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IMPACT OF HUMAN ACTIVITIES ON THE WEST AFRICAN SAVANNA

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EDITED BY

1. J. A. Afolayan
2. E. O. Wangari
3. A. O. Isichei
4. E. A. Agbelusi
5. O. A. Fagbenro
6. S. O. Akindele
7. Z. D. Adeyefa
8. A. O. Olufayo

A. O. ISICHEI

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IMPACT OF LAND USE ON BIODIVERSITY IN THE SAVANNA ZONE OF WEST AFRICA

A. O. ISICHEI
Department of Botany,
Obafemi Awolowo University, Ile-Ife, Nigeria.

Biodiversity is a very important aspect of the natural resources of West African savanna and it is affected by land use. Savanna has traditionally been used for animal husbandry but with the shortage of agricultural land in moist zones, large-scale crop agriculture is being intensified in all the savanna zones. Agricultural expansion and intensification have resulted in reduction of crop diversity and encroached on conservation areas. Conservation efforts through the system of reservation have not been vigorous and current trends of loss of biodiversity will continue unless alternatives to Reserves are found. The Biosphere Reserves Concept initiated by UNESCO offer means of utilizing natural resources in a sustainable manner. The Concept is discussed in relation to the problem of biodiversity conservation in West Africa.

INTRODUCTION

Characteristics of West African Savanna Lands

Savanna Lands and their vegetation

Land comprises the physical environment, including climate, relief, soils, hydrology and vegetation, to the extent that these influence the potential for land use (FAO 1976). Vegetation, as an aspect of land is constituted by the complement of plant species in an area and it forms the most visible aspect of the tropical terrestrial landscape wherever adequate moisture is available. Vegetation epitomizes the climatic and edaphic environment in any area and is also the best indicator of the diversity of animal and other forms of life some of which it also provides habitats. It is not surprising that eco-climatic zones are characterized by the nature of the vegetation they support.

Savanna formations are conceived of as those forms of seasonal vegetation that occur between the equatorial rainforests and the mid-latitude deserts (Cole, 1986). Sanford and Isichei (1986) define savanna as seasonal tropical vegetation in which there is closed or nearly closed ground cover of grasses that are at least 80 cm high, with flat, usually cauline leaves; the vegetation is usually burnt annually and trees and shrubs are most often present. The term has been applied to different types of vegetation and in Africa it connotes low tree or parkland vegetation formation. Such tropical vegetation have structural and functional characteristics that enable them to exhibit seasonal rhythms of growth and productivity (Cole, 1986). Moisture is the major environmental determinant of savannas, with fire, soil nutrients and, in some cases, herbivores as important modifiers of the basic vegetation structure which the water regime promotes (Johnson and Tothill, 1985). Savannas could also be classified on floristic basis. Vegetation structure, a product of soil moisture and nutrient regime has been most frequently used for classification in Africa.

The UNESCO/AETFAT/UNSO vegetation map of Africa (White, 1983) is based on the earlier AETFAT map Keay (1959a) and the scheme, based on regional centres of species endemism, is one of the most widely used today. White does not use the term savanna which he regards as foreign and imprecise, preferring 'grassland' and 'wooded grassland'. The zonation of Keay (1959) has continued to enjoy wide usage in West Africa. But it needs to be emphasized that the nature and composition of savanna vegetation reflect total environmental conditions, including human influences, and provide a reliable index of land potential for agriculture and other uses. Sanford and Isichei (1986) have proposed a West African savanna classification scheme which retains the nomenclature of Keay and proposes four savanna zones for West Africa, namely: Transition savanna, Guinea savanna, Sudan savanna and Sahel short grassland.

UNESCO (1979) distinguishes two savanna systems in West and Central Africa north of the equator: (1) Sudan-type savanna formations in a sub-humid climate which derive from the degradation of dense dry forest and woodlands; (2) Guinea-type savannas in humid climate which have replaced moist semi-deciduous forest. The northern Sudan zone with an annual rainfall of 600 - 900 mm and an active growth period of 3 - 5 months form a transition zone to the Sahel. In the Guinea savannas annual rainfall may vary from 900 mm to more than 1000 mm but with an active

growth period of 5-7 months. These formations correspond to the Sudan, Southern and Northern Guinea, and Derived (Transition) savanna zones (Keay, 1959), and to the Sudanian woodlands and the Guinea-Congolian secondary grassland and wooded grassland of White (1983). These formations, located in the eco-climatic zone where moisture-indexed length of growing season is between 30 and 270 days, or where the precipitation/evapotranspiration ratio is between 0.20 and 1.0, constitute savannas. The rainfall regimes of the savanna zones are presented in Table 1.

Table 1. West African Savanna Rainfall Regimes

Zone	Rainfall Amount (mm)	Rainy Season Duration (Months)
Humid	1200-1500	8-10
Sub-Humid	800-1200	5-7
Dry Sub-Humid	600-800	4-6
Semi-Arid	400-600	3-5

Moist savannas in their natural state, especially in their northernmost parts in West Africa are mainly woodlands, that is, open stands of trees whose crown form canopies 8 to 20 m or more in height. The crowns of adjacent trees are often in contact but not interlocking. The natural vegetation has been profoundly modified by cultivation and where the intervening period between cultivations is short and fires frequent, the trees are often represented only by coppice shoots and mature trees of specially preserved species of economic importance. Around the large towns cultivation is permanent or semi-permanent for several kilometres but valuable trees are protected leaving a parkland savanna (White, 1983).

Widespread in Northern Guinea savanna (Keay, 1959) are *Isoberlinia* woodlands. These woodlands are most associated with plinthite and quartzite ridges. They have a thin but continuous main canopy of *Isoberlinia doka* and *I. tomentosa*. *Isoberlinia* woodlands are often flanked by savanna where *Afzelia africana*, *Monotes kerstingii* and *Xeroderris stuhlmanii* are dominant. Other common trees include *Parkia biglobosa*, *Vitellaria paradoxa* and *Terminalia spp*. *Andropogon gayanus*, *Hyparrhenia spp* and *Schizachyrium spp* dominate the herb layer.

South of these formations are the wetter zones which include the forest/savanna transition zones. These are generally regarded as fire climaxes, burning being a regular feature. These savannas have been derived from forest formations which have been denuded by human activities. The dominant trees in this zone include *Daniellia oliveri*, *Erythrophloem africana*, *Lophira lanceolata* and a scattering of oil palm, *Elaeis guineensis*. Tall grasses (up to 4 m) of the tribe *Andropogoneae* of which *A. tectorum* is the most common, dominate the herb stratum.

Relief and Soil

A line drawn across Africa from Angola to western Ethiopia divides Africa into a 'low' western Africa where most of the land is between 150 and 600 m above sea level with just a few exceptions, and a 'high' eastern and southern Africa which mostly rise 1000 m and higher above sea level (White, 1983). In western (low) Africa where, due to the general low altitude the climate pattern is determined by distance from the Atlantic ocean, vegetation zonation closely follows the isohyet. The dominant soil of the savanna is the Ferruginous Tropical Soil which, including associated areas of ferruginous crusts and soils formed over them, covers about 58% of West Africa (Jones and Wild 1975). The ferruginous tropical soils are bordered on north by Brown and Reddish-Brown Arid and Semi-Arid Soils, and in the south by Ferrisols and Frrallitic soils.

Ferruginous soils are formed on parent material rich in quartz crystalline rocks of the basement complex, on granite and on aeolian and many sedimentary deposits. They are fairly shallow soils with most profiles less than 150 cm deep. The clay fraction is predominantly kaolinitic with low

cation exchange capacities. The soil organic matter status is related to rainfall, soil clay content and previous land use. Structural stability is generally poor and erosion hazard is high. The agricultural value of the soil is rated poor to average.

Hydrology

The major rivers in the West African savanna are the Senegal with a basin area of 128 400 km^2, the Niger with a basin area of 120 000 km^2 and the River Chari with a drainage basin of 450 000 km^2. Rivers Niger and Senegal rise from the Futa Djallon highlands in Guinea while the Chari which drains most of Central African Republic drains into the Chad Basin.

Socioeconomic Conditions in West African Savanna Lands

Savanna occupies 12.3 million km^2 in Africa, about 40% of the continent's land area. Well over 80% of West Africa's 6 million km^2 area is savanna. Savanna covers most of Senegal, Gambia, the southern third of Mali, the southern margin of Niger and Chad, Guinea Bissau, most of Guinea, parts of Sierra Leone, the northern half of Ivory Coast, most of the northern half and southeastern coastal area of Ghana, Burkina Fasso, Togo, Benin, except of a narrow strip, and 80% of Nigeria (Okigbo 1985; Table 2; Fig. 1). Except for Liberia, most of the countries in West Africa became sovereign states in the last 30 - 40 years. Many are still grappling with the teething problems of statehood. West african savanna lands contain several of the world's least developed countries. Their socio-economic features include rapid population growth, subsistence agriculture and dependence on one or two agricultural commodities as the main source of foreign exchange. Such countries have been experiencing declining food production in the last 20 years even if a very high percentage of the population are engaged in agriculture (Table 4) which relies almost entirely on natural resources and human energy for productivity. The countries also face high rates of urbanization, a process that negatively affects food production.

Land Use and Biodiversity in West African Savanna

Biodiversity in the Savanna

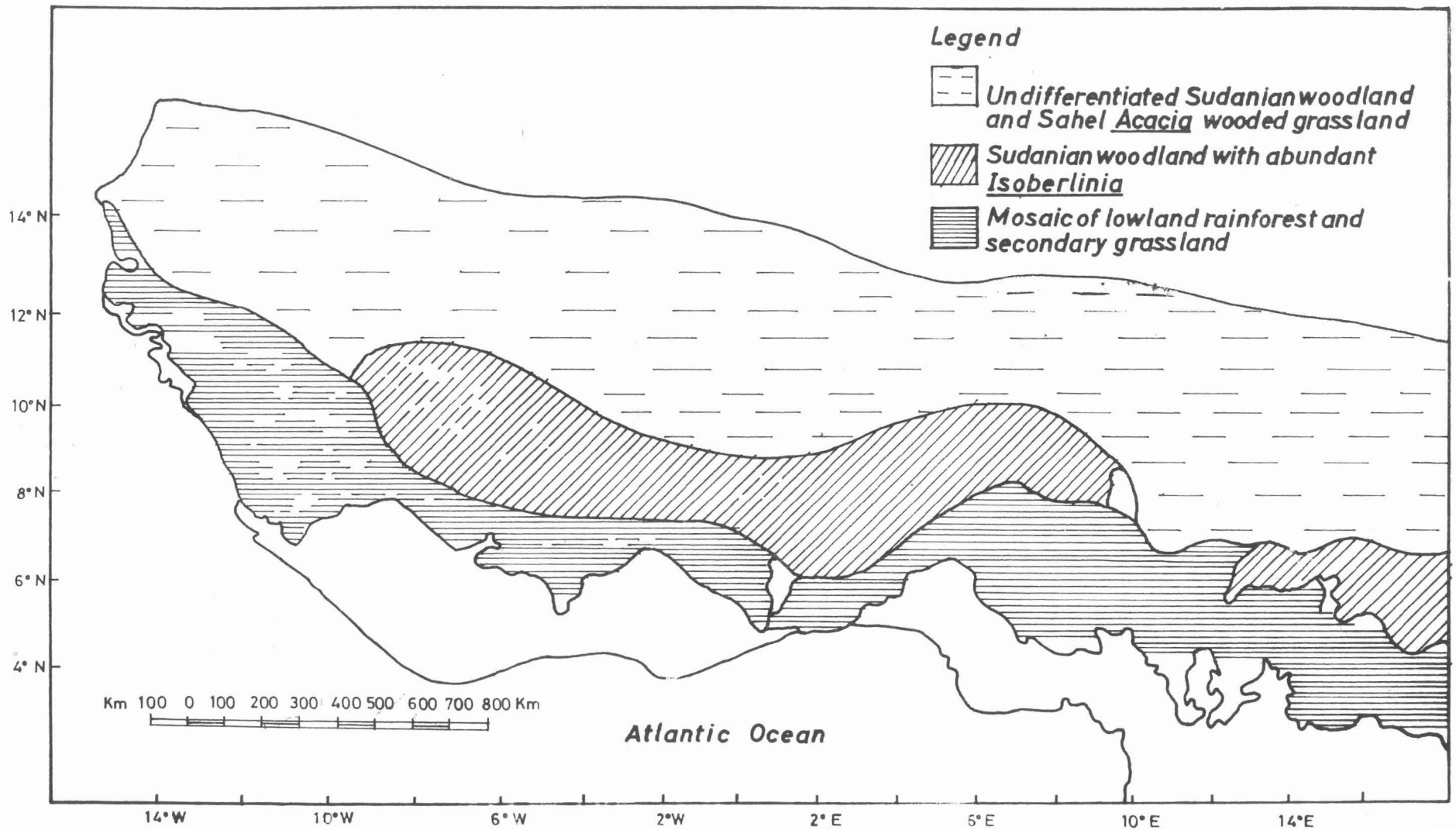
Natural Vegetation Diversity

According to White (1983) two biogeographic regions can be identified in the savanna zone of West Africa: i) Guinea - Congolian/Sudania regional transition zone; ii) Sudanian regional centre of endemism. Some part of the Guinea-Congolian regional centre of endemism, a region of forest formations, and parts of the Sahel regional transition zone also fall within the savanna zone. The Sudanian regional centre of endemism, in the core savanna zone is reported to have 2 750 plant species, of which about one-third are endemic. There are no endemic families and the few endemic genera include *Buttyrospermum (Vitellaria), Haematostaphis* and *Pseudocedrela*, all monotypic (White 1983). White observes that Sudanian linking species are very widespread in the moderately dry parts of Africa and may extend to other parts of the tropics. The Guinea-Congolian regional transition zone occupy the moist savanna zone of West Africa and White reports that there are probably fewer than 2000 species, nearly all of which are Guinea-Congolian or Sudanian-wide, or linking species with even wider distributions. Upland areas in the Republic of Guinea and Sierra Leone support a few endemic species while the Accra Plains, a dry area close to the Ghanaian coast, habour a considerable number of endemic and disjunct species.

Species diversity is partly dependent on variation in topography so it is not surprising that of the 12 countries with the highest levels of plant species diversity in Africa only two, Cameroun (5th in rank with 10 184 species) and Nigeria (12th, with 5 949 species, are in West Africa (see Okigbo 1995). But it is generally agreed that the highest degree of diversity is found in the humid tropics, so a lower level of diversity is expected in the savanna than in the forest zone.

Table 2. Areas occupied by various vegetation zones in West Africa

Country	High For st	Derived/ Coastal savanna	Southern Guinea savanna	Northern Guinea savanna	Highl nds	Arid/ emi arid
Benin	0.2	2.6	3.7	3.4	0.0	1.2
Burkina Fa so	0.0	0.0	1.7	4.5	0.0	20.1
Gambia	0.0	0.0	0.0	0.0	0.0	0.9
Ghana	8.8	5.8	3.0	3.5	0.0	0.5
Guinea Bi: sa	0.0	0.0	0.2	2.2	0.0	0.0
Guinea	3.9	7.2	8.3	2.1	1.2	0.4
Cote d'Ivoire	13.0	9.1	7.9	0.1	0.0	0.3
Niger	0.0	0.0	0.0	0.0	0.0	40.5
Nigeria	9.5	24.0	12.8	10.9	2.6	26.0
Liberia	7.8	1.4	0.1	0.0	0.0	0.0
Mali	0.0	0.0	2.7	4.1	0.0	38.2
Senegal	0.0	0.0	0.0	4.0	0.0	13.1
Sierra eone	2.3	4.1	0.0	0.0	0.0	0.0
Togo	0.4	3.8	0.4	0.8	0.0	0.0
Total	45 9	58.0	40.8	35.6	3.8	141.2


Legend
Undifferentiated Sudanian woodland and Sahel Acacia wooded grassland
Sudanian woodland with abundant Isoberlinia
Mosaic of lowland rainforest and secondary grassland
14° N
12° N
10° N
8° N
6° N
4° N
Km 100 0 100 200 300 400 500 600 700 800 Km
Atlantic Ocean
14° W
10° W
6° W
2° W
2° E
6° E
10° E
14° E

Crop and Forage Diversity

Okigbo (1995) has listed 110 indigenous African plants used as food. The numbers of these plant species used in various types of food and the numbers estimated to be occurring in West African savanna is shown in Table 3. This contrasts with the very few species of beverages and spices and condiments found in the savanna. Cereals are usually grass-like annuals which are favoured in savanna environments while beverages and spices/condiments are often perennial trees. Okigbo points out that of these food plants, considering the African continent as a whole, only 5 cereals, four legumes, three curcurbits, five oil seeds, twelve vegetables, four roots and tubers and 5-10 miscellaneous fruits/seeds contribute significantly to subsistence requirements, at least locally. Most of the major staples consumed - maize, wheat, beans, cassava etc are all exotics introduced from America and Asia and of the African food crops only Sorghum and millet are undergoing routine breeding and research of sufficient scope. It should be observed that introductions have played important roles in structuring natural vegetation communities. One recent example is Chromolaena odorata which was inadvertently introduced with Gmelina seedlings to West Africa in the 1950's. The plant is now the dominant species of the early successional vegetation landscape in humid and subhumid West Africa. Crawley (1986) has observed that such successful introductions and invasions are possible due, at least in part, to non-availability of natural competitors and/or enemies. Diseases of some of these introduced crop plants are already threatening their productivity - cassava mealy bug, maize mildew etc, thus necessitating diversification of the food crop base. The indigenous species may as yet stand some good chance.

Table 3. Numbers of indigenous African food plants and estimated numbers of these found in West African savanna. (From Okigbo 1995).

Food Type	Total No. of Species in Africa	No. Found in West African Savanna
Cereals	8	7
Grain legumes and other legumes	7	4
Curcurbits	9	8
Oil crops (seeds)	10	3
Vegetables	22	9
Roots and Tubers	9	6
Beverages	9	1
Spices and condiments	8	1
Miscellanous tree crops, fruits and seeds	28	8

The contribution of African species to the tropical pasture and fodder gene pool of the world is high. African grasses contribute 70-75% of pasture and fodder crops while legumes contribute 25-30% (Le Houerou 1991). Not only is Africa rich in terms of species diversity, but also intraspecific variability is high in many species. Polyploidy and apomixis are common, particularly in the Panicoideae (Le Houerou 1991). Le Houerou list 20 herbaceous fodder plant and 22 browse plant genera which could still be described as wild and under-utilized but have great potential. Almost all of these are of course savanna or semi arid zone plants. Grasses make up 8% of the plants listed in the Flora of West Tropical Africa (FWTA), a figure that rise to up to 17% in the arid and semi-arid areas. Le Houerou estimates that about 70% of African grasses (about 4,400 species) is palatable to herbivores, at least in their juvenile stages. Species of high fodder quality are fewer and include members of the following genera: Andropogon, Brachiaria, Cenchrus, Cynodon, Panicum and Pennisetum. Several of these, particularly Cynodon, Panicum and Cenchrus have been bred as fodder plants in Australia and Central and South America.

About 2000 legume species are consumed by large herbivores but very few of these are African. African tropical pasture legumes represent only 25-30% of the world cultivated species - 50% comes from central and South America and 20% from South east Asia. Many valuable forage species, especially in the Sub-family Papilionioidae are underutilized (See Skerman, 1977; Isichei and Awodoyin, 1990). Le Houerou (1980) listed 130 browse species most of them legumes, from the arid, semi-arid and subhumid zones of West Africa. The legumes include several genera in the subfamily Caesalpinioideae, Mimosoideae, especially the acacias, and a few Papilionioideae. There are several other families with just one or two browse plants.

Animal Diversity

Africa south of the Sahara belong to the biogeographic region known as the Afrotropical Realm. This Realm possesses the richest mammal faunal diversity of the world's eight realms and has a distinctive fish fauna but relatively impoverished bird, reptile and amphibian faunas (Huntley 1988). According to Mackinnon and Mackinnon (1986), the Sudanian centre of endemism, one of the seven such centres in Africa and a core savanna area, has 46 mammal species of which 2 are endemic, and 319 species of birds of which 8 are endemic. Huntley has observed that bird population correlated with rainfall, vegetation and other.factors in the environment. There is higher bird diversity in the forests.

Okigbo (1985) has observed that the large populations of animals in the savanna is possible because of elaborate specializations related to vegetation types, food preferences, differences in grazing heights, different dry season refuge and use of the same food source at different times. Western 'civilization' which often entailed destruction of forest habitats came from the coast in West Africa. Most of the colonial urban areas are also located near the coast. It is thus not surprising that savanna areas tend to have higher remnant faunal diversity than the forest zone. The main invertebrate fauna of grasslands are mainly Orthoptera, particularly the acridians but also tettigoniids and crickets. There are also the lepidopterous caterpillars, certain Coleoptera among the leaf eaters. The orders of sucking insects are also well represented, particularly several families of heteropterous Hemiptera and various Homoptera and Diptera are also abundant (UNESCO 1979). UNESCO reports biomass values (g/100 m^2) of invertebrate primary consumers of between 3 and 24 in the herb layer, between 2 and 24 in the litter layer and 8 and 30 in the soil layer at Mount Nimba, Republic of Guinea. Densities of various plant-eating invertebrates ranged from 2000 to 54 000 ha^{-1} in the Lamto savanna of Ivory Coast. The dry areas of West Africa are prone to locust inasions during which large areas of vegetation and crops are consumed.

In West Africa density of wildlife even in reserves, is very low compared to East Africa and biomass per unit area is about one-fifth that of East Africa (Ayeni 1982). The same applies to livestock. West African savanna generally appears to have a lower population density of small rodents than the savannas of East and Central Africa.

Land Use

Table 4 shows the sizes of various land uses in West Africa in relation to land areas of the various countries in the sub-region. The Table also shows the percentages of the labour force in each country employed in agriculture, an issue already discussed in the Introduction section. The percentages range from 35 in Cape Verde, a rocky country with little arable land and where the main source of revenue is tourism, to as high as 90% in Niger. In most countries well over 60 - 70% of the labour force is employed in agriculture. This has implication for biodiversity since the original vegetation most often has to be cleared and the soil tilled before crops are planted, practices that reduce biodiversity. Most countries in the sub-region, being in the savanna zone are, however,covered by pastures which are not as destructive as of biodiversity.

Okigbo (1995) has, instead of just recognizing land use types, identified two main farming systems -Traditional and transitional systems, and Modern systems and their local adaptations. These represent various stages in the evolution of crop-based and animal production systems. The implied assumption in the classification is that West African lands have been used mostly for agriculture. As the agricultural system evolves, the intensity of land use increases. The effects of such evolution on biodiversity varies.

Table 4. Land Use in West Africa and percentage of Labour Force Employed in Agriculture. (From Hedberg 1986)

Country	Land Area (1000 ha)	Arable Land	Pastures	Forests and Woodlands	Other Areas	% Labour Force in Agriculture
Benin	11 262	1 546	442	2157	7117	46
Burkina Faso	27 380	5 377	13 755	4 101	4 187	83
Cape Verde	403	40	10	1	352	>35
Gambia	1 000	200	400	303	227	79
Ghana	23 002	2 574	11 237	2 447	7 596	54
Guinea	24 586	1 500	3 000	1 046	19 040	82
Guinea Bissau	2 800	275	1 280	1 000	1 057	>84
Ivory Coast	31 800	8 887	8 000	12 000	3 359	81
Liberia	11 137	366	240	3 622	6 909	71
Mali	122 000	11 600	30 000	4 457	77 943	89
Niger	126 670	15 000	3 000	12 000	96 700	91
Nigeria	92 378	21 795	25 000	31 069	14 514	[illegible]
Senegal	19 200	5 564	5 700	5 318	3 037	77
Sierra Leone	7 174	3 664	2 204	301	1 005	67
Togo	5 600	2 160	200	530	2 710	69

In the traditional and transitional system the first phases are shifting cultivation and nomadic herding, followed by land rotation and rudimentary sedentary agriculture. In the next level of intensification sedentary agriculture is practised in highlands where terracing may or may not be practiced. As agriculture evolves, floodlands and valley bottoms are cultivated. It is clear that intensification generally leads to loss of biodiversity. Intensification in modern farming systems progresses from mixed farming and could involve livestock ranching, intensive livestock production, large scale farms and plantations and finally, specialized horticulture. Such intensifications reduce biodiversity since selection is geared towards few high-yielding varieties but could involve use limited land area and provide opportunities for setting some land aside for the preservation of biodiversity.

The Future of Biodiversity in the West African savanna Zone.

The threats to biodiversity have been outlined and as Huntley (1988) has observed, the romance of the colonial era in terms of biodiversity in Africa has now been replaced by the realism of thirst, starvation and desertification. The concepts of biodiversity and the sustainablity of production and life-support systems carry with them the promise of tangible values and benefits to the community at large. Various methods are currently being used to slow the loss of biodiversity in the savanna zone of West Africa. Each of these methods has its own advantages and disadvantages. Africans have traditionally protected biodiversity by means of cultural and religious rules (BSP 1993); trees have been protected in sacred groves, taboos have limited the harvest of certain species of plants and animals, land fallowing system have been practised and some local plant varieties have been nurtured. Two basic approaches are used to conserve biodiversity - in situ (on site) and ex situ (off site). Conservation around homesteads sacred groves can be considered in situ while procurement of different species and land races from other lands could be considered ex situ.

During colonial times, forest and game reserves were established to conserve flora and fauna. Other in situ conservation system include limited access Strict Nature Reserves which are limited to research and to religious or aesthetic purposes; Natural parks where biodiversity, landscapes and ecological processes of national or international significance are preserved; Managed nature reserve/wildlife sanctuary for preserving species and landscapes of national significance that require specific human manipulation for their perpetuation. Others include Resource Reserves where natural resources are protected pending the establishment of management objectives based on appropriate knowledge and planning. Natural biotic area/anthropological reserves that allow the way of life of societies living in harmony with the environment to continue undisturbed by modern technology; and multiple-use management area that provides for sustained production of renewable natural resources (Stuart et al., 1990).

The most popular of the in situ conservation systems are forest and game reserves. It is, however, in a few cases that these reserves have been used for conservation purposes. Many have been de-classified and converted into farmlands, residential areas and industrial locations. Others have been converted to indigenous exotic tree plantations. Ojo and Ijalana (1994) report a 12% dereservation in the moist forest region of Nigeria. Conservation areas were created and managed by alienation of local communities (see Ayeni, this volume) through repressive legislation and denial of natural endowments. In reaction to these, local commnities resorted to poaching which depleted conservation areas of their highly valued species. New conservation strategies must somehow re-established the link between local communities and their natural resources with the involvement of the scientific community and governments to ensure sustainability. One obvious way out is the adoption of the Biosphere Reserve concept.

The Biosphere Reserve Concept

Biosphere Reserves are sites for the conservation, for present and future use, of the diversity and integrity of biotic communities of plants and animals within natural ecosystems, and are used to safeguard the genetic diversity of species on which their continuing evolution depends (Mackinnon and Mackinnon 1986). They serve as benchmarks or standards for measurement of long-term changes in the biosphere as a whole and are consequently important sites for environmental monitoring. They are conceived of as places where government decision-makers, scientists, managers and local people co-operate in developing a model programme for managing land and water to meet human needs while conserving natural processes and biological resources (Okali 1991). Biosphere Reserves also provide opportunities for baseline ecological research and for

studies on the impacts of human interference as well as for monitoring long-term changes in natural ecosystems. In addition to these they also serve as sites for environmental education and training. Usually, Biosphere Reserves should be large enough, at least 1000 ha to contain the range of habitats that can sustain the biological populations protected and they must be zoned into: (i) a core area from which even manipulative research is excluded, (ii) a buffer zone around the core area in which manipulative research may take place, and (iii) a transition zone where compatible, sustainable human use may be permitted.

The core area of Biosphere Reserves is designated Strict Natural Reserve, SNR. An SNR should cover a minimum of 500 ha in the high forest zone and extend over the major habitat types of the ecological formation in which it is located. Strict Natural Reserves are created to protect representative samples of natural ecosystems for preservation of biodiversity and ecological processes, for scientific study, environmental monitoring, education and for the maintenance of genetic resources in a dynamic and evolutionary state. Local needs of forest resources use should be allowed for by designing buffer zones of sufficient width and permitting various categories of compatible uses and adhering to the provisions of the African Convention for the Conservation of Nature and Natural Resources as it relates to the protection of Strict Natural Reserves. The United Nations Educational, Scientific and Cultural Organization (UNESCO) pioneered the setting up of biosphere reserves when it hosted the 1968 UNESCO Conference on Rational Use and Conservation of the Resources of the Biosphere. This led to the establishment and global interest in biosphere reserves in several countries including Nigeria. There are 323 Biosphere Reserves world wide, in 82 countries covering 80% of the world's biogeographical areas. There are 31 Biosphere Reserves in 17 countries within the Afrotropical Realm (Mackinnon and Mackinnon 1986), while Hedberg (1986) lists 6 in the West African sub-region, four of them in the savanna zone.

The Biosphere Reserve concept fits in with the Biodiversity Convention adopted at the United Nations Conference on Environment and Development (UNCED), held in Rio, Brazil in 1992. The concept also falls within **Agenda 21**, one of the principalproducts of UNCED now adopted by the UN General Assembly as a United Nations priority. Chapter 15 of Agenda 21, 'Conservation of Biological Diversity', points out that our planets essential goods and services depend upon the variety and variability of genes, species, populations and ecosystems (Chapter 9, 'Protection for Development', Chapter 10, 'Planning and Management of Land Use', and Chapter 11, 'Combating Deforestation', are also applicable). Development of counter measures to the loss of biodiversity was delegated to the Biodiversity Convention and several West African countries have already benefitted from the Global Environmental Facility, a global fund set up to study biodiversity. A coordinated network of biosphere reserves should be set up in West Africa while at the same time ensuring that the needs of local people living in and around the reserves are met through sustainable use of natural resources.

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