DOI: 10.31195/ejejfs.427416

Eurasian Journal of Forest Science
2018 6(2): 44-55

http://dergipark.gov.tr/ejejfs

Sustainability of wood harvesting in tropical rainforest of Nigeria

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Abstract
Over the years, Nigerian tropical rainforest has become the main source of timber supply to many countries which were in critical need of timber to feed their wood-based industries. The increase in population has led to increase in the demands for forest products, specifically wood for construction. Improper harvesting practices has substantially degraded the tropical forest that future timber values may be reduced. Sustainable wood harvesting focuses on the trees that are remaining rather than on the trees that are to be fell. Proper wood harvesting and management method must be adopted to facilitate the regeneration of the forest. Efficient wood harvesting in Nigeria requires the construction of landing sites as collection points for the harvested timbers and adequate training must be provided to the operators of the diverse harvesting equipment. With proper timber harvesting techniques, the damages caused by logging can be minimized. Functional forest policies that guide against over-exploitation of timber should be enacted. Reduced impact logging should be incorporated into sustainable forest management to reduce devastating damages to the residual trees in the forest.
Keywords: Sustainability, wood harvesting**,** tropical rainforest, harvesting plan.

Introduction

The tropical rainforest is the earth's most complex in terms of both structure and species diversity. It is dominated by broadleaved trees that form a dense upper canopy and contain a diverse array of vegetation. Nigeria is endowed with rich forest resources. Initially, the whole of Southern Nigeria, approximately 39% of Nigeria's land area was covered with the tropical rainforest (NEST, 1991). Presently, the Nigeria rainforest occupies about 10% of the country's landmass (Akinsanmi & Akindele, 2002), but has over the years suffered from large scale exploitation because of the demand for forest products especially timber became insatiably high, unsustainable agricultural practices and public infrastructural development (Akpan-Ebe, 2017) as a result of population pressure and economic growth (Popoola, 2008). This has led to unregulated forest exploitation, thus resulting in degradation of the forest resources in the Nigeria.

The beginning of forest exploitation in Nigeria can be linked to the history of the people. Machetes, axes and hand saws were the main tools used for timber felling and conversion, it take months to rip open and saw a single log into fitches of needed dimensions. Exploitation was accordingly low and

deforestation virtually absent, except in some patches put under crop cultivation (Akpan-Ebe, 2017). As the chainsaw replaces machete and axe, the rate of exploitation increased astronomically.

The Nigerian tropical rainforest became the main source of timber supply to many European and Asians countries which were in critical need of timber to feed their giant wood-based industries. The arrival of the colonial administrators in Nigeria in the 19th century had its impact in the Nigerian forests as timber exploitation increased as offices, trading posts, rail lines and residential quarters were constructed (Akpan-Ebe, 2017). Nigerian forests formed the major source of tropical hardwood for sawn timber and veneers, nuts, gums, resins, drugs and other useful plant products (Akinola & Akindele, 2012). Forests are valuable for different types of wood products as well as for wildlife, clean air and water, beauty and recreation (Smith, 2000). As the population is increasing the demands for forests products are also increasing. The society's needs depend on forests, so we must manage forests sustainably to keep them productive.

Wood harvesting, forest harvesting or logging is always used synonymously. It refers to the process of cutting trees and delivering them from the forest to sawmills, pulp mills and other wood-products-processing plants. It can also be referred as the preparation of logs in a forest or tree plantation according to the requirements of a user and delivery of logs to a consumer. Wood harvesting includes, the cutting of trees, their conversion into logs, extraction and long distance transport to the consumers or processing mills. Harvesting of wood differs radically from harvesting of other crops in that logging can only be done by professionals who have receive technical training on tree felling with careful, knowledgeable planning to minimize negative effects on the surrounding environment and on the residual stands. Improper harvesting practices can degrade the forest that future timber and non-timber values may be substantially reduced. There is the need to make sure the harvesting practices adopted are environmentally sound and economically acceptable and that simultaneously promote the sustainability of both the timber and non-timber values of the forest (Dykstra & Heinrich 1992).

When wood is harvested some trees gives more growing space for the remaining trees and seedlings. Sustainable wood harvesting should focus on the trees that are remaining rather than on the trees that are to be fell. Trees grow bigger and more rapidly when other trees do not crowd them. Harvesting can lessen competition for soil nutrients and sunlight, if well planned. Wood harvesting constitutes a vital link between timber production and consumption. It involves problems of technology and transportation, especially in Nigeria where the forests are inaccessible and also comprises of trees of irregular shapes and sizes.

Government control on logging in the tropics is limited to the issuance of permits or licenses to loggers after payment of all necessary fees (Adetula, 2008). Presently, the removal of timber occurs in an uncontrolled manner, without strict adherence to the laws. Logging operations are responsible for forest destruction in Nigeria; therefore, sustainable logging is necessary and desirable to attain an appropriate and socially acceptable level of deforestation (Adekunle & Olagoke, 2010).

During logging operations, severe damage is usually inflicted on the forest ecosystem. The damage includes forest soil compaction, damage to residual trees and plants, cutting of seedlings, trampling and wildlife killing (Adekunle & Olagoke 2010), aggravated through insufficient planning, improper operational techniques, lack of operational skill and lack of serviceable modern felling tools (Eroglu et al., 2009). Adequate training must be provided to the operators of the diverse harvesting equipment. Though, the only available felling tool in Nigeria is the motorized or power chainsaw, but dragging of felled trees,

packing into gantries and loading into lorries are generally done manually with chains and winches (Adekunle & Olagoke, 2010). These processes are primitive and tedious, and have the potential to disrupt the ecosystem (Olajide & Udo, 2005). This paper examines wood harvesting in Nigeria, impacts of harvesting on residual trees and suggests the way forward for a more sustainable wood harvesting in the country.

The need for sustainability of tropical rain forest

FAO defined sustainability in the context of human use and the aspirations of people in developing countries to thrust off the yoke of poverty (FAO, 1991; Dykstra & Heinrich, 1992). In 1987, the United Nations released the Brundtland report, which included what is now one of the most widely recognized (WCED, 1987) definitions: "sustainable development as the development that meets the needs of the present without compromising the ability of future generations to meet their own needs". In utilization of the tropical rain forests, the activities associated with this utilization must not irreversibly compromise the potential of the forest to regenerate and continue to provide the industrial wood and non-wood forest products, environmental services, social benefits and global values (such as the maintenance of biodiversity) that are essential for the well-being of both current and future generations (Dykstra & Heinrich, 1992). They further affirmed that the goal should be to maximize the aggregate potential of the forest to provide these goods and services over the long term, which implies that where industrial wood is to be removed from tropical forests, harvesting operations must be carried out in such a way as to leave the forest in a condition that favors a rapid recovery to its pre-harvest state or to some other state that is silviculturally, ecologically and sociologically desirable. In sustainable wood harvest the regeneration and the long-term well-being of the forest should be taken into consideration. The best trees can be left standing until a new forest of younger, healthy trees begins to grow underneath it.

Wood Harvesting Plan

Planning of timber harvests is one part of sustainable forest management planning which is itself a component of comprehensive land-use planning. Meaningful harvest plans involve a good understanding of the objectives of the management plan, the harvesting systems available and the logistics required (FAO, 1998). The objectives of harvesting plan should be aimed at maximizing recovered log volume and value, minimize damage to residual trees and regeneration, facilitate easier log extraction and minimize ground disturbance and avoid disturbance to areas excluded from harvesting (FAO, 1978). Harvesting usually has severe impact on the forest structure and ecosystem functioning. Environmentally sound wood harvesting operations are therefore essential components of sustainable forestry (Grebner, 2013). Proper wood harvesting should begin with proper planning, trained and motivated workers (logging crews) with technically competent supervisors. Timber harvest plans are of three types: strategic, tactical and operational plans. The strategic harvest plan prepared by the forest planning team is a long-term plan and covers large area. It should demarcate non-harvest area, divide the harvestable forest into annual operating areas (coupes) and design the main transportation system. It may include management guidelines, construction of facilities and management intensity. The tactical harvest plan is a short-term plan (i.e cover shorter periods) and is prepared by the team directly responsible for supervision of harvesting operations (FAO, 1996). It can be regarded as the implementation of strategic plans. Operational harvest plan incorporate actions needed to conduct operations on the ground. Harvesting plan should also specify the equipment to be used and the timing of operations, and should include contingency plans for severe storms and other extreme events. It should consider the possibility of complementary harvesting of non-timber forest products (Dykstra & Heinrich, 1992).

Wood harvesting operations when carried out without proper harvest plan is difficult to coordinate and impossible to adequately control for the sustainable utilization of forest products. Lack of adequate harvest plans may equally result in scheduling problems that greatly increase disruptions and force logging supervisors to manage from crisis to crisis rather than being able to carry out operations in a systematic and organized way. According to FAO (1996) both strategic and tactical harvesting plans should be able to meet the following objectives:

- Optimize harvesting production rates
- Minimize environmental and other impacts associated with harvesting operation
- Provide efficient access to the forest for silvicultural, protection and transport purposes
- Minimize harvesting and transport costs, subject to constraints imposed by environmental, ecological and social considerations
- Identifying opportunities to coordinate timber harvesting with the collection of non- timber forest products
- Providing flexibility so that the plans can change to take advantage of new information or changing situations
- Protecting the health and safety of workers and the public.

Timber Harvesting Methods

The following are the different method (https://www.maineforestry.net/timber-harvest-methods) of timber harvesting:

Clearcutting: Clearcutting is a timber harvesting method where most of the trees in a given forest area are harvested at the same time. By adopting clearcut method, mature trees are completely removed in the forest area. It is the most suitable method for tree species that are shade intolerant, as a result of the conditions created by the opening following timber harvest. This method is regarded to be a cheap method to apply since it does not involve individual tree marking, rather only the boundaries of the felling area need to be marked. Mechanized operations could be used since there will be minimal damages to residual trees. Clearcutting results in regeneration, since some tree species in the tropical forests grow rapidly in the open conditions of a clearcut. Clearcut protect the forest, since natural or artificial regeneration could be deploy to control the tree species that grow on the site. Clearcutting is an important forest management tool because it can be used to create edges - areas with two habitat types. It is the most efficient and economical method of harvesting large volume of trees. Like most harvesting methods, clearcutting can have both a positive and a negative impact.

Shelterwood System: In shelterwood cut, most of the mature trees are harvested in a series of cuts over a period of 10 to 15 years (i.e at the end of the rotation) but a portion of the mature stand is left standing. Harvesting of mature trees in shelterwood stand will create space, so it is one of the traditional methods used to encourage the regeneration of any tree species with heavy seed production (Loftis, 1990; Pourmajidian, 2009). It help to modify the environmental conditions on the forest floor in a way that promote germination and survival of the selected species and building up the amount and size of advance regeneration (Jull et al., 1997) to ensure the prompt restocking of the new stand following over-story removal. Sufficient mature trees are left standing to provide shelter in the site for the development and growth of new seedlings. The set back to this method is young trees finds it difficult to regenerate and develop well under shelterwood cut due to some over-storey left unharvested. Furthermore, shelterwood cuts requires more roads to be built through the forest, this can increase the risk of soil disturbance and damage to the remaining trees during harvesting.

Seed tree System: Seed tree harvest, option provides for the removal of the majority of mature trees, few mature trees are retained in small groups or singly, to supply seed for regeneration. These trees are selected based on their growth rate, form, seeding ability, wind resistance and future marketability. The differences between seed tree system and shelterwood:

- Less trees are left standing in seed tree compare to shelterwood.
- In seed tree the trees are usually left standing permanently, whereas in shelterwood the retained trees are used as a future wood source as well as for supplying seed and shelter for developing regeneration.

Prior to harvesting a coupe, the trees that are to be retained for seed supply are marked after which the remaining trees can be harvested. After harvest the forest floor is covered with slashes from the removed trees. Marked trees must carry enough seed in the capsules (gum-nuts) in its crown to result in adequate regeneration. The disadvantage of seed tree harvests is that the remaining trees are prone to damage by heavy wind, lightening, insect attack and logging of nearby trees.

Single Tree Selection System: Single-tree selection, involves the removal of individual trees and leaving majority of the trees on the site standing. The best trees are ones left with room to grow and trees are removed from all age classes. It is the most intensive harvesting method. In single-tree selection, the forest continuously produces timber and constantly has new seedlings emerging to take the place of harvested trees. Single-tree selection harvesting is best for small forest areas, because the method requires more roads. In addition, surrounding trees can be damaged during harvests and frequent use of logging equipment in a given area may compact the soil.

Group Selection System: Group selection is the harvest of small groups of trees in a given forest area over many years rather than single trees. In other words, group selection is essentially an approach that calls for the harvest of mature trees and the thinning of intermediate trees at relatively short intervals. It is a less expensive harvesting method, since the harvested trees are concentrated in patches. This system supports natural regeneration and re-establishment of a sustainable mixed-age stand. This system is an expensive forest regeneration method because it requires intensive management and frequent access to all the forest areas under consideration.

Wood Harvesting Process

The process of harvesting trees from the 'stump to mill' can be broken down into five simple steps.

Felling: Felling is the severing of the tree from the stump and brings it down. It is important that tree felling is carefully planned. Trees must be felled in the direction that it will not cause any damage to log. Well-planned felling makes it easier to continue with well-planned work without any interruption. The factor that affects tree felling is whether there are major obstacles in the felling area. Warning signs should be used, if the logging area is crossed by a road or a lot of people pass through such area, as felling is the most hazardous of all forest operations. Tree crowns interconnected by woody climbers may fall pulling neighboring trees with it, thereby breaking or uprooting neighboring trees (Dykstra & Heinrich, 1992). Their limbs may break off and fly in unpredictable directions. Pre-harvest cutting of climbers is essential before felling, and can substantially reduce damage to residual trees. The cutting of climbers several months in advance of felling reduced the number of trees knocked over or broken to some extent (Fox, 1968). The residual trees damaged during felling are the buck of trees that will form the commercial timber for subsequent harvesting operation; therefore sustainability of timber production depends upon saving as many of these trees as possible (Dykstra & Heinrich, 1992). Presently, most felling operation is done using chainsaws and felling can be classified into:

- Uncontrolled felling. No attempt is made to influence the direction a tree falls, safety precautions and skilled working techniques are not considered.
- Semi-controlled felling. Fellers have a fair idea of the direction a tree will fall but do not influence the lay. The basic rules are observed e.g. rudimentary cutting of felling notches and back cuts.
- Controlled/organized felling. Scarfs are well-executed, back cuts are well placed and hinges in accordance with desired felling directions.
- Directional felling. Fellers are capable of felling trees in the direction desired, which may be different from the natural lean. Operational and silvicultural aspects are taken into account. Additional tools like wedges and winches are used.
- High-tech felling. Fully mechanized felling using feller-bunchers or harvesters and techniques/machines in development, though not feasible for large trees and it is not a common practice in Nigeria.

Felling operation should be carried out by well-trained personnel outfitted with appropriate safety gear and using equipment suitable for the work. Selective felling practically mimics natural tree falls and is generally considered to be relatively benign from an environmental perspective (Hamilton, 1988). The forest gaps created by trees felled properly under any of the selective harvesting systems common to the tropics are often indistinguishable from gaps caused by natural tree falls (Jonkers, 1987). Proper felling operations should:

- Ensure the safety of the felling crews and other personnel working in the vicinity of the felling operation
- Minimize damage to residual trees and seedlings especially those that are expected to make up the population of future trees
- Minimize damage to soils and streams
- Minimize the volume of wood that can be profitably utilized from each felled tree
- Maximize the value of the logs prepared for extraction
- Facilitate extraction activities.

Extraction: Extraction is the process of moving trees or logs from the felling site to a landing or a roadside where they will be processed into logs or consolidated into larger loads for transport to the processing facility or other final destination (Dykstra & Heinrich, 1996). At this point the logs are stored temporarily, awaiting long distance transport. Extraction can be very heavy and hazardous operation that can inflict substantial environmental damage to the forest ecosystems and its regeneration, soils and watercourses. Considerable skill is required from the crews to carry out extraction operations that are efficient and safe as well as environmentally friendly. Pre-planning of extraction improves efficiency of extraction, increases safety and reduces damage to soil and residual trees. Extraction of logs in tropical forests is done with ground skidding equipment. This equipment and machinery include: forwarder, shovel, tractor and bulldozer etc. Any harvesting system that uses an extraction machine that drives into the forest is referred to as ground-based harvesting. Conventional ground skidding systems cause two forms of damage in tropical forest operations. The skidders tend to wander through the forest searching for felled trees, thus causing a proliferation of skid trails and resulting in excessive damage to residual trees and advance regeneration. The skidders also cause soil disturbance and soil compaction, thus increasing the potential for erosion and retarding both regeneration and the growth of residual trees (Dykstra & Heinrich, 1996; Marn & Jonkers, 1982). Low-pressure ground skidders can be used to reduce soil disturbance and soil compaction (Buenaflor & Heinrich, 1980). A well organized and properly supervised extraction should:

- Optimize extraction productivity

- Ensure the safety of extraction crews
- Minimize the amount of soil compaction and soil disturbance
- Minimize damage to streams within the felling area
- Minimize damage to residual trees and seedlings
- Deliver to the landing or roadside all logs prepared for extraction by the felling crew without significant loss of volume or deterioration in quality.

Delimbing, topping and bucking: Felled trees should be processed for transport from harvesting site. The processing includes: delimbing, topping and bucking. Once the felled trees are extracted to the landing, it must be processed before loading out onto the truck. This typically involves taking the branches off (delimbing) either at the stump site or at landing by manual or mechanical methods, topping the tree to remove the undelimbed top portion of the tree and then cutting the stem into logs (bucking) according to mill specifications in preparation for skidding, forwarding, yarding or hauling. These tasks is mainly carried out by chainsaw in Nigeria, but in the developed nations this is typically done mechanically with a loader that has a pull-trough delimber or a number of different machines. The processing of the trees at the stump site is typically referred to as a cut-to-length system. Apart from this, on-site conversion of logs into lumber is a common practice in Nigeria. Timber size, market demands, equipment limitations, transportation restriction and log grades are the factors affecting bucking operations.

Loading: Once the trees have been processed into logs, a loader will help sort, stack and then load out onto logging trucks. It is recognized that the truck loading function alone could account for well over 40% of all man- hours expended in the harvesting operation (Akande & Larinde, 2011). Loading onto trucks is usually done manually or by using a small winch. Most loaders are trailer-mounted, although they can also be track-based for extra mobility on the landing. Loading large logs manually pose a serious risk; therefore loading should be handled by grapple or knuckle boom loaders (http://Wood harvesting\english.htm). The grapple attachment on the knuckle-boom can be fitted with a grapple-saw to help top and buck the trees and a heel on the boom provides stability. On the other hand, loading trucks can be equipped for self-loading with the loads secured on the truck by lateral supports and cables that can be pulled tight. In Nigeria, manual loading of timber onto truck is the common practice. The physical strain and workloads in manual loading are extremely high (http:// Wood harvesting\english.htm).

Trucking: At this stage, the logs are moved from the landing to the mill for processing. Trucks travel only a short distance on low volume roads before entering higher volume roads which make up most of their trip to the mill (Schiess & Krogstad, 2004).

Impact of wood harvesting on the tropical environment

Timber harvesting has short and long-term effects on the forest environment, but sustainable logging has the potential to maintain standing forest and prevent large scale destruction of residual trees. The severity of the direct impacts of logging on tropical forests is linked to harvest intensity, which is measured by the number of stems or cubic meters extracted per ha (Zimmerman & Kormos, 2012). The higher the harvest intensity, the greater is the damage to the forest canopy and to residual trees, including young recruits, until a point is passed at which non-pioneer trees of primary forest may no longer grow (Struhsaker, 1997; Sist & Nguyen-Thé, 2002; Van Gardingen et al., 2006; Anitha et al., 2010). In Nigeria logging operations are responsible for forest destruction, therefore sustainable logging is necessary and desirable to attain an appropriate and socially acceptable level of deforestation (Adekunle & Olagoke, 2010). Harvesting systems should aim at minimizing damage on the environment. Timber harvesting can affect the environment in the following ways:

Forest soil damage: Forest soil plays an important role in forest ecology. During wood harvesting, it is important to minimize negative impacts on soil. Timber harvesting with insufficient planning, improper operational techniques and lack of control of operations results in severe damage to forest soil (Akay et al., 2007; Eroglu et al., 2009). Logging affects the physical, chemical and biological characteristics of soils which in turn may have long term consequences for the soil's productivity, nutrient regime and capability. Logging activities such as landings, access roads, and main skid trails significantly reduce soil productivity.

Improper planned timber harvesting operations cause soil compaction (Greacen & Sand, 1980; Froehlich and& McNabb, 1984). Soil compaction reduces and disrupts soil porosity, decrease water and air movement into and through the soil, increase bulk density affects tree growth and plant productivity (Gupta & Allmaras, 1987; Startsev *et al,* 1995). Soil compaction results to poor soil aeration, poor root penetration, limited water movement and reduced activity of soil organisms involved in nutrient cycling. Soil compaction can also increase surface water runoff which may lead to soil erosion and increased sedimentation in watershed. Timber harvesting predisposes the environment to destructive actions of wind and rainstorm (Fuwape, 2003). Devastating destruction of farmland occurs in areas where indiscriminate tree felling had taken place (Oke & Fuwape, 1995).

Destruction of forest cover during timber harvesting results to the loss of the protection, which the plant cover gives to the soil (Hamilton & Pearse, 1985). Forest cover anchors the soil, increases surface roughness, reduces wind speed, conserves soil moisture and adds organic matter which helps bind the soil particles into aggregates. Large, open fields are especially erosion prone because long, unobstructed distances allow wind's velocity to increase. Timber harvesting also interrupts the normal nutrient balance in forest soils (Brown, 1914), promotes nitrification and increases nutrient leaching thereby leaving the topsoil impoverished and susceptible to erosion (Fuwape, 2003).

Global Warming: Global Warming is caused by excessive emission of greenhouse gases into the atmosphere. Carbon monoxide is one of the major gases causing global warming. Through photosynthetic process trees turn carbon monoxide into oxygen. Unsustainable timber harvest will only be destroying the plants ability to turn carbon monoxide and water into carbohydrate and oxygen. Logging in the tropics contributes a significant proportion of the gross annual anthropogenic flux of carbon dioxide (CO_2) (Bryan et al., 2010; Huang & Asner, 2010). Timber harvesting induced changes in forests architecture and composition result in a cascading set of impacts on the carbon cycling of rainforest ecosystems (Huang & Asner, 2010; Matricardi et al., 2010). It removes large trees, which are the principal carbon stores of a tropical rain forest (Vieira et al., 2005). Timber harvesting leaves behind large amounts of slash, these decomposing slash combined with an increased mortality of residual trees, increases ecosystem heterotrophic respiration and CO_2 emissions for years following harvest (Blanc et al., 2009; Huang & Asner, 2010).

Watershed damage: The negative impact of wood harvesting on watersheds include: runoff and gully erosion, in-field-water erosion, sedimentation of streams, damage to fish spawning ground and changing water table depth, restrictions to fish movement and the pollution of water supplies. Changes in forest cover alter catchment water balances and stream flows (Fuwape, 2003). The effect of timber harvesting on catchment water balance and runoff dynamic depends on the topography, soils and the type of forest (Vertessy & Dye, 2000). Harvesting near streams and lakes requires careful planning and management to reduce these negative effects. If a harvested forest is regenerated promptly, the impact on the watershed can be minimized. Riparian zones should be avoided during wood harvesting to preserve water quality and

wildlife habitat. Riparian zones should be connected with corridors of natural vegetation across watershed boundaries to allow for the movement of animals and plants;

Loss of Biodiversity: The impact of wood harvesting on wildlife leads to the loss of biodiversity which is being lost on a scale that is quite unprecedented. When forest cover is removed, wildlife is deprived of habitat and becomes more vulnerable to hunting. Timber harvesting adversely affects the population and variety of plant and animal species in the forest (Fuwape, 2003). Large scale removal of all the trees cover from a section of the forest has a negative effect on wildlife during their life cycles and these leads to animals and plants lost. The effects on animals are very heartbreaking, they not only lose their habitat and protective cover, but are pushed to sudden extinction. Most wild animals have to migrate from areas with no tree cover to undisturbed vegetation's. Many beautiful creatures, both plants and animals have vanished from the face of the earth due to the removal of forest cover. Sustainable and economically valuable timber harvesting systems can protect the forest ecosystems from biodiversity loss. To prevent the loss of biodiversity as a result of timber harvesting the following steps should be taken:

- Wood harvesting operations should be scheduled against breeding and nesting seasons for any critically endangered wildlife species.
- Trees in the harvesting areas should be left to regenerate and provide den and nesting sites, food sources, cover and travel corridors for wildlife.
- Appropriate conservation of understory species, as well as snags, slash and wood debris on harvested site should be properly managed to enhance wildlife habitat.
- Natural vegetation in the forest management area should be managed to ensure a variety of successional stages.

Conclusion

At the moment sustainable forest management in Nigeria is concentrating so much on wood production. Round logs from Nigeria have been exported to feed wood industries in Europe and Asia. Timber harvesting leads to far worse consequences in tropical forest ecosystems with resultant depletion of timber species. No government has yet shown much capacity to control over-exploitation of timber, rather lip services is paid to sustainable timber harvesting in Nigeria due to the discovery of crude oil in commercial quantity and the tremendous increase in the demand for wood. Over the years, timber harvesting has become so high subsequently leading to severe deforestation without any effort to regenerate the forest. Weak government policy in the forest sector remains a major obstacle to implementing any form of timber harvesting plan in the tropics, law enforcement is lacking and corruption is rampant (Blaser & Sarre, 2010). Governance is the foundation on which any form of forest management must be built, and this foundation is lacking at the national level in the forest sector of many tropical countries (Zimmerman & Kormos, 2012). Reduced impact logging (RIL) should be incorporated into sustainable forest management. This will substantially diminish harvestable timber volume while further increasing management and training costs. RIL have proven effective the world over in reducing collateral damage to the residual stand by 20% – 50%.

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Submitted: 26.05.2018

Accepted: 08.06.2018