

Forest Perspectives

Green gold of Africa: Nigeria's forest, a depleted but resilient renewable resource

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Abstract

Nigeria is the most populous country in Africa and has highly diverse forest ecosystems. Unfortunately, this rich vegetation continues to decline at an alarming rate; 21% of its forest cover has been lost between 1990 and 2005. The lowland rainforest area which is the main source of hardwood timber resources has been depleted to less than 3.94 million ha and continues to decline. The major causes of deforestation and forest degradation are crude oil exploration and exploitation in the coastal regions, increased intensity of land fallow systems, fuelwood collection, charcoal production, illegal logging, infrastructural development and urbanisation. The drastic reduction and degradation of forest cover in the last 50 years have diminished the productive and protective functions of the forests. This article highlights the historical development of forestry and forestry education in Nigeria. It discusses the issues related to policy and legislation development, the challenges facing the forest industries as well as the economic contributions from the forestry sector. It proposes the need for regulated forest exploitation, enactment and implementation of national afforestation and reforestation programmes, and the need for the revitalisation of the sector through a sustainable forest management approach.

Keywords: *Nigeria, lowland rainforest.*

Introduction

The Nigerian land area stretches over 983,213 km² with 78.7% in the savanna zone, 7.7% in the derived savanna zone and 13.6% in the rainforest zone. The country's forest cover is approximately 7.7% and has an estimated growing stock of 936 million m³, while rain-fed agriculture covers over 40% of the territory. A large proportion of the country is on a plateau, divided into three parts by the Niger River and its

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main tributary, the River Benue (Figure 1). The human population is more than 190 million, with a population density of 215 persons per square km and about 51% of the population lives in urban areas (Blaser et al. 2011, UN 2017). The country has over 250 ethnic groups with rich cultural endowment and this cultural diversity has a huge impact on the utilisation and level of protection of forest resources. Although the population density varies from region to region, the interactions of this large population with their respective environments have left indelible marks on the landscape. The manifestations of these impacts include urbanisation, deforestation, desertification, overpopulation, conflicts and all kinds of pollution. All these have had devastating effects on the country's forest ecosystem.

Forests and forest resources are part of the natural heritage, spanning over six ecological zones due to slight variations in the climatic conditions, especially rainfall patterns (Figure 1). These ecological zones are contiguous, running from north to south, with natural ranges that extend from mangrove swamps and tropical forests along the coast to open shrub and savanna woodlands on the low plateau. The woodlands extend to the central part of Nigeria, in the semi-arid plains of the north and the highlands to the east. Hence, diverse and complex vegetation types, such as Sahel, Sudan, Guinea and derived savannas, lowland rainforest, freshwater and mangrove

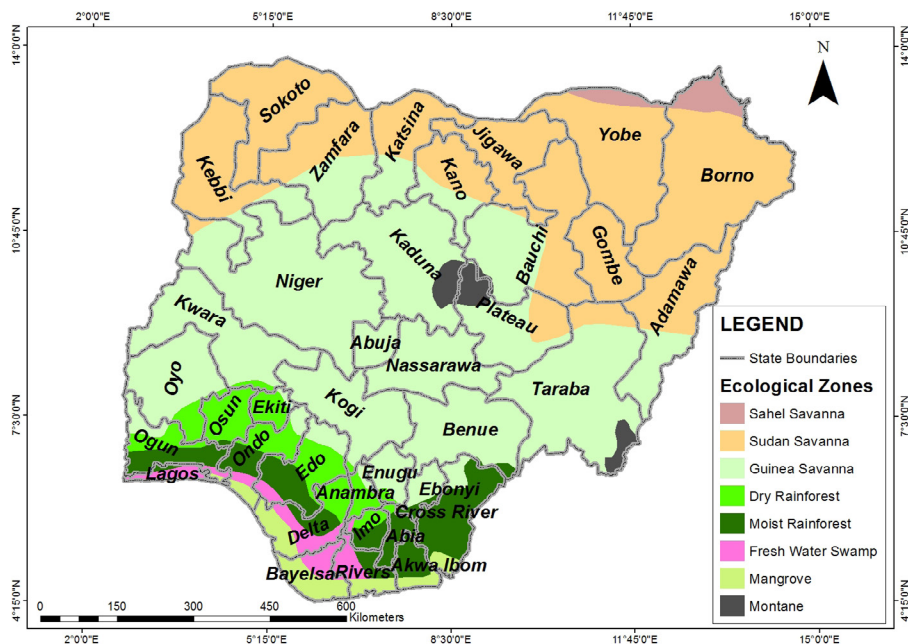


Figure 1: Nigeria's ecological zones and major forest types. The country's forest cover is approximately 7.7% of its land area and extends to 75,707 km²; the area of the island of Ireland is 84,421 km².

swamp forests, coastal marshes and estuaries, are found in the landscapes. In addition, mountainous regions occur on the south-eastern border with the Cameroun Highlands and the Jos Plateau in the middle belt of the country (FAO 2015). The ecological zones are important repositories of biodiversity, home to approximately 20,000 species of insects, 7,895 plant species, 1,000 bird species, 247 species of mammals, 123 species of reptiles, and 1,000 species of fish. It is estimated that 172 plant, 17 mammal, 6 bird and 13 amphibians found in these vegetation types are threatened (IUCN 2004, Usman and Adefalu 2010).

Saline swamp forest occurs along the coastal and Niger Delta regions harbouring a variety of red mangroves (*Rhizophora mangle* L., *Rhizophora racemosa* G. Mey and *Rhizophora harrisonii* Leech M.) as well as trees such as *Avicennia germinans* L. (black mangrove) and shrubs such as *Laguncularia racemosa* (L.) Gaertn. F. (white mangrove) and *Conocarpus erectus* L. (green buttonwood). The largest extent of mangroves in Africa are found in Nigeria (over 730,000 ha). This hydromorphic forest type in the Niger delta is one of the largest contiguous blocks of mangrove forest in the world. *Rhizophora* species are the most dominant and are valued species for their timber, tannins and fisheries capture in swamp forest. They can grow to 45 m in height and 2.7 m in girth (Oriola 2009, Mmom and Arokoyu 2010, Spalding et al. 2010).

The freshwater wetlands occur in the lowland areas (<30 m above sea level) and are majorly influenced by an abundant supply of freshwater from rivers and run-off from heavy rainfall during the wet season. Major large coastal rivers such as the Ogun, Benue, Imo, Niger and Cross Rivers flow through the southern part of Nigeria and deposit large amounts of sediment containing silt, mud and sandy materials into the freshwater swamp forest. The major tree species in this forest are tall and slender, attaining heights that range from 30 to 50 m. These valuable trees include *Zanthoxylum zanthoxyloides* (Lam.) Zepern. & Timler (candle wood), *Symphonia globulifera* L.F. (hog gun tree), *Piptadeniastrum africanum* (Hook F.) Brenan (African greenheart), *Lophira alata* Banks ex C. F. Gaertn. (red ironwood), *Diospyros monbuttensis* Gürke (Yoruba ebony) and others. The disturbed areas in this forest type are dominated by the *Raffia* palm species (e.g. *Raphia hookeri* G. Mann & H. Wendl. (wine palm), *Raphia vinifera* P. Beauv. (bamboo palm), *Raphia taedigera* Mart. (pinecone palm)) which have a competitive advantage and spread quickly, colonizing gaps (Oriola 2009). The *Raffia* palms perform several ecological functions by moderating and controlling flooding in freshwater swamps. They provide habitats for fresh water turtles and tortoises, while their dead and decomposing trunks and roots support the incubation of edible insect larvae such as *Oryctes rhinoceros* L. (Rhinoceros beetle) and *Rhynchophorus ferrugineus* Olivier 1790 (red palm weevil). Local people use the leaves for thatch roofing and the trunk and fronds are used as poles during local, construction and for firewood. In addition, the fibres are used for making brooms,

weaving baskets, sieves, fishing traps and traditional textiles, as well as for making ropes used for climbing and tying (Ndenecho 2007, Oduah and Ohimain 2015).

The rainforest belt contains very tall trees with dense undergrowth of shorter plant species dominated by woody climbing epiphytes. The climbing lianas are clustered and entangled around the tall trees, reducing accessibility and visibility in the forests. There is abundant moisture due to the prolonged rainy season (from April to October), which enhances tree growth in the tropical ecosystem. This belt stretches from the west to Central Africa and cuts across the western border of Nigeria with Benin Republic, through to the south-eastern part of the country. The rainforest is divided into different strata, and the vegetation is organised into a vertical pattern from the soil to the canopy (Figure 2). Each layer is a unique biotic community containing different plants and animals which have adapted to life in their particular stratum. The different layers support a high diversity of birds, small mammals, insects, reptiles, and predators.

In the understory, plants have adapted and evolved in low light communities. It is a habitat for herbs, shade-tolerant shrubs, woody climbers and wildlings of trees in the canopies above. The upper and lower canopies form the primary layer and act as a roof over the two remaining layers (understory and forest floor) and contain most of the largest dominant, broad-leaved evergreen trees (30–45 m in height). The layers



Figure 2: A typical rainforest in Southwest Nigeria, serving as a watershed for a river course.

support an array of species, different epiphytes, including orchids, bromeliads, mosses and lichens able to survive in these layers. The highest layer (emergent) contains a few large trees, which are light-demanding and grow to heights of 45-55 m, and sometimes up to 70-80 m. Animals such as the crowned eagle (*Stephanoaetus coronatus*), king colobus monkey (*Colobus polykomos*) and the large flying fox (*Pteropus vampyrus*) are found in this layer. Some of the common tree species found in the lowland rainforest include *Lophira alata* (red ironwood tree), *Ceiba pentandra* L. Gaertn. (Kapok tree), *Piptadeniastrum africanum*, *Khaya senegalensis* (Desr.) A. Juss. (African mahogany), *Entandrophragma angolense* Welw. C. DC. (tiama mahogany), *Cylicodiscus gabonensis* Harms (African greenheart), *Holoptelea grandis* (Hutch.) Mildbr. (orange barked terminalia), *Milicia excelsa* Welw. C.C. Berg (Iroko), *Terminalia superba* (white afara), *Triplochiton scleroxylon* K. Schum. (African whitewood), *Guarea cedrata* (A.Chev.) Pellegr. (pink African cedar), *G. thompsonii* Sprague et. Hutch (Nigerian pearwood), *Lovoa trichiloides* Harms (African walnut), *Sterculia rhinopetala* (brown sterculia) among others (Olajuyigbe and Adaja 2014). The northern fringes of the rainforest have degraded into secondary forest owing to shifting cultivation, annual bush burning and high population density, changing the rainforest ecosystem into a derived savanna. This derived savanna zone is covered with fire tolerant species such as *Bombax costatum* (red-flowered silk cotton tree), *Adansonia digitata* L. (baobab tree), *Parkia clappertoniana* Keay (West African locust bean), *Daniellia oliveri* (Rolfe) Hutch. & Dalz. (African copaiba balsam), *Azelia africana* Sm. ex Pers. (African mahogany tree) and *Vitellaria paradoxa* C.F. Gaertn (shea butter tree) (Odebiyi et al. 2004). Also found within the savanna vegetation are forest outlines found in the Adamawa highlands. These are gallery forests (i.e. tree corridors along rivers or wetlands in the dry savanna) with economic timber species like *Lophira lanceolata* Tiegh. ex. Keay (Dwarf red ironwood), *Terminalia glaucescens* Planch ex. Benth. (igi odan), *Terminalia macroptera* Guill. and Perr. (kwandari) and *Daniellia oliveri* (Oriola 2009, Borokini et al. 2012).

Socio-economic importance of Nigerian forest

The country consists of 36 states, a Federal Capital Territory and 774 local government areas. Each state has an established forestry service as a division domiciled under an appropriate Ministry. Hence, State Forest Services (SFS) are in charge of setting and administering policies for forest estates under their jurisdiction. Each SFS Department is headed by a Director reporting to the Permanent Secretary, who reports to the Commissioner i.e. the Chief Executive Officer of the Ministry in the state. The forest resources provide production, protection and conservation functions, supplying commercial timber species to the forest-based industries. In the late 1920s and 30s, 20-25% of the rainforest zone in Nigeria was placed under reservation with the purpose of maintaining biological diversity, influencing hydrological processes,

mineral cycling, controlling soil erosion, improving air and water quality, as well as providing wildlife habitats (Usman and Adefalu 2010, FAO 2015). The forest reserve system was officially created in 1937 and by the 1960s, the Nigerian government had set aside 9.7 million ha, about 10% of the country, as forest reserves. These were distributed over some 445 sites, with 75% of the sites in the savanna zone while the remaining 25% were in the lowland rainforest zone (Blaser *et al.* 2011).

Forests have contributed significantly to the socioeconomic growth and development of Nigeria. They support the livelihoods of over 45 million people, providing subsistence and traditional values to the people. Many rural dwellers depend on non-timber forest products (NTFPs) and services for livelihood sustenance and additional income. Trading in NTFPs is an essential economic activity with a complex web of market systems that involve NTFP gatherers, producers, wholesalers and retailers. The general populace obtains tangible products such as food, fodder, fuel, building materials and medicine, along with intangible products such as cultural symbols, traditional functions and ritual artifacts. As a matter of fact, non-timber products such as snails, mushrooms, chewing sticks, sponge, fruits, cola nuts, wild game, food wrapping leaves, medicinal plants and wooden trays are very significant in the livelihoods of many urban and rural dwellers. Approximately 80% of the rural population engages in agro-forestry and agro-allied activities. In addition, rural and urban households obtain domestic energy from fuelwood and charcoal sourced from forests (Usman and Adefalu 2010, Ajewole *et al.* 2013, Amusa *et al.* 2017).

Forest policies and legislation in Nigeria

Forest management in Nigeria is administered through a Federal-State-Local governance structure. Hence, forests and forest resources, their use and control are shared among these three tiers of governance. The policy objectives that guide forest management cover various aspects of sustainability, conservation and environmental protection. The basis of environmental policy in Nigeria is contained in the 1999 Constitution of the Federal Republic of Nigeria (Section 20) and empowers the State in the protection and improvement of the environment while safeguarding water, forest, air, land and wildlife resources. The Federal Department of Forestry (FDF) an arm of the Ministry of Environment holds the responsibility for forest administration at the national level. This division formulates national forest policy and plans land use, forestry development and environmental management. The agency promotes and funds projects of national interest, while coordinating and monitoring forest activities arising from internationally funded projects. They also coordinate the funding of local projects, build the capacity of experts, promote trade and industrial development, while enhancing institutional growth and development through collaboration with other agencies (Gregersen *et al.* 2004, FME 2006).

The Constitution specifies the shared control and development of forest resources between the local and state governments. In theory much of the forest land is considered to be owned by the local communities, held in trust for them by the state governments. All states in Nigeria have adapted and adopted forestry policies and forestry acts from the three old regional governments which existed in Nigeria before the creation of states. Nevertheless, forest management and administration are difficult tasks in the 36 states and Federal Capital Territory. Even though the country uses a federal system of governance, the Nigerian constitution did not clearly indicate the forestry duties and responsibilities of the different levels of government. In 1954, the first federal constitution invested authority of forest management in the three regional governments that existed then. By 1996, 36 states had been created from the three constituent regions of the federation and these states were encouraged to formulate their state forest policies and laws which would reflect the context of a National Forest Policy that had been subsumed in the 1988 Agricultural Policy (Usman and Adefalu 2010, Fameso 2017). Today, many states are still grappling with the challenge of developing clearly defined forest policies and laws that would ensure sustainability of the renewable resource.

The Federal Ministry of Environment operates through several departments whose activities are coordinated by the National Council on Environment (NCE). The NCE is the highest environmental policy formulating organ in the country and is chaired by the Minister of Environment. At the federal level, the Forestry Research Institute of Nigeria has the mandate for research and education in forestry and the utilisation of forest products. In 1939, the first organised training of Silvicultural Assistants took place in Zaria, northern Nigeria, but by 1954, the Forestry Research Institute of Nigeria (formerly Federal Department of Forest Research) had been established (Akande 2008, Erakhrumen 2007).

In the forestry sector, the highest decision-making body is the National Forestry Development Committee (NFDC), which is responsible for policy initiation and co-ordination in the sector. The membership comprises the Federal Director of Forestry who is the chairman, all State Directors of Forestry and Heads of research organisations in both government agencies and universities with forestry departments. Over the years, many policies, laws and regulatory measures have been formulated and some enacted with direct and indirect consequences on both forest management and development. In some instances, some of the related environmental policies and action plans were at variance with one another. This has limited the development of sustainable forest management in Nigeria. In principle, most forests are owned by the people, but the management and control of forest reserves, game reserves and sanctuaries, are the responsibility of the state governments. Hence, local governments manage communal forests, while the federal government manages the national parks (Okonofua 2005, ITTO 2006).

In order to train competent experts to manage the booming forestry industry in

the West African sub-region, the FAO/UNDP funded the establishment of the first professional forestry school in 1963. It was known as the Department of Forestry (now the Departments of Forest Production and Products, Social and Environmental Forestry, Aquaculture and Fisheries Management, and Wildlife and Ecotourism Management) at the University of Ibadan, Ibadan, Nigeria. One year later, the Savannah Forestry Research Station, Samaru, Nigeria was also established. At present, twenty Nigerian universities offer full or partial forestry degree programmes, while over 7 polytechnics, colleges and vocational forestry training schools provide technical training for field staff across the country. The educational training adopts an integrated approach to natural resource management, focusing on themes such as agroforestry, silviculture and forest biology, forest ecology, forest administration and management, wood products utilisation and fibre science, aquaculture and fisheries management, wildlife and ecotourism management, forestry extension and rural sociology, horticulture and landscaping, remote sensing and geographical information science, forest mensuration and biometrics, forest economics, as well as ethno-forestry and indigenous knowledge (Akande 2008, Erakhrumen 2007). Although the growth and advancement of the training institutions are limited by low student enrolments, poor funding, obsolete facilities and weak infrastructure, they continue to make slow



Figure 3: Tropical tree seedling production at the permanent nursery of the Department of Forest Production and Products, University of Ibadan, Nigeria. This facility is used for student training, research and commercial seedling production.



Figure 4: *Field exposure is an important aspect of study for students of the Department of Forest Production and Products, University of Ibadan. A field visit to a tropical forest restoration project site at the International Institute for Tropical Agriculture, Ibadan, Nigeria.*

but steady progress in the domestication of wild tree populations, development of nursery management techniques for tree seedling production (Figure 3), curricula development for tropical forest science and training of world-class tropical forest administrators, managers and scientists (Figure 4).

Economic contributions of forests in Nigeria

Before independence from colonial rule in 1960, Nigeria obtained tremendous benefits from forest resources (particularly timber products). This was before the discovery and commercial exploitation of crude oil. During this era, forestry and agriculture drove the country's economic growth and development. As far back as 1899, the prospective planning for economic development was to exploit forest resources. Timber trade accounted for a significant proportion of the total contribution of agriculture to the economy with export revenue from forestry increasing from 4.1% (1950-60) to 8.0% (1960-70) (Adeyoyu 1975, Kalu and Okojie 2009). During this period, the forest products industry was among the most developed in the economy. At that time, export earnings from wood and agricultural products contributed over 70% of the Gross Domestic Product (GDP). Before the oil boom in Nigeria, the exploitation

and exportation of forest products, especially round wood, was a major industry. Unfortunately, growth in the sector has experienced a continuous decline due to over-exploitation of economic timber species (e.g. Iroko, mahoganies, *Terminalia* spp., red ironwood, mansonias etc.), over the decades and the fact that the industry focused mainly on the exportation of raw materials from which the country obtained most of its earnings. Nevertheless, the multiplier effect on capacity utilisation, employment generation and potential for foreign exchange earnings make it imperative that forestry become modernised to enhance economic growth and development (Kalu and Okojie 2009, Ogunwusi 2012).

In Nigeria, the forest industry is divided into formal and informal sectors. On one hand, the informal sector includes small scale wood-based enterprises that operate without formal corporate entity. They deal in enterprises such as firewood collection and trade, production of charcoal, harvesting and packaging of chewing sticks, wood carving and sculpture making, artisanal cabinet making and lumber conversion. On the other hand, the formal sector involves organised wood-based industries such as the pulp and paper mills, sawmills (Figure 5), plywood mills, safety match making, particle board mills and furniture making factories (Ogunwusi 2012, Aliogo 2017).

Forest resource exploitation had been contributing to economic growth since 1792 when pit sawing operations commenced and later, with the first installation of a power



Figure 5: A small-scale timber conversion industry (sawmill) in Ikire, Osun state, Nigeria.

sawmill in the Delta area in 1902. In the following decades, the industry grew and developed with significant increases in forest product exploitation and utilisation at the domestic and international industrial levels and in the 1950s, wood exportation reached its peak. This period recorded the growth and development of a virile forest products industry with well-structured saw mills, wood-based panel industries, furniture production lines, match making factories as well as pulp and paper industries (Figure 6). This promoted economic growth with positive contributions to raw material production and supply for construction, furniture and packaging (Ogunwusi 2012). The oil glut of the 1970s resulted in high exploitation of round logs for the export market until a ban was imposed in 1976. By this time, the negative effects of intensive exploitation were being felt with volume of wood exports peaking at 700,000 m³ in 1964, decreasing steadily to 290,000 m³ in 1970 (Aribisala 1993, Ogunwusi 2014). This led to a generation of large quantities of wood waste and an eventual reduction in available industrial round wood and other products like round logs, sawn wood, veneer and plywood from forest reserves. This over exploitation of forest resources, particularly timber, impacted negatively on the growth and development of the industry (Ogunwusi 2012, Aliogo 2017). There are over 1,325 sawmills in Nigeria and they account for over 93% of the volume of wood produced at an average recovery



Figure 6: A medium-scale wood processing workshop at the Department of Forest Production and Products, University of Ibadan, southwest Nigeria. The facility is used for research in wood utilisation for furniture, laminated boards, waste utilization, plywood and composite board production etc.

rate of 45-55%.

In 2010, the sawmill industry generated over 1,000,000 m³ of waste (Figure 7) such as tree bark, sawdust, trimmings, off cuts, split wood, plank shavings and sander-dust (Aliogo 2017). Most of the wood processing units do not have the facilities for waste utilisation. The number of sawmills decreased from 1,617 in 1990 to 910 in 1992. There was a slight recovery in the period to 2002 and by 2010, the number of sawmills in Nigeria had stabilised at 1,325 (Figure 8). These sawmills can be categorised as small-, medium- and large-scale sawmills. Small-scale sawmills use basic portable tools such as circular saws and cross-cutting machines. Medium-scale sawmills have in addition to the portable tools, basic wood working machines such as vertical band saws, planing machines, jig saws, etc. But large-scale sawmills use integrated wood processing systems with special purpose machines such as multiple rip-saws, kiln dryers, automated conveyor machines, binding machines and forklifts in addition to equipment found in the smaller sawmills. However, there is a shortage of raw material for sawmills which are unable to process small-dimension plantation materials. This is because most of the installed circular saw head-rigs and CD-series horizontal band saws were manufactured for conversion of large diameter logs. They are mostly outdated technology, poorly maintained and were not configured for small dimension



Figure 7: Waste generation in Nigerian sawmills: a large portion of this material is used as fuelwood and for poultry bedding, while most of the sawdust is incinerated.

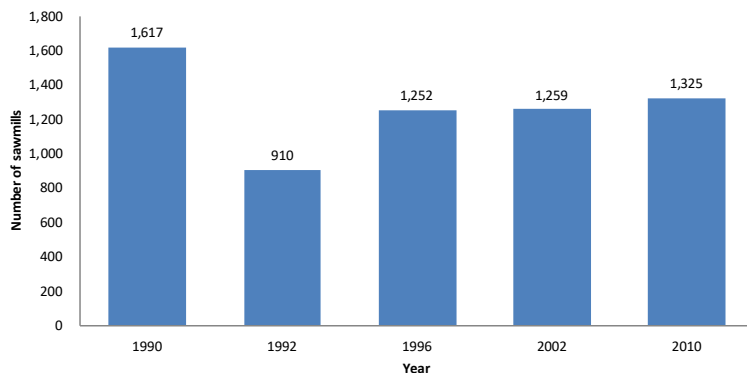


Figure 8: *Number of sawmills in Nigeria in the last 30 years.*



Figure 9: *The author with abandoned small diameter logs of *Tectona grandis* at the log yard of a medium sized sawmill at Ikire, Osun state, Nigeria.*

logs (Figure 9). Unfortunately, there has been a continuing decline in the average size of timber available for processing from forest reserves (Larinde and Popoola 2008, Ogunwusi 2014).

In Nigeria, there are no standardised grading systems for sawn timber, because the logs yield lumber of varying quality when sawn. Hence, to assist consumers

in the purchase of quality lumber, they are graded into use categories, each having an appropriate range in quality. The grade of a piece of lumber depends on the number, character, and location of features that may lower its strength, durability or utility value. Some of the common visual features are knots, checks, pitch pockets, shake and stain. With proper grading, lumber containing these features is entirely satisfactory for many uses, however, the grading is done at the sawmill based on the grading procedures of manufacturer associations (Ohagwu and Ugwuishiwu 2011). Another challenge in the sawmill industry is that they have had to expand the range of exploited trees to lesser used species (e.g. *Albizia saman* F. Muell. (monkey pod tree, see Figure 10), *Antiaris toxicaria* Lesch. (false iroko), *Senna siamea* (Lam.) Irwin et. Barneby (Cassia tree), *Celtis zenkeri* Engl. (African celtis) etc.). These species are replacing most of the large diameter economic tree species which have become scarce in the forests. The increased processing and utilisation of these lesser



Figure 10: Cross section of the bole of *Albizia saman* (Monkey pod tree), a semi-deciduous lesser-used hardwood species in Nigeria. This tree is estimated to be 55-60 years old but can attain heights of 60 m, DBH of 4.5 m and a canopy spread of 30 m.

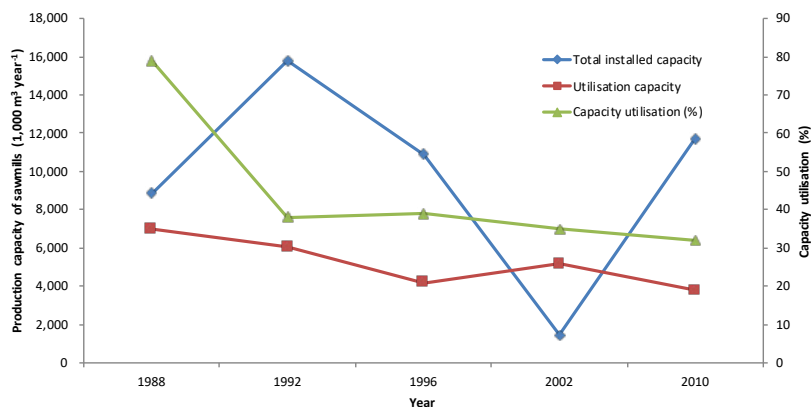


Figure 11: Production capacity and actual capacity utilised by sawmills in Nigeria (Ogunwusi 2012).

used wood species, whose properties are not well understood, have also proven to be problematic. Moreover, the total volume of usable wood of economic tree species, below 30 cm cutting diameter in the forest reserves was 239,775,500 m³ (Larinde et al. 2006, Oriola 2009), causing a decline in the performance of the industry. The production capacity of Nigerian sawmills was estimated at 11,684,000 m³ year⁻¹ in 1990, with a 46% capacity utilisation (Figure 11). However, by 2010 the utilisation capacity had dropped to 32% (Ohagwu and Ugwuishiwu 2011).

Forest expansion and reforestation

The continuous logging of timber resources, harvesting of fuelwood and expansion of agricultural lands have resulted in massive deforestation and loss of natural forests

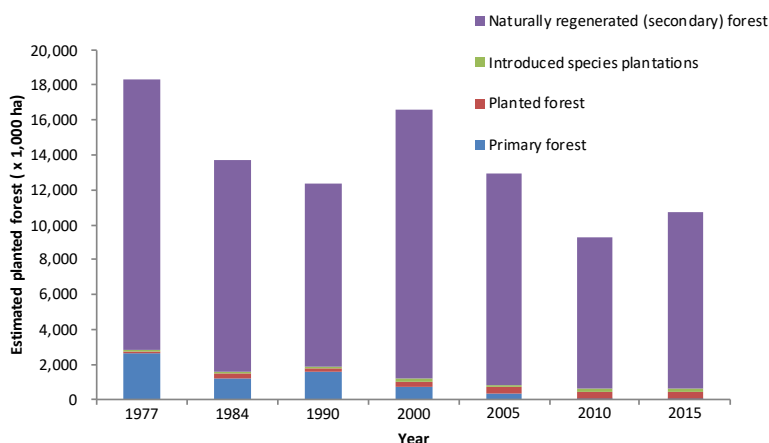


Figure 12: Estimates of planted forest in Nigeria over the last 45 years (FAO 2015).

and their wildlife (Borokini et al. 2012). Presently, most primary forests have been destroyed, with only small and scattered patches of primary forests remaining alongside other naturally regenerated secondary forest in many forest reserves (Figure 12). The harvest levels for timber are high ($2.29 \text{ m}^3 \text{ ha}^{-1} \text{ yr}^{-1}$) and exceed the sustainable yield estimates (Blaser et al. 2011).

In 2000, over 60% of the initial forest reserve area had been degraded as a result of over exploitation, agricultural expansion, urbanisation, illegal logging, cash crop farming encroachment, and infrastructural development (Okonofua 2005, Akpan-Ebe 2017). Unfortunately, the rate of reforestation is low, with an average establishment of $3,400 \text{ ha yr}^{-1}$ with mainly introduced species (such as eucalyptus, *Tectona grandis* Linn. F. (teak) and *Gmelina arborea* Roxb. (Gmelina) plantations). The establishment of these exotic species plantations is the main effort directed at reforestation of the forest landscape, partly because of the slow growth of tropical hardwood species. For example, *Milicia excelsa* (iroko) known as the “king of trees” in local parlance, would take 60-80 years to attain maturity (FAO 2015, Akpan-Ebe 2017). By 2000, an estimated 382,000 ha, comprising 110,000 ha of *Gmelina arborea*, 74,000 ha of teak and 160,000 ha of different indigenous hardwood species (e.g. *Terminalia ivorensis* A. Chev. (black afara), *Nauclea diderrichii* (De Wild. & T. Durand) Merr. (brimstone tree, Figure 13), *Triplochiton scleroxylon*), had been planted in forest reserves and private plantations. In addition, 318,000 ha of *Hevea brasiliensis* Müll. Arg. (rubber tree) plantations are managed as tree crops for both latex and timber production. These planted forests are being harvested, although some of them are adequately managed for long-term production (Okonofua 2005, Blaser et al. 2011).

Challenges of the forestry sector in Nigeria

Despite the country’s long history of forest management, it has moved from being a significant exporter to becoming a net importer of primary forest products. This is coupled with the fact that management of the remaining small productive forest area has become problematic with plantations of exotic species such as teak and gmelina replacing the once rich and diverse natural forests in the country. The forest cover is being heavily degraded at an average annual depletion rate of 4% and the secondary forest succession is impeded by agricultural expansion, land encroachment, over harvesting, bush burning, illegal logging and de-reservations (ITTO 2006, Blaser et al. 2011).

A major constraint to forestry development is inadequate funding and inappropriate infrastructure. There seems to be little attention paid to the sector, with many seeing it more as a revenue generating sector rather than an opportunity for investment. To this end, budgetary allocation is low and inadequate. The various infrastructures required for data collection and monitoring are not readily



Figure 13: An eight-year-old *Nauclea diderrichii* plantation at the Forestry Research Institute of Nigeria, Ibadan, Nigeria.

available with the sector being neglected over a number of decades (Ohagwu and Ugwuishiwu 2011). In recent times, forestry has contributed in a small way to the GDP (1.3-3%) (as has also been the case with other non-oil sectors), while crude oil exportation (over 90% of GDP) has become the dominant force in the Nigerian economy. There is need for increased attention to be paid to forestry with policies and macro-economic measures that would widen the productive forestry

base, increase plantation forestry establishment and implement sustainable forest management strategies, thus diversifying the economic contribution of forests. These interventions would have a positive impact on the development of renewable resources and help increase their contribution to the GDP (Larinde and Popoola 2008, Kalu and Okojie 2009).

In Nigeria, forest administration lacks the resources for adequate supervision of the forest management regime. This is further compounded by weak enforcement of forest laws, and this continues to limit progress in the sector. The land tenure system is another challenge that requires attention. Accessibility and ownership of land is complicated and hence discourages individuals or private investors in forestry. In addition, the sharing of benefits from forestry activities between state governments and local communities is not beneficial to communities and thus discourages them from actively engaging in afforestation/reforestation of degraded land.

Conclusion

There are several obstacles to sustainable forest management in Nigeria. Current forest policies and laws are weak, with different parties exerting significant influence on forest management. The implementation of a sustainable approach to forestry is constrained by poor enforcement, weak institutions, lack of capacity and transparency. The development of proper legal and political frameworks for forestry management is therefore critical for bringing about improvements in the sector. Modern, inclusive policies and laws must be formulated using approaches that engage stakeholders at all levels. The sector requires attention in areas such as basic education of the general population and capacity building of forest managers, researchers and industry practitioners. The objectives and curricula of forestry education in Nigeria need to adapt to meet the diverse needs at global, regional and national levels.

Adequate funding and proper supervision alongside private sector involvement are essential for overcoming the factors that limit reforestation and afforestation of the degraded landscapes. There is need for the domestication of many of the tree species that are still harvested from wild populations in forest reserves. This would promote a gradual transition from continuous dependence on harvested stock from natural forests to purposeful cultivation in plantations, thus ensuring stable product supply and sustainability. Consequently, knowledge gaps on the profitability of indigenous tree species plantations, their silvicultural requirements, genetic diversity, botany and ecology must be addressed to encourage integration of these plantations into agroecosystems. An impediment to sustainable development of the forest products industry, which is the continuous reliance on outdated equipment and technology, must be addressed. Wood waste generation must be brought to the

lowest level, while promoting waste recovery and recycling. It is paramount that waste utilisation, efficient wood conversion and high lumber recovery are achieved, if the forestry sector is to thrive. The potential of forestry in Nigeria is enormous and only requires the right efforts for this green gold to become a viable and sustainable resource again.

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