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Economic Potentials and Conservation of the Genetic Resources of *Eucalyptus Camaldulensis* in Niger State, Nigeria

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ABSTRACT
Eucalyptus camaldulensis is one of the naturally occurring species of trees in the Nigerian savanna regions especially in the northern Nigeria. The species are also cultivated in the forest areas of Mokwa Local Government Area of Niger State, because the naturally occurring form is slow in growth and difficult to manage and harvest. Products obtained include oil, tannins, fuel wood etc whose demand is on the increase due to increasing population. The industrial and other economic uses of the tree species were, however, not of immediate concern. Provenance study on *Eucalyptus camaldulensis* in Niger State revealed a tremendous amount of genetic variation its growth and form characteristics, hence provenance selection can be used to improve them. This provenance selection method include provenance resource stand, provenance conservation stand and seed stand. Since no one provenance stand excelled the others in all the characteristics, it is necessary to conserve even those provenances that were relatively unsuitable for selection on the basis of growth rate for the improvement of those so selected through inter-provenance hybridization. Since other important uses of the species are yet to be properly exploited in Nigeria, there is the need for the conservation of its genetic resources for future studies and user using appropriate conservation strategies. The study recommended more private participation in the production of *Eucalyptus camaldulensis* and urged the state to provide rural feeder roads to link the production sites with the urban (industrial) towns/cities.
Keywords: Eucalyptus, Economic potentials, Niger, Genetic resources.

INTRODUCTION

Eucalyptus camaldulensis, commonly called *Turare* in Hausa language has long been recognized as one of the most fast-growing exotic tree species that are suitable for afforestation programmes in the savanna region of Nigeria. The plant originated from Australia, New Guinea, Indonesia and Philipines and leaves have aromatic smells. In Australia, it is naturally found in the Australia mainland where it is widely distributed. It is one of the best known of the Eucalypts both in the wild and as a cultivated plant (Pryor and Byrne, 1969). *Eucalyptus camaldulensis* belong to the family *Myrtaceae*. Other species in the same family include *Eucalyptus citriodera, Eucalyptus oocarpa, Eucalyptus torreliana, Eucalyptus toreticonis* and *Eucalyptus deglupta* (Mohammed *etal*;2013). *Eucalyptus camaldulensis* was introduced to Nigeria in 1916, when they were planted as base-root transplant (Dauda et al; 2010). Because of its wide distribution, a considerable degree of genetic variation exists in the species due to adaptation to local environmental conditions and because of its simple silvicultural requirements (Dauda *etal*, 2010).

Eucalyptus camaldulensis is common in Sokoto State and Niger State of Nigeria (Dauda *etal*; 2010). The success of *Eucalyptus camaldulensis* as an exotic tree species is due among other factors to its:

i) Superior growth on infertile dry sites compared to other tree species;
ii) Tolerance to drought and high temperature;
iii) Rapid growth when there is enough moisture in the soil;
iv) Good coppicing ability;

v) Tolerance of occasional water logging and soil salinity;
vi) Deep root penetration;
vii) Very useful wood (Midgley *et al*, 1989).

It produces very strong hard, heavy and durable timbers which are useful for structural purposes especially where durability is needed. Reports on the variation pattern in the growth (Jackson and Ojo, 1973, Otegbeye, 1851; Otegbeye and Samarawira, 1991) and morphological characteristics (Otegbeye and Samarawira, 1991) of the species have indicated the existence of tremendous degree of genetic variation in them. Moreover, since no one provenance excelled the others in all the characteristics that were examined, it was suggested that even the provenances that were not recommended for plantation development in the region because of the relatively poor growth rate and stem form should be preserved for future hybridization work in the genetic improvement programme involving the species (Otegbeye and Samarawira, 1991).

During the last decade, people have become increasingly aware of the important role that *Eucalyptus camaldulensis* play in improving the rural livelihood. This paper therefore shows the need for the conservation of this provenance for future use to maximize the utilization of *Eucalyptus camaldulensis* in Niger State of Nigeria and the strategies for doing so. Moreso, Dauda *et al* (2010), reported, that the plant can also help to improve crop yields, income generation and/or diversification and utilization of available labour, in addition to maintaining the environment in good condition, especially when utilized as a forest plant in alley cropping system of agro-forestry.

Current and Potential Industrial Uses of *Eucalyptus Camaldulensis* in Nigeria

The introduction of fast-growing exotic tree species like *Eucalyptus camaldulensis* into the Nigerian savanna region of Niger State for example, was aimed at solving the problem of wood products supplies due to the slow growth rates of indigenous tree species and the increasing ,demand of these products, consequent of the increasing population and demand for wood products). Therefore, growth and form of these exotics have been stressed to the detriment of their other economically important characteristics since their management has been aimed at the production of fuel wood, poles and posts and amelioration of soil conditions for sustainable agriculture production. However, the species that can be put to other economic uses which have either not been explored or have not been fully explored in Nigeria. These include use in agro forestry systems, production of essential oils, tannins, pulp and paper.

Use in Agroforestry system: According to Dauda *et al* (2010), intercropping of *Eucalyptus camaldulensis* with food crops is the prevalent practice among the smallholder farmers, especially under the agro forestry system (Alley cropping) to generate and diversity income. Agro forestry is used to take advantage of the special productive and protective attributes of trees to improve the total output from the land. The system generally yields greater economic rates of return than the traditional forest management system of plantation establishment (spears, 1983). Dauda *et al* (2010) reported a positive return to *Eucalyptus camaldulensis* investment established under agroforestry system in Niger State of Nigeria. However, the beneficial effects of raising trees and crops under the same land management unit are not automatically achieved. Apart from optimum spacing of trees, compatible species have to be used. *Eucalyptus camaldulensis* is one of the tree species that can be used for agro forestry practices in the Nigerian savanna, including Niger State. It has the advantage of producing very light shade because of its crown size and shape. It is used in agro forestry systems in India, Nepal, Pakistan and Tanzania and is a good source of honey (Midgley *et al*, 1989

Production of essential oils: The leaves of *Eucalyptus camaldulensis* contain valuable essential oils which are widely used in pharmacy, industry and manufacture of perfume (Hall *et al*; 1970). Mohammed *et al*, (2013) revealed that oil is one of the essential products obtained from *Eucalyptus camaldulensis* tree, and the value chain, associated in the harvesting and extraction of products from *Eucalyptus camaldulensis* has provided gainful employment to the participant in the business. However, there is indication that the quantity of oil produced varies with species (Akinloye and Adegbeyin, 1981) as well as

within species of *Eucalyptus camaldulensis* (Midgley *etal*. 1989). Although *Eucalyptus citriodora* produces more of these essential oils than some of the other eucalypts-grown in the Nigerian Savanna (Akinloye and Adegbeyin, 1981), it is difficult to raise both in the nursery and in plantations. It is known to have a narrow range of adaptability in the region. On the other hand, *Eucalyptus camaldulensis* is easy to raise in the nursery and in plantation and has a wide range of adaptability in the region although its performance decreases with decreasing rainfall (hence increasing latitude) and soil depth. It is, as a result, necessary to explore the production of essential oils from *Eucalyptus camaldulensis*. For the purpose of maximizing the production of the oils, the various provenances of the species need to be screened for the yield and quantity of their oils.

Production of Tannins: The bark of *Eucalyptus camaldulensis* contains tannins, which are used in tanning industries to produce leather from hides and skins. Similarly, the leaves contain polyphenols, a group which tannins belong. The quality and quantity of the tannins that can be produced by the species is yet to be determined in Nigeria. But provenance variation was reported in leaf polyphenol content of the species (Banks and Hills, 1969). Because of the inherent variation that exists among provenances of the species for this product screening of these provenances is a requirement for optimum production of the product in Nigeria. According to Mohammed *et al* (2013), the total value of world trade in Non-timber forest product (NTFP) including tannin from *Eucalyptus camaldulensis* is estimated in the order of US $11 billion. However statistics are notoriously unreliable for these type of products (Caspary *et al*; 2001).

Production of pulp and paper: Generally, there is shortage of long fibre which is required for the production of high quality paper all over the world. Paper industries have therefore resorted to blending of long-fibre pulp in their production process. In Nigeria, *Gmelina (Gmelina arborea)* is used for the production of short-fibre pulp for blending long-fibre pulp that is mostly imported for paper production and the fibres from this species are in short supply in the country. Recently, in an attempt to boost the supply of short-fibres in Nigeria, Nigerian paper Mill in Jebba started making efforts to raise Eucalypt plantations, mostly of *Eucalyptus camaldulensis* and *Eucalyptus tereticornis, Eucalyptus camaldulensis* is used in Argentina, Israel, Mexico and Spain for the production of hardboard and particle board, and in Burna, California, Morocco, Portugal and Spain for paper pulp (Midgley *et al*; 1989). The new interest in the use of *Eucalyptus camaldulensis* for pulp and paper production in Nigeria requires that wood property studies be done on the specie to see which of its numerous provenances already tested in Nigeria will be most suitable for such production in the country since considerable provenance variation exists in the basic density (Barrett and Carter, 1976) and fibre length (El-Lakany *et al*. 1980) of the specie.

The implication of the uses to which *Eucalyptus camaldulensis* can be put and the assertion (Otegbeye and Samarawire, 1991) that no one provenance of the specie characteristics studies in Nigeria is that provenances not favoured for a particular use may be favoured for other uses like the production of oil, ropes, poles, thatch leaves etc (Mohammed, 2013). For instance, to develop a *Eucalypt* plantation for oil production, it may be advantageous to have dwarf trees with many branches whereas for timber production trees with fast growth, good form and minimal number of branches will be required. More often than not, where the management objectives is to produce both commodities simultaneously, this can be achieved through the production of inter-provenance hybrids since combinational hybridization is an important method of breeding for multiple characteristics (Nikel, 1970' Wright, 1976). This shows a more compelling need for the conservation of all the *Eucalyptus camaldulensis* provenances that have so far been tested in Nigeria for their economic, industrial, social, scientific and educational values now and in the future. The conservation of the different provenances of the this forest genetic resource should therefore be an integral part of its management in Nigeria. Resource conservation stands of petford and other provenances of the specie, which may be future sources of seeds of good genetic quality, were infact established by the Zimbabwe, forestry commission in 1985 (Midgley etal; 1989).

However, the collection and harvesting of *Eucalyptus camaldulensis* products from the natural forest is difficult (caspary *et al*, 2001). It is even more difficult to quantity national trade and its contribution to the national economy in terms of GDP (Gross Domestic Product), which may be very substantial to globalization and economic prosperity, because a very important international traded products rarely appears in statistics, but its production has consequences (Vallenbury *et al*; 1997).

STRATEGIES FOR THE CONSERVATION OF GENETIC RESOURCES

The two methods of conservation of plant genetic resources are *in situ* conservation and *ex situ* conservation. These methods are complementary and frequently one method acts as a back-up to another, and the degree of emphasis placed on a particular method depends on a specific strategy developed to fulfill conservation aims and uses (Cohen *et al*; 1991). *In situ* conservation is a very efficient method of conserving provenances where conservation authority has strong control and the tree species is indigenous to that locality. It is the conservation of genetic resources in areas where they developed their distinctive properties: in the wild or in farmers' field, i.e on "site" conservation (Vernooy, 2003). It has the advantage of conserving a whole ecosystem, not just the constituent species, and also maintains genotypes and gene frequencies not just genes adapted to the local environment (Willan, 1984). Forests and woodlands contain a wealth of plant and animal species that are of actual or potential industrial and socio-economic values. They are sources of wealth and well-being of economies that make use of them in different ways (Otegbeye and Otegbeye, 2002).

Eucalyptus camaldulensis is grown as an exotic tree species in Nigeria, having been introduced from Australia where it naturally occurs. Therefore, only *ex situ* conservation method which is the conservation of plants away from their natural habitat can be used to conserve this genetic resource in Nigeria. Dauda *et al* (2010) submitted that *Eucalyptus camaldulensis* was introduced to Northern Nigeria in 1916, when they were planted as base-root transplant. It is a better option at ensuring humanity's ability to meet the long-term objectives of conservation programmes. The conservation can be achieved through the use of provenance resource stand, provenance conservation can be achieved through the use of provenance resource stand, provenance conservation stand and seed stand. With proper management and conservation efforts, these strategies can be very useful in conserving genetic resources of considerable economic importance for immediate and future uses.

Provenance resource stand: A provenance resource stand is "a forest plantation of known provenance and broad genetic base whose boundaries are marked in the field and recorded on artificial maps, and which may be used for plus tree selection, seed collection, provenance conservation, etc". (Nikels and Newton, 1983). It is used in Queensland, Australia for *Pinus caribaea* var. *hondurensis* to (1) preserve the best trees in each of the stands for future breeding work, (2) to produce a good timber stand. It has also been established in Zimbabwe for some *Eucalyptus camaldulensis* provenances (Midgley *et al*, 1989). Since no one provenance of *Eucalyptus camaldulensis* tested in Nigeria has the best performance in all the growth and quality characteristics so far examined and which may be true of the other economically important characteristics of the species, it is desirable that each of these provenances is preserved in separate provenance resource stands for future breeding work and other studies. In such stands, pure seed of the provenances can be procured for the desired purpose.

Provenance Conservation Stand: Provenance conservation stand is "a stand of known provenance, preferably already tested and found superior in provenance trial and of broad genetic base, which is (1) planted for the primary purpose of maintaining a high degree of genetic diversity within the stand, (2) isolated to reduce pollination from outside sources and (3) managed, by means of systematic thinning, to conserve a high proportion of the original genetic diversity in the stands or clonal materials produced by the stand (William, 1984). It is equivalent to provenance resource stand. It is managed to conserve as much genetic diversity as possible, including trees regarded as inferior, as an insurance against unpredictable environmental

conditions and possible change in future demand of the society.

Seed stand: A seed stand also called a seed production area is an identified superior stand that is generally upgraded by the removal of phemotypically inferior trees and then managed for early and abundant production of seed. It may be in either indigenous forest or plantations and should (1) be old enough to demonstrate that it is well adapted to the site and will continue to exhibit rapid, healthy growth and form; (2) be phemotypically superior to other stands growing in similar conditions and of similar age with which it is compared. (3)be old enough to be producing or about to produce substantial quantity of seeds; (4) not have been managed for the primary purpose of seed production before the selection exercise so that it can be compared with other stands. Seed stands are established to reduce or eliminate dependence on external sources of seeds of desired species on provenances. Self sufficiency in seed supply helps stabilize planting programmes and save valuable foreign exchange particularly in developing countries (Midgley eta; 1989).

In order to obtain the desired result, some degree of isolation is required for the seed stand from other pollen sources. Such isolation can be obtained by either increasing the distance between the seed stand and undesirable pollen sources or by planting a physical barrier such as planting strips of unrelated species around the seed stand. However, because complete isolated may be difficult to achieve some level of contamination is acceptable.

It should be noted that for effective conservation of any genetic resource, the gene pool should not be put in one large conservation stand to avoid losing the entire gene pool in a single disaster. Moreover, where genotype x environment interaction is large, it is highly desirable to establish the conservation stands close to the area where the specie is to be used to maximize yield. Any plantation programme that does not take into account or consideration genotype x environment interaction in forest tree species may lead to partial or complete failure which may be due to the death of the trees, reduced tree growth or reduction in quality characteristics. At the moment, evidence of such interaction does not exist in *Eucalyptus camaldulensis* in the Nigerian savanna, particularly in Northern Guinea Savannah zone (Otegbeye, 1992; Otegbeye and Otegbeye, 2004). Therefore, the conservation stand can be split over few sites but representing arid and semi-arid environments that will take care of the seed needs of the whole Nigerian savanna to reduce cost of establishment and silvicultural management.

CONCLUSION AND RECOMMENDATIONS

The economic and industrial values of *Eucalyptus camaldulensis* have not been adequately exploited in Niger State, Nigeria. There is, therefore, the urgent need to study the specie very closely especially with respect to its wood quality and chemical features. In order to have materials for this purpose and its future uses, proper resources conservation should be a very important integral part of the management strategies developed for the specie in Niger State of Nigeria. This is true of other tree species used in afforestation programs in the country. It is also recommended that more private sector participation in the production of *Eucalyptus camaldulensis* should be encouraged. Government involvement should be in the area of provision of infrastructure such as provision of rural feeder roads, as well as protection of forests against deforestation and/or over-exploitation.

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