Climate Change and *Jatropha curcas*: The Economics of Sustainable Development

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Abstract

There is no doubting the fact that the scenario 'climate change' has evolved from an 'environmental issue' into one that requires collective effort and expertise in sustainable development, energy security, and the health and wellbeing of the general population. The need to mitigate the adverse effects of harmful greenhouse gases expelled into the atmosphere by the actions of man, especially in his quest for domestic and industrial energy source is emphasized. This study equally examines the economic viability of Jatropha curcas L. or physic nut plant, its potential as an alternative feedstock for biodiesel, its prevalence/uses amongst local communities in many African countries, as well as its multi-purpose attribute of carbon dioxide sequestration, rural poverty alleviation and enhancing overall sustainable developmental practices.

Keywords: Jatropha Curcas; Biofuel; Climate Change; Population wellbeing;

Introduction

Our world has experienced profound climatic changes before. What appears different this time is that one specie, human, is contributing to the change and that climate change, which Belewu and Orire, (2011) referred to as 'the changes/variations in all the atmospheric elements over a period of time' is impacting the ecosystems on which man depends. Climate change is generally understood to have the most immediate and severe impacts on people's basic needs and rights in those parts of the world where low – income, resource – dependent communities reside in environments that are already variable and in decline (Bernett and Webber, 2009). Stern (2006) estimate that climate change may cause a global average annual reduction in consumption per head of between 5% and 20%, noting, as almost all assessments do, that the impacts and associated costs of climate change will fall disproportionately, and first on the poorest people and the poor countries. Climate change as far as the indigenous people are concerned, is a life and death issue rather than just another global environmental concern (Salick and Byg, 2007). In the above context, climate change is a negative response currently experienced in the world as a result of the growth of greenhouse gas emission due to the burning of fossil fuels, resulting mainly from industrial activities and motor transportation (United Nations, 2007). As a result of this, obnoxious gases are built up in the air and increase the level of heat in the world. This is is known scientifically, as 'greenhouse effect' (Philander, 1998).

This definition emphasizes on 'human induced' climate change.

Although, some greenhouse gases such as carbon dioxide occur naturally and are emitted to the atmosphere through natural processes and human activities, others like the fluorinated gases are created and emitted solely through human activities (U.S.EPA, 2010). Other principal greenhouse gases that enter the atmosphere because of human activities are:-

Carbon Dioxide (CO_2)

CO_2 enters the atmosphere through the burning of fossil fuels (oil, natural gas, and coal), solid waste, trees and wood products, and also as a result of other chemical reactions (e.g., manufacture of cement). Carbon dioxide is also sequestered from the atmosphere when it is absorbed by plants as part of the biological carbon cycle.

Methane (CH_4)

Methane is emitted during the production and transport of coal, natural gas, and oil. Methane emissions also result from livestock and other agricultural practices and by the decay of organic waste in municipal solid waste landfills.

Nitrous Oxide (N_2O)

This is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste.

Fluorinated Gases

Hydrofluorocarbons, Perfluorocarbons, and Sulfur hexafluoride are synthetic, powerful greenhouse gases that are emitted from a variety of industrial processes. Fluorinated gases are sometimes used as substitutes for Ozone-depleting substances (i.e., CFCs, HCFCs, and Halons). These gases are typically emitted in small quantities, but because they are potent greenhouse gases, they are sometimes referred to as High Global Warming Potential gases ("High GWP Gases"). Source: U.S.EPA, 2010.

Climate change is said to negatively affect biodiversity conservation and management via exacerbated drought conditions, increased risk of wildfires leading to some extreme events such as heat waves, river and coastal flooding, landslide, storms, hurricanes and tornadoes which culminate in environmental degradation (Agbogidi, 2011).

Energy is one of the most important factors to global prosperity; hence, the dependence on fossil fuels as primary energy source has lead to global climatic change, environmental degradation, and human health problems (Elaiyaraju and Nagarajan, 2012). It was reaffirmed by Okkerse and Bekkum (1999) that by the year 2040, it is predicted that the world will have a population of 9 to 10 billion people that must be provided with energy and materials. This is why according to the FGN, (2004) National Policy on Population, an effective population program should be aggressively pursued to manage population growth rate while efforts are being made to improve the economy. This is because high population growth rates, especially in developing countries, put additional pressure on the agricultural sector and the individual farmer alike (Wahl *et al.*, 2009). Concerns about climate change, energy security and the potential for rural development are the main drivers spurring interest in innovative solutions to meet the growing energy needs, and ways to enable economic development and improving living conditions. Also, the worldwide recognition of limits in the availability of major fossil energy sources and the related instability in prices, have introduced a massive search for new energy sources for a sustainable economic development (FAO, 1981). Biofuels are part of these innovative solutions, which can serve as suitable alternative fuel for use in diesel engines (Mondal *et al.*, 2008) and for domestic energy needs.

In order to combat these challenges, increase in the productivity level of pollution free products via advanced, environmental friendly technology, which can manage and allocate efficiently all resources for sustainable development of agriculture should be paramount (Basu, 2011; Bhadoria,

2011; Mondal et al., 2011). One widely acknowledged new bioenergy source therefore, is the Physic nut tree, Jatropha Curcas L. which this study examines and whose cultivation is climate change friendly and contributes to rural socio-economic and ecological development (Francis, *et al.*, 2005; Achten *et al.*, 2008). This underutilized biofuel plant is considered as the best source of biofuel production (converts into biodiesel without refining (Bekker and Makker, 2009) yielding about 1000 barrels of oil per year per sq mile, Belewu et al., 2010) among the various plants based fuel resources the world over (Tint and Mya, 2009), and will help in meeting the challenges of global biofuel demand (37 billion gallons) by 2016 (http://www.jatrophaworld.org).

Jatropha curcas L, Biofuel and Population wellbeing.

Botanical Features

Jatropha Curcas L. which belongs to the family *Euphorbiaceae*, is said to have 176 species and distributed throughout the world (http://agritech.tnau.ac.in/bio-fuels/Biofuel_jatropha). The genus jatropha has about two varieties (i.e. *jatropha curcas* and *jatropha glandulifera*) found in Nigeria. Jatropha Curcas L. is a small tree or shrub with smooth grey bark, which exudes whitish coloured, watery, latex when cut. Normally, it grows between 3 to 5 meters in height, but can attain a height of up to 8 or 10 meters under favorable conditions. It has large green to pale-green leaves, alternate to sub-opposite, three-to five-lobed with a spiral phyllotaxis. Jatropha has about 95% efficiency when compared with diesel and an annual yield of 3000 liters per hectare (http://www.jatrophabiodiesel.org).

Common Names.

Jatropha Curcas L. equally known as Physic Nut or Purging Nut is a hardy plant that is well adapted to diverse climatic types and ecological condition. Although, its origin had been traced to Mexico and Central

America, the only record confirming its early cultivation in Africa was traced to the Cape Verde islands reporting extensive plantations that were established at the commencement of the 19th century (Freitas, 1906, Serrals, 1950 and Heller, 1996 in Wahl et al., 2009). Presently, extensive Jatropha curcas plantations are being cultivated in various African Countries, some of which are Burkina Faso, Cote d'Ivoire, Ghana, Mali, Niger, Nigeria and Tanzania; haven realized its multipurpose properties and economic importance. Physic Nut is traditionally known in many subtropical and semi-arid regions and local communities by very different names. 'Lapal-Lapa', 'Wuluidu', 'Cini Da Zugu' and 'Omangba' are various traditional Nigerian names from the Yoruba, Hausa, Igbo and Igede languages for this plant. 'Esita' and 'Mbono Kaburi'(literally meaning graveyard watch) in the Maasai and Kiswahili languages of Tanzania. Outside Africa it is called 'Lhong Kwong' in Cambodia, 'Ratanjyot' in Hindi, and 'Kattamanakku' in Tamil languages (http://www.agritech.tnau.ac.in/bio-fuels/Biofuel_jatropha).

For generations, farmers according to Henning (1988) were said to have utilized the physic nut tree as a living fence to protect their gardens and food crops from hungry livestock. It thrives well on barren or marginal lands and has the capacity to generate nitrogen and phosphate suitable for the cultivation of other crops as well. Further research work by Olaniyan & Oje (2007), affirmed the non suitability of physic nut oil in the food industry. This is due to the presence of phobolester which is a major anti-nutrient (Belewu et al., 2008). Although, Becker et al.,(1999) had earlier confirmed the existence of a non-toxic (absence of phobolesters) variety of Jatropha curcas in Mexico which is edible for human consumption after roasting. Also, the seed cake can be a good protein source for humans as well as for livestock too. It is also interesting that honey collecting farms could be established through the planting of jatropha, since before the seed emerge the flowers are always attractive to honey bees. In addition, the high quality oil extracted or the sediments after pressing can be use for large-scale soap making, while the press cake is equally useful as a high-grade organic fertilizer. This could generate additional income and thus enhance rural empowerment and population wellbeing.

Rise of biofuel Production.

Based on the understanding that the continued utilization of fossil fuel is largely responsible for the current of global warming, biofuel has emerged as a potential alternative the world over. The word biofuel as defined by the world business council for sustainable development (WBCSD) refers to the liquid, solid or gas fuel derived from biomass either from recently living organisms or from their metabolic waste. Biofuel usage has received ambitious targets by the various regions of the world. Sands (2005), reaffirms the United State's endorsement of the utilization of biofuel as the main way of combating climate change while the European Union aimed to replace 10% of automobile fuel by renewable energy such as biofuel by 2020 (Phillips, 2008), although a target described unreachable even in the European Union.

Likewise in Africa, first trials in Mali in the 1980‟s and early 90‟s to make jatropha oil a diesel substitute failed because of relatively high feedstock costs compared with rather low prices for fossil diesel at those times (Wiesenhütter,2003). But with real energy prices in 2007 soaring to even higher levels than during the second oil crisis in 1979 (McMahon,2008) and general perception of a steady increase in the long term, prospects for jatropha curcas biodiesel production seems better than ever (UNEP). This may explain why many investors, research institutions, NGO, farmers, national as well as local governments from developed and developing countries are embarking on jatropha ventures. The University of Ilorin in the past 3 years have invested immensely into the cultivation and research into jatropha, for climate change mitigation and sustainable national development. However, the numerous potential benefits from the "multi-purpose tree" sound promising: reduction of costly fuel imports, energy security, new employment opportunities for farmers and skilled workforce, a new export commodity, reduction of greenhouse gases and prospects for the marketing of carbon credits while combating erosion and desertification simultaneously. This is probably why Philip (2007) recommended the massive and immediate cultivation of the physic nut tree seen as a high-potential bioenergy tree to all and sundry.

<u>Importance of Jatropha Curcas Plant to Sustainable National Development</u>

Some of the various uses of the plant according to (UNEP) include the following:

- Biodiesel production (with better emission)
- Production of Pesticides
- Soap making (oil is normal triglyceride with high saponification value (Akbar et al.,2009; Belewu et al.,2010)
- Medicinal purpose (treatment of cancer, piles, snake bite, paralysis, dropsy)
- Production of ink
- Production of gum
- Seed coat for water purification
- Dye and tanning production
- Control climate change due to reduction in air pollution
- Organic fertilizer
- Herbal tooth brush (El Gamassy,2008)
- Feedstuff (Livestock)
- Treatment of skin disease (Seed oil)
- Treatment of cough (Leaf decoction)
- To stop bleeding (Stem sap flowing)
- Antimicrobial property (Latex)

Further researches into this wonder plant found its economic benefits also, has it is found to help in increasing rural incomes, self-sustainability and alleviate poverty for women, the elderly, children, tribal communities and small and large scale farmers alike since it can equally assist to boost income from plantations and agro-industries (www.earthrights.net/trees.html). Jatropha cultivation potentially has additional benefits for fighting deforestation and desertification, and increases soil fertility.

- Jatropha fixes the soil with its root system, thus reduces wind and water erosion of the soil;
- The roots allow the percolation of surface water into the ground, thus increases water absorption and reducing runoff, which also improves the soil.
- Nitrogen fixation property has also being linked to jatropha plant. This enhances soil quality, potentially recovering degraded land for other uses.

Source: www.earthrights.net/trees.html

Conclusion

Jatropha oil and Jatropha biodiesel can bring many benefits for developing countries in terms of providing access to clean modern energy services for productive uses in rural areas. In this context, many developing countries are encouraged to making maximum use of their biofuel potential, using their natural resources in a sustainable manner.

To ensure the sustained use of natural resources, the development of biofuel needs to be carefully planned and managed, addressing issues such as agricultural land competition, scarce water resources, soil erosion, biodiversity concerns, food versus fuel competition issues, equity concerns of large versus small-scale biofuel development, and biofuel trade issues. Local production and essentially local transformation and utilisation assure benefits for local, national and sub-regional populations, with added value created within the continent, for the continent. A stimulated local economy and availability of clean modern energy services can together drive local economic growth, create jobs and improve living conditions in rural areas. This in turn reduces rural exodus, where the most dynamic section of society is forced to move to urban centres to look for work, and thus also reduces indirectly urban employment problems.

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