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Global Land-use Change and Sugarcane Production in Nigeria: Understanding the Ecological Consequences

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Abstract
Global investments in large-scale land deals which intensified from 2007, appeared to have increased land use change, leading to inequalities among rural people and countries of the global south. A significant proportion in the world's unfolding investments is the manufacture of biofuels, in Nigeria, sugarcane has become an important raw material for the production of biofuels, which has been entrenched in the Nigeria biofuels policy document. Little attention has been paid to sugarcane production models and to the historical social use in relation to land in the country, given the environmental consequences of biofuel development, in particular, the ecosystem. Though the effect of biofuels proliferation varies among regions, some rural communities in the southern hemisphere are already taking advantage of the development, scholarly works have so far indicated that societies of the countryside are always at the receiving end of this trending advancement of biofuels feedstock, in particular for biofuels derived from plants, specifically production systems from sugar cane. The evolving use of sugarcane-based biofuel in Nigeria is underpinning developments and organisations that intensify heavy gravities against environment and further grasp control of land and water resources from rural poor. This paper will scrutinise this issues through a political economy perspective, and examining the magnitudes of increasing sugarcane biofuel production in Nigeria, because biofuel appeared fervidly in dislodging the means of living of people and underpin waves of adversity, particularly for marginalized rural country farmers.

Keywords: *Biofuel, displacement, ecology, ethanol, feedstock, land use, sugarcane*

1. Introduction

The global obsession of renewable energy in the 21 st century have yielded positive as well as negative setbacks, biofuel development and its accompanying policies present the potential to address fossil fuel challenges, diversify energy sources and reduction of greenhouse gas (GHG) emission which increase environmental concern globally. In Nigeria, sugarcane is one of the most important raw materials of bioethanol production tagged the “new oil” (Gail, 2010), which has been discussed severally and articulated in the Nigerian biofuel policy document. Global sugarcane production literally outpaces the production of other crops (McKay et al., 2016). In 2013, it reached 2.16 trillion tons, more than twice that of corn, which is the next in the harvest. By 2016, the total cultivated area for global sugarcane production is 26,774,304 million hectares, or about 0.8% of the world's agricultural area, producing 1,890,661,751 billion metric tons of crushable stems (FAOSTAT, 2016). Nigeria cultivated 82,586 hectares and produced 1,337,572 tons of sugarcane (FAOSTAT, 2016). The global largest producer of sugarcane is said to be Brazil, having a record of two-thirds total sugar manufacture from 768,678,382 million tones annually on 10,226,205 hectares (FAOSTAT, 2016). However, given the potential impact of biofuel development on ecosystems, little attention has been paid to sugarcane production and historical state society land relation. By 2050, 20% or more of the global farmland is expected to be cultivated with biofuel. At the moment, around 14 million hectares of cultivated land were destined for biofuels around the world and are expected to grow as the scheme gathers momentum (Attah, 2015). The greatest impact of biofuels is associated with changes in the soil used which destroys pristine vegetation. Looking through a global political economy lens, this paper analyses the consequences of proliferating sugarcane-based biofuel production in Nigeria, as biofuel look set to displace livelihoods and reinforce waves of hardship, particularly for marginalized rural farmers and the ecosystem. Presently there is no tangible research focusing on the effect of sugarcane for bioethanol farming on agro-biodiversity in Nigeria.

This explains the focus of this paper on the effects of sugarcane farming. Therefore, it is a necessity to make an appraisal of the existing biofuel policies and its associated global targets in order to protect the downtrodden in the society, prevent ecological destructions and ensure its sustainability for economic growth and development.

2. Global Change in Land Use and Sugarcane Production

Global obsession of land grabbing for the production of biofuel began in 2007, a time that witnessed a continues increase of food prices and insecurity which raised alarms on societies consuming several tonnes of food items more than what can be produced by them. This crisis began parallel to with the world wide economic crisis witnessed around 2007. Nations like South Korea, China, Saudi Arabia and South Korea activated acquiring a substantial portion of land, chiefly in the African continent, to intensify food production (Attah, 2013). Over time, there has been a convergence in the global

increase in acquiring land in thousands of hectares, which attributes to three key principles, known as fuel, food and finance. While an amplified business deal can generate fresh prospects for home-grown means of living and support for state markets, a huge number of individuals are susceptible to expropriation due to uses and changes in land (Vermeulen and Cotula 2010). The main regions that are witnessing the scramble for raw materials of biofuel plants are: Sub-Saharan Africa, South America, Russian Federation and South East Asia which are the greatest productive spots for the main worldwide territorial pacts (Cotula et al., 2009: Visser and Spoor 2011, Zoomers 2010). The supreme land investors are a combination of institutional venture capitalist and private financers from Saudi Arabia, Commonwealth Development Corporation (CDC) of the United Kingdom and sovereign wealth funds of the States of Europe, Asia and the United States of America (U.S.A). According to the International Food Policy Research Institute, from 2006 and 2009, some twenty million hectares of land acreage were chartered as land grab primarily in the African Continent (Braun and Meinzen 2009). As reported, the World Bank Group as at 2010, over forty-five million acreages of land have been allocated on a large scale throughout the world (Deininger et al., 2011).

In addition, countries that are rich are struggling to ensure that food security and its regular flow are competing to venture into profitable land deals in the southern hemisphere, especially in Africa. For example, in 2009, the Kingdom of Saudi Arabia's venture capital paid the sum of $100 million for a farm in Ethiopia to grow wheat and barley and also several other investments in Indonesia, Sudan and Thailand for rice cultivation. Similarly, Chinese investors are accumulating a vast expanse of land across Africa for the production of raw materials since 2007, along the same lines, the Gulf States are also involved in the same trend of land deals in millions of dollars for hectares of land across Africa and Pakistan (Attah, 2013), the scenario in Pakistan includes the contraction of private security to protect the export of final product to the international market (Attah, 2015).

Furthermore, Pension Fund Administrators (PFAs) across the globe is another segment of land grab drivers profiteering from the surging land deals. PFAs have a substantial amount of funds to invest in private companies and businesses, they are seen as cradles of long-term funds with investment portfolio around equities, bonds and landed properties, they are very sacrosanct to capital markets where they dominate activities. Conferring with the Organisation for Economic Cooperation and Development (OECD) in its 2019 report, assets of PFAs globally amounted to $27.6 Trillion. The major PFAs in Nigeria is the Stanbic IBTC, Sigma Pensions Ltd, Premium Pension and Morgan Capital Ltd. The predominant PFAs in the world are those controlled by countries like New Zealand, Canada, Norway, Australia, Poland, Denmark, South Korea, Netherlands and United States of America to mention a few (OECD, 2019). More than one hundred billion dollars are thought to have been invested in businesses relating to the cultivation of commodities worldwide on farmland investment and are expected to increase furtherby 2020 (Attah, 2013). PFAs have assumed among the principal institutional investors generally, deals ranging from commodities and cultivable lands, which off erannual financial returns ranging between 10–20% (Cochet and Merlet 2011). It is vital to have in mind that there are no glaring cases of land grabbing engineered by PFAs in Nigeria for the time being.

Experiments and extensive research on biofuels have been trending since the last two decades of the 20th century. Brazil, precisely ever since the 1970s, invested a lot of resources in sugarcane-based biofuel enhancement. Also, the main driver of policies for investment in land use on a large scale has been the objectives of renewable biofuels of the European Union (EU), which stipulate that 10% of automobile fuels will be provided by renewable clean energy by 2020,with theprobabilitythat80-90percentofthistargetislikely to be met by biofuels (Cotula and Sonja 2009). The narratives on EU biofuelguiding principle policy are said to best imulated through the following principles: development of the rural areas, fighting climate change and security of energy supply. Though, this kinds of conventions do not reflect that change and conversion in crop use often lead to alteration in land use, since fuel crops are sidetracked after one market (such as, food) to another (as, fuel) and increase prices of food make grassl and and forest vegetation modified to become arable land for fuel crops. Critically, this processes challenged the EU's three way win assertion (McKay et al., 2016), and as will be shown later, it has a negative experience in Nigeria. However, the EU due to insufficient land cannot be able to meet up with this target, Europe and other venture capital investors have now turn to Africa, thereby putting more pressures on land. Investments of biofuel projects in West African countries represent $126 million, for processing facilities of 165 million litres of bioethanol per annum on tens of millions of hectares of land (Maltitz, et al., 2009).

3. Land Acquisition for Sugarcane Bio-Ethanol Projects in Nigeria

Nigeria entered a partnership with a consortium comprising Nigerian banks, the African Development Bank (ADB) which developed a new biofuel refinery that has been approved for operations by the Government (Dauvergne and Neville, 2009). Nigeria is also working with Brazil to establish a US$100 million 'biofuel town' near Lagos where 1,000 bioenergy experts from Nigeria, other African countries and Brazil would work on novel technologies so as to improve bioenergy production (Molony and Smith 2010). Furthermore, a United States of American corporation popularly known as the Lemna International, planned the creation of a bioethanol factory in the state of Taraba. The mission will cost $50 million, which would require 30,000 to 50,000 hectares of sugarcane cultivation (Galadima, 2011). It must be well-known that the Nigerian Sugar Industry has still not satisfied the loca production of sugar, but the country is too ambitious, as it aims to invest in bioethanol production, which requires a series of investments in water, large scale land grab, use of excessive agro-inputs and human labour. The acquisition of large scale lands is not a new phenomenon in Nigeria, but it has long been at the mercy of retired armed forces Generals and multinational forces since the reform of legislation that regulate contemporary land use from 1978. Nigeria's federal government ratify in June 2007, a new biofuel policy for renewable energy development, which bids investors a favourable environment, and provide the transport sector with a

mandatory fuel mixture of E-10, a mixture of 10% bioethanol with 90% gasoline (Onyekakeyah, 2013) just like the European Union target policy strategy.

NNPC in this context has created a Renewable Energy Division (RED), which is the driving force behind the development of the country's biofuels segment. RED has thus launched a biofuels initiative incorporating the most imperative joint venture investors in the biofuel industry (Onyekakeyah, 2013). The joint scheme plans include investments in significant crop growing of sugar cane for ethanol production, below is the NNPC Bioethanol project sites and location in Nigeria.

Scheme	Estimable Cost	Site	Proprietors	Feedstock	Feedstock quantity (tonnes/year)	Scheme Summary ethanol production/year	Land take (ha)	Scheme phase
Automotive biofuel project	$306Million	Agasha, Guma, Benue State	NNPC/private sector	Sugarcane	1.8 million	75 million litres, 116,810 metric tonnes	20,000 (16,000 to be cultivated)	Planning
Automotive biofuel project	$306Million	Bukaru, Benue State	NNPC/private sector	Sugarcane	1.8 million	75 million litres, 116,810 metric tonnes (sugar), 59 MW of power supply	20,000 (16,000 to be cultivated	Planning
Automotive biofuel project	$306Million	Kupto, Gombe state	NNPC/private sector	Sugarcane	1.8 million	75 million litres, 116,810 metric tonnes (sugar), 59 MW (electricity)	20,000 (16,000 will be cultivated	Planning
Automotive biofuel project (Kwali Sugarcane ethanol project)	$80 - 100M	Abuja, FCT	NNPC/private sector	Sugarcane	1.8 million	120 million litres, 10– 15 MW (electricity)	26,374 estimated	Planning
Ethanig (via Starcrest Nigeria Energy)	$300M estimated	Kastina Ala/Benue River Basin of Benue State	Private	Sugarcane	3.25 million estimated	100 million litres, sugar, and electricity	50,000	Planning
Ethanig (via Starcrest Nigeria Energy)	$300M estimated	Kebbi State	Kebbi State	Sugarcane	3.25 million estimated	100 million litres, sugar, and electricity	50,000	Conception
Savannah sugar company	$167M	Numan, Adamawa State	Dangote Industries Ltd	Sugarcane	1 million	Expansion to produce 100 million litres,1 million tonnes of sugar, 100,000 metric tonnes fertilizer and 300 MW electricity	36,000 (Lau, Taraba State)	Planning
Bioethanol from sugarcane/ molasses	$85M	Niger Delta region	Not Available	Sugarcane	0.857 million estimated	60 million litres	67,692 estimated	Beginning

Table 1: Showing Biofuel-Ethanol Projects in Nigeria Promoted by the NNPC.
Source: E.I. Ohimain(2010) Emerging Ethanol Schemes in Nigeria

NNPCRED projects have lured state governments in Nigeria to make agreements with investors to provideland for bioethanol projects from sugarcane, such as Nasarawa, Niger, Jigawa and the Kebbi States respectively as seen in the table above. In the next ten years, these lands will be fully operational; Other ongoing sugarcane projects in the country with intensive land use for sugarcane and ethanol are BUA Sugar project in Kwara state, Sunti Golden Sugar in Mokwa Niger state and Crystal Sugar in Jigawa State (Bakari, 2017). All these projects continue without taking into account ecological their consequences.

4. Sugarcane Biofuel Projects in Nigeria and its Ecological consequences

The cultivation of the sugarcane plant is done in numerousareas of Nigeria, mainly through a lesser scale, from 0.2 to 1.0 hectares, to chew as juice and for animal feed (Galadima et al., 2011). Subsequently, the upsurge in demand for biofuels in the 21st century intensified its cultivation. So far, $3.86 billion have remainedspent in the feedstock of sugarcane and cassava for biofuel production in Nigeria. Thus, nineteen (19) ethanol biofuels refineries have been operating in the country with an annual production capacity of around 2.66 billion litres ofbioethanol (Ben- Iwo, Manovic and Longhurst, 2016). This development has revealed a lot of consequences to the environment. There are many fears about substituting the primary forest with sugarcane cultivation, especially in the north-central states, such as Adamawa, Nasarawa, Niger, Kogi and Kwara States respectively. The loss of forest cover rises increase themenace of forest fires (Dauvergne and Neville 2009). By way ofemissions of methane and carbon dioxide, the influence of the adjustment of forests for biofuels is seen as exceedingly negative, additional greenhouse gases are continuously being generated andreleased in the atmosphere as a result of these renewable energy plantations, which are counterbalance with their use as anancillary for crude fuels (Dauvergne and Neville, 2009) which affects the ecosystem balance. In the same way, the excessive use of chemicals in this industry is a major threat to communities surrounding the commercial areas of sugarcane projects, which are further elaborated in subsequent sections of this paper.

4.1.1. Biodiversity

Biodiversity is a very vital component of the environment, carrying out key services of the ecosystem such food production, provision of oxygen, shelter and soil improvement. In addition to improving the productivity of the ecosystem, biodiversity cycle renderpliability and steadiness of the ecosystem. A subset of biodiversity known as Agro-biodiversity consist of agricultural products and domestic animals other wild lineages and interrelated types of predators, pollinators, parasites symbionts and other contenders (Boef, 2000). Looking through the lens of agriculture, ecosystem support services provision exceed food, fuel, fibre. Biodiversity is sacrosanct to the environment because of its design to adjust the level of micro-climate the operations of environmental hydrology and determine the existence of species and organisms that might be detrimental with destructive toxins (Netendo et al., 2010). Sugarcane is the most cultivated crop along the River Niger and River Benue in Nigeria, in setting upthese companies, rural livelihoods and biodiversity were not seriously considered. This biodiversity, in particular, biological resources, constitutes a basis for national, economic and ecological security (Netendo et al., 2010). Since the establishment of the Savannah Sugar Company in 1973, no environmental assessment was conducted until 2008, in this period it was revealed that the company's activities in more than 5,000 operational hectares of land such as civil works, water storage and irrigation affected the physical parameters of the environment (Environment 2008: 29), other sacrosanct effects through factory waste, canals and field operations include the excessive use of fertilizers, agricultural chemicals and aquatic pest infestations (Environmental 2008: 30).
This associated signatures on the ecosystem are also glaring in other sugarcane companies like NISUCO, by mowing down of pristine grassland forest wilderness.

4.1.2. Deforestation

In addition, a U.S bioethanol company signed a memorandum of understanding with Nigeria Kogi state for the construction of a sugar factory. The plant is valued at $510 million, this contract between International Trans Oil (ITO) Corporation and Kogi State is exceptional, the project is projected for production of approximately tons of litres of biofuel amounting to eighty-seven million on 31,000 cultivable hectares of farmland. (Attah,2013). In this vein, the state government of Kogi sought for lands at Ibaji, an area rich in agriculture, without compensation. The Memorandum of Understanding stipulates that the Kogi State will have 13% stake, the Ibaji community will have 2%, while 75% will be in under the control of ITO and other investors. The contract did not take into account the suffering that will surface as a result of the project and the compensation that will be made by farmers who have been expelled from their land, nor have they been given substitute land. Nevertheless, the government has guaranteed the creation of around four hundred (400) job vacancies, which was later not fulfilled (Attah, 2013), the company has initiated the liquidation of land for cultivation, this has had an impact on a wide range of habitat shelters in seasonal tropical forests and evergreen shrubs of the savanna vegetation.

Another major driver of deforestation is the National Sugar Master Plan. As of 2008, the Government of Nigeria instructedits sugar regulatory body, the National Sugar Development Council (NSDC) to develop an ideal project implementation that will achieve self-reliance in sugar production in the shortest possible period of time. Accordingly, the NSDC initiated the Nigerian Sugar Master Plan (NSMP) which was ratified by the National Executive Council inits September 2012 meeting. This plan projected that Nigeria's sugar demand would attain 1.7 million metric tonnes (MMT) by 2020. In order to meet this cumulative demand, the government stimulated and engineered the establishment of approximately twenty eight (28) sugar mills of diverse capacities that will bring more than 250,000 hectares of cultivable land for sugarcane, in the next coming decade (NSMP 2012: 4) which aim at 161 million liters of ethanol per annum (NSMP, 2015). With this stratagem in place, investors like Dangote Sugar are driving the retirement of grassland forest vegetation in northern Nigeria, specifically in States like Taraba, Kebbi, Jigawa, Niger, Kwara, Kogi and Nasarawa on 210,000 hectares of land (Jika, 2016), this involves the loss of primary trees, shrubs and wetlands that are a refuge for various animals and organisms. This deforestation led to erosion and flooding in areas driven by sugarcane as recorded in Kwara (1979) and Adamawa (2011).

4.1.3 Water

Water in Africa is legally owned by countries, the government has an exclusive legal mandate to allocate water for land irrigation to indigenous and transnational venture capitalist. Once land is allocated to venture capitalist, transactions directly affect users who are in this land, but in the case of water, the situation is different, because irrigation water affects a much wider range of users along the river as a result of compounding (Skinner and Cotula 2011). Specific water allocations for large-scale agricultural irrigation, in many cases, decision-makers do not adequately account for low-level impacts, such as coastal markets, fisheries, horticulture or grazing lands in the dry season, which support thousands of livelihoods (Skinner and Cotula 2011). More than five thousand people are affected downstream of Kiri Dam which supplies Savannah Sugar Company with water for sugarcane irrigation, these people have lost some of their fundamental livelihood due to hoarding or damming of water.

It is projected that the cultivation of sugarcane for the production of bioethanol requires an average of six (6) billion litres of water, which represents roughly three 3% of Nigeria's water possessions (Krebs, 2010). Unless it is controlled, it will add to a significant water shortage in Nigeria in the next imminent years (Krebs 2010), given that Nigeria is the eighth utmost populated country in the globe, with around 200 million people. The problem of pollution is also directly linked to water. The major aspect of pollution in sugar manufacturing are mainly waste released from processing the stalks of sugarcane such as vinasse of molasses. This wastewater has a high potential for water pollution as a result of the high absorption of organic matter, which intensify the bio-chemical oxygen demand (BOD) in the composition of water in such areas (Gunkel et al., 2007). In addition, agrochemicals, such as fertilizer, pesticide and herbicide, are seen as a significant constituent of the pollution of water bodies around such industries and its surrounding communities (Corbi et al 2006 and Silva et al., 2008), this agrochemical runoff affects aquatic species, and in some cases water for domestic use. Such kind of cases have been highly recorded around the communities surrounding the Numan Savannah Sugar Company through field studies conducted in 2013, communities like Gyawana, Kem and Opalo relied on the use of such water. Since the beginning of the company operation in 1981, cases of skin diseases emanating from washing along the water areas.

4.1.4. Soil Degradation

This aspect constitute issues that affects the environment due to the soil compaction and erosion of the land cover as a result of constant land development with the use of sophisticated heavy duty machineries like Tractors, Bulldozers, excavators, harvesters, heavy mechanical sprayers and the like (Martinelli and Filoso 2008). The frequent operations of these machines on such land covers increases the level of compaction (Naseri et al., 2007) of the soil, thereby reducing water infiltration into the soil which leads to soil erosion and runoff. This cases have been glaring in the two major sugarcane estates in Nigeria like NISUCO Bacita and Savannah Sugar Company Numan (Dangote et al., 1995; Martinelli and Filoso 2008). All these soil related issues happens during land development for opening of new sugarcane estates and harvesting for production coupled with replanting such fields after expiration of ratoons (Fishcher et al., 2009: 43).

Conversion of such pristine vegetation or soil for sugarcane cultivation constantly lead to its degradation (Politano and Pissarra 2005) which reduces the soil nutrients, structure and content. Experts are of the opinion that the standard level for soil erosive rate becomes destructive when it exceeds thirty Mg per hectare in a sugarcane field and two Mg per hectare in natural vegetative covers (Sparovek and Schnug 2001). When sugarcane fields are poorly managed, the result that follows is the increase deposition of sediments at the river downstream and its wetlands, these sediments deposited which comprises chemicals and fertilizers relegate the water quality thus affecting downstream vegetation and aquatic species (Corbi et al., 2006) such evidence are widespread in Nigeria Sugarcane fields.

4.1.5 Sugarcane Harvest

In addition, harvesting techniques using the fire burn method are a critical ecological problem. Owing to environmental and health concerns, various countries decided to introduce rules for limiting combustion, the traditional of burning sugarcane straw in the field has been a practice that has been used for centuries in many countries, Bacita and Numan inclusive. The practice has been the same without any changes over the past thirty- seven (37) years. This collection method has consistently led to the destruction of the soil healing organism. This burning takes place in a small and very limited area and is very fast, on average 10 minutes, so that the sugarcane stem does not burn completely (Ben-Iwo,

Manovic and Longhurst 2016). There are concerns about the sustainability of sugarcane, in terms of land use change. This has been a particular issue in Nigeria with the increasing farmer-herder conflict brewing faster for the past two decades, sugarcane expansion has been encroaching into grazing areas. This has pushed livestock systems into the forest zones thereby intensifying conflicts and destroying the ecology as a result of the pressure on land. Unlike Nigeria, Brazil the world largest producer of sugarcane, this concerns led to the placement of restrictions on sugarcane expansion to minimize the negative impacts (Ben-Iwo,
Manovic and Longhurst 2016).

5. Conclusion

The considerable means of bioethanol production by the Nigerian government is an interesting alternative to development. Of course, if Nigerian leaders paid attention to food production when it delivered bioethanol, the country would have been self-sufficient. Sugarcane-based bioethanol in Brazil have been successful, Nigeria should be given priority to replace the import of sugar, in order to achieve self-sufficiency in sugar production, which can be produced with

a moderate amount of ethanol. The direct and indirect land use change for the production of biofuels have raised some concerns about the conversion of the earth and the ecological consequences; To reduce these ecological problems, there is a certain potential, Nigerian must support second-generation biofuels, such as jatropha and algae-based fuels, research and development to reduce the growing marginal areas of pressure, that will open up new avenues for energy supply. The political economy and the growth potential of biofuels, where it grows inadequately, reinforce the environmentally friendly and harmful models. When consumer countries are willing to accept unsustainable products from countries that do not want to apply environmental legislation, biofuels seem to be invaluable for further weakening vulnerable ecosystems.

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