubs, occasionally becoming more open.

B) Non-shrubby formation with Aristida stipoides, Chlorus pilosa and Leptadenia hastata on silty-sandy soils

This type of formation, which has most probably been free of flood-waters for a shorter period of time than the preceding one (one to three years only) is located on soils less rich in organic matter.

It is a non-shrubby formation, at least for the present, if one excepts a few isolated examples of Acacia sieberiana, Acacia nilotica var. adansonii, Calotropis procera and, even more rare in occurrence, Hyphaene thebaica, Mimos a pigra, and Borassus aethiopum. Calotropis procera, on the other hand, occasionally becomes very abundant.

The perennial herbaceous stratum is composed of Leptadenia hastata, an Asclepiadaceae which creeps over the ground as well as over the shrubs at times, of Indigofera oblongifolia, and Cynodon dactylon.

The annual herbaceous stratum also reflects the heterogeneity of this evolutionary formation; it is based on Chloris pilosa, Cenchrus biflorus, Pennisetum pedicellatum and Aristida stipoides.

It can be designated under the name of transitional steppe.

C) Formation with Phragmites sp., then Calotropis procera and Sporobolus spicatus, on recently emerged sands

This type of formation occupies sandy areas which correspond to the patches of grass and aquatic plants which were visible when the waters of the lake were higher and which were then actually growing on sand shoals.

After flood-waters have receded, this formation presents the aspect of a dense grass savanna with Phragmites which is rapidly destroyed by cattle herds and fires.

At that point, Calotropis procera makes its appearance, taking over the area thus freed. Phragmites unable to withstand the lowering of the waters disappears and is replaced by Sporobolus spicatus, occasionally accompanied by Aristida and Chloris.

This formation could possibly evolve into one with Acacia sieberiana.

D) Non-shrubby formation on organic, silty soils, bare at first, then with Calotropis procera and Sesbania sesban and with possible growths of Acacia nilotica var. adansonii
IV. VEGETATION OF LAKE CHAD

This is a subject which, if studied in detail, would constitute matter enough for a whole book. The totality of the facts cannot, therefore, be examined here; we shall have to content ourselves with indicating the general organisational pattern of the type of vegetation involved, without giving the details of the numerous facies which it may present.

This general organisational system begins with the formations occupying the backwaters of the lake, which are more or less flooded by rains and heavy floods and function then as temporary ponds, continues with the sandy banks formations prolonged by floating and semi-floating patches, to arrive, in the open, smooth waters, at the "herbiers", or patches of grasses and aquatic plants. The shallows of the lake constitute shoal-islets and bear a specific type of vegetation.

A) Formations on ponds and wadis of the shores of Lake Chad

Depressions here contain natron; at the center, they usually do not bear any shrub whereas their outer edges do, in particular Hyphaene thebaica. The herbaceous species are located in the center of the depressions; they are Sporobolus helvolus, and Sporolus spicatus; on the edges, one finds Cyperus leucogatus.

B) Formations on the sandy banks of the islands and of the lake

The transitional formation between that of the lake and the next one, located on sahelian sands, is a short one; it is limited to a narrow strip (three to six meters wide) of green vegetation. Cyperaceae abund (Cyperus sp., Scirpus sp.) and so do graminaceae: Imperata cylindrica, Cynodon dactylon, Paspalidium geminatum, Panicum subalbidum, Leersia hexandra.

This composition differs slightly on the southern shore of the lake where the transition between sand and water is less abrupt, as the slope is...
more gentle. The formation is then composed of Cyperus sp., accompanied with Eragrostis atrovirens, Digitaria debilis, Pycreus mundtii, Paspalum conjugatum, Hemarthria altissima, and Diplachne fusca.

C) **Shore formation; semi-aquatic vegetation**

This type of formation occurs in areas where the transition between sand and water is less abrupt than in the case of the islands of the northern archipelago, allowing the existence of a semi-permanent expense of water, which subsequently serves to maintain a sufficient humidity level. Its facies is often mixed with the southern one of the preceding formation. It is characterized by a tall, erect graminaceous, Echinochloa pyramidalis.

D) **Shore formations; floating fringes**

This type of formation is found in abundance in the Chari river delta, at the edge of sandy banks and of sand-shoals. The predominant species is Vossia cuspidate. On the same floating fringes with Polygonum senegalense stands, one may come across Sacciopelis africana.

The smooth waters also harbor species which are spread out on the surface, whereas the preceding ones were, on the whole, erect. These species, found at the edge of the others' growth area are Ipomoea aquatica, Ludwigia adscendens, Ludwigia lectocarpa, Ludwigia octovalvis, and Ludwigia erecta.

E) **Formation with Cyperus papyrus (Papyrus stands)**

It occurs in the form of a floating fringe, closely maintained together by the dense radicular system of species such as Oxystelma bornouense, Mukia mederaspatana, Ipomoea aquatica, and Ludwigia spp., and of a fern, Thelipteris interrupta. These floating masses with papyrus groves are detached from the shore by the winds and constitute the floating islands of Lake Chad on "Kirtas".

F) **Formation with Phragmites australis (Phragmites stands)**

This type of formation occupies the edges of the shores and the sandy shallows. It is almost monospecific, the other species being creeping grasses such as Oxystelma bornouense, and Mukia mederaspatana.

It is possible to encounter such Phragmites formations on sandy shallows, a certain distance from the water's edge.

G) **Formation with Typha domingensis (Typha stands)**

Often situated at some distance from the shore, this formation is almost completely monospecific. Typha domingensis usually occupies slimy shallows.
H) Formation with Aeschynomene elaohroxylon

This species, locally known under the name of "ambach" can reach a height of two to four meters and form veritable forests, especially when the waters are low.

I) Patchy formations with Potamogeton and Vallisneria

This type of formation is found in shallow, smooth waters, off Hadjer el Hamis. These patches of grasses and aquatic plants (herbiers) are based on Potamogeton schweinfurthii and Vallisneria aethiopica, as well as on Ceratophyllum demersum.

In certain zones, one encounters a facies with Nymphaea and with Utricularia.

J) Specific case of the shoal-islets

Shoal-islets are shallows covering a very extensive area; they bear Phragmites australis in their center, are girded first with a belt of Cyperus papyrus, then with a floating Vossia cuspidata fringe. The root network promotes the installation of Oxystema bornouense, Ipomoea rubens, Polygonum sp, and Ludwigia spp.
VEGETATION OF MOUNTAINS AND REGS

This type of vegetation occurs in Cameroon and in Nigeria, in the mountainous region of the Mandara Hills and in the foot-hills of the Adamaoua.

The highest zones support a vegetation based on Isoberlinia doka, while the slopes, which are drier, bear shrub savannas with, frequently, some thorny bushes as well as annual graminaceae.

1. SHRUB TO TREE SAVANNA WITH ISOBERLINIA DOKA

SHRUB TO TREE SAVANNA WITH ISOBERLINIA DOKA, DIHETEROPOGON AMPLECTENS

(R/ID)

This type of formation is located in Cameroon along the border with Nigeria, between the 10th and 11th parallel.

The woody stratum, more often than not destroyed, is characterized by Isoberlinia doka, the predominant species, accompanied by Combretum spp.

The herbaceous stratum is based on Andropogon tectorum and Diheteropogon amplexens.

11. TREE SAVANNA WITH AFRORMOSIA LAXIFLORA

TREE SAVANNA WITH AFRORMOSIA LAXIFLORA, AND DETARIDUM MICROCARPUM AND WITH ANDROPOGON SPP.

(R/DA)

This formation occurs in Nigeria, on the right bank of the Sénoué River, between Numan and Lén.
The arboreal stratum is composed of Detarium microcarpum, Afrormosia laxiflora, Croscopetryx febrifuga, Anogeissus leiocarpus, Prosopis africana, Combretum glutinosum, C. ghasalense, and Terminalia avicennioides.

The herbaceous stratum is dominated by Andropogon gayanus, A. asci-nodis, A. schirensis, A. fastigiatus, Schizachyrium exile, and Pennisetum pedicellatum.

TREE SAVANNA WITH AFRORMOSIA LAXIFLORA, ANOGEISSUS LEIOCARPUS, DETARIUM MICROCARPUM, BOSWELLIA DALZIELII WITH SHRUB SAVANNA WITH COMBRETUM SPP.

(R/CH)

This particular type of vegetation is a heterogeneous one because of the various formations of which it is made up. It is found in Nigeria, between little Gombe and Girei.

The herbaceous stratum is more homogeneous in character; It is dominated by Hyparrhenia bagirmica, H. involucrata with Andropogon pseudapricus, A. gayanus Aristida kerstingii, and A. togoensis.

TREE SAVANNA WITH AFRORMOSIA LAXIFLORA, DETARIUM MICROCARPUM, PENNISETUM PEDICELLATUM, AND SCHIZACHYRIUM EXILE

(R/AD)

This formation is located in Nigeria, west of Len. The woody stratum is characterized by Afrormosia laxiflora, and Detarium microcarpum.

The herbaceous stratum is based on Pennisetum pedicellatum, and Schizachyrium exile.

TREE SAVANNA WITH AFRORMOSIA LAXIFLORA, ANOGEISSUS LEIOCARPUS, DETARIUM MICROCARPUM, AND WITH ISOCERLINIA DOKA

(R/CA)

It is found in Nigeria, South of little Gambi and in the region of Uba, near the Cameroonian border.

The herbaceous layer is identical with the preceding one.
III. TREE SAVANNA WITH BOSWELLIA SPP.

TREE SAVANNA WITH BOSWELLIA DALZIELLI, ACACIA SPP., WITH LOUDE'TIA SP. AND ARISTIDA SP.

(R/BD)

It is situated South and South West of Biu. The arboreal stratum is characterized by Boswellia dalzielli, Anogeissus senegalensis, Entada africana, Combretum nigricans, C. ghasalenze, Crossopteryx febrifuga, Acacia dudgeoni, A. hockii, with locally, Haematostaphis.

The herbaceous stratum is composed of Loudetia togoensis, L. ennu, L. hordeiformis, Aristida kerstingii, A. hordeacea, and A. adscensionis.

TREE SAVANNA WITH BOSWELLIA DALZIELLI, ACACIA SPP; SHRUB SAVANNA WITH TERMINALIA SPP.

(R.HL)

It is found in Nigeria, close to the border with Cameroon. One encounters Acacia dudgeoni, A. hockii, as well as Hematostaphis and Bombax in the woody stratum.

The herbaceous layer is identical.

SHRUB SAVANNA OF THE PIEDMONT WITH BOSWELLIA DALZIELLI, AND LOUDE'TIA TOGOENSIS

(R/SL)

It is situated in Cameroon, in the region of Maroua, on the gravelly piedmonts at the foot of the hills.

The shrubby stratum is characterized by Boswellia dalzielli, Acacia sp., Combretum glutinosum, and Anogeissus leiocarpus.

The herbaceous cover is dominated by Loudetia togoensis, and Heteropogon contortus.

IV. TREE SAVANNA WITH ANOGEISSUS AND BOSWELLIA SPP.

TREE SAVANNA WITH ANOGEISSUS LEIOCARPUS, DETARIIUM MICROCARPUS, BOSWELLIA DALZIELLI, ACACIA SPP, AND WITH LOUDE'TIA SP AND ARISTIDA SP.

(R/AL)
This type of savanna is found in Nigeria, north-east of Gandika. Its woody stratum is characterized by Anogeissus leiocarpus, and Detarium microcarpum with, locally, patches of savanna with Boswellia dalzielli and Acacia dudgeoni, and A. hockii.

The annual herbaceous stratum is more homogeneous in character, with Loudetia togoensis, L. annua, L. hordeiformis, Aristida kerstingii, A. hordeacea, and A. adscensionis.

**TREE SAVANNA WITH ANOGEISSUS LEIOCARPUS, DETARIUM MICROCARPUM AND SHRUB SAVANNA WITH GUIERA SENEGALENSIS, AND COLBRETUM GLUTINOSUM.**

*(R/SA)*

These formations are situated in Nigeria, north of Ginei; also found are patches of savanna with Boswellia dalzielli and Acacia dudgeoni, and A. hockii.

The herbaceous cover is identical with the preceding one.

**TREE SAVANNA ON REG, WITH ANOGEISSUS LEIOCARPUS, BOSWELLIA DALZIELLI, AND B. ODORATA.**

*(R/AB)*

This type of formation is widespread in the south-western part of Chad and in Cameroon on granite, peneplain soils or on rocky, metamorphic surfaces which have been subject to little erosion.

The arboreal stratum is a dense one; it is dominated by Anogeissus leiocarpus, Boswellia dalzielli, B. odorata, Sterculia setigera as well as by Acacia hockii, A. dudgeoni, and Hexalobus monopetalus.

The herbaceous stratum is characterized by Aristida kerstingii, Loudetia togoensis, Schizachyrium exile, and Andropogon gayanus.

V. **SHRUB SAVANNA WITH ACACIA HOCKII**

**SHRUB SAVANNA WITH ACACIA HOCKII, ALBIZIA CHEVALIERI, ARISTIDA KERSTINGII AND LOUDETIA TOGENSESIS.**

*(R/AA)*
It occurs in the same regions as the preceding one, of which it may be a regressive form.

The shrubby stratum is composed of Acacia hockii, Albizia chevalieri, Dalbergia melanoxylon, and Ziziphus mauritania.

The herbaceous cover is identical with that of the preceding formation, with Aristida kerstingii, Loudetia togoensis, and Pennisetum pedicellatum.

**SHRUB SAVANNA WITH ACACIA HOCKII, BOSWELLIA DALZIELLI, ISOBERLINIA DOKA, AND ANDROPOGON SPP.**

This type of formation occurs in Nigeria, in the region of Miringa. The woody stratum is characterized by Acacia hockii, Boswellia dalzielli, Isoberlinia doka, Anogeissus leiocarpus, Combretum spp., Terminalia avicennioides, and Piliostigma thonningii.

The herbaceous stratum is characterized by Andropogon gayanus, A. ascinodis, A. schirensis, and Schizachyrium exile.
APPENDIX II
<table>
<thead>
<tr>
<th>Class</th>
<th>Wet season quality*</th>
<th>Dry season quality*</th>
<th>Yield of dry matter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(H=high; M=medium; L=low)</td>
<td></td>
<td>kg/ha</td>
</tr>
<tr>
<td>1. Aristida/Andropogon</td>
<td>5</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td>2. Aristida</td>
<td>6</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>3. Cenchrus</td>
<td>5</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>4. Brachiaria</td>
<td>5</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>5. Schizachyrium exile</td>
<td>5</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td>6. Loudetia togensis</td>
<td>4</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>7. Pennisetum pedicellatum/</td>
<td>4</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>L. togoensis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. P. pedicellatum/S. exile</td>
<td>4</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>9. Hyparrhenia spp.</td>
<td>3</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td>10. Hyparrhenia involucrata</td>
<td>3</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>11. Andropogon spp.</td>
<td>4</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>12. Loudetia/Aristida</td>
<td>4</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>13. Hyparrhenia soluta</td>
<td>3</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>14. Andropogon gayanus/</td>
<td>2</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>Diheteropogon</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Andropogon gayanus/</td>
<td>2</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>Hyparrhenia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Sporobolus helvolus</td>
<td>6</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>17. Schoenefeldia/Panicum</td>
<td>6</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>18. Schoenefeldia/Loudetia</td>
<td>4</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>19. Sorghum spp.</td>
<td>1</td>
<td>L?</td>
<td>L?</td>
</tr>
<tr>
<td>20. Alluvial Complex</td>
<td>1</td>
<td>H</td>
<td>H</td>
</tr>
</tbody>
</table>

In P.N. de Leeuw, A. Lesslie and P. Tuley
The Land resources of North East Nigeria, Vol. 4, p.81,
Present and Potential Land Use.
<table>
<thead>
<tr>
<th>Grassland Community</th>
<th>Estimated Yield (ET) 1</th>
<th>Ideal Grazing Days ET</th>
<th>Grazing Days Net season ET</th>
<th>Grazing Days Dry season ET</th>
<th>Wet season to dry season ratio (days)</th>
<th>WE Carrying Capacity (RGC)</th>
<th>DS Carrying Capacity (RSC)</th>
<th>Total Carrying Capacity (TCC)</th>
<th>DS Stocking Rate (RGR)</th>
<th>Total Stocking Rate (RTR)</th>
<th>Total Stocking Rate (RGR)</th>
<th>Net season quality</th>
<th>Dry season quality</th>
<th>Dry carrying capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>500-550</td>
<td>50</td>
<td>125</td>
<td>12</td>
<td>20</td>
<td>25/60</td>
<td>80/200</td>
<td>6.7 2.7</td>
<td>11.2 4.7</td>
<td>19.7 8.1</td>
<td>85 37</td>
<td>II</td>
<td>II</td>
<td>SM SM SM</td>
</tr>
<tr>
<td>2</td>
<td>500-550</td>
<td>30</td>
<td>80</td>
<td>7 20</td>
<td>15 40</td>
<td>80/280</td>
<td>11.4 4.0</td>
<td>18.6 7.0</td>
<td>33.9 12.1</td>
<td>56 25</td>
<td>34 14</td>
<td>II</td>
<td>II</td>
<td>SM SM SM</td>
</tr>
<tr>
<td>3</td>
<td>500-550</td>
<td>50</td>
<td>125</td>
<td>12</td>
<td>30</td>
<td>25/60</td>
<td>80/200</td>
<td>6.7 2.7</td>
<td>11.2 4.7</td>
<td>19.7 8.1</td>
<td>85 37</td>
<td>II</td>
<td>II</td>
<td>SM SM SM</td>
</tr>
<tr>
<td>4</td>
<td>500-550</td>
<td>50</td>
<td>125</td>
<td>12</td>
<td>30</td>
<td>25/60</td>
<td>100/260</td>
<td>8.3 3.3</td>
<td>10.4 4.3</td>
<td>20.6 8.4</td>
<td>77 30</td>
<td>II</td>
<td>II</td>
<td>SM SM SM</td>
</tr>
<tr>
<td>5</td>
<td>500-550</td>
<td>50</td>
<td>125</td>
<td>12</td>
<td>30</td>
<td>25/60</td>
<td>100/260</td>
<td>8.3 3.3</td>
<td>10.4 4.3</td>
<td>20.6 8.4</td>
<td>77 30</td>
<td>II</td>
<td>II</td>
<td>SM SM SM</td>
</tr>
<tr>
<td>6</td>
<td>500-550</td>
<td>100</td>
<td>250</td>
<td>25</td>
<td>60</td>
<td>50/125</td>
<td>120/260</td>
<td>4.6 2.0</td>
<td>6.8 1.9</td>
<td>10.6 4.3</td>
<td>133 50</td>
<td>L</td>
<td>L</td>
<td>L L L</td>
</tr>
<tr>
<td>7</td>
<td>500-550</td>
<td>100</td>
<td>250</td>
<td>25</td>
<td>60</td>
<td>50/125</td>
<td>120/260</td>
<td>4.6 2.0</td>
<td>6.8 1.9</td>
<td>10.6 4.3</td>
<td>133 50</td>
<td>L</td>
<td>L</td>
<td>L L L</td>
</tr>
<tr>
<td>8</td>
<td>500-550</td>
<td>100</td>
<td>250</td>
<td>25</td>
<td>60</td>
<td>50/125</td>
<td>140/220</td>
<td>5.6 2.3</td>
<td>4.4 1.8</td>
<td>11.0 4.5</td>
<td>114 43</td>
<td>L</td>
<td>L</td>
<td>L L L</td>
</tr>
<tr>
<td>9</td>
<td>500-550</td>
<td>100</td>
<td>250</td>
<td>25</td>
<td>60</td>
<td>50/125</td>
<td>140/220</td>
<td>5.6 2.3</td>
<td>4.4 1.8</td>
<td>11.0 4.5</td>
<td>114 43</td>
<td>L</td>
<td>L</td>
<td>L L L</td>
</tr>
<tr>
<td>10</td>
<td>500-550</td>
<td>100</td>
<td>410</td>
<td>40</td>
<td>100</td>
<td>80/200</td>
<td>140/220</td>
<td>3.5 1.4</td>
<td>2.7 1.1</td>
<td>6.8 2.7</td>
<td>182 71</td>
<td>L</td>
<td>L</td>
<td>L L L</td>
</tr>
<tr>
<td>11</td>
<td>500-550</td>
<td>100</td>
<td>410</td>
<td>40</td>
<td>100</td>
<td>80/200</td>
<td>140/220</td>
<td>3.5 1.4</td>
<td>2.7 1.1</td>
<td>6.8 2.7</td>
<td>182 71</td>
<td>L</td>
<td>L</td>
<td>L L L</td>
</tr>
<tr>
<td>12</td>
<td>500-550</td>
<td>100</td>
<td>250</td>
<td>25</td>
<td>60</td>
<td>50/125</td>
<td>140/220</td>
<td>5.6 2.3</td>
<td>4.4 1.8</td>
<td>11.0 4.5</td>
<td>114 43</td>
<td>L</td>
<td>L</td>
<td>L L L</td>
</tr>
<tr>
<td>13</td>
<td>500-550</td>
<td>100</td>
<td>250</td>
<td>25</td>
<td>60</td>
<td>50/125</td>
<td>140/220</td>
<td>5.6 2.3</td>
<td>4.4 1.8</td>
<td>11.0 4.5</td>
<td>114 43</td>
<td>L</td>
<td>L</td>
<td>L L L</td>
</tr>
<tr>
<td>14</td>
<td>500-550</td>
<td>100</td>
<td>250</td>
<td>25</td>
<td>60</td>
<td>50/125</td>
<td>140/220</td>
<td>5.6 2.3</td>
<td>4.4 1.8</td>
<td>11.0 4.5</td>
<td>114 43</td>
<td>L</td>
<td>L</td>
<td>L L L</td>
</tr>
<tr>
<td>15</td>
<td>500-550</td>
<td>100</td>
<td>250</td>
<td>25</td>
<td>60</td>
<td>50/125</td>
<td>220/350</td>
<td>2.8 0.9</td>
<td>1.9 0.7</td>
<td>4.8 1.8</td>
<td>256 111</td>
<td>L</td>
<td>L</td>
<td>L L L</td>
</tr>
<tr>
<td>16</td>
<td>500-550</td>
<td>100</td>
<td>250</td>
<td>25</td>
<td>60</td>
<td>50/125</td>
<td>220/350</td>
<td>2.8 0.9</td>
<td>1.9 0.7</td>
<td>4.8 1.8</td>
<td>256 111</td>
<td>L</td>
<td>L</td>
<td>L L L</td>
</tr>
<tr>
<td>17</td>
<td>500-550</td>
<td>100</td>
<td>250</td>
<td>25</td>
<td>60</td>
<td>50/125</td>
<td>120/260</td>
<td>4.8 2.0</td>
<td>4.8 1.9</td>
<td>10.6 4.3</td>
<td>133 50</td>
<td>L</td>
<td>L</td>
<td>L L L</td>
</tr>
<tr>
<td>18</td>
<td>500-550</td>
<td>100</td>
<td>250</td>
<td>25</td>
<td>60</td>
<td>50/125</td>
<td>120/260</td>
<td>4.8 2.0</td>
<td>4.8 1.9</td>
<td>10.6 4.3</td>
<td>133 50</td>
<td>L</td>
<td>L</td>
<td>L L L</td>
</tr>
</tbody>
</table>

1Utilisation is in the wet season only
2Utilisation is in the dry season only

3Utilisation all the year round

4It is assumed that access to these units is available only in the dry season

/Assumes availability of 200 days once water level commences to fall

in P.N. de Leeuw, A. Lesslie and P. Tuley
The Land resources of North East Nigeria, Vol. 4, p.86-87,
Present and Potential Land Use