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Inventory and Species diversity of trees on Farmlands

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Abstract: Combination of trees on farmlands is a common practice and these trees provide food, fuel wood, shade and other ecological services to farmers and the environment. This study on the inventory of trees occurring on farmlands was carried out in the Ikwerre Local Government Area of Rivers State, Nigeria with the aim of data capturing to improving conservation and sustainable management. Five out of the twelve towns in the area were randomly selected and four communities were purposely chosen from the selected towns based on their farming activities. Data inventoried include taxonomy information and tree growth variable measurements and estimations. A total of 101 trees from 18 families and 23 species were inventoried. Anacardiaceae and Fabaceae were the most frequently occurring families on farmlands with *Mangifera indica, Anthocleista vogelli, Pterocarpus santalinus, Ficus exasperate* and *Spondia mombin* the top five common species. Biodiversity indices (Margalef Richness and Shannon Index) was highest in Igwuruta community and lowest in Aluu community. *Mangifera indica* had the highest diameter at the base (160.01-180.00cm) and diameter at breast height (130.01-150.00cm), followed by *Milicia excelsa and Dacryodes edulis* which were classed in 120.01-140.00cm and 110.01-130.00cm for diameter at the base and breast height. *Gmelina arborea, Pentaclethra macrophylla* and *Mangifera indica* were amongst trees in the top class (9.01-12.00m) for crown diameter while highest tree height and volume was recorded in *Milicia excelsa*. The research still point out that farmlands in River State still hold significant amount of trees and could be prioritized if given attention as evidenced by the 101 tree species encountered coupled with the presence of highly valued economic and keylihood tree species.
[Eguakun F.S., Egubogo A.C., Anteyi O.A. **Inventory and Species diversity of Trees on Farmlands.** *Researcher* 2020;12(3):17-22]. ISSN 1553-9865 (print); ISSN 2163-8950 (online). http://www.sciencepub.net/researcher. 4. doi:10.7537/marsrsj120320.04.

Keywords: Farmlands, Biodiversity, Inventory, Species

1. Introduction

The alteration of tropical primary forests into various land use systems has serious impacts on distribution, community structure and population characteristics of flora and fauna (Schulze *et al*., 2004). As human population increases, there will also be a resulting increase in anthropogenic activities which in turns leads to the depletion of forest resources as they are converted to farmland or other land uses. Environmental degradation is a global concern and researchers have identified the role of trees as a strategy for environmental restoration. Tree resources outside forest can play a valuable role for enhancing sustainable development and people's livelihoods (Giri, 2004; FAO, 2002).

Growing trees in and around homesteads, and on farmland has long been associated in rural areas and hence, considered as integral components of rural livelihoods (Oli, 2002), these tree resources are considered as trees outside forest (GFRA, 2000). Trees on farmland are as a result of retaining residual trees from the natural forest, selection of valuable trees from natural regeneration and active planting of selected species at specific locations on the farm (Somarriba and Beer 2011; Somarriba, 2012; Pinoargote *et al*., 2016; Somarriba *et al*., 2016). Farmers have been observed to preserve trees during land clearing and cultivation as they provide means of meeting some needs such as food, medicines, agricultural materials and other non-tangible services. Trees on farm land offer farmers a regular flow of valuable goods (Cerda *et al*., 2014), provide soil cover and help to maintain soil fertility and crop productivity, diversify the production of goods (timber, fruits, etc.) and reduce the financial risk of the household, reduce vulnerability to contingencies (Ramirez *et al*., 2001), store carbon in wood, and provide other cultural and aesthetic benefits (Kuyah *et al*. 2016), regulate the hydrological cycle.

Trees on farms are widespread all over the world, but are generally not included in regular inventories of tree and forest resources (Perry *et al*., 2009; Sloan and Sayer, 2015). Inventory information on trees on farmland is essential in management and planning and for formulating sound strategies for forestry development (Rawat *et al*., 2003). According to FAO (2005), most tree on farms are not qualify as 'forest' because of either size or spatial limitations set out in many technical forest definitions and consequently they are not included in most national forest inventories (Kleinn 2000).

This study details inventory of trees on farmland in Ikwerre Local Government Area of Rivers State, Nigeria, in order to provide quantitative data on the tree species diversity and richness.

2. Material and Methods

The study was carried out in Ikwerre Local Government Area (LGA), Rivers State, Nigeria. Ikwerre LGA was created in 1991 with its headquarters in Isiokpo town. The land area is 530 sqmi (1,380km2) with the longitude of 6°53'3"E and latitude of 5°2'36"N. Its rainfall is generally seasonal, variable, as well as heavy and occurs between the month of March and October through November. The Ikwerre LGA is in the coastal sand ridges Zones. The soils are mostly sandy or sandy loams.

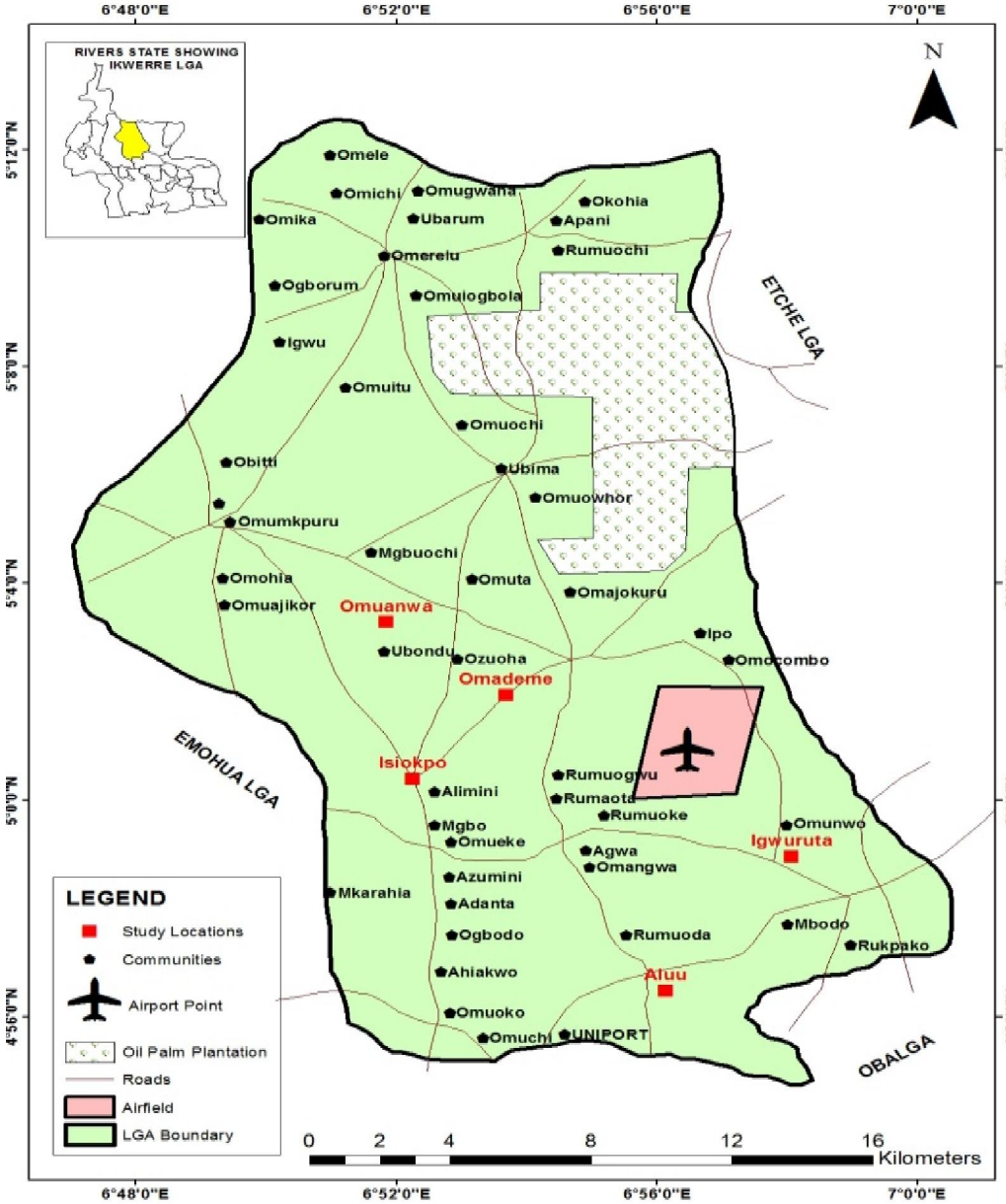

Figure 1. Map of Rivers state showing Ikwerre LGA and selected study locations

From the 12 towns in Ikwerre LGA, 5 towns (Aluu, Isiokpo, Igwuruta, Omuanwa and Omademe) were randomly selected, a total of 4 communities was purposely selected in each towns, that is, Aluu (Omuoko, Omuchiorlu, Omuike and Omuoda), Isiokpo (Mbuohara, Ogbodo, Okpirikpe and Ngbo), Igwuruta (Omueke, Omuohia, Omuchi and Alimini), Omuanwa (Omuchinwo, Omugbala, Omuagu and Omukwosi) and Omademe (Omuowhor, Omunkwo, Omuechem and Omunchala).

Tree variables measured include; total height, merchantable height, basal diameter, diameter at breast height, crown diameter and volume estimated using volume equation. For each town, diversity indices were determined using the following;

i. Shannon-Weiner index (H) according to Shannon and Wiener (1949),

$H = -\sum P_i \ln P_I$

Where $P_i = \frac{S}{N}$; S = number of individuals of a species and N = total number of all species in the town.

ii. Margalef species richness index, according to Margalef (1985);

Margalef's index = $\frac{(S-1)}{\ln N}$

Where S = total number of species, N = total number of individuals in the town.

iii. Relative Density (RD), is used to assess species relative distribution of the town using;

$RD = \left(\frac{ni}{N}\right) x\ 100$

Where n_i = the number of species and N = the total number of trees in the town.

3. Results

Table 1 shows the family, species and counts in the study towns. A total of 18 families 23 trees species and 101individual trees were encountered with most tree occurrence in Omuanwa (23) followed by Isiokpo (21), Igwuruta (20), Omademe (20) and Aluu (17). Three species belonged to the family Anacardiaceae, 2 species were recorded in Euphorbiaceae, Fabaceae and Moraceae while only one (1) species was represented in the other families. Igwuruta town was represented by twelve species followed by Omademe (11 species), Isiokpo and Omuanwa towns which had ten species each and Aluu (6 species). The result also shows that *Gmelina arborea, Spondia mombim, Mangifera indica* and *Anthocleista vogelli* had the highest frequencies in Aluu, Isiokpo, Igwuruta and Omuanwa respectively. *Mangifera indica* was the only species found to occur in all the towns studied and is the most abundant species with twelve trees followed by *Pterocarpus santalinus* (10), *Anthocleista vogelli* (10).

Table 1. Total count of trees within the study towns

Family	Scientific name	Overall	Aluu	Isiokpo	Igwuruta	Omuanwa	Omademe
		9	4	5	-	-	-
	Mangifera indica	12	1	1	5	3	2
	Anacardium occidentale	1	-	-	1	-	-
Apocynaceae	*Funtimia elastic*	4	-	1	-	1	2
Asparagaceae	*Dracaenia spp*	1	-	-	-	1	-
Bignoniaceae	*Newbouldia laevis*	4	-	1	2	-	1
Burseraceae	*Dacryodes edulis*	3	-	-	1	-	2
Comretaceae	*Terminalia catappa*	3	2	-	-	1	-
Euphorbiaceae	*Macaranga spp*	1	-	-	1	-	-
	Alchornea laxifolia	4	-	-	-	-	4
Fabaceae	*Pentaclethra macrophylla*	5	-	2	2	-	1
	Pterocarpus santalinus	10	-	1	-	5	4
Lamiacea	*Gmelina arborea*	8	7	-	1	-	-
Lauraceae	*Persea Americana*	4	-	-	-	3	1
Longaniaceae	*Anthocleista vogelli*	10	2	3	-	5	-
Malvaceae	*Ceiba pentandra*	1	-	-	1	-	-
Moraceae	*Ficus exasperate*	9	1	4	3	1	-
	Milicia excels	1	-	-	-	-	1
Myristicaceae	*Pycanthus angolensis*	2	-	-	-	1	1
Myrtaceae	*Psidium guajava*	1	-	-	-	-	1
Rubiaceae	*Nauclea latifolia*	1	-	-	1	-	-
Sapotaceae	*Chrysophyllum albidum*	5	-	2	1	2	-
Urticaceae	*Musanga cecropiodes*	2	-	1	1	-	-
Total (18)	**23**	**101**	**17**	**21**	**20**	**23**	**20**

Spondia mombin (9) and *Gmelina arborea* (8) ranking in the top five. Tree species on farmlands in Aluu town consists of *Gmelina arborea* (7) *Spondia mombin* (4), *Terminalia catappa* (2), *Anthocleista vogelli* (2), *Ficus exasperate* (1) and *Mangifera indica* (1). Species found in Isiokpo town were made up of *Spondia mombin* (5), *Ficus exasperate* (4) *Anthocleista vogelli* (3) *Pentaclethra macrophylla* (2) *Chrysophyllum albidum* (2), *Mangifera indica* (1), *Funtimia elastic* (1), *Musanga cecropiodes* (1) *Newbouldia leavis* (1) and *Pterocarpus santalinus* (1). In Igwuruta town species comprised *Mangifera indica* (5), *Ficus exasperate* (3), *Newbouldia laevis* and *Pentaclethra macrophylla* (2), *Dacryodes edulis*, *Macaranga spp.*, *Anacardim occidentale*, *Gmelina arborea*, *Ceiba pentandra*, *Nauclea latifolia*, *Chrysophyllum albidum* and *Musanga cecropiodes* (1). Species in Omauanwa town were *Pterocarpus santalinus* and *Anthocleista vogelli* (5), *Persea americana* (3), *Mangifera indica* and *Chrysophyllum albidum* (2), *Funtima elastic*, *Dracaenia spp.*, *Terminalia catappa*, *Ficus exasperate* and *Pycanthus angolensis* (1) while those at Omademe include *Alchornea laxifolia* and *Pterocarpus santalinus* (4), *Mangifera indica*, *Funtima elastic* and *Dacryodes edulis* (2), *Newbouldia laevis*, *Pentaclethra macrophylla*, *Persea americana*, *Milicia excelsa*, *Pycanthus angolensis* and *Psidium guajava* (1)

Among the towns, highest diversity (H^i) and species richness was seen in Igwuruta (2.29, 3.67) followed by Omademe (2.23, 3.33), Isiokpo (2.10, 2.95), Omuanwa (2.08, 2.87) and Aluu (1.54, 1.76). Highest species relative density was observed in Igwuruta (52.2), Omademe (47.8), Isiokpo and Omuanwa having same value at 43.5 and Aluu (26.1) (Table 2).

Table 2. Comparison of diversity indices (Species present, Shannon index, Margalef richness index and Relative density)

Diversity indices	**Overall**	**Aluu**	**Isiokpo**	**Igwuruta**	**Omuanwa**	**Omademe**
Total trees	101	17	21	20	23	20
Species present	23	6	10	12	10	11
Shannon, H^I	2.83	1.54	2.10	2.29	2.08	2.23
Margalef Richness Index	4.76	1.76	2.95	3.67	2.87	3.33
Species Distribution (Relative density)	100%	26.1%	43.5%	52.2%	43.5%	47.8%

Mangifera indica had the highest diameter at the base (160.01-180.00cm) and diameter at breast height (130.01-150.00cm), followed by *Milicia excelsa and Dacryodes edulis* which were classed in 120.01-140.00cm and 110.01-130.00cm for diameter at the base and breast height. *Gmelina arborea, Pentaclethra macrophylla* and *Mangifera indica* were amongst trees in the top class (9.01-12.00m) for crown diameter while highest tree height and volume was recorded in *Milicia excelsa*.

Table 3. Tree size distribution on farmland

Species	**DBH Class (cm)**	**Db Class (cm)**	**CD class (m)**	**TH Class (m)**	**MH Class (m)**	**Vol Class (m^3)**
Anacardium occidentale	20.01 - 30.00	20.01 - 40.00	0.01 - 3.00	0.01 - 20.00	0.01 - 10.00	0.01 - 10.00
Ceiba pentandra	20.01 - 30.00	20.01 - 40.00	0.01 - 3.00	0.01 - 20.00	0.01 - 10.00	0.01 - 10.00
Musanga cecropiodes	20.01 - 30.00	20.01 - 40.00	0.01 - 3.00	0.01 - 20.00	0.01 - 10.00	0.01 - 10.00
Funtimia elastic	20.01 - 30.00	20.01 - 40.00	3.01 - 6.00	0.01 - 20.00	0.01 - 10.00	0.01 - 10.00
Nauclea latifolia	20.01 - 30.00	40.01 - 60.00	3.01 - 6.00	0.01 - 20.00	0.01 - 10.00	0.01 - 10.00
Alchornea laxifolia	30.01 - 50.00	20.01 - 40.00	0.01 - 3.00	0.01 - 20.00	0.01 - 10.00	0.01 - 10.00
Chrysophyllum albidum	30.01 - 50.00	20.01 - 40.00	3.01 - 6.00	20.01 - 30.00	0.01 - 10.00	0.01 - 10.00
Macaranga spp	30.01 - 50.00	40.01 - 60.00	0.01 - 3.00	30.01 - 40.00	10.01 - 20.00	0.01 - 10.00
Spondia mombin	30.01 - 50.00	40.01 - 60.00	3.01 - 6.00	20.01 - 30.00	0.01 - 10.00	0.01 - 10.00
Terminalia catappa	30.01 - 50.00	40.01 - 60.00	3.01 - 6.00	0.01 - 20.00	0.01 - 10.00	0.01 - 10.00
Pterocarpus santalinus	30.01 - 50.00	40.01 - 60.00	3.01 - 6.00	20.01 - 30.00	10.01 - 20.00	0.01 - 10.00
Newbouldia laevis	30.01 - 50.00	40.01 - 60.00	3.01 - 6.00	20.01 - 30.00	10.01 - 20.00	0.01 - 10.00
Anthocleista vogelli	30.01 - 50.00	60.01 - 80.00	0.01 - 3.00	20.01 -	10.01 - 20.00	10.01 - 20.00

Species	DBH Class (cm)	Db Class (cm)	CD class (m)	TH Class (m)	MH Class (m)	Vol Class (m^3)
				30.00		
Ficus exasperate	30.01 - 50.00	60.01 - 80.00	3.01 - 6.00	20.01 - 30.00	0.01 - 10.00	0.01 - 10.00
Dracaenia spp	50.01 - 70.00	60.01 - 80.00	3.01 - 6.00	0.01 - 20.00	0.01 - 10.00	0.01 - 10.00
Gmelina arborea	50.01 - 70.00	60.01 - 80.00	9.01 - 12.00	40.01 - 50.00	30.01 - 40.00	10.01 - 20.00
Psidium guajava	50.01 - 70.00	60.01 - 80.00	3.01 - 6.00	20.01 - 30.00	10.01 - 20.00	0.01 - 10.00
Pycanthus angolensis	50.01 - 70.00	60.01 - 80.00	6.01 - 9.00	30.01 - 40.00	0.01 - 10.00	0.01 - 10.00
Persea Americana	50.01 - 70.00	80.01 - 100.00	6.01 - 9.00	20.01 - 30.00	0.01 - 10.00	10.01 - 20.00
Pentaclethra macrophylla	90.01 - 110.00	120.01 - 140.00	9.01 - 12.00	30.01 - 40.00	10.01 - 20.00	40.01 - 50.00
Dacryodes edulis	110.01 - 130.00	120.01 - 140.00	6.01 - 9.00	40.01 - 50.00	20.01 - 30.00	40.01 - 50.00
Milicia excelsa	110.01 - 130.00	120.01 - 140.00	3.01 - 6.00	50.01 - 60.00	20.01 - 30.00	70.0 1- 80.00
Mangifera indica	130.01 - 150.00	160.01 - 180.00	9.01 - 12.00	30.01 - 40.00	10.01 - 20.00	60.01 - 70.00

4. Discussions

Trees are indispensable part of the agricultural systems. When local communities clear land for farming, they leave a wide selection of tree species on farmland (Ajake, 2012). The results of this study revealed that the farmlands consist of different tree species in different families. This is evidenced by the 101 tree species distributed among 18 families and 23 species in the farmland. The presence of *M. indica* in all the communities showed that farmer are interested in retaining or planting fruit trees on their farmlands. Oke and Odebiyi (2007) also observed the presence of fruit trees on farmland in their study. Generally, tree species found on the farmland are in agreement with tree species found on other farms literature (Saska *et al*., 2019; Adebayo & Oluronke, 2014).

Removal of trees from landscapes has for long been seen as a sign of intensification and progress in agriculture (Zomer, 2014). This could be the reason for low tree abundance in the total farmlands visited during the study. The highest diversity index recorded in Igwuruta and the highest abundance recorded in Omuawa could be attributed to the relative undeveloped nature of the place compared to the other communities. As development approaches, tree diversity and abundance must suffer a huge decline. Wide individual distribution of few tree species lowers biodiversity of an area (Kharal and Oli, 2008). This is evidenced in this study as Omuanwa community despite having the highest tree abundance (23) recorded a lower biodiversity index 2.08 and 2.87 for Shannon and Margelef richness index respectively as compared to Igwuruta (2.29, 3.67) and Omademe (2.23, 3.33) which has relatively lower tree abundance 20 each.

Diameter at breast height and tree height are biometric parameters that often times predict the nature and state of a forest stand. Throughout the study different diameter and tree classes were recorded which is an indication of an uneven aged forest. Collectively, the entire study areas harbor trees of different ages.

The alteration of tropical primary forests into various land use systems has serious impacts on distribution, community structure and population characteristics of flora and fauna. Most notable among the various land use system affecting tree distribution is agriculture. Inclusion of trees on farmland has always been a part of farmers but ever since the inception of technological development, these trees are now ignored in farming systems. Farmlands in River State still hold significant amount of trees and could be prioritized if given attention as evidenced by the 101 tree species encountered coupled with the presence of highly valued economic and keylihood tree species.

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References

1. Adedayo, A. G., & Oluronke, S. (2014). Farmers' perception and adoption of agroforestry practices in Osun State, Nigeria. *Forest Res*, *3*(127), 2.
2. Ajake, A. O. (2012). The role of forest trees in indigenous farming systems as a catalyst for forest resources management in the rural villages of Cross River State, Nigeria. *Global Journal of Human Social Sciences, Geography and Environmental Geosciences*, *12*(13), 13-24.
3. Cerda, R., Deheuvels, O., Calvache, D., Niehaus, L., Saenz, Y., Kent, J.,... & Somarriba, E. (2014). Contribution of cocoa agroforestry systems to family income and domestic consumption: looking toward intensification. *Agroforestry systems*, *88*(6), 957-981.
4. FAO. 2002. Trees Outside Forests A Key Factor in Integrated Urban and Rural Management. http://www.fao.org/tempref/docrep/fao/005/y2328e/Y2328E01.pdf Accessed on 9th March, 2020.
5. GFRA. 2000. The Global Forest Resources Assessment 2000-Main Report. FAO Forestry Paper.
6. http://www.fao.org/3/Y1997E/Y1997E00.htm Accessed on: 8th March 2020.
7. Giri, N. (2004). Assessment of tree resources outside forests: a lesson from Tanzania. *Banko Janakari*, *14*(2), 46-52.
8. Kharal, D. K. and Oli, B. N. 2008. An estimation of tree species diversity in rural farmland of Nepal. Banko Janakari 18 (1): 3–10.
9. Kleinn, C. (2000). On large-area inventory and assessment of trees outside forests. *UNASYLVA-FAO-*, 3-10. http://www.fao.org/tempref/docrep/fao/X3989E/x3989e02.pdf.
10. Kuyah, S., Öborn, I., Jonsson, M., Dahlin, A. S., Barrios, E., Muthuri, C.,... & Nyberg, Y. (2016). Trees in agricultural landscapes enhance provision of ecosystem services in Sub-Saharan Africa. *International Journal of Biodiversity Science, Ecosystem Services & Management*, *12*(4), 255-273.
11. Oke, D. O., & Odebiyi, K. A. (2007). Traditional cocoa-based agroforestry and forest species conservation in Ondo State, Nigeria. *Agriculture, Ecosystems & Environment*, *122*(3), 305-311.
12. Oli, B. N. (2002). Trees outside forests: an ignored dimension of forest resource assessment. *Banko Janakari*, *12*(1), 79-81.
13. Perry, C. H., Woodall, C. W., Liknes, G. C., & Schoeneberger, M. M. (2009). Filling the gap: improving estimates of working tree resources in agricultural landscapes. *Agroforestry Systems*, *75*(1), 91-101.
14. Ramirez O, Somarriba E, Ludewigs T, and Ferreira, P (2001) Financial returns, stability and risk of cacao-plantain-timber agroforestry systems in Central America. *Agrofor Syst* 51(2):141–154.
15. Rawat, J., Dasgupat, S., Kumar, R., Kumar, A. and Chauhan, K., (2003), Training Manual on Inventory of Trees Outside Forest (TOF), FAO Regional Office for Asia and the Pacific, Bangkok.
16. Schulze, C. H., Waltert, M., Kessler, P. J., Pitopang, R., Veddeler, D., Mühlenberg, M.,... & Tscharntke, T. (2004). Biodiversity indicator groups of tropical land‐use systems: comparing plants, birds, and insects. *Ecological applications*, *14*(5), 1321-1333.
17. Sloan, S., & Sayer, J. A. (2015). Forest Resources Assessment of 2015 shows positive global trends but forest loss and degradation persist in poor tropical countries. *Forest Ecology and Management*, *352*, 134-145.
18. Somarriba, E. (2012). The population dynamics and productivity of Acacia pennatula in the pasturelands of the Nature Reserve Mesas de Moropotente, Estelí, Nicaragua. *Agroforestry systems*, *84*(1), 1-9.
19. Somarriba, E., & Beer, J. (2011). Productivity of Theobroma cacao agroforestry systems with timber or legume service shade trees. *Agroforestry systems*, *81*(2), 109-121.
20. Somarriba, E., Sepúlveda, N., Ayerdis, JR, & Cornelius, J. (2016). Fruit trees and timber in patios and farms in the area of Los Pueblos, Nicaragua.
21. Zomer, R. J., Trabucco, A., Coe, R., Place, F., Van Noordwijk, M., & Xu, J. C. (2014). Trees on farms: an update and reanalysis of agroforestry's global extent and socio-ecological characteristics. *World Agroforestry Center Working Paper*, *179*.

3/12/2020