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ASSESSMENT OF TREE SPECIES USED AS SHELTERBELT IN THE SEMI-ARID PART OF YOBE STATE, NIGERIA

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Abstract

This study examines the type of tree species used in the establishment of shelterbelts in the semi-arid parts of Yobe State, northeastern Nigeria. The study uses both primary and secondary sources of data in order to ascertain the success of the species used in shelterbelts establishment in the zones. The study shows that Azadirachta indica is the most frequently used species and the most successful in the area. Others with relative importance are Acacia spp and Eucalyptus camaldulensis. Their success and preference are because of their xerophytic characteristics which enable them to survive long dry seasons. It also reveals that the farmers prefer indigenous economic trees like Acacia nilotica, Hyphaene thebaica and Balanites aegyptiaca because of economic and social benefits derived from the trees. Therefore the study recommends that Government should encourage the involvement of local people in the planning and management of shelterbelt programmes and generally afforestation projects in arid zones.

Keywords: shelterbelts, silvicultural practices, tree species, arid environment, afforestation, Yobe state

Introduction

The arid and semi-arid zones have short rainy season which limits the ability of plants to grow. However, the short rainy season can be exploited by growing and nurturing adaptable varieties of tree species in the form of afforestation. Afforestation is the intentional planting of trees where it has not existed before or where original tree cover had been removed. Studies have shown that without careful nurturing and support for trees, it is almost impracticable to restore vegetation cover in most tropical arid lands (Gadiga, 2012). These are typically as the result of short growing seasons and high uncontrollable level of overgrazing. In the event of natural regeneration of plants in the area, the frequent removal by grazing animals makes the plants short-lived.

Drought and desertification are major environmental challenges of the arid and semi-arid regions of the world. Studies in the arid zones south of the Sahara revealed that desertification is spreading and the Sahara Desert may be expanding southward at a rate of about 0.6 kilometer per year (UNEP, 2008). This is bound to have negative effects on food security as rain fed agricultural yields was predicted to drop by 50 percent in some places due

to climate change (Boko, 2007). In the Sahel, the impact of climate variability on agricultural activities is evident as current high temperature and reduced rainfall regimes make it difficult for local communities to continue the cultivation of traditional varieties of crop (UNDP, 2009). The ecological problems that affect the Arid and semi arid environments are diverse especially the ones caused by desertification. This has resulted in deterioration of socio-economic wellbeing of people dwelling in the area. Mitigating the ecological problems will go a long way in ameliorating these problems. Shelterbelts are known to improve the micro climate of an area thereby contributing to restoration of the vegetation in arid environment (Gadiga and Adesina 2015). The lee side of the shelterbelt is protected from the desiccating winds of the desert to a distance of up to about 10-15 times the height of the belt. This sheltered area provides a 'safe site' for natural restoration of vegetation because of the increase in organic matter and soil moisture which are major limiting factors of arid environment (Gadiga and Adesina 2015; Gadiga and Dan, 2015).

Shelterbelts have enormous benefits on both ecology and the society. Apart from improving the soil condition at the safe site, they also increase the biodiversity of the area where they are sited. They further provide linkages to fragmented habitats known as wildlife corridors. Socially, shelterbelts can provide food security by improving the ecological condition upon which agricultural production depends. This will also reduce number of environmental refugees as a result of degradation and food insecurity. Studies carried out by Onyewotu et al., (1998) and Gajja *et al*., (2008) revealed an increase in agricultural output due to the influence of shelterbelts.

Shelterbelts are rows of trees planted perpendicular to the direction of the prevailing winds. They are planted mainly in the arid and semi arid environments in order to protect the area from activities of wind. Some of the activities of wind in the drylands include; sand dune movement, sand storm, soil erosion and desiccation of soil and vegetation. A lot of efforts are required in order to establish a plantation in arid zones this is because of the huge resources needed in order to achieve success. The high rate of failure of many afforestation projects in arid environment is due to poor knowledge of the area and the functioning of the selected tree species used in the project. The attitude of using any type of tree species without proper study of its adaptability to the arid environment has resulted in massive failure in some sites. Apart from adaptability of species to the environment, local farmers' preferences are also important in species selection. Igagu and Osemeobo (1990) observed that the use of pure stands of either *Azadirachta indica* or *Eucalyptus camaldulensis* in shelterbelt establishment tend to reduce the short-term economic benefits to the farmers. Therefore a mixed stand of shelterbelt is a better option for local participation. This is because farmers prefer local species of which their uses are familiar to them than the exotic species. In selecting tree species for shelterbelt project in arid zones, care

must be taken to ensure that the selected species are drought resistant, fast growing and are acceptable by the local farmers. For shelterbelts to be able to succeed in the arid and semi-arid zones, proper species selection is one of the major requirements. Therefore this study intends to assess the types of tree species used in shelterbelt programmes in the arid and semi-arid zones of Yobe State.

The study Area

This study is conducted in the arid part of Yobe State where shelterbelts were established to protect the land against desertification and to improve the living standard of those living in the area. The shelterbelts selected were those established by the federal government of Nigeria under the Nigeria Second Forestry Development Project (Forestry II Project) which took-off in 1987 with the plan of establishing 11,700 km of shelterbelts (Omiyale, 2006). In order to achieve the objectives of establishing the belts, government has expended huge resources in the State to check the menace of desert encroachment in the area.

The two shelterbelts that were considered for this study are located in Machina and Karasuwa Local Government Areas of Yobe State. The area lies between latitude 12^0 52' 26''N and 13^0 01'52'' N, and longitude 10^0 12'17'' E and 10^0 53'45'' E (Figure 1). It is a part of the Sahelian region of Nigeria where desertification is threatening the ecology and livelihood of the inhabitants of the area (UNESCO, 2000; UNDP, 2009; Orounye, 2009).

Yobe State is bordered to the North by Niger republic to the East by Borno State, to the West by Jigawa and Bauchi States and to the South by Gombe and Borno States. It has a land area of 47,153 sq.km and a population of 2.7 million based on 2006 National Census. Yobe State like other parts of the Sahel savanna has clearly defined wet and dry season largely determined by the properties and movement of the Inter-tropical Convergence Zone (ITCZ). Much of the climatic condition of the State is that of general northern Nigeria's climate.

Agriculture is the principal occupation of the inhabitants and the dominant crops grown in the area varies depending on climate and soil conditions. Wherever aeolian sediments cover extensive areas, millet, cowpea and groundnuts are the dominant rainfed crops. However, where the soils are formed by alluvial sediments, which retain more water than the aeolian sediments, crops such as maize, rice and sorghum are grown. During the dry season, crops such as tomatoes, onions, and wheat are grown under irrigation. The northern part of the state is faced with the challenge of water scarcity for agriculture and domestic use (Gadiga, 2012).

Methodology

Questionnaires, interviews and Group Discussion methods were used in assessing the types of species used for shelterbelt establishment in the study area. A semi structured questionnaire was administered to forty (40) senior forestry staff of the Federal and State Departments of Forestry

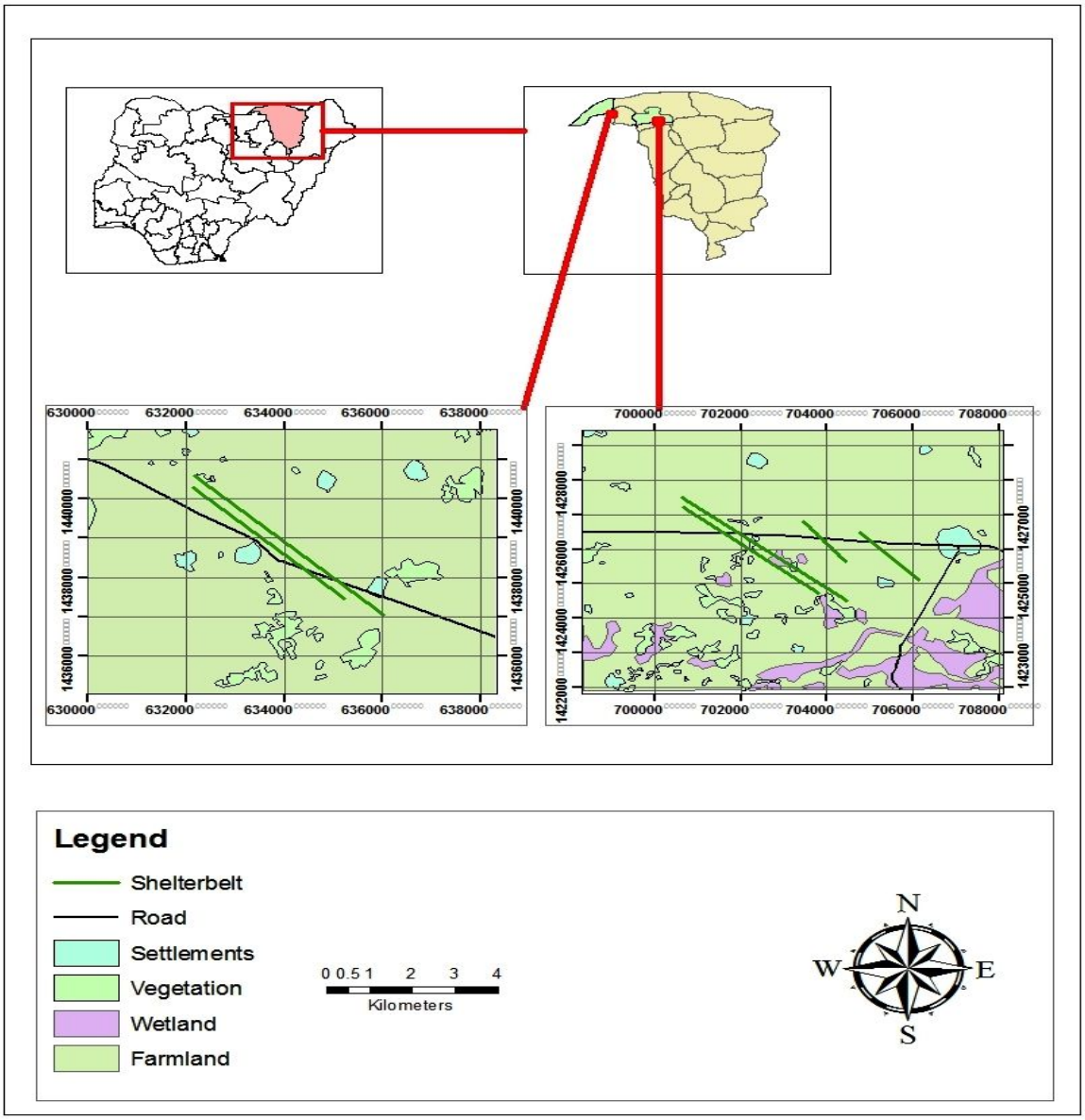

Figure 1: The Study Area (source: Gadiga, 2012)

The respondents were purposively selected based on rank and length in service. Two Focus Group Discussions were conducted in villages located close to the selected shelterbelts sites. The villages are Garanda in Machina L. G. A and Gargada in Karasuwa L. G. A. of Yobe State.

Data Analysis

Descriptive statistical methods were used in characterizing the data collected from questionnaires. Attitudinal scale was used to analyze the intensity of foresters' attitudes towards the types of species used. This is because the technique provides combine attitudes towards different aspects into one overall indicator (Kumar,

2005). The analysis of data collected during focus group discussions was also used to unearth some salient issues that are important in the management of shelterbelts in the area.

From both the questionnaire and FGD responses, the following were analyzed; type of tree species used in shelterbelt projects, successful tree species and most preferred tree species.

Results and Discussions

4.1 Tree Species used in Shelterbelt projects in Yobe State

Species selection is an important silvicultural practice in any arid and semi-arid region. Figure 2 shows the responses of respondents on the frequency of tree species used in shelterbelt projects in the region. Attitudinal scale was used in this study to measures the intensity of respondents' attitudes towards the used of the various tree species. This technique according to Kumar, (2005) provides combine attitudes towards different aspects of issues into one overall indicator. The result from the study revealed that *Azadirachta indica* is the most commonly used species in shelterbelt projects as indicated on the attitudinal scale with total responses of 141. Followed by *Eucalyptus camaldulensis* (118), *Acacia senegal* (116), *Acacia nilotica* (109), *Prosopis juliflora* (87), *Cassia siamea* (86), *Khaya senegalensis* (76), *Acacia seyel* (64), *Parkinsonia aculeate* (61), *Delbergia sisso* (53) and the least used *Faidherbia albida* (48) respectively.

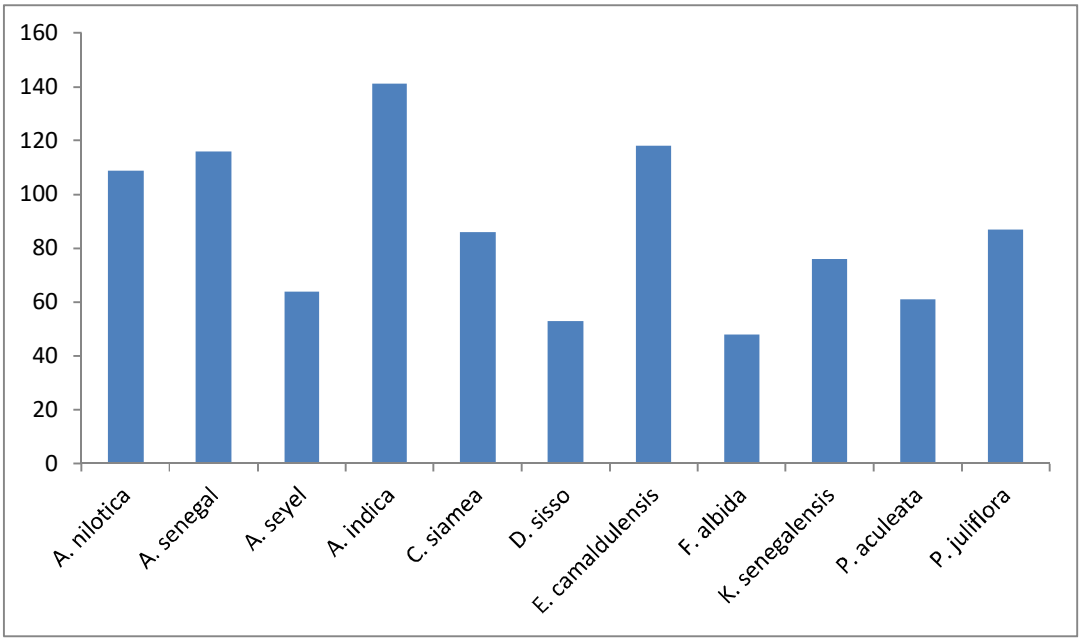

Figure 2: Frequency of tree species used in shelterbelt projects (Source: Fieldwork)

The field observation also confirmed *Azadirachta indica* as the tree species that is frequently used in the establishment of shelterbelts in the study area followed by

the *Acacia* family (Senegal, nilotica and seyel). *Eucalyptus spp.* was sparingly observed at Jajimaji shelterbelts where there is evidence of inundation because of the harsh environmental conditions of the location of the sites, which is above 12^0 $00^/$ N of the equator in the northern part of the State. *Eucalyptus spp* may require a lot of efforts in terms of water requirement at the early stage of establishment that is why in selecting site for its establishment areas that have high soil moisture levels should be preferred. Another tree species that was used in one of the shelterbelt sites but with little success is *Prosopis juliflora*.

Tree planting programmes require clearly stated objectives before planting commences with all economic, ecological, staff and time-frame carefully analysed and documented. This will then guide the choice of species to be planted. Species selection is therefore an important step in establishing any type of plantation in the arid zone (Boland, 1986; Otegbeye and Ogigirigi, 1987). This is as a result of the harsh environmental conditions witnessed in the area which has contributed to failure of most plantations in the arid environment especially during the (7-8 months) long dry season. For this reason, the selection of any species of tree for afforestation project in the arid zone has to be based on its resistance to drought, that is to say the species should be able to withstand the long dry season. In most cases, exotic tree species were preferred by foresters for afforestation projects in Yobe State and in other northern States of Nigeria. This is because the indigenous tree species are generally slow growing and are difficult to establish in the field due to challenges faced from grazing animals and from pests and diseases. In order to meet up with the demand of trees in the area, hundreds of tree species of both exotic and indigenous species have been screened for plantation development in the semi-arid area of Nigeria (Igagu and Osemeobo, 1990). It is a fact that trees growing together in a given area must have a genetic adaptation to the area for the trees to grow, regenerate and perpetuate themselves to maturity. When tree species are introduced to an area other than its natural environment, it may not be able to adapt to the new environment. Therefore, introduction of exotic tree species in the study area has to follow prescribed procedures so as to achieve the goal of establishing plantations in the arid zones. The procedures include species elimination trial, species growth trial and plantation trial. From the various elimination trials carried out in Nigeria in the past, many tree species have been identified for each ecological zone. Some of these species identified for the northern part of Nigeria include; *Eucalyptus spp, Pinus spp, Acacia spp, Cassia spp, Prosopis* and *Azadirachta indica*. Many of these tree species have been used in afforestation programmes with high level of success.

This therefore shows that drought resistance is an important basis for the selection of species to be used in shelterbelt development in semi-arid environment as adaptability of tree species to the harsh climatic conditions of the semi-arid environment is a panacea to a successful development of shelterbelts.

The most successful Tree species use in shelterbelt projects

As earlier mentioned, the success of any plantation in the arid zone depends on the type of species selected. From the responses gathered (Figure 3) *Azadirachta indica* was considered as the most successful and widely used tree species in afforestation projects in Yobe State and indeed the entire northern semi-arid region of Nigeria. Other tree species that have shown to be promising for use in afforestation projects includes; *Eucalyptus camaldulensis, Acacia Senegal, Acacia nilotica* and *Prosopis juliflora.* The success of these tree species in terms of their survival rate in the area is as a result of their xeromorphic characteristics which allow them to conserve water especially during the dry season. These trees have evolved different adaptation strategies overtime which permit them to survive arid conditions. These characteristics include; rapid elongation of taproots, extensive superficial root system, high ratio of volume to surface area of leaves, that is the leaves are small and compact.

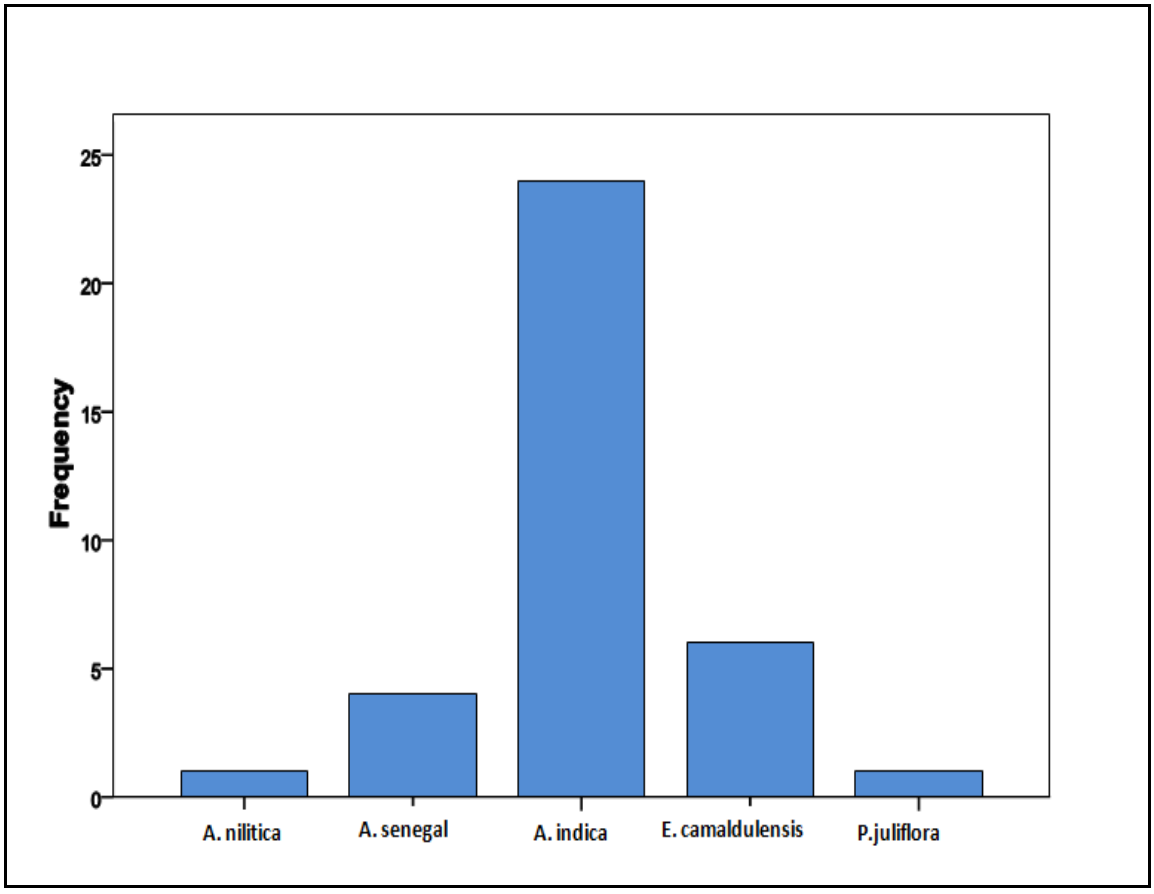

Figure 3: Successful Tree Species used in Shelterbelt Projects

These trees have evolved different adaptation strategies overtime which permit them to survive arid conditions. These characteristics include; rapid elongation of taproots, extensive superficial root system, high ratio of volume to surface area of leaves, that is the leaves are small and compact. The adaptability of species used in shelterbelt projects in the region showed varying success depending on the management and environmental condition existing at the site where the plantations are located. For example *Eucalyptus camaldulensis* have proved to be successful in the areas located below latitude $12^{0}30^{/}$ N except in waterlogged areas where the nature of soil has allowed the retention of moisture for longer period as observed during the field study. Generally, there was low patronage in the use of *Eucalyptus spp* in shelterbelt project in the extreme northern parts of the State beyond latitude12^{0} 30'N.

Preferred Tree Species

The preference of tree species by local communities as revealed by the study depends on the success of the species in established plantation. The result from the questionnaire showed that 63% indicated that *Azadirachta indica* is the most preferred tree species (Figure 4).

It was gathered during focus group discussion in Garanda village that the local communities did not show clear preference for indigenous species over exotic ones as most of them indicated that the mixture of both the exotic and the indigenous tree species used in the shelterbelt projects have provided poles, firewoods and seeds for their use. The realization of the importance of trees in protecting their settlements, crops and animals against sand storms, make them to consider the type of species use in shelterbelt projects as immaterial as long as it will yield the expected benefits.

However, during focus group discussions at Gargada village located close to Jajimaji shelterbelt, the responses showed that there were mixed reaction about the preferred tree species. In the discussion, respondents ascertained that they preferred the multipurpose tree species like *Acacia nilotica* which its bark is used in rope making, the fruits for leather tanning and as a medicament, the wood for firewood and poles and the leaves as fodder for their animal. Other species preferred by farmers include *Hyphaene thebaica and Balanites aegyptiaca.* This is in contrast with the questionnaire responses from the foresters who did not even indicate indigenous trees as preferred species. The choice of tree species used in shelterbelt projects by foresters is in relation with the successes witnessed in plantation during trials. Even though successes of trees in plantations are also reason for preference of trees by farmers as indicated by respondent during FGD, however, their benefits are equally important. This is because farmers will only be willing to sacrifice their farms to projects that will yield substantial benefits to them. The discussions revealed that the local communities even though wish to have trees on their farms lack the capacity to raise seedling in nurseries for planting. Although they practice a form of agroforestry where different types of indigenous trees such as *Balanites aegyptiaca, Adansonia digitata, Hyphaene*

thebaica, Guiera senegalensis, Bauhinia reticulate and various *Acacia spp* were seen scattered on farms, though they still need more trees to have proper protection for their crops. They stated that the trees on their farms were not planted by them but seedlings growing on their farms were protected and nurtured to maturity because of the benefits they provide. They also indicated willingness to plant trees on their farms and around their homes if given the seedlings.

Plate 1 shows part of Garanda shelterbelt with a mixture of *Azadirachta indica* and *Acacia spp.* while plate 2 shows part of Jajimaji shelterbelt with only *Acacia spp* as *Azadirachta indica* could not survive the site condition. This buttressed the importance of site selection in any afforestation project especially in arid environment (Gadiga and Adesina, 2015). These shelterbelts are under government care therefore the local people have minimum control over them. They are only allowed to cultivate their crops around the belts and pick dry woods for their domestic energy requirement

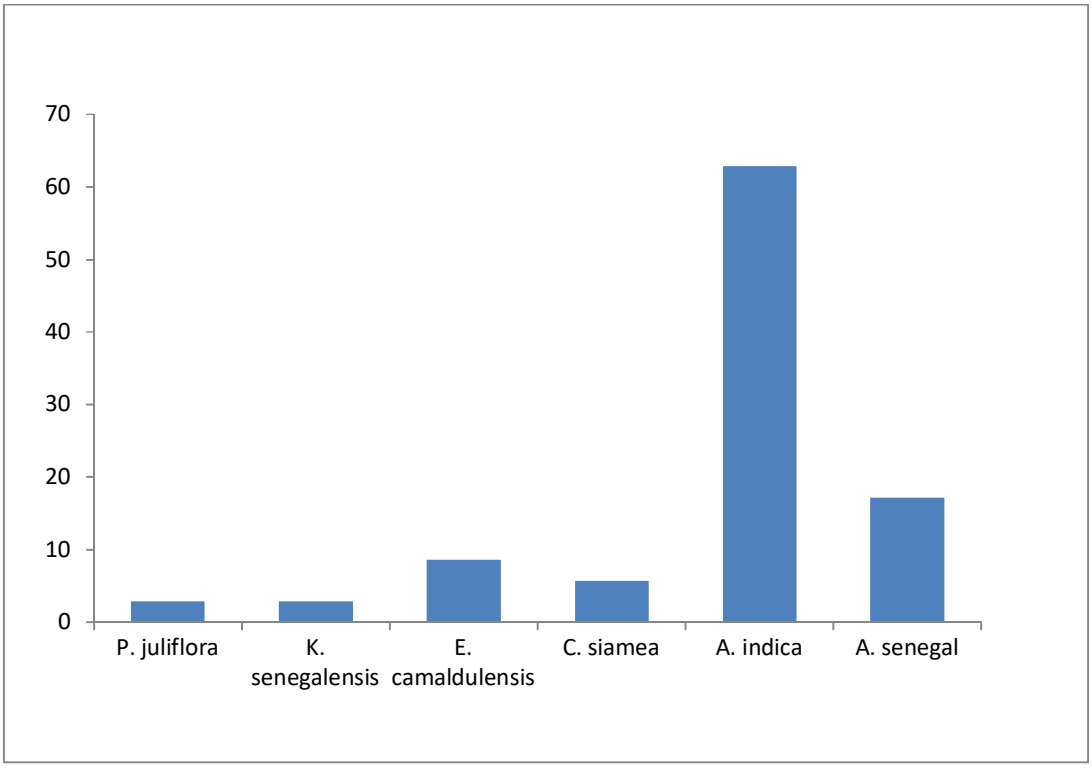

Figure 4: Preferred Tree Species

Plate 1: Part of Garanda Shelterbelt in Machina LGA.

Plate 2: Part of Jajimaji Shelterbelt in Karasuwa LGA

Conclusion

Species selection in shelterbelt project in arid and semi-arid zones is an important silvicultural practice that requires careful planning before the commencement of the project. This is because of the huge challenges faced by plants as a result of environmental as well as human factors. In order to achieve success in shelterbelt establishment in the arid and semi-arid zones, species that are drought resistant, fast growing and accepted by the local farmers should be selected. The study revealed that *Azadirachta indica* is the most successful and frequently used tree species in shelterbelt project in the area. It is also the most preferred specie used in shelterbelt project in the area. The success of this tree species in terms of survival rate in the area is as a result of its xeromorphic characteristics which allow it to conserve water especially during the dry season. This tree has evolved different adaptation strategies overtime which permit it to survive arid conditions. Other tree species used in shelterbelt project in the area includes; *Eucalyptus camaldulensis, Acacia Senegal, Cassia siamea, Khaya senegalensis, Acacia nilotica* and *Prosopis juliflora.*

This study recommends that mixture of different species of both exotic and indigenous trees should be encouraged in shelterbelt establishment in the arid and semi-arid environment. Government should support the involvement of local farmers in the vicinity of the shelterbelt in planning and management of shelterbelt programmes and afforestation projects generally. This will create a sense of belonging among the farming communities.

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