Journal of Biodiversity and Ecological Sciences
(JBES©)
Vol. 5, Issue 4
ISSN: 2008-9287
Fall 2015

Original Article

Tree Diversity Status of Soil Seed Bank and Overstory Vegetation of Six Different Physiognomies in Shasha Forest Reserve, Nigeria

Adebola S. I *
Awotoye O.O
Institute of Ecology and Environmental Studies, Obafemi Awolowo University, Ile-Ife, Nigeria

***Corresponding Author:**
adebolasamuel@gmail.com

ABSTRACT
Tree species in the soil seed bank (SSB) and overstory vegetation were assessed in six contrasting physiognomies; (secondary re-growth natural forest (SRNF), *Terminalia superba* plantation (TSP), *Pinus caribaea* plantation (PCP), *Gmelina arborea* plantation (GAP), *Tectona grandis* plantation (TGP) and *Theobroma cacao* plantation (TCP) in Shasha Forest Reserve. Eight plots 25m x 25m were randomly selected in each physiognomy for the overstory vegetation study. Tree species were identified and assigned into families. Twenty four composites soil samples were collected from three quadrats of 5m x 5m at surface soil layer (0-15 cm), in each physiognomies. The soils were spread in well-drained porous bowls and watered for a year for tree seedling emergence inside the screenhouse.
Tree diversity indicated that overstory vegetation and soil seed bank emergence varied among the physiognomies, with the trio of secondary re-growth natural forest, *T. superba* and *P. caribaea* plantations having the highest tree diversity and abundance. The highest tree emergence was observed in TSP (33.3%) followed by GAP and SRNF (26.6% and 20.0%) while the least occurred in TCP, TGP and PCP (6.6%). The study revealed poor representation of standing overstory tree species at the SSB and showed the reason why traditional abandonment of forest fail to allow restoration of most tree species without human effort. This study concluded therefore, that future restoration planning should not be based on traditional abandoment of forest that relies on SSB succession; deliberate introduction of endangered tree species through enrichment planting of forest reserves is thereby recommended.

KEYWORDS: Physiognomies, Regeneration, Seedlings, Soil Seed Bank, Tree diversity.

INTRODUCTION

Reliance on soil seed bank for the restoration of tropical natural forest may be part of the major reasons causing wanton loss of tree species in our protected areas. A study into the natural process which influences forest dynamics has revealed that soil seed bank is one of the major sources of recruitment for new individual (Butler and Chadzon, 1998), forest stands receive it seeds from the overstory vegetation or from dispersed seeds from other location. According to FORMECU (1999), *Terminalia superba*, *Triplochiton scleroxylon*, *Sterculia rhinopetala*, *Mansonia altissima*, *Cordia millenii*, *Melicia excelsa*, *Nesogordonia papaverifera*, *Antiaris africana*, Cr*inium spp.*, *Pterygota macrocarpa*, *Khaya spp.* and *Alstonia boonei* were parts of the tree species that were mentioned to be threatened and faced with extinction in Nigeria. The impact of unsustainable forest management practices including selective logging within gazetted forest reserves in Nigeria was identified as part of the reasons contributing to tree species loss in the country protected areas (Adekunle, 2006). Forestry experts have reported that about 65% of Nigeria's 560 species of trees are now faced with extinction while many others are at different stages of possible extinction (Agbelade and Olusola, 2010).

The traditional methods of allowing degraded forests in Nigeria to self-recover through the seeds that are *believed* to emerge from seed bank after logging activities might have encouraged loss of important species in our natural forest ecosystem. Moreover, this method might have contributed to extinction of some valuable tree species whose seeds fail to emerge due to predation and need deliberate planting and nurturing within the forest ecosystem. The regeneration of native tree species after forest degradation could be constrained by a number of factors including low seed availability, predation of seeds and seedlings, competition with grasses and other non-woody vegetation, soil degradation and unfavourable climate. Onyekwelu *et al.* (2008) reported that where these factors are prevailing, restoration may be difficult; otherwise the degraded forest site may recover just fairly well. Philip (1998) submitted that forests have been recently affected by large scale anthropogenic and natural changes causing great problems in the management of forest reserve on a sustainable manner. This justifies the claim of Oke *et al*. (2010) that species composition and age structure in the forest reserves are influenced greatly by anthropogenic disturbances, contributing to higher heterogeneous mosaic of succession within the system, though disturbance tolerant species dominate the field.

There is increasing recognition that aboveground and belowground components of ecosystems (forest) are strongly linked through a variety of direct and indirect interactions (Kardol and Wardle, 2010). Aboveground vegetation influences soil physicochemical organic matter content, soil structure and microclimate (Kara *et al.*, 2008). Forest disturbance has a way of affecting biological properties thereby imposing survivor differential on the plants and animals based on the intensity and frequency of habitat alteration. Conversely, disturbance of natural forest may affect the diversity, relative abundance and interaction of ecosystem regulators, with varying resultant effect on ecological functions across different micro-habitat.

Natural processes which influence forest dynamics have shown that the soil seed bank is one of the principal sources of recruitment for new individuals in the initial stages of secondary succession (Butler and Chazdon 1998). Restoration of biodiversity in degraded tropical forests is a challenge to forest managers and conservationists today in developing countries (Adekunle, 2006). As reported by Akinyemi and Oke (2013) woody species of the standing vegetation were poorly represented in the soil seed bank assessment conducted on three physiognomies in Shasha. This quickly brings to mind the question of capability of relying on soil seed bank in restoring degraded natural forest? The objective of this study was to evaluate and compare the tree diversity and abundance between standing vegetation and soil seed bank within planted forest stands and native stands. This will help to reveal the extent to which forest regeneration can rely solely on soil seed bank for restoration of degraded forest ecosystem in the tropics.

In response to this, the tree species composition of the soil seed bank and the standing vegetation were investigated in natural forest and tree plantations to ascertain the potential of relying on soil seed bank for future regeneration of forest ecosystem.

MATERIALS AND METHODS

Study Area

The study area, Shasha Forest Reserve was originally created in 1925 (Isichei,1995), has a land area of 310,798 km^2 (Salami *et al.*, 2007) and lies within (7^0 05′and 4^0 55′ E) with 178 m above sea level. The reserve share a common boundary with Ago Owu, Oluwa and Omo forest reserves. It has a mean annual rainfall of 1421 mm (Adekunle, 2006) most of which falls during the rainy season from April to October. Shasha Forest Reserve is a fragmented habitat whose landscape has been partitioned as result of plantation development and agricultural intensification into Secondary re-growth natural forest (SRNF), plantations of both local and exotic tree species, farm settlement and agricultural land (Figure 1). Substantial part of the reserve have been converted to plantation especially *Gmelina arborea*and *Tectona grandis*plantations, while recently larger part of the secondary re-growth forest was converted to cocoa plantation. Each of these physiognomy are separated by forest road, footpath or abandoned grassland. This reserve is one of the few forest reserves that contain some biologically unique flora and fauna in lowland rainforest south-western Nigeria (Adekunle, 2006), besides containing different physiognomies of interest such as native natural forest, native tree plantation, exotic tree plantation and farm lands respectively. The vegetation of the area is classified as the Guinea-Congolian drier forest types (White, 1983). The five major soil types recognized in this area are; inselberg soils, Hill creep soils, sedimentary non-skeletal soils, drift soils and alluvial deposits (Hall, 1969). The soil of the area is derived from old basement complex which is made up of granite metamorphosed sedimentary rock (Hall, 1969). The soil in this area has been classified as lixisols and ultisols (FAO/UNESCO, 1988). It is also well-drained with a major river (known as Shasha) and its tributaries which provide a good network of rivers and streams that defines dentritic patterns suggests a fairly homogenous rock of uniform resistance which makes up the basement complex. The influx of settlers and installation of traditional rulers in the enclaves within the reserve has increased the pressure on both the natural and plantation forest because of demand for farmland and cocoa plantation.

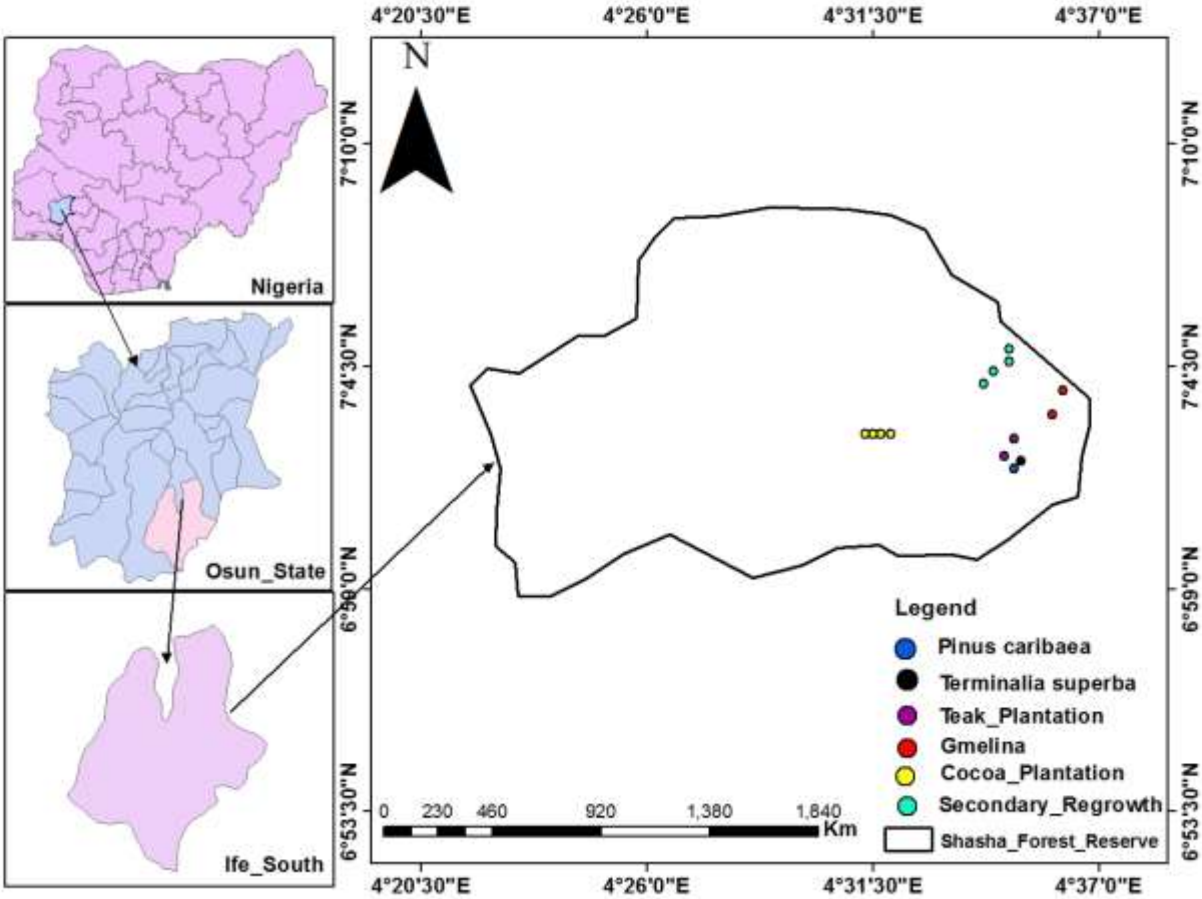

Fig 1. Map of the study area in relation to Nigeria, Osun State and Ife South Local Government areas where the reserve is located

Sampling Procedure for Tree Specie Assessment

Stratified sampling technique was adopted for selection of six different strata known as physiognomies within the forest reserve before random sampling technique was later used for the plot's location in each of the stratum. The sampling units were located inside each of the physiognomy where the vegetation was relatively undisturbed and edge effect adequately overcome. Eight plots of (25 m x 25 m) were selected for the study in each physiognomy where all tree species was identified and assigned to families.

Soil Seed Bank Assessment

For the assessment of soil seed bank, Twenty four composites soil samples were collected from three quadrats of 5 m x 5 m at the surface soil layer (0-15 cm), within eight (25 m x 25 m) plots in each physiognomies. Collected soil samples were air-dried at room temperature and spread in well-drained porous bowl in the screen house where they were watered daily and monitored for seedling emergence for one year (Roberts, 1981). As seedlings emerged, the seedlings in each bowl were identified, counted and removed. The seedling emergence test was terminated at the end of one year. Sorenson index of similarity was used to compare the species composition between the standing vegetation and the soil seed bank.

RESULTS

Species Composition of the Standing Vegetation

The families' composition and species diversity of tree species were comparatively fewer in plantations relative to secondary re-growth natural forest (SRNF). A total of 1,610 individual tree stands, belonging to 36 families and 103 species were encountered in all the six physiognomies. The tree richness decreased from SRNF to plantation established by native tree species, and finally to plantations established by exotic tree species. The plantation established with native species resembled the secondary re-growth natural forest in terms of indigenous tree composition. The tree species abundance was highest in secondary re-growth natural forest (SRNF) , closely followed by *Terminalia superba* plantation (TSP) and *Pinus caribaea* plantation (PCP) as well as *Gmelina arborea* plantation (GAP) and *Tectona grandis* plantation (TGP) and the least was found on the *Theobroma cacao* plantation (TCP). The dominant tree species were in the families of Sterculiaceae and Euphorbiaceae (33.3%), followed by Moraceae (27.8%) and Ebenaceae (19.4%). In addition to the existing *Terminalia superba* tree plantation, a number of indigenous trees such as *Trichlisia monadelpha* A Juss (5.65%), *Rauvolfia vomitoria* Afzel (5.2%), *Buchholzia coriacea* Engl (4.47%), *Strombosia pustulata* Oliv (4.22%), *Funtumia elastic* (Preuss) Stafp (4.03%), *Sterculia rhinopetala* K Schum (3.60%) and *Diospyrous canaliculata* De Wild (3.47%) were also encountered (Table 1).

There were 665 individual tree stands, belonging to 60 species and 22 families in secondary re-growth natural forest. *Strombosia pustulata* Oliv of the family Olacaceae (56) mostly dominated the secondary re-growth natural forest, followed by *Musanga cercropionides* R. Br of the family Moraceae (38).The overstory native tree species in *Terminalia superba* Engl. & Diels Limba plantation apart from itself as presented in (Table 1) showed that a total of 511 individual native tree stands, belonging to 22 families and 48 species of native tree were encountered within its stand. The physiognomy was mostly dominated by *Trichlisia monadelpha* A Juss of the family Combretaceae (84), followed by *Buchholzia coriacea* Engl of the Meliaceae family (54). A total of 197 individual native tree-stands belonging to 22 families and 38 tree species were encountered during the floristic assessment within *Pinus caribaea* plantation. In the stand, *Rauvolfia vomitoria* Afzel of the family Apocynaceae was the dominant native tree species (16.1 %) followed by *Oxyanthus specious* DC of Rubiaceae family (9.0%). However, the tree composition showed that there were 120 individual tree stands, belonging to 31 species and 20 families in *Gmelina arborea* Plantation. *Lonchocarpus sericeus* (Benth) of the family Papilionaceae and *Mallotus subulatus* Mūll-Arg of Eurphorbiaceae family were the tree species that dominated the physiognomy (20%) followed by *Funtumia elastica* (Preuss) Stapf of the family Apocynaceae (10 %). The data presented in Table 1equally showed that *Theobroma cacao* plantation contain 70 individual tree stands belonging to 8 families and 13 species. The table revealed that *Cola nitida* (Vent) Schott & Endl of the family Sterculiaceae was the most dominant species (37) followed by *Citrus sinensis* (L.) Osbeck of the Rutacea family (8). Majority of these tree species are fruit trees. The distribution of native adult tree species co-occurring with *Tectona grandis* Roxd in teak plantation as presented revealed that there were 47 individual tree stands, belonging to 21 species and 15 families in *Tectona grandis* plantation. *Ficus capensis* Thunb of the family Moraceae (14.9 %) was the most abundant native species, followed by *Baphia nitida* Lodd of Papilionaceae (12.8 %). Majority of the tree species encountered within *Tectona grandis* plantation are non-timber tree species.

Table 1. Species, Family and Species Abundance of Tree Species in the Standing Vegetation in Each Physiognomies

Species	Family	SRNF	TSP	PCP	GAP	TCP	TGP
Strombosia pustulata Oliv.	Olacaceae	56	8	2	1		
Musanga cercropioides R.Br	Moraceae	38		5		2	1
Diospyros dendo Welw.ex Hiern	Ebenaceae	34	1		1		
Psidium guajava Linn	Myrtaceae						1
Sterculia rhinopetala K. Schum.	Sterculiaceae	32	8	17	1		
Diospyros canaliculata De Wild	Ebenaceae	28					
Trichlisia monadelpha A Juss	Meliaceae	26	54	7			
Deinbollia pinnata Schum & Thonn	Sapindaceae			2	2		2
Funtumia elastica (Preuss) stapf	Apocynaceae	25	23		13	2	2
Citus sinensis (L.) Osbeck	Rutaceae					8	
Elaeis guineensis Jacq	Arecaceae					7	2
Rauvolfia vomitoria Afzel.	Apocynaceae	24	26	32	2		
Bosqueiaangolensis Ficalho	Moraceae		2				
Celtis zenkeri Engl	Ulmaceae	21	16	2	2		
Anthocleista vogelli Planch.	Loganiaceae		3				3
Pricalima nitida (Stapf) T Durand & H.Durand	Apocynaceae	21	4				
Diospyros suaveolens Gurke	Ebenaceae	20	11				
Lonchocarpus sericeus Benth	Papilionaceae			1	24		3
Garcinia kola Heckel	Gattiferae			1			
Bridelia ferruginea Benth	Euphorbiaceae		6				
Macaranga barteri Mūll-Arg	Euphorbiaceae	18	20	5			

Newbouldia laevis Seem.	Bignoniaceae						1
Mansonia altisima A Chev.	Sterculiaceae	18	3	4			
Ficus capensis Thunb.	Moraceae						7
Alchornea cordifolia	Euphorbiaceae						2
Cola gigantea A.Chev.	Sterculiaceae	17	12	14			
Mitragyna inermis (Willd.) O Ktze	Rubiaceae				1		
Trilepsium madagascariense Dc. Fl. Cam	Moraceae				1		
Buchholzia coriacea Engl.	Capparaceae	17	48	7			
Blighia sapida K Konig	Sapindaceae		4	7			2
Trema orientalis (Linn.) Blume	Ulmaceae		4				
Terminalia superba Engl. & Diels (Limba)	Combretaceae	17	84	3			
Drypetes principum (Muell.Arg) Hutch	Euphorbiaceae	16					
Drypetes paxii Hutch.	Euphorbiaceae	12					
Pterocarpus sp	Papilionioideae						1
Carpolobia lutea G. Don	Polygalaceae						1
Icacina triacantha Oliv.	Icacinaceae						1
Microdesmis puberula Hook f. ex planch	Pandaceae	12			2		
Spathodea campanulata P. Beauv.	Bignoniaceae	12	6		11		
Sterculia oblonga Mast	Sterculiaceae	12	3				
Alstonia boonei DeWild.	Apocynaceae	11	5	5		1	
Desplatsia lutea Bocq	Tiliaceae	11			5	|	
Octolobu angustatus Hutch.	Sterculiaceae	11					
Zanthoxylon zanthoxyloides (Guill. & Perr.) Engl.	Rutaceae			1			
Mallotus subulatus Müll-Arg	Euphorbiaceae				24		
Dichapetalum barteri	Dichaptaliaceae				4		
Cleistopholis patens (Benth.) Engl. and Diels	Annonaceae	9		7			
Drypetes floribunda (Muell.Arg) Hutch.	Euphorbiaceae	9	12				
Mikhamia spp	Bignoniaceae	8					
Nesogordonia papaverifera (A.Chev.) R.Capuron	Sterculiaceae	8					
Aningeria robusta (A.Chev.) Aubrev. And Pellegr.	Sapotaceae	7	4		2		
Ficus exasperata Vahl	Moraceae	7	19	4		3	1
Milica excelsa (Welw.) C.Berg	Moraceae	7	4	2			
Pycnanthus angolensis (Welw.) Ward	Myristicaceae	7	24			1	
Cola millenii K.Schum	Sterculiaceae				1		
Pterygota macrocarpa K. Schum.	Sterculiaceae				1		
Anthonotha macrophylla P. Beauv.	Caesalpiniodeae		3		2		
Antiaris toxicaria Lesch. Subsp. Welwitschii (Engl.) C.C Berg	Moraceae		3	2			
Danieli ogea (Harms) Rolfe ex Holland	Caesalpiniodeae	6					
Sterculia tragacantha K.Schum	Sterculiaceae	6	4		1		
Triplichiton scleroxylon K.Schum	Sterculiaceae	6					
Celtis mildbraedii Engl	Ulmaceae	5	2	1			
Cocos nucifera Linn	Aracaceae					1	
Piptadeniastrum africanum (Hook.f) Brenan	Mimosoideae					1	
Albizia zygia (DC) J. F Macbr	Mimosoideae					1	
Albizia ferruginea (Guill. & Perr.) Benth	Mimosoideae						

Entandrophragma angolense (welw.) C. DC	Meliaceae	5					
Guarea cedrata (A.Chev.) pellegrin	Meliaceae	5					
Holarrhena floribunda (G.Don) T. Durang & Schinz	Apocynaceae	5		2			
*Malactha alnifolia (*Baker) Pierre	Sapotaceae	5	2	1			
Morus mesozygia Stapf	Moraceae	4	2				
Myrianthus arboreus P. Beauv.	Moraceae	4		2		1	
Ricinodendron africanum (Ball.) Pierre	Euphorbiaceae	4					
Canthium hispidium Benth	Compositae	3	14	11			
Celtis tenufolia Nutt.	Ulmaceae	3					
Rothmannia hispida (K. Schum.) Fagerlind	Rubiaceae				1		
Desplatsia dewevrei (De. Wild. And Th.Dur.) Burret	Tiliaceae	3					
Diospyros monbuttensis Gurke	Ebenaceae	3					
Diospyros piscatoria Gurke	Ebenaceae		4		5		5
Diospyros canaluculata De Wild	Ebenaceae	3	28				
Memecylon afzelii G.Don	Melastomatacae	3					
Oxyanthus specious DC	Rubiaceae	3	7	18			
Terminalia ivorensis Chev.	Combretaceae	3					
Barteria fistulosa Mast	Passifloraceae	2					
Cnestis ferruginea Vahl ex De cantolle	Connaraceae				1		
Cola nitida (Vent) Schott & Endl	Sterculiaceae					37	
Enantia chlorantha Oliv.	Annonaceae	2					
Hildegardia barteri Schott & Endl	Sterculiaceae	2			2		
Ricinodendron heudelotii (Ball.) Pierre	Euphorbiaceae	2		2			
Rinorea dentata (P. Beauv.) Kuntze	Violaceae	2	4	3			
Xylopia aethipica (Dunal) A.Rich	Annonaceae	2			1		
Chytranthus macrobotry Benth	Sapindaceae	1	4				
Diospyros barterii Hiern	Ebenaceae	1	1				
Drypetes chevellerii Beille	Euphorbiaceae	1	3				
Diospyros mespiliformis Hochst. Ex A. DC	Ebenaceae		3	6			
Magritaria discoidea (Baill.) G. L	Euphorbiaceae		3	1			2
Uapaca togoensis Pax	Euphorbiaceae		3	3			
Canarium schweinfurthii Engl.	Burseraceae		3				
Ficusmucuso Welw Ex Ficalho	Moraceae		2				1
Microdesmispaniculata Pax	Pandaceae		2	1			
Drypetes gilgiana (Pax) & K Hoffm	Euphorbiaceae			9	1		
Grewia coriacea mast	Tiliaceae			3			
Tabernaemontana pachysiphon Stapf	Apocynaceae			3	1		
Ceiba pentandra (L.) Gaertn.	Bombacaceae				2	2	2
Baphia nitida Lodd.	Papilionaceae			1	5		6
		665	511	197	120	70	47

SRNF = Secondary Re-growth Natural Forest, TSP = *Terminalia superba* Plantation, PCP = *Pinus caribaea* Plantation

GAP = *Gmelina arborea* Plantation, TCP = *Theobroma cacao* Plantation, TGP = *Tectona grandis* Plantation

Tree Species Composition of the Soil Seed Bank

Excluding shrubs and grasses, a total of 15 individual tree stands, belonging to 6 species and families germinated during the one year period of incubating the soil in the screen house. The following tree species, *Cnetis ferruginea* Vahl ex De cantolle, of the family Connaraceae, *Alchornea cordifolia* Mūll-Arg of the family Euphorbiaceae and *Cassia sp* of the family Leguminosaea had the highest density. Table 2 indicated that *T. superba* plantation had the highest tree emergence with 33.3% followed by *G. arborea* plantation and secondary re-growth natural forest with 26.6% and 20.0% respectively, while the other (*T. cacao* plantation, *T. grandis* plantation and *P. caribaea* plantation) had 6. 6%. Tree species diversity were highest in *T. superba* plantation (5) and *G. arborea* plantation (4), followed by secondary re-growth natural forest (3), while others had one recruitment each. Except *Cnetis ferruginea* (Vahl ex De cantolle) and *Gmelina arborea* Roxb that were represented at the above vegetation in GAP, the other four tree species that emerged at the soil seed bank of other physiognomy had no representative at the standing vegetation(Table 2).

Table 2: List of Tree Species Diversity Recorded in Seed Bank across Different Physiognomy

Tree Species Diversity	Physiognomies					
	SRNF	TSP	PCP	GAP	TCP	TGP
Trema sp	2	-	-	-	-	-
Cnestis ferruginea Vahl ex De cantolle	1	-	1	1	-	-
Gmelina arborea Roxb.	-	1	-	1	-	-
Ficus sp		1	-	-	1	-
Alchornea cordifolia Mūll-Arg	-	3	-	-	-	-
Cassia sp	-	-	-	2	-	1
Total Tree Diversity	3	5	1	4	1	1

SRNF = Secondary Re-growth Natural Forest
TSP = *Terminalia superba* Plantation
PCP = *Pinus caribaea* Plantation
GAP = *Gmelina arborea* Plantation
TCP = *Theobroma cacao* Plantation
TGP = *Tectona grandis* Plantation

DISCUSSION

Understanding the soil seed bank dynamics of tropical forest is fundamental to restoration of degraded lowland rainforest ecosystem. Species richness, being an index of biodiversity, varied considerably among the physiognomies under consideration but was comparatively higher in secondary re-growth natural forest and plantation of native species *T. superba* plantation compared with other planted physiognomies. This conformed to the position of Brockerhoff *et al.* (2008) that natural forest are usually more suitable as habitat for a wider range of native forests species than plantation forests. This may be attributed to the presence of high structural complexity that enhanced seed transfer and germination of some plants especially animal dispersed species in natural forest (Lindenmayer and Hobbs, 2004; Carnus *et al.*, 2006; Paritsis and Aizen 2008). The comparison of the floristic diversity of the six physiognomies showed that secondary re-growth natural forest, *T. superba* plantation and *P. caribaea* plantation were more diversified and richer than the other planted forests. These findings corroborate Hunter (1999), Hartley (2002) and; Healey and Gara (2003) that forest plantations, especially exotic single-species plantations, are thought to offer a less favourable habitat for indigenous species than natural forests.Akinyemi and Oke (2013) concluded in their report that potential for vegetation restoration of the degraded forest reserve from the soil seed bank was insignificant.

The poor representation of the standing vegetation at the soil seed bank in this study further revealed the insufficiency of relying on soil seed bank for restoration of degraded forest ecosystem. Comparison of the standing overstory vegetation with soil seed bank emergence clearly showed absence of substantial numbers of tree species in the standing vegetation at the soil seed bank. This result corroborated the reasons why most valuable tree species are not returned after selective logging into our forest ecosystem. Disappearance of remaining remnant of natural forest as a result of forest degradation will further restrict the contribution of adjoining forest through seed rain to degraded forest areas. This brings to mind the question of capability of relying on soil seed bank for future forest regeneration. A lot of reasons are given for the poor representation of woody species in the soil seed bank assessment performed in the screenhouse for predicting regenerative potential of forest ecosystem. Some of them are; predation (Johnson, 1975), soil depth (Roberts, 1981; Li Ning *et al.*, 2007, Mohammed and Hussein, 2008), seasonal effect (Akinyemi and Oke 2013). The results of the abundance of individual tree species were significantly higher at the overstory vegetation compared to the one obtained in the soil seed bank. According to the result the soil seed bank of Shasha Forest Reserve was dominated by the following species *Cnetis ferruginea* Vahl ex De cantolle, of the family Connaraceae, *Alchornea cordifolia* Mūll-Arg of the family Euphorbiaceae and *Cassia sp* of the family Leguminosaea. Except *Cnetis ferruginea* Vahl ex De cantolle and *Gmelina arborea* Roxb which are represented at the above vegetation in *Gmelina arborea* plantation, the other four tree species that emerged at the seed bank of other physiognomy had no representative at the above ground vegetation of their physiognomy. This conforms to the observation of Akinyemi and Oke (2013) who recorded low representation of the standing vegetation in the soil seed bank among three contrasting physiognomy in Shasha forest reserve. The overall abundance of individual tree that emerged from the experiment was considered low and many of them are not commercially demanded timber species. Many researchers have consistently recorded higher number of Herbs, Shrubs and Grasses compare to woody species in seed bank assessment performed in screenhouses. Akinyemi and Oke (2013) noted emergence of few woody species compared to shrubs, herbs and grasses in their studies. Lementh and Teketay (2006) also observed 78 % herbs emergence and advised that regeneration planning of forest vegetation should not be designed based on soil seed bank. This also agrees with Taye jare (2006) who observed that the soil seed bank of Harena forest in Ethiopia was dominated by herbaceous species 89 % compared to 5.7 % woody species. The outcome of Grombone-Guaratine *et al*. (2004) in Brazil also showed that the soil seed bank assessment of Galery forest was low in woody species composition 8.2 %. This suggest that restoration of tree species diversity on degraded forest needs to be based on deliberate planting of valuable tree species through enrichment planting rather than relying on natural succession originating from the soil seed bank.

CONCLUSION

The results showed that the establishment of plantation is no doubt one of the major drivers of tree species loss in the study area. The inability of most trees that are existing at the standing vegetation to germinate at the soil seed bank necessitate the need to review the current abandonment method of regenerating natural forest reserves in Nigeria. Concerted forest management efforts through appropriate forest policies should be devised to return most of the endangered and extinct tree species in the study area back into the reserve through deliberate forest enrichment planting programme (DFEPP).

ACKNOWLEDGEMENT

We thank the Osun State Ministry of Environment, Department of Forestry for the permission to use the Shasha Forest Reserve and also Mr. James Anayo for his assistance during the field work.

REFERENCES

Adekunle, V. A. J. (2006). Conservation of tree species diversity in tropical rainforest ecosystem of southwest Nigeria. *Journal of Tropical Forest Science* 18 (2): 91–101.

Agbelade, D. A. and Olusola, J. A. (2010). Impact of biodiversity conservation on economy and climate change; In: Onyekwelu, J.C.,

Adekunle, V.A.J. and Oke, D.O. (eds.). *Proceeding of the 2nd Biennial National Conference of the Forest Products Society.* Akure26th-29th April, 2010.Pp 11-17

Akinyemi, D. S. and Oke S. O. (2013). Soil Seed bank Dynamics and Regeneration in the Different Physiognomies in Shasha Forest Reserve In Southwestern Nigeria. *Ife Journal of Science* 15:367- 383

Brockerhoff, E. G., Jactel, H., Parota, J. A., Quine, C. P. and Sayer, J. (2008). Plantation forests and biodiversity: Oxymoron or Opportunity. *Journal of Biodiversity and Conservation*17: 925–951

Butler, B. J. and Chadzon, R. L. (1998). Species Richness Variation and Abundance of the soil Seed Bank of a Secondary Tropical Rain Forest. *Biottopica*, .30, 2, 214-222

Carnus, J. M., Parrotta, J., Brockerhoff, E., Arbez, M., Jactel, H., Kremer, A., Lamb, D., O'hara, K., and Walters, B. (2006). Planted Forests and Biodiversity. *Journal of Forestry* 104, 65-77.

FAO/UNESCO, (1988). Soil Map of the World, Revised Legend. World Soil Resources Report 60. FAO, Rome. 113 Pp.

FORMECU, (1999). Forest Resources study of Nigeria. Overview Revised National .

Report prepared for Forestry Management Evaluation and Coordinating Unit, Volume 1:108 pp.

Grombone-Guaratine, M. T., Leitão-Filho, H. F. and Kageyama, P. Y. (2004). The seed bank of a gallery forest in southeastern Brazil. *Brazilian Archives of Biology and Technology* 47,793- 797

Hall, J. B. (1969). The Vegetation of Ile-Ife. University of the Ife Herbarium *Bulletin* 1.

Hartley, M. J. (2002). Rationale and methods for conserving biodiversity in plantation forests. *Forest Ecology and Management* 155: 81–95.

Healey, S. P. and Gara, R. S. (2003). The Effect of a teak (*Tectona* grandis) Plantation on the Establishment of a Native Species, in an Abandoned Pasture in Costa Rica. *Forest Ecology and Management* 176 497-507

Hunter Jr. M. L. (1999). Maintaining biodiversity in forest ecosystems. Cambridge University Press, Cambridge. 716 p.

Isichei, A. O. (1995). Omo biosphere reserve: current status, utilization of biological resources and sustainable management (Nigeria). UNESCO South-South cooperation programme working paper No.11, 48 p.

Johnson, E. A. (1975). Buried seed populations in the subarctic forest east of Great Slave Lake, Northwest Territories. *Journal of Vegetation Science* 9,669-678.

Kara, Ö., Bolat, I., Çakıroglu, K. and Öztürk, M. (2008). Plant canopy effects on litter accumulation and soil microbial biomass in two temperate forests. *Biology and Fertility of Soils.* 45, 193- 198

Kardol, P. and Wardle, D. A. (2010). How understanding aboveground-belowground linkages can assist restoration ecology. *Trends in Ecology and Evolution* 25, 670-679.

Keenan, R., Lamb, D., Woldring, O., Irvine, T. and Jensen, R. (1997). Restoration of plant biodiversity beneath tropical tree plantations in Northern Australia. *Journal of Forest Ecology and Management* 99, 117- 131.

Lementh, M. and Teketay, D. (2006). Changes in soil seed bank composition and density following deforestation and subsequent cultivation of a tropical dry Afromontane forest in Ethiopia. *Tropical ecology* 47(1): 1-12

Li, N., Feng, G., Tian, C. Y. (2007). Characteristics and dynamics of the soil seed bank at the north of Taklimakan Desert. *Sci China Ser D-Earth Science* 50, 122-127.

Lindenmayer, D. B. and Hobbs, R. J. (2004). Fauna conservation in Autsralian plantationforests –a review. *Biological Conservation* 119, 151-168.

Mohammed, H., Hussein, M.(2008).Temporal and Spatial variation in soil seed bank in Elain Natural Forest Reserve North Kordofan, Sudan. Conference on International Research on Food security, natural resource Management and Rural Development. 7th-9th October, 2008. University of HohenheimMolofsly and Augspurge 1992.

Oke, D. O., Boboye, O. and Faruwa, F. A. (2010). Impact of Bush Fallowing on the Diversity of Plant Species and Population of soil microbes in a humid tropical rainforest ecosystem (Apomu Forest Reserve). In: Onyekwelu, J.C., Adekunle, V.A.J. and Oke, D.O. (eds). *Proceeding of the 2nd Biennial National Conference of* *the Forest Products Society. Akure.26th-29th April, 2010*. Pp 18-23.

Onyekwelu, J. C., Mosandl, R. and Stimm, B. (2008). Tree Species Diversity and soil status of primary and degraded tropical rainforest ecosystem in South-western Nigeria. *Journal of Tropical Forest Science* 20 3: 193-204

Paritsis, J. and Aizen, M. A. (2008). Effects of exotic conifer plantations on the biodiversity of understory plants, epigeal beetles and birds in *Nothofagus dombeyi* forest', *Forest Ecology and Management,* 2555, 1575-1583.

Philip, S. (1998). Factor influencing species composition in tropical lowland rainforest: Does soil matter? *Ecology* 79 (1): 23-30

Roberts, H. A. (1981). Seed banks in Soils. *Advances in Applied Biology* 6: 1-55

Salami, A. T., Balogun, B. O., Oloyede-Kosoko, S. O. A. (2007). Geospatial Data Application in the Assessment of Population Impact on a Tropical Lowland Rainforest of Southwest Nigeria. *Geo Observateur* 16, 31-37.

Taye Jara, (2006). *Canopy gap regeneration and dynamics in the afromontane forest of Bale Mountains*. Unpublished Thesis. School of Graduate studies Addis Ababa University.

White, F. (1983). The vegetation of African: a descriptive memoir to accompany the UNESCO/AETFAT/UNSO vegetation map of Africa. Paris, France: UNESCO