

## **Exploitation of Carbon Energy and the Integrity of Protected Rainforest Areas in Nigeria**

**Ewah, J. O. PhD**

Department of History and International Studies  
University of Calabar  
Nigeria

### **Abstract**

*Exploitation of fuel wood in pre-colonial Africa did not affect ecological balance. Carbon generated was sunk into living trees in exchange for oxygen. However, the coming of colonialism, industrial revolution, introduction of scientific or industrial forestry and urbanization has substantially altered the balance between exploitation and forest sustainability. The impact of fuel wood exploitation on protected areas in Nigeria and beyond on the environment is degrading. The study identified climate change and global warming as products of deforestation enhanced through charcoal and fuel wood exploitation. The study traced the origin of fuel wood and charcoal business in Nigeria and suggested alternatives to fuel wood that will enhanced the sustainability of the remaining rainforest areas in Nigeria and beyond. This study examined the form and content of fuel wood or biomass exploitation in different ecological zones in Nigeria and its impact on the integrity of the rainforest and savannah region in Nigeria. It also referred to environmental challenges such as climate change desertification global warming and floods as some of the major effects and contributions of fuel wood and charcoal to environmental degradation. The study emphasized the role of households and commercial exploitation in environmental abuse and suggests alternative methods such as renewable energy and stoves to check the negative effects of climate change, desertification and global warming in Nigeria and beyond.*

### **Introduction**

There are different sources of energy in Nigeria. Carbon energy, gas, petroleum and renewable energy, primary to this study is the popular and most accessible form of energy in Nigeria carbon energy. Carbon energy predates imperialism in Africa and has remained dominant in utility in Nigeria and beyond. In Nigeria, predominantly rural population depends mainly on fuel wood to meet basic energy needs for cooking and heating. Recent studies revealed that Nigeria produces about one million tons of charcoal annually of which 80% is consumed in cities. Fuel wood and charcoal account for about 50% of the natural primary energy consumption. Fuel wood is demanded by both household and industrial sectors in all ecological zones of the country. It is estimated that about 90% of the rural households in the southern Nigeria and upto 98% in northern Nigeria depend on fuel wood as their source of domestic energy.

Fuel wood is very important in local restaurants, bakeries; local factories institutions such as hospitals, prisons, schools also demand fuel wood for cooking. The per-capita consumption of fuel wood in rural areas is 393.43 kg/annum while the urban households consumed 355.75 kg/annum. Fuel wood exploitation is limited to community forest areas in the south and savanna areas in the north. These areas are proximate to reserves and protected park areas in Nigeria (FOSA Country Report on present status of forestry sector of Nigeria, 1998. See also FDF, 1986).

### **Management of the Nigerian Rainforest**

Local governments in Nigeria are responsible for the administration of communal rainforest lands. The state governments control and manage forest reserves, game reserves and game sanctuaries. The federal government under the exclusive legislation list is responsible for the control, protection and management of National Parks. There are about 1129 forest reserves 29 game reserves 4 game sanctuaries and 12 National Parks (CFA). The impact of fuel wood and charcoal exploitation on these ecosystems is enormous and negative on the Nigerian society and environment. Nigeria is at present a wood deficit nation.

In order to ameliorate the situation, the policy on forest resources management and sustainable use is aimed to achieve self-sufficiency in all aspects of forest production through the use of material resources. The overall objectives of forest policy is to prevent further deforestation or protective purposes on already deforested fragile land (present status of the forest sector of Nigeria FOSA Country Report Nigeria, p. 12).

### ***Carbon Energy***

Carbon energy has many sources in the forest. Dead plants from old age wind storm flood and macro-farms from peasant farming. In pre-colonial era, traditions are firm that access to carbon energy was not restricted. Farmers, hunters and other users access carbon products in the rainforest. Dry wood had many uses. Its firewood for cooking food, cooking spirits, blacksmithing, fashion as seats at home and in the farms Cam wood for decoration, design and manufacturing domestic crops, property and cultural mask or artifacts. Within riverine Nigeria, rainforest hardwood is dried and used to manufacture canoes. The forest was the only supermarket and source of all materials mentioned above.

Biomass evolved from household need for energy into lucrative commercial enterprise in the colonial era. As a lucrative business the returns are enormous for households who exchange surplus with urban dwellers and biomass companies. In Kenya capital Nairobi over 70 tonnes of charcoal dust is discarded daily. Ten percent of that waste is absorbed by the company called chardust which salvages it from charcoal traders across the city and processed it with blinders as charcoal alternative. The company produces about 350 tones per month as saleable product.

In Tanzania charcoal market remains largely backstreet industry valued at about 150 million dollars a year. The figures serviced East African Friguette Company which produced an organic alternative in a region where 90% of the people use charcoal. The company product Mkaa-Bora is prepared for waste and post harvest products such as sawdust, charcoal, dust, maize, cobs and banana skins. The product burns more slowly and is 30% hotter than traditional charcoal (Camilla Tailmin, 2009).

In Uganda, where the forest is half zone in the past 30 years charcoal production yields 20,000 jobs and generates more than 20 million collars in income every year. Cameroon, Kenya, Nigeria, Mali and Congo republics are high income earners from charcoal production with Kenya topping the list of producers. In Chad, charcoal is the sole source of household fuel for about 79% of Chadians. The banned on charcoal leaves households with option of gas which is sold at about 135 dollars per tag out of reach to Chadians households. The ban was prompted by damaging environmental records. Government estimates are that the country has lost at least 60 percent of its natural tree cover. The Sahara desert is advancing southwards to the Sahel zone is a major environmental challenge (Camilla Tailmin, 2009).

Within sub-Saharan Africa, temperatures are climbing up to 50 degrees Celsius and sporadic rains start a month late to devastate the environment. Ban of charcoal in Chad had created scarcity in obtaining and delivering charcoal to urban areas. This is already causing catastrophic rise in prices of charcoal and food prices. Are African countries keen to break away from the convenient job creator under this challenging economic climate? The challenges of climate change and economic benefits from biomass business are the challenging options that informed the choice of this study.

However, if African states can remove about 5 billion tons of carbon dioxide from the atmosphere through tree planting and leaving the rainforest intact, this will attract about 825 billion dollars a year. This is a compelling argument for Africans to conserve the tropical rainforest. Is African preparing for this windfall? According to United Nations, the continent is losing forest twice as fast as the rest of the world. In pre-colonial times Africa boasted of about 7 million square kilometers of forest but a third of that has been lost most of it to charcoal and carbon wood (Camilla Tailmin, 2009).

In sub-Saharan Africa 7.5% of the population have access to electricity. Wood and its by-product charcoal until radical steps are taken will likely remain primary source of energy for many decades. It is estimated that carbon from deforestation is accumulation in the atmosphere at an annual rate of 3.5 million metric tonnes. One hectare of trees can offset up to 200 tonnes of carbon per year. In Africa 70% of household income is spent on energy (diesel, kerosene, charcoal and gas) 80% of Africans rely on biomass for energy, 4 million hectares of forest is felled each year in Africa twice the world average (Camilla Toulmin (2009), Speak up or go under in BBC focus on Africa magazine, October – December 2009, p. 14).

In Nigeria fuel wood exploitation is restricted to community forest reserves private estates, farmlands and public plantations. These areas of exploitation are however proximate to protected park and reserves areas in all ecological zones in Nigeria.

### ***Carbon Energy and the Nigerian Experience***

Biomass and the Nigerian experience can be classified into two: the pre-colonial and colonial era. During the pre-colonial era, traditions are firm that firewood like water was products of nature from the rainforest. Dead leaves decomposed to sustain living trees while the trunk and branches are dismantled and used as fuel wood. Besides fallen trees, fuel wood was also obtained from macro farmlands. Farmers cut down trees to attract sunlight to growing crops, farmers often cut down trees or set fire to them. Overtime the decomposing trees are exploited as firewood. The quantity of wood needed to cook food was obtainable from deadwoods and dry wood in farmlands. Firewood was not an article of trade but for domestic use by households.

Within different ecological zones in Nigeria, the quantity and application or utility of biomass began to change with the coming of Germans and British imperialism in modern Nigeria. The penetration of the modern Cameroon by Germans into the interior upto modern Boki, Ejagham and Obanliku areas across modern Nigeria – Cameroon borderline completely altered the source, quantity and utility of fuel wood in Nigeria. The Germans introduced commercial agriculture which involved clearing and logging large acres of land for plantation agriculture. German firms extended upto border areas within modern Cross River region of Nigeria (Tambi Eyongetah, Robert Brain *et al*, 1987).

In 1913 there were fifty-eight plantations established in German Cameroon. Most of the companies were registered and based in Germany. The companies were owned by individuals, the state and missions. The companies employed about 17837 African labour and about 199 Germans as managers and technicians. The most influential of the companies was they were owned by Hamburg based trader called Adolf Woermann. The firm achieved dominant position also in Liberia and Gabon. Degraded dry woods became the major source of energy in plantation to provide food, energy, light and fashioned wood tools. Within the Cross River region fuel wood became the dominant source of carbon energy, commercial exploitation became necessary to sustain increase demands by resident workers in German plantations (Tambi Eyongetah, Robert Brain *et al*, 1987).

Labour relations in the plantations were horrible. Ill-treatment meted out to plantation workers and high death rate of workers unaccustomed to the malarial zones created mass poverty among the workers and high dependence on fuel wood as a source of energy. British conquest and occupation of modern Cross River region and subsequent take over of German territories along modern Nigeria – Cameroon borderline in 1914 further degraded the rainforest. Like the Germans the British established agricultural plantations in modern Cross River region. The British established Calaro Rubber and Oil Palm estates within lower Cross River region within modern Odukpani, Akamkpa and Akpabuyo Local Government Areas. In eastern and western ecological region, the British promoted oil palm and cocoa plantations respectively. These plantations degraded the rainforest and attracted unskilled labour that depended on fuel wood for energy needs across the country. The British did not only promote local plantation agriculture but exploited and exported logs and wood processed sawmills that also generated saw dust round wood, sawn wood and wood based panels particles as carbon energy within ecological regions (FOSA Country Reports, 1986).

Post independent Eastern Regional government intensified exploitation of the rainforest and reproduction of fuel wood. The government established cocoa rubber, oil palm plantations across modern Cross River north, central and south forest areas. Each of these estates established farm settlements that depended on fuel wood for energy. These estates elevated fuel wood from domestic use by households to a lucrative commercial venture for locals within farm settlements and beyond. The state equally granted logging concessions to local timber dealers and logging companies and pay royalties to the states and host communities.

The construction of rural – urban highways in Nigeria also helps to promote the expansion of fuel wood production and circulation in all ecological zones. A classic example is the construction of Calabar – Ikom – Katsina Ala road across the south middle belt and northern Nigeria between 1970 and 1980. Because of access roads, communities within the Cross River region and beyond embarked on plantation agriculture cultivating large acres of plantain and bananas to sell in northern Nigeria. The highway also touched off increase production of fuel wood in high demand in urban areas in the middle and northern regions of Nigeria.

The construction of Seromwood Industry, Nigeria Newsprint Manufacturing Company (NMMC), Oku-Iboku and Wemco Wood Processing Company within the Cross River region degraded the rainforest, created biomass depended settlements and increased production of fuel wood. The degradation of the rainforest in ecological zones in Nigeria, mass production of fuel wood and the attendant consequences on climate change are the direction of this study.

The growth of urban areas in Nigeria accounts for increase demand on fuel wood. The rural and urban poor populations are increasing. Households within these classes depend heavily on fuel wood to provide energy. Majority of these low income earners cannot afford electricity or gas to serve energy needs such as cooking and heating. Recent studies revealed that Nigeria produces about 1 million tonnes of charcoal annually of which 30% are consumed in the cities. Fuel wood and charcoal account for more than 50% of the natural primary energy consumption. Fuel wood is demanded by both household and industrial sectors in all ecological zones of the country. It is estimated that about 90% of the rural households in southern Nigerian and upto 90% in northern Nigeria depend on fuel wood as their source of domestic energy.

Between 2003 and 2012, when the federal government, states, banks and external donors made grants available to cassava farmers, locals who produce cassava put more than half of their energy into garri production. Garri production requires high quantity of biomass or charcoal to dry the garri for consumption. Within centres of high production, example Ugep, Obubra and Ogoja Local Government Areas, informants are firm that the demand for charcoal and fuel wood is increasing in quantity and price. The buyers locate the suppliers from Boki, Etung, Akamkpa and other support zone communities within Okwangwo and Oban Division of Cross River National Park.

The expansion of cocoa estates from Southwestern Nigeria to southeast of the country have equally led to increase demand for biomass. To produce cocoa for external markets a lot of energy is required to heat the cocoa seeds. Within the west, biomass is obtained from community forest area proximate the cocoa farms, labour settlements and cocoa, rely on importation of charcoal from the north. Within Cross River region, charcoal is imported from the north to supplement decreasing supplies from community forest and state reserves. Charcoal from the north is equally in high demand by hatchers, prisons, institution, industries, and bakeries, schools within urban areas in both north and south. Bakers, prison management and schools are firm that gas and electricity are too expensive and unstable in supply to plan feeding with it. Charcoal circulation in urban areas is from the north. It is expounding to meet the demand of institutions nationwide.

Biomass is very important nationwide in local restaurants, bakeries, local breweries, pottery, and blacksmith and burnt brick factories. Institutions such as hospitals, prisons, schools also demand fuel wood for cooking and heating. The per capita consumption of fuel wood in rural areas is above 393.43 kg/annum while the urban households and cottage industries consume more 255.75 kg/annum. Fuel wood exploitation is limited to community forest and savannah areas. These areas are proximate to reserves and protected park areas in Nigeria (Present status of forestry sector of Nigeria, 1998). Biomass utility is not limited to Nigeria. In Africa 70% of household income is spend on energy (diesel, kerosene and charcoal). 80% of Africans rely on biomass for energy wood or charcoal fuel. 4 million hectares of the forest is felled each year twice the world average (Camilla Toulmin 'Speak up or go under' in BBC Focus on African Magazine, October – December, 2009, p. 14).

### ***Economic Benefits***

The production and commercial exchange of biomass in Nigeria are incidental products of colonial economy. Between 1854 and 1914 the Germans created 58 plantations partly housed within modern Cross River region. Each of estates has labour settlements that depended on fuel wood for cooking and heating. The British like the Germans between 1914 and 1960 established agricultural plantations in modern Cross River region and equally encouraged locals within western and eastern regions to cultivate cocoa and oil palm plantations. The plantations degraded the rainforest and attracted unskilled labour that depended on fuel wood for energy needs. The British equally created industrial and administrative cities that created the urban poor from the villages and inter-city networks that created biomass depended markets.

Post independent governments in Western and Eastern region established cocoa and oil palm plantation that attracted rural migrations to plantation farms. Each of this estates established farms settlements that depended on fuel wood to dry cocoa seeds and provide energy to cook food.

The German, British and post independent agricultural policies put in motion the elevation of fuel wood from domestic use by households to a lucrative commercial venture for locals within farm settlements and the urban poor. The construction of highways linking different ecological zones and cities further elevated fuel wood business into inter-regional trade in Nigeria and beyond.

Within the ecological zones of Northern Nigeria in the savannah region isolated trees are cut down and processed into charcoal and marketed across all ecological regions in Nigeria. Despite the existence of reserves and National Parks the volume of fuel wood production appear to be on the increase. 80% of average northerners are low income households with over 98% of households depending on fuel wood for energy. Processing fuel into charcoal that burns with intensity makes their biomass products marketable and attractive to bakeries, schools, prisons, institutions across Nigeria. The demand for fuel wood increases daily as rural migrations into urban centres in northern Nigeria is not defined to include rural and social development of rural areas. The urban poor who constitute about 98% of city populations rely on biomass for cooking and other energy uses.

Economic gains of charcoal production and exchange are enormous. Africa energy power clearly suggests the benefits of biomass, wood, charcoal to African economies. In northern Nigeria biomass creates jobs despite encroaching desertification in the region. Biomass production and distribution creates more than 200,000 jobs and generates more than 50 million dollars income every year. The income is shared unevenly amongst tree cutters petty traders, hawkers and whole sale traders who supply to consumers across the regions of the country. Informants are firm that fuel wood business is independent from government interference despite taxation of lorries transporting the products across the nation. Production and circulation of fuel wood involves the rural poor, urban poor and industries across the nation (Ahmed Yakubu and others BHTIV). Any future alternative from this convenient job creator, must attend to the basic need of the urban and rural poor especially under present or existing and challenging economic climate in Nigeria to invest in any alternative. This will be a test on the commitment of the state to environmental protection in Nigeria. This situation is not peculiar to Nigeria. In Tanzania, Kenya, Uganda, Chad and most states in sub-Saharan Africa, charcoal has produced huge income and industries that process charcoal and provide jobs to complement employment provided by producers and traders in business. Eastern African Friquette Company, chardust and Brit Nicholas Harrison Companies are notable multinational fuel wood managing companies in East Africa.

In Africa, only 4% of electricity generates worldwide is produced in Africa. Sub-Saharan Africa has the world lowest electricity rate at 25 – 29%. Rural electrification rate in sub-Saharan Africa is only 8%. About 70% household incomes in Africa are spent on energy (diesel, kerosene and charcoal). 80% of Africans rely on biomass (wood and charcoal fuel). The above data clearly reflect the relevance and dependence on biomass for meeting energy needs in the continent. Nigeria, Tanzania, Chad, Kenya and Uganda, biomass has attracted huge income (Anthea Rowan “Burning Issues, Charcoal is big business in Africa but the long term impact could be disastrous”, in BBC Focus on Africa, October – December 2009, pp. 14 – 16).

In Nigeria fuel wood constitute a major source of household income. Studies carried out by the Federal Department of Forestry revealed that the estimated annual income accruing to this sector is about N17.63 billion on a conservative note. The predominantly rural Nigerian population depends mainly on fuel wood to meet basic energy needs for cooking and heating. Recent studies revealed that Nigeria produces about 1 million tonnes of charcoal annually. 80% is consumed in the cities. Fuel wood and charcoal accounts for 50% of the natural and primary energy consumption. Fuel wood is demanded by both household and industrial sectors in all ecological zones of the country. It is estimated that about 70% of rural households in southern Nigeria and upto 90% in northern Nigeria depend on fuel wood as a stable source of domestic energy.

Industrial uses include institutions, food and craft industries. Fuel wood is very important in local restaurant, bakeries, local breweries, pottery, blacksmith, smoked fish business, fish restaurants and burnt brick factories. Institutions such as hospitals, prisons and schools also demand fuel wood for cooking. The per-capita consumption of fuel wood in rural area is 39343 kg/annum while the urban households consume 25575 kg/annum (FDF, 1986). Within Ebony, Cross River and Benue States rice and palm oil producers rely on fuel wood to pre-heat palm nuts and per-boil rice seeds for processing. The demand for fuel wood from amongst marketers far outpaces supply. The major source of fuel wood is from community forest and reserves areas controlled by the states. Marketers of fuel wood are firm that the demand for fuel wood will continue to expand because of state emphasis on food production, cereals, garri cocoa, and oil palm which resume increase demand of biomass (Bassey Oden Ewah and other, Ugep Historical Text IV 24 February 2013; Cassava and Garri producers.

See also Ukpar BJ and others, Ogoja Rice Farmers and Producers Association, Ishibri village, 27th January 2013). Charcoal produced by bread industries is resold to corn, yam, fish, akara and plantain roasters in different ecological zones in Nigeria. Thus, the production of fuel wood is expanding in all ecological zones in Nigeria. The implications of fuel wood on the Nigerian and global environment is enormous and chilling.

### ***Biomass and the Challenges of Climate Change***

Climate change can be described as the collapse of the atmosphere system processes and pattern which represent massive environmental challenges to maintaining a habitable earth-climate change and climate variability manifest themselves in global warming and extreme weather events such as floods, drought, heat waves and typhoons. These phenomenons affect land and marine products systems from which livelihoods are derived and also destroyed infrastructure and other life support system.

In Nigeria, the above scenarios have manifested itself. The release of water from Gado dam in 1992 in the Republic of Cameroon into Rivers Niger and Benue that flow into the Atlantic Ocean causes flood. The flood caused extensive damage in riverine communities and delta areas. Apart from destruction of infrastructure, lives and properties, farmlands were swept away signaling impending hunger and famine in Nigeria. Isolated forest areas and savannah trees in the north were cleared for farming or cut to produce fuel wood. This has induced high temperatures in the north. Soil degradation and erosion now pose serious challenges to Eastern States and floods within Niger Delta and coastal states in the west especially Lagos and Ibadan.

Climate change poses fundamental and varied challenges to all communities across the globe. The situation is worse in Africa because climate change risk and exposes or exacerbated by a wide range of endemic structural and vulnerabilities such as wide spread poverty reduce yields of main staples entrenched inequalities in rights over land resources, lack of access to technology and information, endemic corruption and lack of effective governance (Prof. Fagbohun: "Nigeria's Quest for Environment Governance" in the Nation Tuesday 12, February, 2013, pp. 36, 37).

Growing human activity besides exploitation of biomass has equally increased the concentration of radioactive gases in the atmosphere thus changing the radiation balance of the earth. These human actions include: burning fossil, deforestation, bush burning and industrial pollution. Other sources of carbon include cars, trucks that generate lead to contaminate the atmosphere, dust, noise and smoke pollution. New species of green house gases have been created by man's use for solvents, refrigerators, aerosol spray, propellants, foam packing, mothem ( $\text{CH}_4$ ), carbon ( $\text{CO}_2$ ), nitrate oxide, halocarbon and hellions have increased in the atmosphere green house gas is evenly distributed between countries and regions. While the industrialized countries are responsible for the majority of historical and current emissions other regions particularly African states emit negligible amount of air pollution and anthropogenic green house gases. Generally, United Nations current report on climate change and global warming report in September 2013 revealed that in the past fifty years human activities predominate in the promotion of global warming (CNN News, 27th September, 2013).

Africa contributes less than 3.5% of global emission of  $\text{CO}_2$  compared to the industrialized countries. The greatest emitters of carbon are United States of America 5.2 billion, India 4.3 billion and China 3.6 billion. To combat climate change, world climate fund a product of Doha Congress 2012 budgeted only 78 million dollars to ensure clean air. This project is promoted by Clean Air Coalition, the organization responsible for promoting climate change stability. The resolutions of Doha Congress on climate change are not remarkable different from that of Koyoto protocol between 1750 carbon in the atmosphere increased from 10% to 60% in 1990. Growing human activities is regrettably increasing the concentration of radioactive gases that alters the radiative balance of the earth.

Climate change induced by deforestation and green house gases are generated by industrial nations has multiple impacts on diverse scales and in particular affected ecosystems which in turn affect livelihoods and human well being. A rise in temperature of  $10^0\text{C}$  will affect land, coastal, marine, freshwater, forest, wood and land resources. The incidence of increase coral reef bleaching may be responsible for recent rises in global ocean temperature. New health challenges are expected such as vector borne diseases such as malaria, dengue fever, schistosomiasis, chagas disease, asthma, respiratory diseases are predicted to be on the increase. Climate change will equally affect food production system negatively through floods and high temperatures thus contributing to malnutrition, famine and starvation. Climate change may contribute to population displacement as a result of flood and drought undermining social cohesion and cultures as occasioned in 2011 in Nigeria.

Hurricane Katrina, Hurricane sandy in United States and floods in India, Pakistan, China and Pakistan; heat waves in Europe, bushfires in Europe and China have been linked scientifically to the presence green house gases in the atmosphere.

In Africa Biomass fuel related deaths are only second to those caused by malaria, an expert has said. In Nigeria Infrastructure Advisory Facility (NAIF), an expert Hajia Amina Salihu disclosed in a workshop organized by NAIF and the Better Life Programme for African Rural Women (BLPARW) on clean cooking, said that inhaling smoke from cooking with unclean fuel was equivalent to smoking three packs of cigarettes a day. Burning biomass fuels has adverse effect on the environment and the climate. Air pollution caused by firewood cooking and other biomass fuels is responsible for 93,000 deaths annually, thus making it the second highest killer in Nigeria after malaria.

### ***What is to be Done***

One of the major consequences of sustained forest degradation is climate change. Fuel wood is one of the major factors in forest degradation. Global warming involves dry areas getting drier and wet areas getting wetter. This imbalance will make subsistence farming upon which millions of rural and urban poor depend even more precarious. It will promote famine and diseases amongst urban and rural poor. The only positive option for Africans is to adopt the option for Africa to keep her forest standing so that they provide environmental services such as carbon sink. It is estimated that carbon from deforestation is accumulating in the atmosphere at an annual rate of 3.5 million metric tones. One hectare of trees can offset up to 200 tonnes of carbon per year.

The state, regional and international institutions must recognize that carbon is everywhere. It is found in the oceans, air, soil, plants and animals. Carbon is a multi-purpose element able to bond with many other elements to form solids liquids and gases. The process where carbon can be captured and stored is known as carbon sinks. Some options exist to reduce emissions which can be captured and stored. There are possible ways of reducing warming using the mirror in space to reflect sunrays away from the earth. Capturing and storage of carbon dioxide emission in old and new forest lands appear natural and cheaper means of carbon sinks.

Carbon can also be reduced in the atmosphere through the use of less energy consuming instruments and activities such as vesto stove, flight reduction, improved energy efficiency such as driving fuel efficient cars using energy with lesser carbon content such as converting from coal to solar power, using energy with lower carbon content such as it is better to use gas than oil which is till better to use than coal and charcoal. Above all, it is better to use renewable energy from wind, sun and waves to limit the use of carbon. Renewable energy also includes hydropower biofuel and nuclear power which involves trapping energy flow in nature.

Another approach is to use technology to capture industrial carbon at the point of emission before burying it. Plants are natural carbon sunk plants, breath in carbon and store it in their biomass as they grow. Trees are particularly good at this because of the size and longevity. To sink carbon using trees the amount of emission must be equivalent to new forest created and preserved. In China, solid waste sites are processed into carbon energy and used to generate electricity. This acts as carbon credit points by industries generating the waste to service electricity bills.

Recent pictures and commentary on air pollution in challenges of climate change in Northern China shared increasing fog or hose in major cities of the north preventing traffic from industrial activities and pedestrian movement. The state is intensifying methods to get unfit cars off road, industrial carbon fumes to reduce carbon energy and promote solar energy, noting more fundamental in checking climate change than checking industrial pollution and allowing the trees to stay (CCTV). Solar waste sites in China are used to generate energy for electricity for both domestic Chinese and international markets in the West as carbon credit. The depression of western markets to declines in the prices of carbon credit in the West (CCTV, 10th November, 2013). Carbon credit involves two categories of buyers Industrial or transnational companies covered by the Kyoto Protocol. These companies are required to limit gas emission to regular levels. This category of buyers is referred to as compliance market. The credit they buy from developing nations must be certified by United Nations Clean Development Mechanism (CDM). The second category comprises companies and individuals not regulated by Kyoto Protocol. These are buyers who simply want to offset their carbon emissions for social responsibility reasons. This second category of buyers is referred to as voluntary market and several third party standards additional to the CDM are available to these buyers. Prices vary between 5 dollars to 20 dollars per tonne of carbon requested.

In fact, current prices in August 2013 have further dropped from 20 to 25 dollars per tonne to 3 – 5 dollars (Dr. Goenin Ojo) further considered that African's would planned their economy beyond the benefits of carbon credit market because market instability amongst voluntary market operators (Punch Friday August 23, 2013, p. 9).

As it stands, Africa has the potential to generate about 5 billion dollars a year in carbon credit by ensuring that agricultural production methods are greener and by protecting or adding to the continuants forest cover. However, one serious limitation facing Africa is that agro-forestry, disforestation and forestry are activities excluded under the Kyoto Protocol of 1991 and therefore restricted to the voluntary carbon markets. Climate change summit in Copenhagen in 2009 and Doha Congress in 2012 have done little to alter this restriction on carbon market for developing economies (Anver Versi, (2009), How Africa can earn billions from carbon trading in New Africa 43<sup>rd</sup> edition June, 2009 NLO 483, pp. 65 – 67). The last Climate Change Conference in China in November, 2003 led to massive walkout of Environmental NGOs walking out of the conference hall because industrialized nation, held to be great polluters of the environment are not converted to carbon credit and refusing to promote green energy production (CCTV, 11th November, 2013)

Another approach to control carbon emission is to use technology to capture industrial carbon at the point of emission before burying it. Plants are natural carbon sinks; plants breathe in carbon dioxide and store it in their biomass as they grow. Trees are particularly good at this because of their size and longevity. To achieve sinking using trees the amount of emissions must be equivalent to new forest created and preserved.

A 40 year study organized by the University of Leeds on African forest revealed that the forest accounted for a third of the world total tropical forest. The size demonstrates clearly that Africa is indeed a significant carbon sink. The removal of nearly 5 billion tones of carbon dioxide from the atmosphere by leaving the rainforest intact is valued at about 25 billion dollars a year. This is compelling argument for the protection of the tropical rainforest and income gain from carbon credit. To achieve this feat, the state must encourage communities within rainforest area to stop using the traditional slash and burning technique of clearing land rather, locals should be encourage plant trees which replenish forest cover that strengthens the world lungs (Anthea Rowan, BBC Focus on Africa, p. 14).

Reduction of wood carbon in both urban and rural areas can be achieved through the use of cow dung, vesto stove and solar energy to generate alternative carbon energy. In Kenya Dr. Cheryle Moirb, of Fubal Voice consultancy has induced extraordinary cow dung fuel initiative to counter deforestation in Kenya parks. The Dung is mixed with waste paper and water fashioned into briquettes and sundried for use. Since the project was initiates in March 2009 the firewood collection has reduced by 75% in the five villages where the scheme has been piloted. Adopted in Nigeria this approach will reduce deforestation in Northern region where cow dung is available in commercial quantity (Celeste Hicks, 2010; Fuel Fiasco BBC).

Another example for Nigeria is the Tanzania experience. The East Briquette Company produce organic alternative to carbon in a region where 90% of the population depended on the use of charcoal. The company's product Mkaa Bora is prepared from waste and post-harvest products such as sawdust, charcoal dust, maize cobs and even banana pills or skins. The waste burns more slowly and it is 30% hotter than traditional charcoal where about 40% of the wood fuel is converted into charcoal as usable fuel. Using gas instead of fuelwood will reduce atmospheric gases. The Nigerian state can learn lessons from Republic of Chad where charcoal is banned and replace with gas. The state of Chad is subsidizing gas sales in urban areas though the price of gas is still above the reach of low income earners. The state appeared to have no alternative than to halt desert encroachment and culture low income earners to turn to gas usage. Gas is imported from Nigeria and highly subsidized by the Chadian state. Stopping the Sahara from taking over Chad's still semi-arid Sahel zone is a major environmental challenge. In Nigeria, fuel is subsidized and made available to urban and rural populations. Gas can be subsidized and made equally accessible to urban and rural poor. This approach will reduce dependence on charcoal trade in urban areas in Nigeria like virtual power plants designed to conserve electricity, vesto stove is designed to save trees by its inexpensive and efficient wood burning cooker. Unlike gas which is available to high income earners, vesto stove is available to both urban and the rural poor in terms of affordability and applicability. The portable vesto stove burns wood and dung more efficiently and with fewer emissions than conventional stoves. Dung its major component is a low yield and smoky fuel. The key to its efficiency is the design that it pre-heats the fire and prevents heat loss. Another important aspect of the store is that its production process does not require complex and expensive process of manufacturing. The stove burns virtually any biomass fuel. This enables households to depend less on charcoal or fuelwood.

The state can subsidize mass production of vesto stove and made them available at cheaper prices to rural north urban poor and enclaves and support communities within National parks, reserves and protected areas in Nigeria (Crispin Pemberton – Pigott ‘in Swaziland, saving a ‘virtual forest with an efficient new stove design’ in one country Newsletter of Bahai International Community, October – December, volume 16, Issue 3, pp. 8-9.

The use of renewable energy is equally important in fighting global warming and climate change. In Africa and other parts of the world, 1.5 billion people lack access to modern forms of electricity and three billion cook on smoky inefficient use of energy resources. Dependence by the industrial world on fossil fuels and inefficient use of energy resources are doing irreparable harm to our planet though global warming and threat to global populations on the lives and livelihood of Africans in particular. That is why the promotion universal access to sustainable energy is welcome development.

The activities of Solar Aid Company in producing solar powered lamps for reading and lightening in East and Southern Africa – Kenya, Malawi Tanzania and Zambia and spreading into west Africa in 2013. The spread is a welcomed development to people who need it to tackle climate change. Solar Aid was given the prestige’s Ashden award for a green sweep across parts of Africa in the production of solar powered lamps sold were half a million across South and Central Africa. The aim of solar energy lamps according to Solar Aid is to eradicate the kerosene lamp from Africa by 2020 (Stephen Williams (2013) ‘African completes a green sweep’ in New Africa 17th year August/September 2013, N<sup>o</sup> 531, pp. 62 – 63).

Besides, solar powered lamps impacts have improved in Uganda reckon that improved. Cooking stoves Technologists can save families fuel cost that reduces fuel by two thirds. In Uganda improved cook stove has been distributed to over 200,000 families. This operation alone, have displaced nearly one million tons of greenhouse gas emissions and saved about 700,000 trees. The company employs around 80 individuals and supports the income of 800 retailers. Even Shaigler who heads the carbon company team in the development of carbon finance projects in less developed countries explained that Uganda operations alone have displaced about one million tons of greenhouse gas emissions and saved some 700,000 trees.

In a similar situation in DR Congo the World Wildlife (WWF) is supporting the establishment of the local production of efficient cook stoves in order to cut down the use of charcoal. After trials and testing, the WWF selected the Jiko Ngawe Nyeusi (Black Power Stove) for mass production and distribution. The success of this project was staggering. Six months into the project, a total of 45,000 stoves had been produced by WWF and its affiliates with 55% of the stoves sold in Goma. Each stove cost under 10 dollars with the savings from charcoal they pay for themselves in every two weeks of normal use.

Elimination of charcoal for energy uses will be difficult amongst rural and urban poor. To tolerate charcoal, WWF project introduced plantation plant farms of about 3,900ha plantation to supply fast-giving trees for charcoal production on sustainable basis until solar and gas energy eventually replace carbon energy. This WWF project is targeted also at trying to stop the felling of trees in Virunga National Park by illegal charcoal producers that previously supplied about 30% of the charcoal sold in Goma with a population of about 1 million people with 90% of the population cooking with charcoal Virunga National Park is considered of huge importance for the biodiversity it contains and also the home of endangered mountain gorilla. It is estimated that WWF project, has saved 7,500ha of the forest (Stephen Williams, 2013, New Africa, p. 65).

Amongst improved cooking stove, vesto stove is designed to save many trees by its inexpensive and efficient wood burning cooker. Unlike gas which is available to high income people, vesto stove is available to both urban and rural communities in terms of affordability and applicability. The portable vesto stove burns wood and dung more efficiently and with fewer emissions than conventional stoves. Dung its major component is a low-yield and smoky fuel. The key to its efficiency is the design that the pre-heats the fire and prevents heat loss. The stove production process does not require complex and expensive process of manufacturing. It burns virtually any biomass fuel. This enables households to depend less on expensive charcoal. The federal, states and local governments councils in the northern region and National Park areas can subsidized mass production of vesto stove and market them at cheaper prizes to low income households (Crispin Pemberton,204).

Finally, applying the research of Umeghalu and Okonkwo on mitigating the effect of climate change on Nigerian agricultural production suggest that overgrazing, gas flaring, land clearing, bush burning, all promote climate change which affects agricultural production negatively. To mitigate the effects of climate change on agriculture, the authors suggest the adoption of drought resistant crops in Nigeria (Umeghalu, J. C., Okonkwo, 2013).

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