

# INTERNATIONAL JOURNAL OF ADVANCEMENT IN BIOLOGICAL SCIENCES

Volume 6, Number 1, 2016

1971

PAN-AFRICAN BOOK COMPANY

# INTERNATIONAL JOURNAL OF ADVANCEMENT IN BIOLOGICAL SCIENCE

Volume 6, Number 1, 2016

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This Journal is an academic Journal published quarterly. Subscription rate for individuals is US\$25 per issue (foreign Price) and c25 (Domestic). Per annum cost is US\$100 (foreign) and c100 (Domestic).

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Volume 6, Number 1, 2016

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ISSN: 2276-819X

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## ENERGY PLANTATION OF MULTIPURPOSE PLANTS SPECIES IN GUINEA SAVANNA, NIGERIA

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### ABSTRACT

*The energy crisis is a global problem today. The survival of man will be difficult if the energy problem is not solved on priority basis. The paper presents some multi-purpose plants species producing hydrocarbon or petro plants contents in Guinea Savanna zone of Nigeria. The species information for their biofuel contents was gathered through observations and interviews from elders and housewives. Fifty one species of angiosperms belonging to thirty three families in forty genera were mostly used for their hydrocarbon contents as charcoal, oil and as source of food and other raw materials. The paper also discusses the importance of energy plantation and fruits and food trees for outlying farms and compound. The paper recommends social energy, commercial energy plantation, conservation forestry and formulation of energy plantation policies and involvement of native population in protection, regeneration and development of energy plantation in Guinea Savanna.*

**Keywords:** *Energy Plantation, Petroplants, Social Forestry*

### INTRODUCTION

Green plants by virtue of possessing special pigment are able to absorb and use a portion of solar energy for the synthesis of food. The process is called Photosynthesis. By this, organic substances are synthesized from carbon dioxide and water using the light energy absorbed by special pigment of chlorophyll. Plants are the sole suppliers of basic energy to the universe (Meher, 1998). In this process solar energy is converted into chemical energy or food energy and molecular oxygen is produced as a by-product. (Kamil, 1999) All other organisms including man directly or indirectly depend on energy accumulated in green plants in the form of organic food. Fuel wood has been a primary energy source for mankind from the beginning of civilization and still continues to be the main source of energy in the developing countries (FAO, 1999).

Plant based energy is obtained by energy plantations which can produce biomass from selected trees in the shortest possible time at low cost. These plants yield solid, liquid and gaseous fuel through burning, gasification, digestion etc such plantation can be raised in both hills and plains particularly on marginal land water hyacinth when grown in water enriched sewage, may produce 8-10 tons of plant material acre which yield 3500-7000 cubic meter of methane.

Biomass obtained from biotic source is an important source of energy. Biomass collected in form of wood, roots, foliage, algae etc. from agricultural lands or forest can be converted into energy sources in gaseous, liquid or solid form through diverse ways. Biomass from the natural forests and energy plantation will serve as dependable and renewable energy sources in future. For increasing forest biomass fast growing trees species are planted, harvested and regenerated on short form rotation of 2-4 years. (Chandel and Shukla, 2006).

In Nigeria, there is the problem of environmental pollution, burning of petroleum product which leads to injection of by-products such as  $SO_2$ ,  $PbO_2$ ,  $CO_2$  etc., into the atmosphere. Presently, fossil fuels provide the bulk of world's primary energy. Since fossils are non-renewable, and the supply of fossil fuels (especially oil and gas) may soon get completely depleted due to over reliance, there is thus need to develop alternative source to replace the fast depleting fuels (Yaro, 2010).

Plantation energy has enormous importance in solving energy crises in Nigeria and national development. The common savanna tree species include *Lophira alata*, *Acacia spp*, *L. lanceolata*, *Terminalia spp*, *Daniellia oliveri*, *Vitex doniana*. Many valuable timber species and non-timber species provides benefits such as Locust bean, baobab fruit, sheabutter tamarinds, gum Arabic and variety of local fruits.

It has been reported that over 70% of the total domestic energy consumed in the rural communities of Nigeria is generally from fuel wood (FAO, 1989) almost all people living in rural areas in Nigeria depend on



## Energy Plantation of Multipurpose Plants Species in Guinea Savanna, Nigeria

fuel wood for cooking. Approximately 80% of the total energy used for domestic needs per annum in rural areas in Nigeria are sourced from charcoal and firewood.

All trees and shrubs can be used for energy plantation species for charcoal generally have a higher density ( $>600\text{kg/m}^2$ ) than these burnt solely for firewood. Good charcoal species include many hard woods such as *Acacia spp*, *Securidaca longipedunculata*, *Burkea africana*, *combretum spp*, *Terminalia spp* give off smoke which act as insecticides especially species of botanic families of Meliaceae and Euphorbiaceae (Kantai, 2002). Several plants are known to yield liquid, hydro carbons, the substitute liquid. Such plants are called petro – plants. The hydrocarbons in plants can be converted into petroleum hydrocarbon of high molecular weight. More than 385 plant species belonging to Euphorbiaceae, Asclepiadaceae, Apocyanaceae, convulvalaceae, Sapotaceae and other families have been screened for their hydro carbon contents, now, the efforts are being made to increase biomass of such plants and convert their hydrocarbon into petroleum products (Shukla and Chandel, 2006).

Incorporating savanna plants like *Azadirachta indica*, *Vitellaria paradoxa*, *Piliostigma thonningii*, *sucurinea virosa*, *Detarium microcarpum* and other species that are energy plant are of a growing demand for Shea seedling and other species has seen savanna plantations, a plantation development organization. The Shea tree (*Vitellaria paradoxa*) is indigenous to Africa and produces a fruit from which Shea butter is extracted. Shea butter is used in cosmetics and lotion. (Landlord, 2013).

Extensive cultivation plantation energy should be undertaken in Nigeria more especially in the savanna zones. Plants that contains proteins, carbohydrate, and lipid in varying amounts and are rich source of hydrocarbons should be cultivated. Biomass obtained from biotic sources is an important source of energy. Biomass collected in the form of wood, roofs, foliage, algae etc, from agricultural land or forest can be converted into energy sources either in gaseous, liquid or solid forms through diverse ways (Mola and Aronsson, 2008) Biomass from natural forest and energy plantation will serve a dependable and renewable energy sources in future. The fast growing trees for example *Zizyphus*, *Prosopis*, *Acacia*, *Ficus* can be raised on saline and alkaline soils.



Table 1. Some Savanna Plants species, Family, English Name, growth Form and their Life Cycle Suitable for Energy Plantation in Nigeria.

s/n	Species	Family	English Name	Hausa Name	Growth Form	Life cycle
1	<i>Detarium microcarpum</i>	Caesalpinaceae	Sweet dattock	Taura	Tree	Perennial
2	<i>Prosopis africana</i>	Mimosaceae		Kiriya		
3	<i>Entada africana</i>	Mimosaceae	Entada	Tawatsa		
4	<i>Annona senegalensis</i>	Annonaceae	custard apple	Gwandandaji	Tree	Perennial
5	<i>Moringa oleifera</i>	Moringaceae	Horse Radish	Zogala		
6	<i>Newbouldia leavis</i>	Bignoniaceae		Aduruku		
7	<i>Boehavia diffusa</i>	Nyctaginaceae	Spreading Hogweed	Babbajuji	Herb	Perennial
8	<i>Bambusa vulgaris</i>	Poaceae	Bamboo	Gora	Herb	Perennial
9	<i>Azadirachta indica</i>	Meliaceae	Neem	Dongonyaro	Tree	Perennial
10	<i>Mangifera indica</i>	Anacardaceae	Mango	Mangora	Tree	Perennial
11	<i>Adansonia digitata</i>	Bombacaceae	Baobab	Kuka	Tree	Perennial
12	<i>Pterocarpus eraneus</i>	Papilionaceae	African rose tree	Madobiya	Tree	Perennial
13	<i>Jatropha curcas</i>	Euphorbiaceae	Physicnut purging nut	Binidazugu	Shrub	Perennial
14	<i>Euphorbia hirta</i>	Euphorbiaceae	Asthma herb		Herb	Annual
15	<i>Sterculia setigera</i>	Sterculiaceae		Kukuki	Tree	Perennial
16	<i>Hymenocardia acida</i>	Euphorbiaceae	Heart fruit	Jam yaro	Shrub / tree	Perennial
17	<i>Daniellia oliveri</i>	Caesalpinaceae	Balsam tree soft timber	Maje	Tree	Perennial
18	<i>Vernonia amygdalina</i>	Compositae	Bitter leaf	Shuwaka	Shrub	Perennial
19	<i>Isobertlinia doka</i>	Caesalpinaceae		Doka	Tree	Perennial
20	<i>Tamarindus indica</i>	Caesalpinaceae	Tamarind	Tsamiya	Tree	Perennial
21	<i>Aloe vera</i>	Asphodelaceae	Medical aloe		Herb	Perennial
22	<i>Anogeissus leocarpus</i>	Combretaceae	Axle wood	Marike	Tree	Perennial
23	<i>Gardenia sokotensis</i>	Rubiaceae		Gaude	Shrub	Perennial
24	<i>Vitellaria paradoxa</i>	Sapotaceae	Shea butter	Kandanya	Tree	Perennial
25	<i>Cochlospermum planchonii</i>	Chochlospermaceae	Cotton plant	Balge	Shrub	Perennial
26	<i>Piliostigma throningii</i>	Caesalpinaceae	Camel foot	Kalگو	Shrub	Perennial



Energy Plantation of Multipurpose Plants Species in Guinea Savanna, Nigeria

28	<i>Calatropis procera</i>	Asclepiadaceae	Sodom apple	Tumfafiya	Tree	Perennial
29	<i>Parkia biglobosa</i>	Verbenaceae	Locust bean	Doruwa	Tree	Perennial
30	<i>Securinega virosa</i>	Euphorbiaceae		Tsa	Shrub	Perennial
31	<i>Ficus platyphylla</i>	Moraceae	Wild fig	Gamji	Tree	Perennial
32	<i>Ficus sycomorus</i>	Moraceae	Fig	Baure	Tree	Perennial
33	<i>Cussonia arborea</i>	Araliaceae		Takandargiwa	Tree	Perennial
34	<i>Ximenmia americana</i>	Olacaceae		Tsada	Shrub	Perennial
35	<i>Acacia sieberiana</i>	Mimosaceae	Acacia paper back	Farar kaya	Tree	Perennial
36	<i>Acacia nilotica</i>	Mimosaceae	Acacia Egyptian	Gabaruwa	Tree	Perennial
37	<i>Dichrostachys cinerea</i>	Mimosaceae	Princess earing	Dundu	Shrub	Perennial
38	<i>Khaya senegalensis</i>	Meliaceae	Mahogany	Madaci	Tree	Perennial
39	<i>Ceiba pentadra</i>	Bombacaceae	Silk cotton	Rimi	Tree	Perennial
40	<i>Cochlospermum tinctorium</i>	Chochlospermaceae	Cotton plant	Kwata	Shrub	"
41	<i>Diospyros mespiliformis</i>	Ebanaceae	Ebony tree	Kanya	Tree	"
42	<i>Vitex doniana</i>	Verbenaceae	Black plum	Dunya	Herb	Perennial
43	<i>Lageria siceraria</i>	Curbitaceae	Bottle gourd	Gora	Herb	Annual
44	<i>Borassus aethiopicum</i>	Areaceae	African fan palm	Giginya	Tree	Perennial
45	<i>Burkea africana</i>	Caesalpinaceae	Burkea, wild seriga	kolo	Tree	Perennial
46	<i>Azelia africana</i>	Caesalpinaceae	Pod mahogany	Kawo	Tree	Perennial
47	<i>Hibiscus cannabinus</i>	Malvaceae	Kenaf	Rama	Herb	Annual
48	<i>Terminalia schimperiana</i>	Combretaceae	Tult	Baushe	Tree	Perennial
49	<i>Zizyphus mauritiana</i>	Rhamnaceae	Jujub tree	Magarya	Shrub	Perennial
50	<i>z. spina Christi</i>	Rhamnaceae	Christplant or thorns of Christ	Kuma	Shrub	Perennial
51	<i>Luffa cylindrica</i>	Cucumbitaceae	Luffa	Soso	Shrub	Perennial



## IMPORTANCE OF ENERGY PLANTATION

Energy plantation is the practice of planting trees, purely for their use as fuel. Terrestrial biomass i.e. woods plants, has been used since long time to generate fire for cooking and other purposes. In recent years, to meet the demand of energy, plantation of energy plants has to be re-emphasized.

It is well known fact that trees have been intensively cut in Nigeria forests and savanna, leaving the area totally denudes. The advantages of plantation energy are as follows according to Chandel and Shukla, 2006

- ❖ The energy plantation wood would save enormous quantity of coding which is applied as natural manure or farm yard manure (FYM) or compost.
- ❖ Energy plantation would provide an inexhaustible and renewable source of energy.
- ❖ Use of energy plantation wood produces non-hazardous mineral rich ash which can be use as fertilizer
- ❖ It causes little or no pollution
- ❖ Plants create pleasant and beautiful surrounding and provide safe habitat for wildlife.
- ❖ There is little or no energy inputs in energy plantation
- ❖ Energy plantation plants provides fruits, seeds, edible leaves, forage, tannins, gums, dyes and several other useful substances
- ❖ Soil erosion is checked through energy plantation
- ❖ There is no problem of waste disposable energy. Apart from the above importance plants provides primary and secondary uses such as uses in medicine, social forestry streets plantations, religious and magic purposes,
  - For constructions such as Banboos, and *Khaya*
  - Serve as shade and nurse trees, cover crops mulches green manure, fallow crops, live fences, wind breaks and water cleaning agents such as (*Moringa oleifera*)

## Reasons for Energy Plantation in Nigeria

The chiefs objectives of energy plantation is to produce biomass from the selected trees and shrub species which are harvestable in a comparable shorter time (5-10years) at the end of minimal cost, so as to satisfy local energy needs in the decentralized manner. This would certainly relieve the pressure on the consumption of fossil fuel like kerosene and prevent destruction of plant cover which is one of the primary components of the life support system

Presently, Nigeria is in the grip of unprecedented energy crisis caused by the political influence on fuel supply and distribution, shifting of relationship among the oil companies and host communities, face-up between the oil-rich communities and the Federal Government of Nigeria due to long time development and environmental pollution, and the price hike of fuel (petroleum, diesel, kerosene, liquefied, natural gas) beyond the rich of common people. The hike in price of these commodities along with erratic supplies in the long run draws most urban consumers away from the use of gas and kerosene gradually back to the use of local fuel for cooking food and other domestic activities, such shifts towards the use of fuel have adversely resulted into mass deforestation without proper replacement and consequently cause a great threat of desert encroachment and erosion of top soil (Ndana and Mohammed, 2010).

In an energy plantation growing plants that collects and store solar radiation for subsequent release of high temperature and heat. The plant materials can be burnt as solid fuel or converted into ethanol, methanol and produced gas anaerobic biological process. Certain plant species production practices are preferred for maximizing sustained solar energy storage capacity of energy plantations. Solid fuel from energy plantations will be less expensive throughout the nation than fuel oil. Synthetic natural gas produced from energy plantations will be competitive with that produce from coal. If all the required technologies are at hand, adequate land will be available for energy plantations on a large scale without encroachment on land needed for other purposes. Energy plantation will offer many potential benefits and no serious drawbacks for our country.

## Fruits and Food Trees for Outlying Farms and Compounds in Guinea Savanna Zone

Most of the fruit and food trees for outlying farms and compounds fall into the categories of semi-wild and protected species in cultivated farm land. Few are cultivated. The selected species are *Borassus aethiopicum*, *Azalia africana*, and *Vitellaria paradoxa*, in term of supplying wood and products, such as timber and stakes such species are important, it is possible to propagate repetitively, from cutting buds and seeds. *A. africana*,



*Parkia biglobosa*, *Detarium microcarpum* and *Vitex doniana* and most of Caesalpiniaceae and Mimosaceae families, enrich the soil with nitrogen through the bacterial root nodules as well as serving nutrient pumps bringing up nutrients that have been leached to soil horizon deeper than topsoil, and eventually releasing them in the form of leaf litter and decaying organic plant residues. Apart from their role in restoring soil fertility, the trees also provide much – needed shade, for instance, some farmers reported that the performance of several crops like pepper (*piper nigrum*) is better around and under the shade of *Parkia biglobosa* and *Vitellaria paradoxa* and other species, few non – food trees are good energy plants example *Ricinodendron* and *Heudelotia* and *Newbouldia laevis* are used in boundaries and fences, *Acacia* Spp also serve the purpose.

### CONCLUSION

Under taking plantation with particular emphasis on fuel and other uses and more attention for energy plantation research, personnel management and data base in the field of plantation. Derived, hills, slopes are found throughout the country, the energy plantation should not be only for productive reasons but also for conservation of soil and water. Energy plantation should be done along the rivers and deserts for species which can adapt to such habitats.

Energy plantation policy should be initiated in Nigeria and if exists should be framed to give priority to energy plantation of multipurpose plants species in Guinea Savanna.

### RECOMMENDATIONS

Conservation forestry of existing forests and restoration of the degraded forest in ecologically sensitive areas, catchments areas, National parks, Sanctuaries and Biospheres reserves should be improved. Energy plantation through social forestry should be emphasized by the government to meet the demand of fuel and fodder. This include planting trees along road sides, canal, railway line and waste lands in village and cities. Energy plantation program should include control of fires, plantation of fast growing plants, legislations to check deforestation and control of plantation diseases and pests. Involvement of tribal population in protection, regulation and development of *Vitellaria paradoxa* and *Parkia biglobosa* species plantation which are endangered and use of alternative energy sources like solar and wind to reduce the use of trees as fire wood.

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