POPULATION STRUCTURE AND THREATS TO SUSTAINABLE MANAGEMENT OF TREES ON AGROECOSYSTEMS IN IJEBU NORTH, OGUN STATE, NIGERIA.

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Olanrewaju, R. I. and Jimoh, S. O. (2018): Population Structure and Threats to Sustainable Management of Trees on Agroecosystems in Ijebu North, Ogun State, Nigeria. *Nigerian Journal of Forestry, 48 (2)* 28 - 32

Abstract
Woody tree species are important component of agricultural lands in Ijebu-North Local Government Area (LGA) and their management is crucial to the sustainability of their roles in improving agroecosystems productivity, food security and rural livelihood. However, information needed for their sustainable management in the area is inadequate. This study provided information on the population structure and threats to the sustainable management of woody tree species on agroecosystems of the LGA. Data was collected from 48 temporary sample plots (TSPs) on the three predominant agroecosystems types in the area. Trees with diameter at breast height (DBH) ≥2cm and total height (TH) ≥1m on all the plots were measured, recorded and categorised into DBH and TH classes. One hundred and twenty questionnaires were administered in the study area to identify threats to sustainable management of on-farm trees and the data collected were analysed using descriptive statistics. Arable farmlands have high proportion of trees with DBH ≥ 50cm and Cash crop plantations have high proportion of trees with DBH ≤10cm and DBH ≥.20cm. Both arable farmlands and cash crop plantation have high proportion of trees with TH ≥10m. Overexploitation (31%) and Bush burning (30%) were the greatest sources of threat to woody species in the study area. The population structure of woody species on agroecosystems in the area suggests the abundance of seedlings, saplings and matured trees. This has positive implication for sustainable management of on-farm trees in the study area. However, overexploitation, bush burning and firewood collection poses serious threats to their sustainable management.

Keywords: Biodiversity, Agroforestry, Sustainability, Species Distribution, Trees Outside Forests.

Introduction
The accelerated decrease of forest area can be traced to increased demand for arable lands and timber products as a result of increasing demographic pressure, drought and shortened fallows leading to decreased tree regeneration (Boffa, 2000). The human population in Nigeria is estimated to be about 196 million (NBS, 2018). The continuous upsurge in population, industrialization and farming has resulted in increased competition for land (Adesiyan *et al.*, 2007). FAO (2015) reported that Nigeria lose about 410,000 hectares of forest area annually. One of the major causes of this massive loss is the fragmentation of large area of natural forest into small isolated patches of native vegetation surrounded by matrix of agricultural lands and human habitat that makes up the agricultural landscapes (Tripathi *et al.,* 2010). In order to reduce pressure on the existing forest and maintain the valuable services provided by woody trees, many local communities are making efforts to retain and or plant useful trees and shrubs within farmland, grazing areas, and other parts of the farming landscapes (Teferi *et al.,* 2014).

Woody tree species has always been a prominent component of agricultural lands in sub Saharan Africa. These woody species are retained during land preparation or deliberately planted on farmlands (Bayala *et al.,* 2011). These trees support the production and ecological functions of the agroeco systems (Jakulski and Jakulski, 2012) and provide diverse goods and services that are crucial to the survival and sustainable livelihood of farmers and rural dwellers (Boffa *et al*., 2008). They also contribute significantly to biodiversity conservation (Atangana *et al*., 2014), by providing supplementary habitat for species that tolerates a certain level of disturbance (Schroth *et al.*, 2004).

In many places, forest and tree products are being over exploited (FAO, 2013). The threat posed by overexploitation has shifted global attention to the conservation and sustainability of biodiversity in tropical forests (Ihenyen *et al.*, 2009). Human related disturbances that influences tree species population structure usually affect the source of regeneration material such as seedlings, saplings and young trees (Maiwada 2014). This might lead to depletion of such trees if allowed to go unchecked resulting in the elimination of other flora or fauna which depend on such trees for survival (Ihenyen *et al.*, 2009). This engenders the need for a study of the on-farm tree population structure and the threats to their sustainable management. This study therefore aims to determine

the population structure of woody tree species on farming landscapes in Ijebu North Local government and identify the threats to the sustainable management of woody tree species on agricultural lands in the area.

Methodology

The study was conducted in Ijebu-North Local Government Area of Ogun State, Nigeria (Latitude 6° 52' and 7° 10'N and Longitude 3°45' and 4° 12'E) situated within the humid lowland region of the South-west, Nigeria. The vegetation comprises dense evergreen tropical rainforest. The mean annual rainfall is 1050mm-1280mm. Temperature ranges between 23°C to 32°C (Obayelu *et al.* 2015. The relative humidity is about 50% all-round the year (Mustapha and Jimoh, 2012). There are usually two seasons in the year, rainy and dry season. The main occupation is agriculture. Subsistence and commercial crops production, livestock farming, home gardens, arable and cash crop plantations etc. are the predominant agricultural practices in the area (Mustapha and Jimoh, 2012).

Study Design

Tree inventory and structured questionnaire were used for this study. A three stage sampling design was used. The first stage is the purposive selection of four wards where agriculture is predominant in the area. The second stage is the purposive selection of six farmlands within each selected ward; two farms for each of the three agro ecosystems included in this study (Arable farmlands, Cash crop Plantations and Farm Fallows). The third stage is the random selection of two temporary sample plots (TSP) with size 20m×30m on each farmland. A total of 48 TSPs were used in the study (16 sample plots to each agroecosystems).

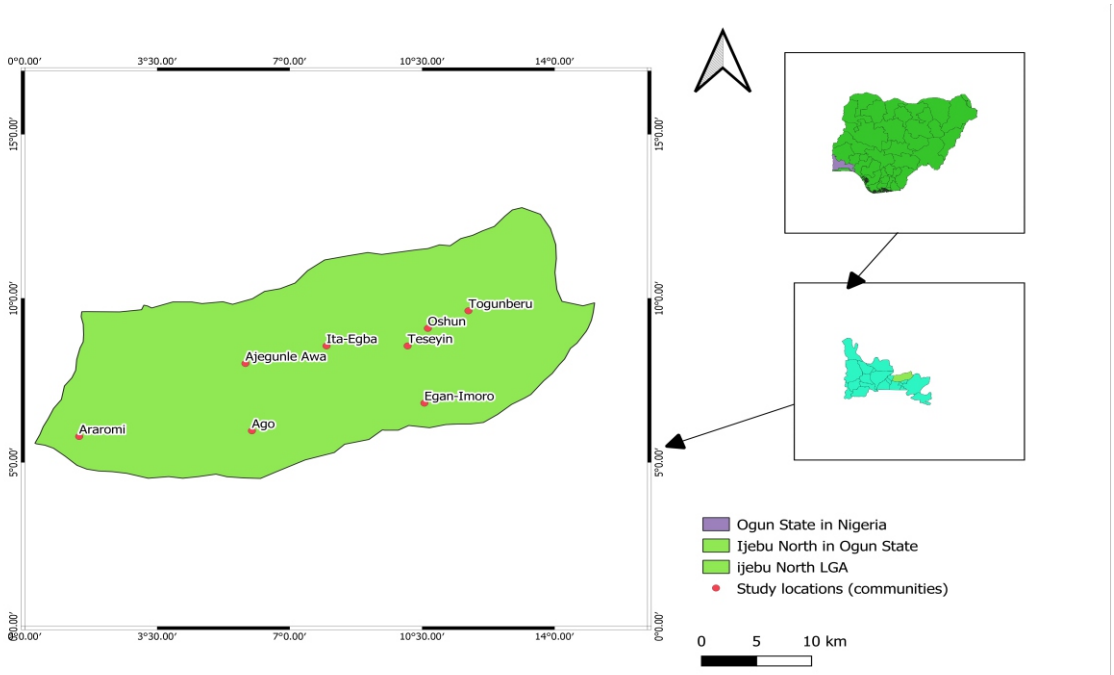

Figure 1: Map of Ijebu North Local Government Area showing the study locations

For the tree inventory, data on diameter at breast height (DBH) and total height (TH) of all trees with DBH ⩾ 2cm encountered were measured and recorded from each TSP. The DBH of individual trees was obtained by measuring tree diameter in centimetre at 1.3 m above the ground using a diameter tape. The total height (TH) was estimated with the aid of a metric Spiegel relaskop. This was categorized into diameter and height classes and used to form a chart to depict the population structure of the on-farm trees.

Information on threats to sustainable management of agroforestry tree species was collected with the aid of questionnaire and field observation. A total of 120 questionnaire were administered in the four (4) selected wards (Mamu, Ako, Osun budepo and Omen). Thirty questionnaires were administered in each ward. Also, direct observation during field survey was recorded. The data collected were analysed using descriptive statistics.

Results

Population Structure of Woody Species on Agroecosystems of Ijebu-North LGA.

A total of 1775 woody species were encountered on the sample plots during inventory. This include: 357 trees on arable farmlands, 529 trees on cash crop plantation and 889 tree on farm fallows. The DBH of trees on arable farmland ranges from 2.8cm to 69.25cm with the higher proportion of the trees above 20cm DBH (Fig. 2). Arable farmlands have a higher proportion of trees with DBH of above 50cm as compared to other agroecosystems on the agricultural landscapes of the study area (Fig. 1). Cash crop plantation has the widest

range of DBH with DBH ranging between 2.10cm and 98.73cm and a higher proportion of trees belonging to diameter size classes above 20cm (Fig. 2). The DBH of trees on farm fallow ranges from 2cm to 91.80cm with a high proportion of trees having DBH below 10cm (Fig. 2).

Cash crop plantations in the study area have TH ranging between 1.8m-35.20m, trees on farm fallows have TH between 1.5m - 34.50m with trees on arable farmlands having TH within the 2.75m-24.60m range. All the three agroecosystems have a high proportion of trees with TH below 20m (Fig. 3).

Threats to Sustainable Management of Woody Species on Agricultural Landscapes in the Study Area

Overexploitation (31%), bush burning (30%), Debarking (24%) and uncontrolled felling (14%) were the major threats to sustainable management of on-farm tree species in Ijebu-North LGA (Figure 4). However, grazing poses little or no threat to sustainable management of trees in the area.

Discussion

Population structure of woody species on Agroecosystems of Ijebu-North LGA.

The presence of higher proportion of large diameter trees and minimal pole size trees on arable farmlands is a reflection of the land preparation activities of farmers. During land preparation, large trees are spared and retained while the seedlings and saplings that will eventually grow to pole size were cleared off. The higher proportion of trees with DBH above 50cm may be due to their shade property because farmers retain large trees on their farmlands for the shade they provide, these trees serves as a relaxation spot for farmers in the area after the day's work. However, large trees are minimal on cash crop plantations. This may be as a result of felling of the large girth trees for timber to boost farm income. FAO (2013) reported that farmers fell trees on their farmlands to boost farm income. The presence of small diameter trees ($\leqslant$ 10cm) as well as matured trees ($\geqslant$ 20cm) on cash crop plantation suggests the presence of seedlings and saplings that are the regeneration stock as well as matured trees that serves as seed trees. This is a healthy development for species conservation because the larger trees will keep producing seedlings for future regeneration while the seedlings will gradually replace the matured trees when they age and die.

On farm fallows, proportion of trees decreases with increasing DBH exhibiting a reverse J curve. This is an indication that the farm fallow is a recuperating ecosystem recovering from disturbances. The low proportion of pole size trees (10-20cm) in the landscape may probably be as a result of the slash and burn farming system practiced during the cultivation phase prior to the fallow period; this may have resulted in the reduction of seedlings and saplings population which would have replaced the pole size trees as they grow and attain maturity. The presence of both juvenile and matured trees have an implication on woody species conservation and ecosystem resilience because the matured trees will keep producing seedlings for regeneration and gradually replace them as they grow old and die until ecosystem stability is attained. However, this is provided the farm fallow is not converted to arable farmland after the fallow period.

The abundance of trees with TH less than 10m on arable farmland may be connected to the fact that trees started growing and re-growing after the initial clearing during land preparation. The high proportion of tall trees in the farming landscapes (above 10m) could be linked to the abundance of *Elaeis guinensis* which is naturally an abundant component of the original vegetation and reaches between 15 and 30m and *Spondias mombin* with height up to 25m. The African oil palm is naturally abundant in all the African rainforest and can reach between 15-18m in height and 30m in the dense forest (Barcelos *et al*. 2015). The presence of very few trees with TH between 20m-30m on agroecosystems in the study area may be as a result of harvesting of merchantable tree for timber. Farmers harvest on farm trees to bolster farm income to meet household needs (FAO, 2013). The abundance of trees with TH above above 20m on cash crop plantations is an indication that this agroecosystem was not as disturbed as arable farmlands and trees were allowed to grow to their maximum height. This agro ecosystem has potential as a tree species conservation hotspot. The height distribution curve for farm fallow shows that as tree height increases frequency decreases, indicating a higher proportion of lower stratum trees. The high proportion of trees with TH below 10m was probably due to the abundance of seedlings and young trees growing and re-growing after the cultivation phase prior to the fallow period. The high proportion of trees found in small DBH and TH classes in all the selected agroecosystems in the study area is an indication of the abundance of young trees which is characteristic of natural forests. An abundance of juveniles is a characteristic of a natural forests (Nduwayezu *et al.*). This is a manifestation of the resilience of the agroecosystems and it also indicates that regeneration was taking place and the population of tree species on agricultural landscapes in the study area was stable and healthy.

Threats to Sustainable Management of Tree Species on Agricultural Landscapes in the Study Area

Overexploitation had negative implication on sustainable management of tree species in the area because the frequency of tree exploitation and harvesting did not give room for the affected tree to recover before another exploitation. Farmers in the area perceived bush burning as a very efficient and fast land clearing method. This poses great threat to tree species survival because it causes outright death of young tree species and also destroys the regeneration stock (seeds, seedlings and saplings) thereby reducing the composition and diversity of woody components of the agricultural landscapes.

It also has implication on sustainability of the agroecosystems that makes up the agricultural landscapes by adversely affecting the ecosystem resilience and stability. Also, de-branching and felling of trees for firewood have deleterious effect on the composition and population of on-farm trees and continuous harvest of fruits and seeds of on-farm trees reduces the quantity of seed stock for natural regeneration.

Conclusion and Recommendation

The population structure of woody tree species on agroecosystems of Ijebu-North LGA suggests a high proportion of seedlings, saplings and matured trees which is a positive reflection of the sustainability of the tree species population. However, overexploitation, bush-burning and firewood collection poses serious threat to the sustainable management of tree species on agroecosystems of Ijebu-North LGA. There is therefore the need for studies on the interaction between plant and woody components of agricultural landscapes in the area to better understand the dynamics of the population. It is recommended that agricultural policies should take into consideration the incorporation of trees on agroecosystems and also trees on farm lands should not be excluded from forestry policies and laws in Nigeria.

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Figures and Table

Table 1: Summary of structural characteristics of woody species in farmlands in Ijebu North LGA Agricultural landscapes

Agricultural landscapes	DBH (cm)		Total height (m)	
	Mean±STD	Min±Max	Mean±STD	Min±Max
Arable farmlands	30.07±17.30	2.8 ± 69.25	12.80±6.48	2.75 ± 24.60
Cash crop plantations	29.45±18.26	2.10 ± 98.73	14.34± 9.19	1.80 ± 35.20
Farm fallows	17.04±15.40	2.00 ± 91.30	10.54±7.89	1.50 ± 34.50

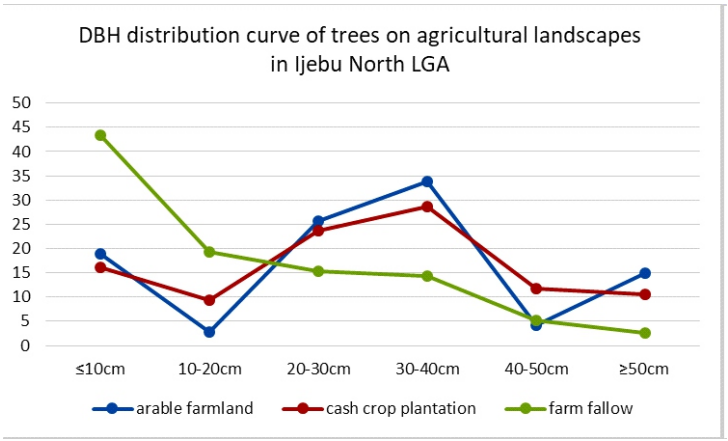

Figure 2: Tree diameter distribution in agricultural landscapes of Ijebu North LGA

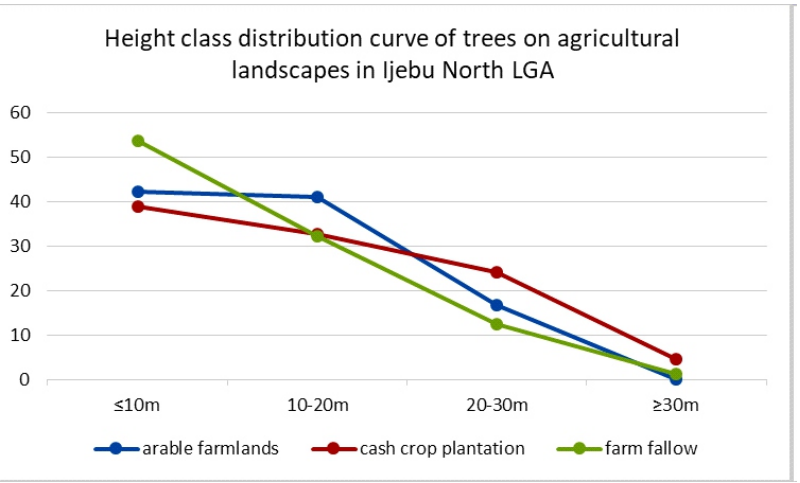

Figure 3: Tree height distribution in agricultural landscapes of Ijebu North LGA

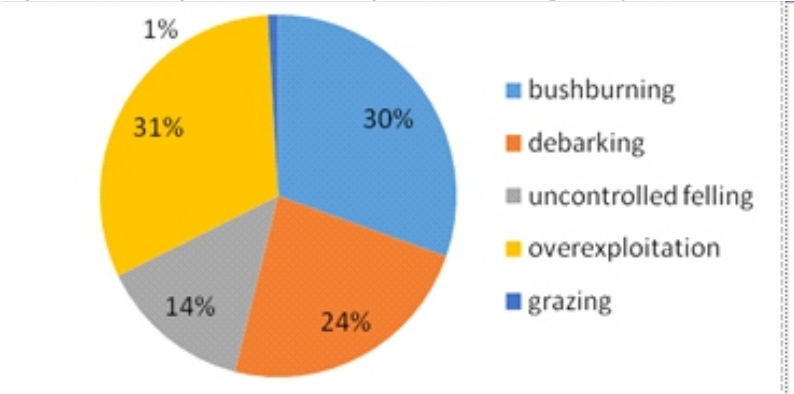

Figure 4: Sources of threats to trees on agricultural landscapes of Ijebu North LGA