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ASSESSMENT OF TREES PERFORMANCE UNDER COMMUNITY FORESTRY MANAGEMENT DURING WORLD BANK ASSISTED FORESTRY II PROJECT IN KANO STATE, NIGERIA.

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Abstract
An assessment of trees performance under community tree management during World Bank assisted Afforestation project was carried out in Kano State. The project promoted two major species of trees among the participating mainly (Eucalyptus camaldulensis and Azadirachta indica) for various environmental protection purposes, such as windbreaks, stabilization of the sand dune, supply of fuelwood and other forest products. The performance was assessed on the basis of the trees growth pattern in relation to the farmers spacing management. Information on average tree heights, diameter at breast height (Dbh) and tree volume (m^3) of Eucalyptus camaldulensis and Azadirachta indica over the period of four years planting dates were obtained at the seven Local Government Areas in Kano State. The result obtained from the trees of Eucalyptus camaldulensis and Azadirachta indica planted from 1992 – 1995 at spacing intervals of 3m x 3m, below 3 x 3m and above 3m x 3m mean revealed a mean height of 6.70m, 5.60m and 6.50m with Dbh of 0.41m, 0.30m and 0.58m and the wood volume of 0.00083 m^3, 0.00030 m^3, and 0.00064 m^3 respectively the test for significant difference at 0.05 probability level revealed a significant difference between the treatments in terms of trees height and Dbh having the 3m x 3m spacing taken the lead followed by above 3m x 3m while below 3m x 3m spacing recorded the least performance in all the variables investigated. However the mean wood volume of the trees was not significant at 0.05% level under all the treatments indicating no much difference in wood volume formation irrespective of the tree spacing use over the periods

Keywords: Plantation management, Tree performance and Tree volume.

Introduction
The increase in the demand for various forest products, such as fuel wood and fruits, among inhabitants of many parts of sub-Saharan Africa and Asia had prompted many development partners to encourage people to engage in tree planting. The story is the same during the World Bank Forestry II project in Kano State, Nigeria, in which farmers and other community members were mobilized to participate in social forestry programme (IBRD, 1987). The effort was meant not only to provide fuelwood to the teeming populace in the area, but also to halt the menace of desertification. Through this effort, Kano State government has mounted formidable campaigns to encourage the populace to invest in private orchards and woodlot plantations under Kano State Afforestation Project and many people responded positively to the call for rapidly growing exotic species such as *Eucalyptus camaldulensis and Azadirachta indica* to be planted in their farms (KNAP, 1996).

Research Problem
Farmers were encouraged to plant trees for various environmental purposes in form of boundary planting, wood lots, orchards and avenue planting purposes. In the course of doing that some farmers failed to adhere to the standard of tree spacing leading to poor growth performance of the tree. Quest for forest products had prompted many farmers from compromise with the tree spacing standard as such it become detriment to the overall tree growth performance. Lack of proper evaluation and documentation of the tree performance at various stages of their development was observed to hinder a clear record of the success or otherwise of tree performance in the field. Trees and their products remain potential tools for income generation to the resource poor farmers in addition to stabilizing soil condition. The findings on the tree performance in the field through community efforts will greatly help in assessing how best farmers were able to manage their trees in the field for sustainable tree production. It will also assist in exploring available planting and harvesting techniques adopted by the farmers in the study area which were hitherto neglected or unknown despite its benefits. Proper tree management strategy will greatly improve the vegetation cover of the area and at the same time provide additional basic forest products required among the members of the community.

Eucalyptus is among the most widely cultivated forest tree in the world (over 22 million hectres) and Brazil is the major Eucalyptus grower in the world while south Africa is the first country in Africa with over half a million hectres. Growing Eucalyptus trees had tremendously provide wide range forest products for construction work, fuelwood, poles, fencing post etc. Eucalyptus plantations had contributed significantly to reducing the wide gap between demand and production of wood in shortest possible time (Chandra, 1986). On the other hand *Azadirachta indica* which is medium size tree is of equal value and importance with *Eucalyptus camaldulensis* can grow and attain a height of 15m to 30m and its economic qualities can be reach after 10 -12 years . It can provide a wide range of products such as food from fruits, fodder from the leaves, fuel wood, timber, gum resin as well as tanning dye stuff (Orwa et al, 2009).

As a result of the importance of *Eucalyptus camaldulensis* observe globally for its multiple usages, attention is nowadays been given towards increasing local community participation towards planting of the specie and possible rehabilitation of degraded plantation.. The effort was considered as an innovative response for meeting the conflicting goals of livelihood improvement and sustainable forest management among the local populace (Ministry for land and forestry Ghana, 1994; Chamshama and Nduwayezu, 2003; Castre'n 2005).

Rehabilitation activities based in the Community have often included the promotion of *Azadirachta indica* and *Eucalyptus camaldulensis* (Evans, 1992; Siaw, 2001; Yirdaw, 2002). The introduction of sustainable farming systems where trees are grown together with crops in order to reduce pressure on forest and avoid further degradation of forest was one of the approaches towards increasing tree density through community efforts (Prah, 1997; Appiah, 2001, 2003; Franzel *et al*, 2002). Therefore, there is the need to do everything possible to ensure that the natural resources in the region are manage sustainably in order to prevent the land from further degradation. In view of that seeking information on tree performance under different community forestry management efforts is paramount which will further brings understanding of the appropriate techniques of tree management such as spacing to be adopted in future most especially by the local farmers .

Study Area

Kano State has a total land area of 20,417 Km^2 approximately 4.7% of the total land area of Nigeria. The State is located centrally on the northern border of Nigeria and lying between latitude 10^0 30"N and 12^0 35' and longitude 7^0 44' E and 9^0 20'E and also has an altitude of 400 - 750m above sea level. The State has a population of 9,401,288 (NPC, 2006; Leadership, 2009). However, the research was purposively restricted to seven (7) Local Government Areas where project contact farmers were identified from the project records. The local governments are as follows: Bagwai, Bichi, Danbatta, Dawakin Tofa, Tsanyawa, Gabasawa and Minjibir (Fig. 1)

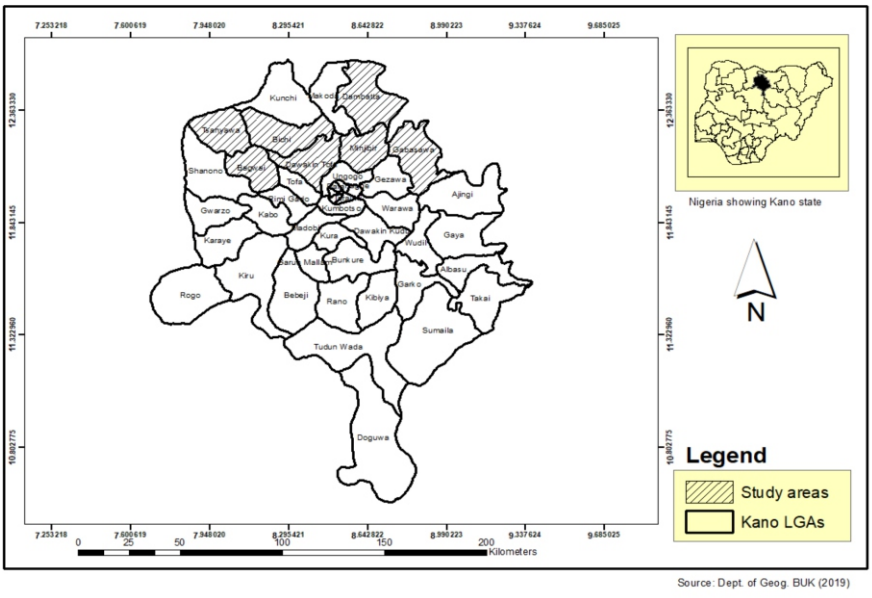

Fig 1: Map of Kano state showing the study area
Source: Cartography unit Geography Department Bayero University Kano.

Research Methods and Tools

The research was carried out using qualitative and quantitative methods of data collection. The major reasons for combining qualitative and quantitative methods are to overcome the issue of limitation of using single approach to data collection and also to make the result obtained acceptable. Reconnaissance survey was initially carried out in order to identify the members of the communities involved in various afforestation activities such as orchard and woodlots development. However this research was restricted mainly to assessment of the tree performance i.e. *Eucalyptus* and *Azadirachta* species planted under various spacing arrangement. The tree heights, diameter at breast height (Dbh) and tree volume estimates were obtained. Data were subjected to some statistical analyses such as Analysis of variance (ANOVA) frequency count, percentage and other descriptive statistic. A totals of twenty eighty (28) farmers were identified using purposive random sampling using four (4) farmers from each location for this study area. Information obtained was subjected to descriptive statistic and the results were presented in form of graphs, charts and tables.

Result and Discussion

Growth Performance.

Height (m) of *Eucalyptus camaldulensis*:

The study revealed that *Eucalyptus camaldulensis* planted at 3m x 3m (Fig 1) perform better in terms of average mean height with a record of 6.7m compared to 5.6m recorded on trees planted below 3m x 3m spacing which indicated the negative effect of low spacing due to competition between the trees. Under normal circumstances Eucalyptus specie can increase in height from 0.27m to 0.55m annually indicating an appreciable performance among the trees under community management as shown by the above findings. Therefore the average tree performance recorded on trees planted above 3m x 3m proves to be more advantageous compared to the values obtained on trees planted below 3m x 3m spacing. The performances recorded at 3m x 3m signify good tree management among the farmers in the study area. The efforts must be encouraged among the farmers for sustainable tree growing and possible good tree performance as indicated in (Table 1). In general the performance on the mean height of *Eucalyptus camaldulensis* in the study area revealed a significant difference at .050% significant level among the treatments, while (Table 7 and 8) revealed that the tree performance in relation to wood volume is not significant between all the treatments.

Table 1: *Eucalyptus camaldulensis* mean Height (m) performance

Parametres	Spacing/Years	1992	1993	1994	1995	Average
Height	3m x 3m	7.1	6.9	6.5	6.3	6.7
	Below 3m x3m	5.9	5.8	5.6	5.2	5.6
	Above 3m x 3m	6.9	6.6	6.3	6	6.5

Diametre at Breast Height (Dbh) (m) **of *Eucalyptus camaldulensi***

The diametre at breast height of (Dbh) *Eucalyptus camaldulensis* revealed a remarkable improvement on the performance of the trees planted above 3m x 3m spacing. The spacing arrangement conform with the recommended spacing of *Eucalyptus camaldulensis* as such it enable proper physiological activities of the tree such as sunlight intake and proper nutrients intake. Adequate photosynthetic activities witnessed among the trees planted at recommended spacing and a little bit above 3m x 3m had resulted in providing appreciable increase in tree growth parameters investigated such as height and stem diametre increase through accumulation of photosynthetic materials. The average mean values of 0.58 m^3 recorded on trees planted above 3m x 3m had attested that while the lower performance was witnessed among the trees planted below 3m x 3m spacing due to overcrowding of tree leading to competition for sunlight and other growth parameters requirements. Farmers should therefore be encourage to accept the practice of planting within the recommended spacing for better tree performance as suggested in (Table 2). The test for significant differences among the variables investigated revealed a significant difference at 0.05% level (Table 7 and 8) indicated advantage of planting within the recommended spacing most especially between the DBH of *Azadirachta indica* and *Eucalyptus camaldulensis* planted under various treatment as indicated on the table which signify better performance on the mean diametre.

Table 2: *Eucalyptus camaldulensis* mean Diametre at Breast Height (m) (DBH)

Parametres	Spacing/Years	1992	1993	1994	1995	Average
Dbh	3m x 3m	0.43	0.45	0.41	0.36	0.41
	Below 3m x3m	0.35	0.33	0.31	0.22	0.30
	Above 3m x 3m	0.69	0.67	0.65	0.34	0.58

Wood volume (m^3) of *Eucalyptus camaldulensis*

The performance on Eucalyptus wood volume revealed a remarkable improvement on trees planted at 3m x 3m spacing however no significant difference between the treatments at 0.05% level. The average mean wood volume of 0.00083m^3 was recorded on trees planted at 3m x 3m spacing while the lower performance of 0.00030 m^3 was witnessed among the trees planted below 3m x 3m spacing which was believe to be due to overcrowding of the neighboring trees. Farmers should therefore be encourage to accept the practice of planting within the recommended spacing for better tree performance as suggested in (Table 3) that will provide better yield. The mean values revealed no statistically significant difference at 0.05% level (Table 7 and 8) on wood volumes recorded among the species.

Table 3: *Eucalyptus camaldulensis* mean Wood Volume (m^3)

Parametres	**Spacing/Years**	**1992**	**1993**	**1994**	**1995**	**Average**
Wood Volume	3m x 3m	0.00092	0.0009	0.00064	0.00086	0.00083
	Below 3m x3m	0.00035	0.00034	0.0002	0.00031	0.00030
	Above 3m x 3m	0.00069	0.00066	0.00057	0.00065	0.00064

Average Height of *Azadirachta indica* (m)

The performance of *Azadirachta indica* was recorded and discovered that trees planted at 3m x 3m spacing possessed higher mean values of 6.95m against the lowest performance recorded among the trees planted below 3m x 3m (Table 4). The performance recorded followed a similar trend witnessed on other species such as *Eucalyptus camaldulensis*. The mean height of Azadirachta indica at 3 x 3m spacing revealed a significant difference at 0.05% level (Table 7 and 8) indicating higher performance on the spacing adopted.

Table 4: *Azadirachta indica* mean Height (m)

Parametres	**Spacing/Years**	**1992**	**1993**	**1994**	**1995**	**Average**
Height	3m x 3m	7.5	7.2	6.8	6.3	6.95
	Below 3m x3m	7	6.9	6.3	6	6.55
	Above 3m x 3m	7.8	6.9	6.3	6	6.74

Average Diametre at breast height of *Azadirachta indica* (m)

The performance of *Azadirachta indica* on diametre at breast height (m) was recorded in which trees planted at 3m x 3m spacing possessed a higher mean value of 0.71m over the years while the lowest Dbh of 0.60m was recorded on the spacing below 3m x 3m indicating low performance by the spacing arrangement as such farmers will be encourage to strictly adhere to the planting on the appropriate recommended spacing of 3m x 3m for better result as shown by (Table 5). However despite recording higher performance on the mean values at 3m x 3m arrangement the findings revealed a significant difference at 0.05% level between all the treatments (Table 7 and 8).

(Table 5: *Azadirachta indica* mean Diametre at Breast Height (m) (DBH)

Parametres	Spacing/Years	1992	1993	1994	1995	Average
Dbh	3m x 3m	0.8	0.72	0.69	0.61	0.71
	Below 3m x3m	0.68	0.65	0.58	0.48	0.60
	Above 3m x 3m	0.82	0.7	0.65	0.6	0.69

Average Wood volume of *Azadirachta indica* (m)
The tree performance in wood volume revealed that *Eucalyptus camaldulensis* planted below 3m x 3m spacing performed better with higher mean value of 0.000337m while the lowest performance of 0.000264m was recorded on the trees planted above 3m x 3m (Table 6). However despite having higher mean values most especially on the trees planted below 3m x 3m arrangement the results revealed no statistically significant difference at 0.05% level in terms of wood volume obtained among the treatments indicating no difference on the average total mean wood volume obtained (Table 7 and 8).

Table 6: *Azadirachta indica* mean Wood Volume (m^3)

Parametres	Spacing/Years	1992	1993	1994	1995	Average
Wood Volume	3m x 3m	0.000377	0.000293	0.000254	0.000184	0.000277
	Below 3m x3m	0.000203	0.000169	0.000106	0.00087	0.000337
	Above 3m x 3m	0.000412	0.000266	0.000209	0.000169	0.000264

Table 7: Dependant variables indicating interaction between tree species

		Estimates			
				Lower Bound	Upper Bound
Height (m)	E. camaldulensis	6.270	.054	6.163	6.377
	A. indica	6.774	.054	6.667	6.881
Dbh (m)	E. camaldulensis	.437	.010	.418	.456
	A. indica	.666	.010	.647	.685
Wood volume (m3)	E. camaldulensis	.001	.000	.001	.001
	A. indica	.000	.000	.000	.000

Table 8: Pairwise Comparisons indicating mean difference among the variables

Dependent Variable			Mean Difference (I-J)	Std. Error	Significant (p < 0.05)
Height (m)	E. camaldulensis	A. indica	-.504*	.077	.000
	A. indica	E. camaldulensis	.504	.077	.000
Dbh (m)	E. camaldulensis	A. indica	-.229*	.014	.000
	A. indica	E. camaldulensis	.229	.014	.000
Wood volume (m3)	E. camaldulensis	A. indica	.000	.000	.000
	A. indica	E. camaldulensis	.000*	.000	.000

The mean difference is significant (p< .05).

Conclusion

The mean values on the trees height and Dbh among the species of *Eucalyptus camaldulensis* and *Azadirachta indica* revealed statistically significant at 0.05% level, while the mean wood volume obtained was not statistically significant among the treatments investigated indicating that planting within or outside the recommended spacing of 3m x 3m does not statistically favours the mean values of the two species investigated. However the trees planted above the recommended spacing perform better in terms of mean wood volume despite the fact that the number of tree stands obtained is reduce per unit area which in turn physically reduced the quantity and volume of wood. In view of that future afforestation project with social forestry components in it need to adequately intensify public enlightenment campaign to the general public on the need for compliance with the recommended planting techniques such as spacing for optimum production. Farmers should be carried along in project design in order to obtain proper techniques of trees management. Farmers should be encourage be raising their seedlings rather than depending on government to supply most of the seedlings requires most especially for woodlots and orchard development.

Recommendations

1. There is the need for government and future social forestry projects to adequately sensitize the members of the public on the importance of tree planting and the expected socio economic benefits.
2. Government should involve farmers in the decision making on the choice of tree species to be promoted in their locality for general acceptance of the programme.
3. Farmers with challenges in land acquisition should be assisted with a piece of land for tree planting activities.
4. Government should encourage farmers to actively participate in seedling production of various tree species by supporting them with inputs for protection, water supply, labor support and pest control management at the initial stage of the project.

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