A REVIEW OF RANGE MANAGEMENT PROBLEMS IN THE SOUTHERN GUINEA AND DERIVED SAVANNA ZONES OF NIGERIA

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ABSTRACT

The present status of management in the southern guinea and derived savanna zones of Nigeria is reviewed and opportunities for rangeland improvement are discussed.

INTRODUCTION

It is generally agreed by agricultural scientists that food production throughout the world, and particularly in developing countries such as Nigeria, can only be increased by raising the efficiency of both livestock and crop husbandries. In order to achieve this goal, the status and utilization of native grasslands with a fuller understanding of their ecology and management must be appreciated. The management of grassland to the best advantage is an important factor that governs the standard of productivity from both crops and livestock.

This paper proposes to discuss the grassland resources of southern guinea and derived savanna zones of Nigeria in terms of their present level of management, examine the limitation of our knowledge for adequate management and make suggestions about areas that need further investigations.

Description of the area

A large proportion of Nigerian grasslands may be considered in the accepted definition of range as land producing native forage for animal consumption or lands that are naturally or artificially revegetated and managed like native vegetation (Range Term Glossary Committee, 1964). The southern guinea savanna zone is one of the four major zones into which Keay (1953) divided the savanna regions of Nigeria. The northern and southern guinea savanna zones occupy about 40% of the area of Nigeria while the derived savanna zone occupies slightly over 10% of the country's land area and extends southwards from the southern guinea zone into the forest zone. Much of the savanna occupies the area commonly known as the Middle Belt—a thinly populated area which has great potentialities for agricultural development (Figure 1). This area has been described by Pullan (1962) in his presentation of a comprehensive report on the concept of the Middle belt as "that area of Nigeria in which, over a period of years, 50% or more of all years have a dry season of four to five months duration". Clayton (1962) in his study of the derived savanna in Kabba province of the Middle belt stated that rainfall showed two peaks in July and September respectively and as the rainfall decreases, the dry season increases in severity from south to north as shown below (Table 1).

Pullan (1962) confirmed that the length of the dry season is the most important climatic factor in the savanna zones, with rainfall varying between 1,000 mm in the northern end of the southern guinea zone to 1,800 mm in the south-east end of the derived savanna zone.

Vegetation varies a great deal in the savanna zones. The southern area of the derived savanna zone contains relic patches of high forest or forest trees including oil palm (*Elaeis guineensis*) and climbers growing on relatively dry ground which receives water only from rain. Typical vegetation in the southern guinea savanna consists of rather open savanna woodland, sometimes so open that the term open savanna has been applied. The general appearance of vegetation type in the southern

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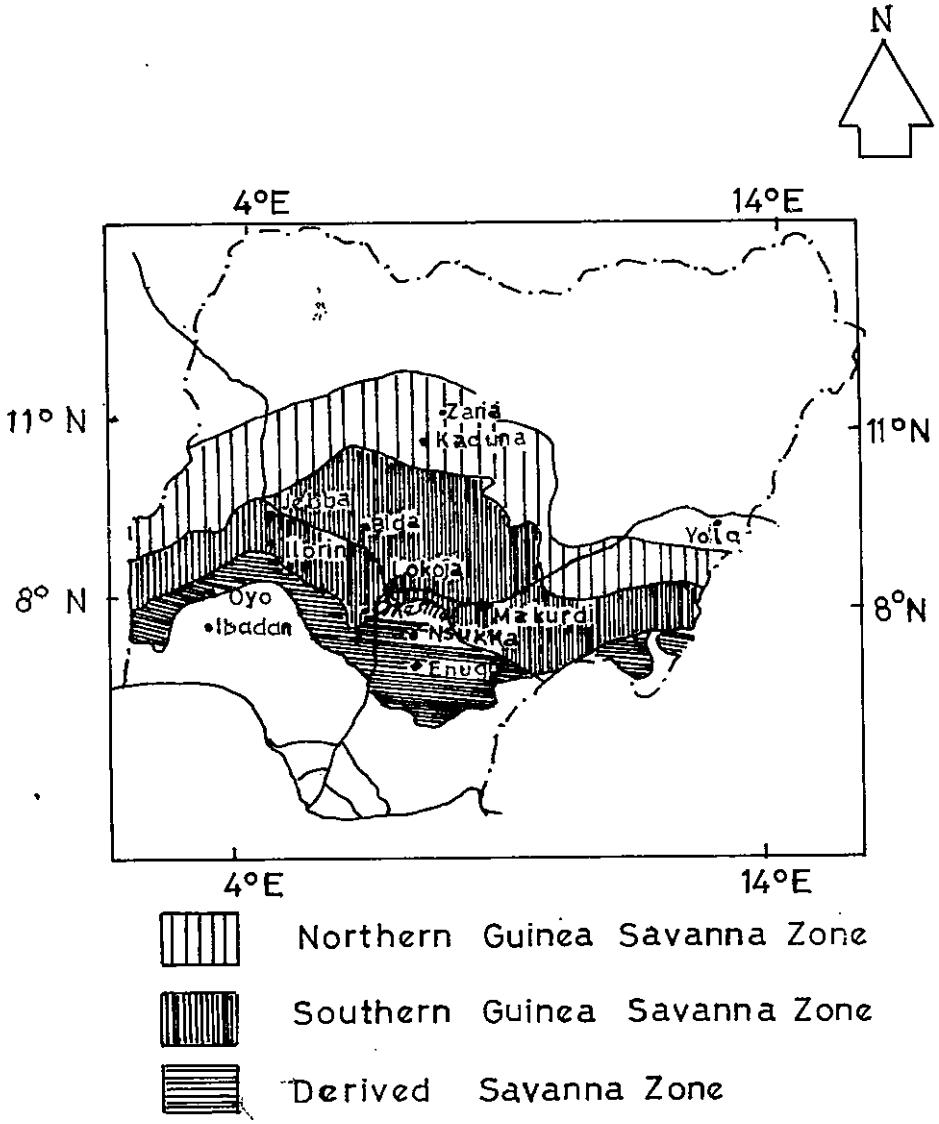

Figure 1 Map of the Guinea and derived Savanna Zones (After Keay)

TABLE 1

Rainfall figures for stations in Western Kabba

	Mean annual rainfall in mm	Months with less than 25 mm of rain	Months with no rain
Kabba	1510	3	0
Okene	1270	4	0
Lokoja	1170	4	1

guinea and derived savanna is very similar (Clayton 1962, Hopkins 1965) and for the matured derived savanna woodland there may be no floristic difference. Most of the important woody species, smaller trees and shrubs as well as the major grass species occuring in the southern guinea and derived savanna zones as enumerated by Keay (1959) Clayton (1962) Rains (1963) and Hopkins (1965) are shown in the appendix.

Adegbola (1969) has observed that *Andropogon gayanus* (northern gamba grass) Kunth and *A. pseudapricus* together with *Hyparrhenia* spp. (jaragua grass) and *Pennisetum* spp. are the most abundant grasses of the southern guinea zone. The derived savanna contains less *Hyparrhenia* but allows more vigorous growth of the *Panicum* spp. (the guinea grasses) than in the guinea savanna zone. Along the riverine areas and in the forest clearings associations of *Pennisetum purpureum* (elephant grass), *Panicum maximum* (guinea grass) as well as *Andropogon tectorum* (southern gamba grass) can be observed in the forest—savanna transition fringes. Overgrazed fields are usually invaded by *Imperata cylindrica* (spear grass) frequently associated with *Sida carpinifolia* (sida), *Sporobolus pyramidalis* (wire grass), *S. jacquemonti* and *Eleusine indica* (crows-foot grass).

PRESENT UTILIZATION AND MANAGEMENT

Grazing by nomadic herds

Planned management, such as practised in countries where a degree of control by a central authority is exercised over the handling of livestock and the use of range, does not exist in Nigeria. Primary factors of management such as proper numbers of livestock and proper season of use for various range types have not been evaluated. There is no provision of water at strategic points in this area for the use of the grazing animals. The southern guinea and derived savanna zones characterized by luxuriant growth of many grass species, particularly in the rainy season, is generally regarded as no-man's land by herdsmen. It is a free-for-all area subject to all abuses which follow in the wake of unrestricted and unsupervised grazing.

Most of the cattle found in this area are owned by the nomadic Fulani herdsmen who move from place to place in search of nutritious pasture for their animals. The grazing system practised by the Fulani herdsmen allows occasional use of the large expanse of grassland resources available in the southern guinea and derived savanna zones when they migrate from north to south. At the moment the resources of this area, to say the least, are inefficiently utilized. The contribution of the area to the national economy is very little while its potential is very great.

Traditionally the Fulani grazier wanders about with his herd of cattle, sheep and occasionally goats in search of green grass or water. He generally takes his herd out in the morning about 10 o'clock after the animals have been milked by the women and children. The milk is not pasturized but is often boiled before consumption or being taken to the market for sale.

Animals are allowed to wander around a specific location, seeking shade and lying down from about the noon hour till the late afternoon when they are allowed to graze some more and later driven to the temporary kraals about six o'clock in the

evening. The cattle are not supplied with any supplements and salt but depend entirely on what they can get from the limited grazing. They usually stop by a stream or brook on the return journey to the night kraal where the animals are fenced or tethered. Since animals are not allowed to graze during the night, there is little doubt that they do not get enough in the few hours of grazing during the day, hence the calves grow up half-starved and cattle mature in five to six years.

This system of grazing results in the elimination of the most important forage species in the range and an increase in plants of little value to livestock. There has been limited range inventory in Nigeria but strong evidence (De Leeuw, 1965) exists that the vegetation results from a combination of severe dry seasons, indiscriminate grazing, shifting cultivation and uncontrolled burning (De Leeuw, 1965).

Tsetse fly

Adegbola (1969) further observed that the main reason why both the southern guinea and the derived savanna zones of this country have been neglected for livestock development despite the vast area of natural grassland is the occurrence of the tsetse fly. These biting flies (*Glossina* spp.) carry the disease trypanosomiasis, which is very deadly both to man and beast. *Glossina morsitans* is found in the savanna vegetation under the tree and scrub cover while *G. longipalpis* is restricted to the heavy woodland and *G. tachinoides* is confined to the riverine areas of the southern guinea savanna zone. Before any large scale livestock development programme can be undertaken in this area, intensive efforts must be made to eliminate or at least reduce the population of tsetse flies to the barest minimum.

Breeds of cattle

In spite of this limitation some breeds of cattle, such as Muturu (West African short-horn cattle) Keteku and Ndama which have developed some degree of tolerance to trypanosomiasis, are kept in the southern guinea and derived savanna zones. The Ndama appear to be the most important cattle of the area and are found on ranches such as Upper Ogun, Akunu, Oke-Ako, in the Western State, and in other government livestock centres such as Fashola, Ado-Ekiti and Shaki also in the Western State, Obudu and Abakaliki in the south Eastern State and in the East Central State. Many private and cooperative farms involved in beef cattle production also keep this breed. It is estimated that nearly 18,000 cattle of the breed are in the Western State alone. Apart from its resistance to both trypanosomiasis and streptothricosis, the Ndama has the capacity to survive on sparse fodder and under conditions of stress intolerable to many other animals. The breed is, however, small in size (about 273-318 kg at maturity) and has a very slow rate of growth. The growth rate can be greatly improved by intensive selection and feeding. At Fashola current work has shown that it is possible to obtain a daily weight gain of 0.7 kg from a well established pasture of guinea grass (S.112) and centro (*Centrosema pubescens*), while on the same station a daily weight gain of 0.15 kg was obtained from unfertilized rangeland (Adegbola *et al* 1968).

Burning

The major management method of natural grassland employed in the area under discussion is indiscriminate annual burning. All the open range and fallows that will burn are burnt annually by fire of varying intensities. Burning is uncontrolled and can take place at any time from late November to early April i.e. from the onset of the dry season to the begining of the rains.

Burning is usually carried out by two different groups of people: (a) The villagers who organise themselves into hunting groups and set rangelands on fire for the sole purpose of killing bush animals (b) the Fulani herdsmen who migrate from north to south during the dry season in search of pastures for their cattle. Burning clears the land for cultivation and travels (Hopkins 1965), provides grazing at the time of the year when feed is in short supply, and exposes game for easy capture. It

also helps to prevent accumulation of ungrazeable materials and controls ticks; late burning may help to reduce tsetse fly population (Rains 1963). Against these seeming benefits of burning, it could be argued that burning destroys vegetation cover and thus exposes the soil to various agents of erosion. Useful plant species are destroyed by fire leaving only the fire resistant, coarse and unpalatable plants (Brockington 1961; West 1958; Moore 1960). The use of fire in the savannas of Nigeria can only become an instrument of range management with better understanding of its effect on the productivity of the range. Preliminary observation from current work at Upper Ogun (Akinyemi 1974a) seems to indicate that the use of fire will be helpful in maintaining the balance between the trees and the grass species of the area in addition to its provision of some dry season feed. Further, paddocks that were burnt early (December 21, 1971) produced a low-growing, leafy herbage with a yield of 400 to 500 kg ha^{-1} and a crude protein content of 8.7% by February of the following year. This material was grazed by Fulani cattle. Plots burnt in mid dry season (February 21, 1972) on the other hand, produced grazeable material by the end of March. Late season burning in April had less harmful effect on grass vigour during the rains. At the end of the growing season in August, yields varied from 7,000 kg ha^{-1} to 7,800 kg ha^{-1} for the three treatments respectively. Grazing in February may have reduced the total dry matter production of the December-burnt paddocks at the end of the dry season but the early burn had the advantage of helping to solve part of the dry season problem. Burning tended to reduce the number of trees and encouraged the growth of *Hyparrhenia* spp. and *Andropogon* spp. This seems to confirm similar observation made by Strang (1974) on the Rhodesian highveld. The use of fire in tropical and subtropical Africa as a tool in range management was summarised by West (1965).

Improvement of Rangeland—Increased Productivity

The productivity of the natural grassland is affected by a number of factors such as climate, soil fertility (especially the parent material), the topography of the area, the composition of the species and management practices such as rotational grazing, stocking rate, fertilizer application, cultivation and burning.

In the southern guinea and derived savanna zones, productivity of about 3,000 kg dry matter and 100 kg crude protein per ha per year had been obtained. Rains (1963) stated that in the northern guinea savanna, where grassland productivity is lower than that of the southern guinea savanna, average land cleared of shrub and subjected to a suitable rotation would support one mature (320 kg) animal on 2.8 ha on a year round basis. This stocking rate would allow for maintenance and production. Increased productivity of the natural grassland can be achieved if the following methods are adopted:

Intensity of use

Adequate rest periods should be allowed between grazings if the productivity of the range land is to be maintained at a desirable level. Frequent grazings at very high stocking rates will invariably lead to over-grazing and the elimination of the palatable and most desirable species. In a study of natural grassland at Fashola in the derived savanna zone, the cover of northern gamba grass was reduced by increasing the frequency of cutting or by close cutting at 5 cm height. After nine months of cutting every 2 weeks to a 5 cm stubble the cover of this grass had declined from 68% to 15% (Ahlgren *et al* 1959). The experiment suggests that an adequate rest period following the defoliation of northern gamba grass is probably as important in its management as closeness of grazing.

Soil nutrient status

In considering the use of fertilizers in rangelands, we must take note of both the soil nutrient status and the inherent ability of the native species to utilize the added nutrients. Not much work has been done on the nutrient status of soils in these areas.

Recently however, Van Amburg (1972) working at Fashola, Oyo, provided a brief profile description along with the physical and chemical properties of the study area. Van Amburg's data showed that there is a low status of exchangeable cations in the soils, especially in the A horizons where the roots are abundant. He also confirmed the acid nature and low clay content of these soils.

Adegbola (1971) indicated that the soils in these regions are largely deficient in nitrogen, phosphorus and sometimes in potassium. Savanna soils are also low in magnesium and calcium when compared with forest soils. The content of these minerals in pasture plants and natural grassland herbage tends to be very low and closely related to the soil contents (Table 2).

TABLE 2

Nutrient deficiency survey of maize in Western Nigeria (ADEGBOLA, 1971)

Soil zone	A. Soil content of minerals				
	pH	P (kg ha^{-1})	K (kg ha^{-1})	Mg (meq 100g^{-1})	Ca (meq 100g^{-1})
Savannah crystalline rock	6.00	15.7	314.7	1.91	3.65
Savannah sedimentary rock	5.80	14.4	160.2	2.09	3.13
Forest crystalline rock	6.03	26.3	319.2	2.09	5.08
Forest sedimentary rock	5.76	23.2	197.1	2.22	3.56

	B. Tissue content of minerals								
	N	P	K	Ca	Mg	B	Cu	Zn	Mn
	(% dry matter)				(ppm)				
Savannah crystalline rock	2.55	0.26	2.64	0.54	0.20	6.7	5.4	24	60
Savannah sedmentary rock	2.74	0.26	1.93	0.46	0.25	7.0	7.0	27	41
Forest crystalline rock	2.53	0.28	2.76	0.47	0.16	7.9	8.2	30	48
Forest sedimentary rock	2.89	0.29	2.09	0.53	0.30	7.7	7.9	27	30

Use of fertilizers

Rains (1963) concluded that the application of fertilizers to rangeland was not likely to provide an economic return. Adegbola *et al* (1968) however showed some responses from the application of ammonium sulphate to a grass cover that was mainly northern gamba grass at Fashola. The plot sizes were one hectare each replicated four times, with stocking rates of 1, 1.2 and 1.5 animal ha^{-1}.

Dry matter production and utilization by livestock increased with increase in the rate of nitrogen fertilization of the range. In the same experiment, unfertilized range produced 116.5 kg live weight increase on growing steers (Table 3).

TABLE 3

Effect of N fertilization on the performance of growing steers in the natural grassland (June-December 1967) (from Adegbola et al 1968).

Treatment kg N ha^{-1}	Animal days ha^{-1}	Total weight gain kg ha^{-1}	Weight gain per animal kg day^{-1}
0	714	116.5	0.16
56	842	148.9	0.18
112	832	250.0	0.30

This represents a carrying capacity of one mature animal (318.2 kg for Keteku or Ndama breeds) to 2.9 ha which allows for maintenance and production. Adegbola (1969) calculated that in the area under consideration, it should be possible to obtain

an annual production of 5,605 kg DM per hectare at an average crude protein content of 2 percent i.e. 112 kg crude protein per ha from shrub-free natural grassland. This will give a total of 15,909 kg DM and 318 kg crude protein from 2.9 ha of land. Assuming that only 40 percent of the material is grazable by stock, this gives a production potential of 6,364 kg DM and 127 kg CP which with adequate protein concentrate feeding should be ample to sustain one mature animal since cattle require only 2,273-2,727 kg DM for each adult. The authors also showed that fertilized range plots produced liveweight increases of 19 per cent and 114 percent respectively after the application of 56 kg and 112 kg N when compared with the unfertilized range. The composition of this rangeland (Table 4) indicated very little change in northern gamba grass content although significant increases were recorded in the amounts of *Pennisetum pedicellatum* (annual kyaswa grass) and spear grass following grazing.

TABLE 4

Dry matter per cent of natural grassland by species at the beginning and end of the grazing period (July-December 1967) from Adegbola et al 1968).

	No	N	56	N	112	N
	July	Dec.	July	Dec.	July	Dec.
Andropogon gayanus	66	67	65	69	65	64
Pennisetum pedicellatum	1.1	13.0	1.1	14.6	1.5	18.0
Imperata cylindrica	3.3	9.5	6.3	11.0	6.1	13.1
Sida carpinifolia	—	1.3	—	—	1.7	—
Aspilia sagitata	3.1	—	—	—	—	—
Tridax procumbens	26.5	9.2	27.6	5.4	25.7	4.9

In a study designed to evaluate the use of nitrogen and phosphorus fertilizers on natural grasslands in the derived savanna zones based at Fashola, Van Amburg showed that seasonal yields of the fertilized plots varied from a high of 7,139 kg/ha for plots which received 134 kg/ha to a low of 3,548 kg/ha for the control plots. There were no significant differences in production between plots receiving phosphorus and those receiving no phosphorus. Using ^{15}N (from urea and ammonium sulphate) and ^{32}P labelled superphosphate, the same researcher concluded that the seasonal values for nitrogen uptake were rather low ranging from 5.0 to 16.1% of applied nitrogen and he observed no differences in P uptake between treatments since there were no significant yield response from phosphorus application. It must be noted that the low uptake of nitrogen is quite characteristic of native grass response to nitrogen fertilization since these grasses have developed under conditions of low nutrient levels in these soils and have become adapted to low levels of fertility.

From the foregoing, the use of nitrogen fertilizers as a method of range improvement on these grasslands appears economically not feasible and greater emphasis needs to be paid to other forms of introducing nitrogen to the rangeland soils for increased forage productivity.

Use of legumes

The low protein content of the grass species, which is often as low as 2% particularly in the dry season, can be raised by oversowing with legumes. The advantages of legumes in improving the nitrogen status of the soil and thereby increasing the herbage yield and nutritive value of associated grass species are very well known to grassland scientists. These can be exploited in the grassland areas under consideration to effect improved herbage quality.

Stylosanthes gracilis (stylo) and *Centrosema pubescens* (centro) are two common tropical legumes which have been shown to be adapted to a wide range of climatic conditions in Nigeria. These legumes can be used for improved livestock

performance in the rangeland. Stylo is more drought resistant than centro and can be used in the guinea savanna while centro can be planted in the derived savanna zone. McIlroy (1962) has shown that annual contribution of fixed nitrogen to the sward by centro at Ibadan in the derived savanna zone was about 280 kg ha^{-1}. It has been shown that stylo could be established into rangeland by simply feeding the seed to cattle who spread it through their dung (Foster 1961). The establishment of legumes by hand broadcasting the seed soon after burning the grass is worth trying. Hagaar *et al* (1971) oversowed stylo on disc harrowed strips in burned savanna. Although the establishment was poor, yet liveweight gain increased by 23 percent over the control (45 kg ha^{-1} per annum) over a two year grazing period.

Weed control

The encroachment of undesirable grass species usually results from excessive use of natural rangeland through over-stocking. This phenomenon is very evident in ranches such as Upper Ogun, Ado-Ekiti, Fashola and around villages in the southern guinea and derived savanna zones where grazing animals are kept. In the savanna zones of Nigeria, weeds such as *Sida* spp. and *Acanthospermum* spp. are very common on over-grazed areas while grass weeds such as *Imperata cylindrica, Sporobolus* spp. and *Eleusine spp.* often take over such areas. Although these species may be grazeable at the young stages of growth, they do not represent the best stage in grass succession for livestock use.

Several methods have been used to control weed encroachment in natural grassland. In Kenya, Pratt and Knight (1971) successfully reduced the population of *Tarchonanthus camphoratus* and *Acacia brevispica* and grass weeds by the use of fire. Harrington (1973) used stump treatment with picloram to eradicate *Acacia hockii* in Ugandan rangeland. In Nigeria the relative value sof weed control methods, including re-seeding the range with seed of northern gamba grass alone or a seed mixture of gamba and stylo seeds, have been tried at Fashola (Adegbola *et al* 1971). Dry season fallow (ploughed to 15 cm, disc harrow in December and May) followed by seeding in May with Northern gamba grass or a mixture of gamba grass and stylo reduced the stand of spear grass from 95% to 3% within six months of first treatment (Table 5).

TABLE 5

Effect of three seeding treatments on the stand of spear grass (from Adegbola et al 1971).

Main factor	Sub-plot factor	Percent composition of spear grass in plot			
	Name of seed	Sampling dates			
		30.ix.61	13.x.61	27.x.61	20.xii.61
Control	gamba	24	20	20	18
	gamba + stylo	58	55	51	38
	stylo	51	53	54	55
Dry season fallow	gamba	5	5	8	4
	gamba + stylo	6	8	7	3
	stylo	10	16	14	17
Cultivation only	gamba	12	10	10	5
	gamba + stylo	10	13	10	3
	stylo	13	28	28	31
Chemical only	gamba	22	17	17	16
	gamba + stylo	19	16	11	6
	stylo	19	17	18	19
Cultivation plus chemical	gamba	12	10	10	5
	gamba + stylo	10	13	16	3
	stylo	13	28	28	30

Chemical methods of weed control have been adopted in attempts to eradicate *Sida* at Fashola. Application of dalapon at the rate of 28 kg ha^{-1} proved very effective in suppressing this weed. This rate of application was, however, too high for spear grass. A better kill of spear grass was achieved with 14 kg ha^{-1}.

Dry season feed

The lack of adequate dry season feed has long been recognised to be responsible for the considerable loss in weight by livestock at this period of the year. Concerted efforts are however being made to solve this problem. On government farms such as Fashola and Upper Ogun, experience has shown that losses in weight by animals could be considerably reduced if not eliminated by a judicious balance of range management and improved pasture conservation techniques. As already pointed out, fire has been used to extend the grazing season to the early of the dry season (Akinyemi 1974b). Feed conservation in form of silage appears to be an accepted practice on most government farms but Miller (1969) has suggested that conservation of natural or sown herbage either as hay or silage should be discouraged because of the low nutritive value of the product. Dried crop-residues particularly groundnut haulms have been shown as a most valuable source of material for dry season feed (Miller 1969). This suggests that crop residues such as rice husk and bran, guinea corn leaf hay, groundnut hay and husk as well as cotton seed should be considered for use as dry season feed for livestock.

The need for research

It seems quite clear that while information is becoming increasingly available on the nature and productivity of the natural grassland in both the southern guinea and derived savanna zones, a great deal still needs to be done to achieve economic use of the rangeland. (1) Intensive research is needed to increase our knowledge of the role of some forage species such as northern gamba grass, jaragua grass, elephant grass, annual Kyaswa grass and stylo which are very well adapted to the soil and climate of the southern guinea and derived savanna zones. Research information is also required as to their distribution, variability, reactions to grazing intensity, tolerance to fire, seedling vigour and seed production potentials as well as their nutritive qualities in relation to stage of growth and productivity. (2) Due attention should be paid to the problem of lack of feed in the dry season through improved methods of range management, especially the introduction of suitable legumes into the rangeland. (3) The reaction of natural grassland to burning and the use of fire to maintain grass species and production in the dry season need very careful study. Information is needed on when to burn, how frequently and with what intensity to burn, if fire is to be efficiently used as a tool in range management. (4) Another area of rangeland improvement where more work must be carried out is in the eradication of tsetse fly. The success or failure of livestock production will depend to a large extent on the degree to which we can successfully eradicate the tsetse fly in the savanna zones of Nigeria. (6) Finally, there is the need for integration of different levels of grassland improvement in time and in space.

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APPENDIX

Some associated species in the Southern and Derived savanna zones of Nigeria

Trees and Shrubs

Afzelia africana
Lophira lanceolata
Maytenus senegalensis
Terminalia glaucescens
Daniellia oliveri
Gardenia piliostigma
Elaeis guineensis
Hymenocarelia acida
Butyrospermum parkii
Vitex doniana
Ziziphus jujuba
Khaya senegalensis
Psorospermum ferbrifugum
Detarium microcarpus
Ziziphus spina-christi

Sedges and other weed species

Cyperus sphaceolata
Mariscus umbellatus
Sida carpinifolia

Grasses

(a) **Perennials**

Andropogon gayanus
A. tectorum
Hyparrhenia rufa
H. dissoluta
H. subplumosa
H. filipendula
Ctenium nubicum
Pennisetum purpureum
P. polystachyon
Cymbopogon giganteus
Panicum maximum

(b) **Annuals**

Pennisetum pedicellatum
Andropogon pseudapricus
Hyparrhenia chrysargyrea
Dietomis fastigata

(c) **Grass weed species**

Imperata cylindrica
Sporobolus jacquemonti
S. pyramidalis
Eleusine indica

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