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CHEMICAL ENGINEERING | RESEARCH ARTICLE

Identification of the woody biomasses in Southwest, Nigeria as potential energy feedstocks in thermal power plants for air pollution control

F. B. Elehinafe[1]*, O. B. Okedere[2], J. A. Sonibare[3] and A. O. Mamudu[1]

Abstract: This study identified one hundred samples of woody biomasses in the southwest, Nigerian. The woody biomass samples identified were collected from different saw mills, farms and kitchens in Osun State, Nigeria. The identification of the woody biomass samples was done using literature materials and at a herbarium in the Botany Department, Obafemi Awolowo University, Nigeria, using the vegetative parts of their trees. The identification was carried out to know the numerical availability, the family or English names, the common names and the botanical names of the southwest Nigeria woody biomasses. From the findings, 100 samples of the woody biomasses were identified of 39 families and classes of hard woody biomasses and soft woody biomasses out of which only two are soft and rest are hard. It was discovered that Southwest, Nigeria has the capacity to embark on the massive production of these woody biomasses identified due to her land mass of 77,818 km^2 comprising 85 forests. In conclusion, serious investment in the propagation of these energy crops would lead to the production of woody masses to serve as feedstocks in thermal power plants for sustainability in power supply, air pollution control and employment opportunities.

Subjects: Power & Energy; Renewable Energy; Clean Tech; Renewable Energy

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Oyetunji B. Okedere's research interest include air pollution (monitoring, analysis, modelling and control), and renewable energy.

Angela O. Mamudu's is a researcher with interest in process optimization; health, safety and environment; plant design; petroleum refining; and petrochemicals.

Ademola J. Sonibare's research interest include air pollution (monitoring, analysis, modelling and control

PUBLIC INTEREST STATEMENT

Woody biomasses when utilized as fuel discharge carbon recently removed from the air, thereby, hypothetically not expanding GHG levels in the atmosphere. The GHG discharges during the burning of woody biomass are thought to be equivalent to that taken from the atmosphere through the process of photosynthesis during woody biomasses were growing. Woody biomasses as sources of energy do not fluctuate like other renewable sources of energy. For example, solar energy is not available during cloud cover and rainfall, hydro-electricity drops during the dry season. Seasons do not affect the supply of fuelwoods once trees have grown to the peak in sizes, numbers and as the ripe ones are being felled, they are replanted. So, power plants fired using woody feedstocks would never have a down time in operations. Hence, air emissions associated with the combustion of fossil fuels are controlled.

Keywords: Woody biomass; energy feedstocks; thermal conversion; power plants; air pollution control

1. Introduction

Air Pollution is a huge concern faced by the world today and impacts all human beings in so many different ways. The decisions concerning the fight against air pollution should be guided by the understanding that economic development, social development and environmental protection are interdependent and mutually reinforcing components of sustainable development (Ogbonnaya et al., 2007; Ganesan et al., 2015). The growing interest in moving energy generation away from petroleum fuels and toward alternative means is pulling together considerations for the utilization of renewable energy sources to help meet the global energy needs and sustainability of the environment. Thus, the previous decade has witnessed an increasing attention for understanding the roles the renewable energy sources can play in the energy adequacy and a quantum rise in research support into conversion technologies and obtainability as reported by a number of authors (Ganesan et al., 2013; Hoseinzadeh et al., 2020; Javadi et al., 2020; Mason et al., 2009; Siamak et al., 2020).

Nigeria is enriched with adequate renewable sources of energy assets to meet its present and future growth and development prerequisites. Nonetheless, hydropower is the main reasonable resource at present exploited and connected to the network of electricity grid (Nnaji et al., 2010). Sourcing for renewable and sustainable energy development and awareness creation in Nigeria is driven by, in addition to other things, the ongoing increment in fossil fuel prices, the inaccessibility of power supply to the greater part of the Nigerians and the significant losses associated with cost, energy during grid extension and air pollution control. The Nigerian government has put forth attempts through a lot of endeavours, policies and programmes to encourage private investments to go into renewable energy exploitation (Ogbonnaya et al., 2007). Notwithstanding, there are impediments, primarily because of technical and money-related hindrances, that should be addressed for this to be a reality. More importantly, the carbon, sulphur, nitrogen and ash contents of the woody biomasses are insignificant and mild to constitute air pollution (Boluwaji et al., 2019) and the energy contents of woody biomasses are at par with those of the fossils.

In Nigeria, the absolute value of both the woody and non-woody products of forest just as their ecological functions is tremendous however not totally quantifiable (Daniel & Babatunde Hope, 2020). Generally, the forest is underrated in its embedded value within the government economic reckoning of Nigerian woody vegetation assets comprise the thick forest, bushland, woodland, trees on farmlands and plantation. Every one of these different resources adds to production, conservation and protection functions of the national vegetation. In the nation, studies have indicated that forest reserves extend to 10 million hectares, which represents about 10% of a land region of roughly 96.2 million hectares (Adelakun & Olugbade, 2019). Nigeria is well geographically located for maximum rainfall and temperature throughout the year for plant growth thus for woody biomass production (Agboola, 1979). There are a lot of woody biomasses that could be used as feedstocks for power generation in this part of the globe.

Southwestern Nigeria has eighty-five forest reserves with a total area cover of 842,499 hectares (Adelakun & Olugbade, 2019). The climate of the region is tropical naturally and it is portrayed by dry and wet seasons. The temperature ranges somewhere in the range of 21°C and 34°C while the annual precipitation ranges from 1500 mm to 3000 mm (Adelakun & Olugbade, 2019). The wet season is related with the southwest monsoon winds from the Atlantic Ocean while the dry season is associated with the northeast trade wind from the Sahara Desert. Agboola (1979) reported that the vegetation in Southwest, Nigeria comprises mangrove forest and fresh water swamp at the belt region, the low land in primary forest zone stretching inland to Ogun State and part of Ondo State while the secondary forest is towards the northern borderline where southern savannah and derived savannah likewise exist. This forest area of the southwest is enough to meet the energy need of Nigeria through woody biomass production for power generation if serious attention is paid to it by the government.

Consumption of petroleum fuels and other fossils releases carbon put away underneath the crust of the earth for centuries into the air, a crucial part of the environment as ozone-depleting substances called greenhouse gases (GHG). Be that as it may, these gasses are answerable for a global temperature alteration (Demirbas, 2005; Odunlami Olayemi et al., 2018; Ganesan et al., 2015). Then again, woody biomass when utilized as fuel discharge carbon recently removed from the air, thereby, hypothetically not expanding GHG levels in the atmosphere. The GHG discharges during the burning of woody biomass are thought to be equivalent to that taken from the atmosphere through the process of photosynthesis during woody biomasses were growing (Boluwaji et al., 2019; Demirbas, 2005), particularly on account of agricultural residues and forest (Biagini et al., 2006). In any case, a general life cycle investigation has demonstrated a rise in GHG emissions for woody biomass usage for biofuels (ICF, 2009). The rise in GHG emissions was the consequence of the utilization of fossils for energy production during different tasks engaged with, in supply-chain logistics (Nitschke & Innes, 2013). Then again, revealed that woody biomass gathering from sustainably managed forests really diminishes net GHG emissions, in this way, making it carbon negative.

Fossil-fired thermal plants, unlike biomass-fired thermal plants, produce large quantities of Sulphur IV oxide (SO_2) and nitrogen oxides (NO_x), the basic deleterious emissions in the acid rain. Acid rain increases the pH of water bodies, and damages the vegetation and seaside biological systems (Elehinafe Francis et al., 2017; Piotr, 2020; Trang et al., 2020). SO_2 and NO_x engender particulate formation. It is reported by US EPA in 2004 that ozone (smog) and nitrates are formed with NOx as precursors. Ozone mars the functions of lungs and diminishes the yields of numerous economically significant agricultural plants. Nitrates in precipitation make water bodies over-enriched, causing algal sprouts that kill aquatic and hamper biodiversity.

Woody biomasses as sources of energy do not fluctuate like other renewable sources of energy. For example, solar energy is not available during cloud cover and rainfall, hydro-electricity drops during the dry season. Seasons do not affect the supply of fuelwoods once trees have grown to the peak in sizes, numbers and as the ripe ones are being felled, they are replanted (Balat et al., 2009). So, power plants fired using woody feedstocks would never have a down time in operations. Hence, air emissions associated with the combustion of fossil fuels are controlled. Considering woody biomass potentials Nigeria has and the environment, there is need to identify, as many as possible, the available woody biomasses in terms of trees in Nigeria to the knowledge of investors, government and researchers.

2. Methodology

2.1. The study area

The study area is Southwest Nigeria which comprises Oyo, Ekiti, Ondo, Osun, Ogun, and Lagos States (Figure 1). The area is between Latitudes 6° 21^1 and 8° 37^1 N and Longitudes 2° 31^1 and 6° 00^1 East. The study area has an approximate land area of about 77,818 km^2 and 85 forest reserves with a forest area covering 842,499 hectares as reported by Faleyimu and Agbeja (2012). The climate of Southwest Nigeria is tropical and it is characterized by dry and wet seasons. The temperature ranges between 21°C and 34°C while the annual rainfall ranges between 1500 mm and 3000 mm (Agboola, 1979). The wet season is connected with the Southwest monsoon winds from the Atlantic Ocean and the dry season is associated with the northeast trade winds from the sahara desert. According to the report of Oluseyi (2014), the vegetation in Southwest, Nigeria is made up of fresh water swamp and mangrove forest at the belts, the low land in forest stretches inland to Ogun and part of Ondo state while the secondary forest is towards the northern boundary where derived and southern Savannah exist.

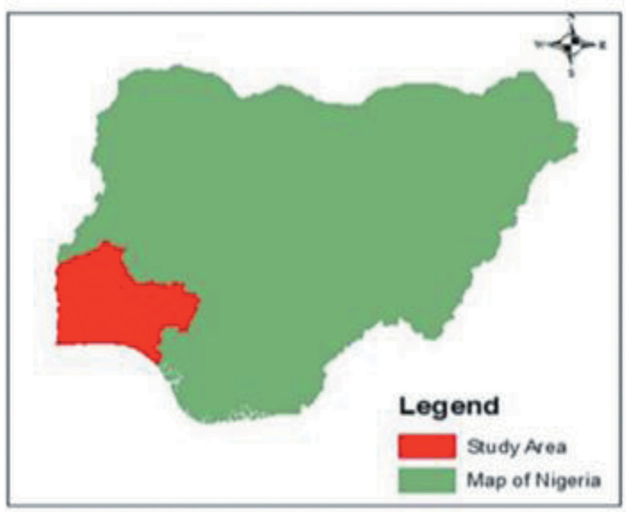

Figure 1. Vegetation map of South-West Nigeria **(Izuchukwu et al., 2020).**

2.2. Procedure for identification woody biomasses in Southwest, Nigeria

The woody biomass samples identified in this work were collected from different saw mills, farms and kitchens in Osun State, Nigeria. One hundred (100) samples of different common woody biomasses were gotten. Literature materials (Abdulrahaman et al., 2006; Erakhrumen et al., 2010; Oladunmoye & Kehinde, 2011; Wahab et al., 2013) were used to identify many of the woody biomasses in translating the vernacular name to the common, family or English and botanical names as well as the woody types—hard or soft. Flowers and fruits as well as vegetative parts of the rest whose vernacular names could not be traced to the common and botanical names in the literature, were taken to the herbarium of Botany Department, Obafemi Awolowo University, Ile-Ife for identification. The woody biomasses were classified into hard woody biomasses and soft woody biomasses.

3. Results and discussion

The results of the identification, nomenclature and classification are presented in Table 1. The identification was carried out to know the common names, the family or English names and the botanical names of the southwest Nigeria woody biomasses. The same categories of woody biomasses are processed at all the saw-mills visited. This is corroborated by the work of Olufemi et al. (2012) that the same kinds of woody biomasses are present in southwest Nigeria. One hundred samples of the woody biomasses identified were grouped into 39 families and classified into hard woody biomasses and soft woody biomasses out of which only two are soft and rest are hard.

From the numerical distribution of the woody biomasses based on families, the woody biomasses comprise 1 of *Bombaceae, Rhizophoraceae, Poceaea, Myrtaceae, Annonaceae, Gentianaceae, Myristiceae, Boraginaceae, Lecythidaceae, Phyllanthaceae, menispermaceae, Vitaceae, Urticaceae, Pinaceae, Asteraceae, Rosaceae, Fagaceae, Olacaceae and Acanthaceae;* 2 of *Clusiaceae, Rubiaceae, Lamiaceae, Irvingiaceae, Sapotaceae, leguminoceae, Bignoniaceae and Sapindaceae*; 3 of *Sterculiaceae, Apocynaceae*; 4 of *Arecaceae and Combretaceae*; 5 of *Meliaceae and Euphorbiaceae*; 6 *of Moraceae*; 7 of *Rutacaceae*; 11 of *Malvaceae* and 14 of *Fabaceae*. Ninety-eight of them are hard woody biomasses while two are soft woody biomasses (*Bombax buonopozense* from the family of *Malvaceae* and *Pinus ponderosa* from the family of *Pinaceae*). From the identification and nomenclature of the woody biomasses, the *Fabaceae* family is most abundant, 14%, followed by *the Malvaceae* family, 11%. According to Richardson et al. (2011), they have many species, grow and mature faster than other families. They are also resistant to climatic and edaphic factors. *Fabaceae* and *Malvaceae* families are known for their naturalization and invasion potential for they are mostly

Table 1. Woody biomasses identified in Southwest, Nigeria

S/N	Botanjcal name	Family	Comman name	Wood type
1	*Adansonia digitata*	*Malvaceae*	Baobab	Hard woody biomass
2	*Afrormosia elata*	*Fabaceae*	Shedum	Hard woody biomass
3	*Albizia gummifera*	*Fabaceae*	Ayinre Banaban	Hard woody biomass
4	*Anacardium occidentale*	*Anacardiaceae*	Cashew	Hard woody biomass
5	*Anogeissus leiocarpus*	*Combretaceae*	Orin Dudu	Hard woody biomass
6	*Antiaris africana*	*Moraceae*	Oriro	Hard woody biomass
7	*Anthocleista vogelii*	*Gentianaceae*	Sapo sapo	Hard woody biomass
8	*Antrocaryon micraster*	*Anacardiaceae*	Akikogbon	Hard woody biomass
9	*Artocarpus altilis*	*Moraceae*	Bread fruit	Hard woody biomass
10	*Asteromyrtus symphyocarpa*	*Myrtaceae*	Waria	Hard woody biomass
11	*Alstonia boonei*	*Apocynaceae*	Ahun funfun	Hard woody biomass
12	*Azadirachta indica*	*Meliaceae*	Dongoyaro	Hard woody biomass
13	*Berlinia grandifolia*	*Fabaceae*	Itako	Hard woody biomass
14	*Blighia sapida*	*Sapindaceae*	Isin	Hard woody biomass
15	*Bombax buonopozense*	*Malvaceae*	Ponpola	Hard woody biomass
16	*Brachystegia leonensis*	*Fabaceae*	Ako	Hard woody biomass
17	*Bytraria marginata*	*Acanthaceae*	Eso	Hard woody biomass
18	*Cassia fistula*	*Fabaceae*	Cassia	Hard woody biomass
19	*Ceiba pentandra*	*Malvaceae*	Araba	Hard woody biomass
20	*Celtis zenkeri*	*Ulmaceae*	Ita	Hard woody biomass
21	*Chasmanthera dependens*	*Menispermaceae*	Ato	Hard woody biomass
22	*Chrysophyllum africanum*	*Sapotaceae*	Agbalumo	Hard woody biomass
23	*Cissus adenopoda*	*Vitaceae*	Gbolagbola	Hard woody biomass
24	*Citrus limon*	*Rutaceae*	Lemon	Hard woody biomass
25	*Citrus sinensis*	*Rutaceae*	Osan pupa	Hard woody biomass
26	*Citrus paradisi*	*Rutaceae*	Osan wewe	Hard woody biomass

(*Continued*)

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Table 1. (*Continued*)

S/N	Botanjcal name	Family	Comman name	Wood type
27	*Citrus aurantifolia*	*Rutaceae*	*Grape*	Hard woody biomass
28	*Citrus medica*	*Rutaceae*	Tanjarini	Hard woody biomass
29	*Cleistopholis patens*	*Annonaceae*	Apako	Hard woody biomass
30	*Cocos nucifera*	*Arecaceae*	Agbon	Hard woody biomass
31	*Cola millenii*		*Sterculiaceae*	Hard woody biomass
32	*Cola acuminata*		*Sterculiaceae*	Hard woody biomass
33	*Cola nitida*		*Sterculiaceae* Obi Gbanja	Hard woody biomass
34	*Cordia milleni*	*Boraginaceae*	Omoh	Hard woody biomass
35	*Crassocephalum biafrae*	*Asteraceae*	Gbolagi	Hard woody biomass
36	*Cylicodiscus gabunensis*	*Fabaceae*	Okan	Hard woody biomass
37	*Daniella oliveri*	*Leguminaceae*	Iyaa	Hard woody biomass
38	*Daniella ogea*	*Leguminaceae*	Asunwole	Hard woody biomass
39	*Delonix regia*	*Fabaceae*	Panseke	Hard woody biomass
40	*Diospyros crassiflora*	*Fabaceae*	Ebony	Hard woody biomass
41	*Elaeis guineensis*	*Arecaceae*	Ope Igbo	Hard woody biomass
42	*Entanda gigas*	*Fabaceae*	Agbaa	Hard woody biomass
43	*Entadrophragma cylindricum*	*Meliaceae*	Sapelle Mahogany	Hard woody biomass
44	*Eucalyptus marginata.*	*Myrtaceae*	Jarrah	Hard woody biomass
45	*Ficus thionningii*	*Moraceae*	Odanko	Hard woody biomass
46	*Ficus carica*	*Moraceae*	Opoto	Hard woody biomass
47	*Ficus mucuso*	*Moraceae*	Obobo	Hard woody biomass
48	*Funtumia elastica*	*Apocynaceae*	Ire	Hard woody biomass
49	*Garcinia kola*	*Clusaceae*	Orogbo	Hard woody biomass
50	*Gliricidia sepium*	*Fabaceae*	Agunmoniye	Hard woody biomass
51	*Gmelina arborea*	*Lamiaceae*	Milaina	Hard woody biomass
52	*Hevea brasiliensis*	*Euphorbiaceae*	Para Rubber	Hard woody biomass

(*Continued*)

S/N	Botanjcal name	Family	Comman name	Wood type
53	*Hildegardia barteri*	*Malvaceae*	Okurugbedu	Hard woody biomass
54	*Hymenocardia acida*	*Phyllanthaceae*	Kampalaga	Hard woody biomass
55	*Irvingia grandifolia*	*Irvingaceae*	Karakoro	Hard woody biomass
56	*Irvingia excelsa*	*Irvingiaceae*	Oro (wild Mango)	Hard woody biomass
57	*Isoberlina doka*	*Fabaceae*	Babo	Hard woody biomass
58	*Khaya ivorensis*	*Meliaceae*	Ogano	Hard woody biomass
59	*Lecaniodiscus cupanioides*	*Sapindaceae*	Isin	Hard woody biomass
60	*Lophira lanceolata*	*Ochnaceae*	Pahan	Hard woody biomass
61	*Lovoa trichlioides*	*Meliaceae*	Tiger wood	Hard woody biomass
62	*Macaranga barteri*	*Euphorbiaceae*	Asasa	Hard woody biomass
63	*Mangifera indica*	*Anacardiaceae*	Mango	Hard woody biomass
64	*Mansonia altissima*	*Malvaceae*	Mansonia	Hard woody biomass
65	*Milicia excelsa*	*Moraceae*	Iroko	Hard woody biomass
66	*Mitragyna ciliata*	*Rubiaceae*	Abora	Hard woody biomass
67	*Musanga cecropiodes*	*Urticaceae* Alagbao	Soft woody biomass	Hard woody biomass
68	*Napoleona vogelii*	*Lecythidaceae*	Ito	Hard woody biomass
69	*Nauclea diderrichii*	*Rubiaceae*	Opepe	Hard woody biomass
70	*Nesogordonia paparivera*	*Malvaceae*	Oro	Hard woody biomass
71	*Newbouldia laevis*	*Bignoniceae*	Akoko	Hard woody biomass
72	*Parkia biglobasa*	*Fabaceae*	Irugba	Hard woody biomass
73	*Percuguaria daemia*	*Apocynaceae*	Koleagbe	Hard woody biomass
74	*Phoenix dactylifera*	*Arecaceae*	Date Palm	Hard woody biomass
75	*Pinus ponderosa*	*Pinaceae*	Pine	Hard woody biomass
76	*Piptadeniasrum africanum*	*Rosaceae*	Agboin	Hard woody biomass
77	*Poga oleosa*	*Rhizophoraceae*	Eku- Ijebu	Hard woody biomass
78	*Prunus dulcis*	*Rutaceae*	Fruit	Hard woody biomass

(*Continued*)

Table 1. (*Continued*)

S/N	Botanjcal name	Family	Comman name	Wood type
79	*Pterygota macrocarpa*	*Malvaceae*	Poroporo	Hard woody biomass
80	*Pterocarpus erinaceus*	*Fabaceae*	Gbigbigbi	Hard woody biomass
81	*Pterocarpus osun*	*Leguminoceae*	Osun Pupa	Hard woody biomass
82	*Pycnanthus angolensis*	*Myristicaceae*	Akomu	Hard woody biomass
83	*Quecus robur*	*Fagaceae*	Ayan Iroko	Hard woody biomass
84	*Raphia africana*	*Arecaceae*	Ayan Oguro	Hard woody biomass
85	*Ricinodendron heudelotti*	*Eurphorbiaceae*	Orunmodo	Hard woody biomass
86	*Spondias mombin*	*Anacardiaceae*	Iyeye	Hard woody biomass
87	*Sterculia rhinopetala*	*Malvaceae*	Aye	Hard woody biomass
88	*Strombosia pustulata*	*Olacaceae*	Itako	Hard woody biomass
89	*Strychnos spinosa*	*Loganiaceae*	Atako	Hard woody biomass
90	*Swietenia macrophylla*	*Meliaceae*	Mahogany	Hard woody biomass
91	*Symphonia globulifera*	*Clusaceae*	Okilolo	Hard woody biomass
92	*Tectona grandis*	*Lamiaceae*	Teak	Hard woody biomass
93	*Terminalia glaucescens*	*Combretaceae*	Idi	Hard woody biomass
94	*Terminalia ivorensis*	*Combretaceae*	Idigbo	Hard woody biomass
95	*Terminalia superba*	*Combretaceae*	Afara	Hard woody biomass
96	*Theobroma cacao*	*Malvaceae*	Cocoa	Hard woody biomass
97	*Triplochiton scleroxylon*	*Malvaceae*	Obeche	Hard woody biomass
98	*Uapaca heudelotii*	*Euphorbiaceae*	Akun	Hard woody biomass
99	*Vitellaria paradoxa*	*Sapotaceae*	Emi	Hard woody biomass
100	*Zanthozylum leprieuril*	*Rutaceae*	Ata	Hard woody biomass

leguminous plants (Richardson et al., 2011). They have noodles in their roots that house nitrogen-fixing bacteria. So, the soil on which they grow is always fertile. By these, in the absence of deforestation, southwest, Nigeria would never run out of supply of feedstocks to power plants if their utilization as energy carriers, is given attention by the governments and private investors.

Most of the woody biomasses identified are hard, 98%, for they are much more abundant than soft ones in the region. Woody biomasses contain varying amounts of cellulose, hemicellulose, lignin, proteins, simple sugars, starches and small amounts of lipids. They additionally contain inorganic components and a small amount of water. Among these constituents, hemicellulose, lignin, and cellulose are the three significant constituents with respect to energy or heating value of any woody biomass (Zhang et al., 2010). Lignocellulose is the blend of hemicelluloses, lignin, and cellulose, which involves around half of the plant matter manufactured during photosynthesis and make up the most bountiful renewable natural asset on earth. Cellulose, lignin and hemicelluloses are sturdily interlinked in lignocelluloses and are bonded chemically, by covalent cross-linkages. The biggest part of any lingo-cellulosic material is cellulose, trailed by hemicellulose and then lignin (Zhang et al., 2010). Though hemicellulose and cellulose are macromolecules built from various sugars; lignin is a polymer aromatic in nature produced from phenylpropaniod forerunners.

There are significant differences between hard woody biomasses and soft woody biomasses according to their compositions. Hard woody biomasses are on average about 10% denser than softwoods due to higher lignin and less moisture contents (Braaten & Sellers, 2013). These make hardwoods more useful for energy generation. Southwest, Nigeria is highly favoured naturally with hard woody biomasses to run her thermal plants on renewable feedstocks for air pollution control.

4. Conclusion

Considering the harmful effects of fossil fuels; the advantages of renewable energy sources and the challenges the world faces to have sustainable energy production and environment while reviewing the literature, and the results obtained in this study, i.e., the numerous woody biomasses of families of *Bombaceae, Rhizophoraceae, Poceaea, Myrtaceae, Annonaceae, Gentianaceae, Myristiceae, Boraginaceae, Lecythidaceae, Phyllanthaceae, menispermaceae, Vitaceae, Urticaceae, Pinaceae, Asteraceae, Rosaceae, Fagaceae, Olacaceae and Acanthaceae; Clusiaceae, Rubiaceae, Lamiaceae, Irvingiaceae, Sapotaceae, leguminoceae, Bignoniaceae and Sapindaceae; Sterculiaceae, Apocynaceae; Arecaceae and Combretaceae; Meliaceae and Euphorbiaceae; Moraceae; Rutacaceae; Malvaceae* and *Fabaceae* are available in southwest, Nigeria. Hence, the following conclusions were arrived at: the woody biomasses identified are many enough to be termed energy crops in the southwest, Nigeria for them to receive attention from investors and governments; the nation has the land mass that can support massive production of these woody biomasses identified. Employment opportunities would also be created through investment in the propagation of these energy crops in the region. It is expedient that the stakeholders look into these for the attendant benefits.

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