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Prospective Jatropha Curcas based Firms in Nigeria. How Viable?

[1]Fakayode, Segun Bamidele [2*]Belewu, M.A, [1*]Muhammed, N.O, [4*]Adekola, O.F, [5*]Adebayo, G.B, [5*]Ameen, O.M, [6*]Raji, S. A., [6*]Jimoh, A. A, and [7*]Olaniyan, A.M*

[1]Department of Agricultural Economics and Farm Management, [2]Department of Animal Production, [3]Department of Bio-chemistry, [4]Department of Agronomy, [5]Department of Chemistry, [6] Department of Civil Engineering, [7] Department of Agricultural and Bio systems Engineering
*Member University of Ilorin. Jatropha Research Group
URL:www.unilorin.edu.ng
e-mail: fakay@unilorin.edu.ng,segun_fakayode@yahoo.com
Cell no: +234-8060236283

Abstract

This study examined the viability of prospective Jatropha based firms vis–a-vis employment opportunities in Nigeria, specifically the study identified the Jatropha bio-diesel and other allied products that were been researched into in Nigeria, estimated the costs and returns structure to Jatropha cultivation and the production of Jatropha based products. For the study, small scale Jatropha based firms were investigated. The results of the study revealed that Jatropha based products manufactured include bio-diesel, Jatropha kernel cake livestock feed, Jatropha ink pigment and dye, glycerine and Jatropha seeds-coat cement sheet and floor tiles. All the various parts of the Jatropha seeds are useful either for one or two of these products. Jatropha cultivation, was shown to be very profitable. Among Jatropha products, only the costs of the biodiesel Jatropha fuel is relative expensive when compared with the common fossil diesel.

Based on the study findings, the study calls for the mobilisation of the Nigerian farmers to cultivate Jatropha, Alongside training to intimate the masses of the numerous products and benefits from Jatropha is necessary. They should be trained to manufacture simple Jatropha based necessities like those highlighted in the study. Market

accessibility training to farmers and other stakeholders involved should also be embedded in the training. There is also the need to popularize the practicality of using Jatropha to produce these products via workshops and seminars. It is also necessary to step-up steps at introducing these products to the markets so as to enhance the marketability and competitiveness of the Jatropha based firms. Government and also other individuals and stake-holders need ensure the availability of supporting infrastructures for these small holder industries to thrive in the long-run

Key words: *livestock feed, ink pigment, dye, glycerine, supporting infrastructures*

Introduction

In recent times, the globe has come under the scourge of rocketing fossil oil prices and devastating climate change conditions. Global bio fuel production has therefore risen substantially in recent years, driven primarily by government support for bio fuel industries. The stated motivations for these initiatives are numerous and have varied over time. (*Spark et al, 2010*). In remedying these problems and in the name of environmental protection, developed and emerging countries are implementing policies encouraging bio-fuel production. In this respect the Jatropha curcas L plant is reportedly capable of providing green/bio-diesel oil and other important allied products. The benefits that accrue from the plant can avail the poor masses in the developing nations 'pro-poor' employment opportunities. Jatropha *curcas L.* is a promising non-food first generation bio-fuel crop. It can grow on marginal land, requiring little water, nutrients and farm management, thereby competing less with the food crops. Unlike the other bio-fuel crops including maize, cassava and other food crops alike, Jatropha is a non-food bio-fuel crop which is very rich in green fuel. The food crops globally are in short supply and thus their use as fuel crops poses great threat to global food security. To produce one litre of bio-ethanol requires 14.3 kg of sugar cane, 2.5 kg of corn, 2.9 kg of wheat, 16.7 kg of sorghum or 5.6 kg of cassava. The Jatropha fruit is also relatively richer in green fuels than most of the other food crops used (Table 1) (Gaydou et al,1982). Jatropha curcas has therefore been touted as the future of biodiesel (Tee Meng , 2009)

Table 1: bio-fuel potentials of crops

Crops	Crop production MT/ha	Fuel production /ha	Energetic equivalent kwh/ha
Elaeis guineensis	18–20	3,600–4,000	33,900–37,700
Jatropha curcas	6–8	2,100–2,800	19,800–26,400
Aleurites fordii	4–6	1,800–2,700	17,000–25,500
Saccharum officinarum	35	2,450	16,000
Ricinus communis / castor	3–5	1,200–2,000	11,300–18,900
Manihot eaculenta	6	1,020	6,600

Source : Gaydou et al. (1982).

In Nigeria, investments in the bio-fuel industry especially the non-food based ones is a long overdue one both in terms of her drive towards diversifying the nation's economic base from the limited petroleum oil dependent to the non-oil sectors. Efforts at diversifying and capitalizing on viable alternative energies sources like the Jatropha oil need be accorded utmost priorities According to the United Nations Development Project UNDP (2002) 'It is of utmost importance that Nigeria and other countries in Africa start integrating bio-fuels into their economy before this opportunity to industrialize passes. It is estimated that Nigeria's oil reserves can only last the nation for only the next 30-36 years, both in terms of her economic development and poverty alleviation.

Currently, Nigeria has no place among committee of bio-fuel producing countries (Table 2).

Table 2: World Bio-fuel Production in 2007 production (million litres)

Ethanol	Biodiesel	
USA	26,500	1,688
Canada	1,000	97
European Union	2,253	6,109
Brazil	19,000	227
China	1,840	114
India	400	45
Indonesia	0	409
Malaysia	0	330
Others	1,017	1,186
World total	52,009	10,204

Source: OECD (2008)

Based on most documented facts about Jatropha activities in Nigeria, one could easily conclude that there is a lack of knowledge on the profitability of Jatropha cultivation and pro-poor employment opportunities that accrue from the Jatropha fruits bio-diesel oil and its allied products markets. Most farmers are unaware of the structure of costs and returns in the cultivation of Jatropha and have limited information on the market and its buyers.

The outcome of the study investigations therefore is expected to present the possible economic gains derivable in the Jatropha-based products firms. The part of the study examining viability of Jatropha production will go a long way to provide relevant information on the possible profit potentials accruable to Jatropha cultivation. This is more so considering the fact that most farmers in the Nigeria's rural areas gain very little from their major occupation: farming. The current work identifies the challenges limiting viability of the Jatropha-based firms in Nigeria and proffers ways to solving these problems. This feat is expected to stimulate farmers to engage in meaningful Jatropha cultivation and in operating Jatropha-based firms so as to enjoy derivable possible benefits. The study also stands show case the green fuel ability of the Jatropha plant and its poverty

alleviating potentials. This will help popularize the crop's cultivation even on the vast desert/marginal soils in Nigeria thereby reducing devastating climate change effects across the globe.

Prospect of Jatropha curcas for Economic Development

Jatropha carcus continues to be a new and exciting alternative energy source, and the world continues to watch its development closely, there are still many misnomers about where it should be grown, how to grow it and what resources the plant needs to achieve commercially productive yields (Environmental Business, 2011). However not much has been researched about the viability as well as competitiveness of the crop. In his own view Ibraheem (2012) emphasized that 'investments in Jatropha curcas plant for biodiesel production will amongst other things yield opportunities including reduction in fuel importation, total cancellation of petroleum subsidy, self sufficiency in biodiesel for transportation and industrial uses, wealth creation, employment opportunity, climatic balancing as well as domestic use for cooking and medicinal applications. Jatropha curcas plant whose nuts have been found to have a good capacity for oil production have been used to fuel lanterns, power generators and for the production of biodiesel. The use of this vegetable oil is gaining good prospect especially as it is expected to enhance both national and household energy security, while raising farm incomes at the local level in the country. Fuels from fossil systems are said to be generally very toxic, non-biodegradable and whose sources are not renewable. Energy from bio fuels appears to be more environmentally friendly needing little investment to combat the potentially high carbon emissions peculiar to fossil fuels (Tsado, 2012). Tsado further stressed that considering the serious need for food security in many African countries, biodiesel production have being focusing on non-edible oil species. It is in this light that governments are developing tough policies to allow the bio fuel sector to grow without conceding efforts at achieving food security at the expense of national resources.

In its contribution the United Nations Environmental Programme (UNEP) (2011) confirms that some of the various uses of the Jatropha plant 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
- Feedstuff (Livestock)
- Treatment of skin disease (Seed oil)
- Treatment of cough (Leaf decoction)
- To stop bleeding (Stem sap flowing) and;
- Antimicrobial property (Latex)

In the light of the foregoing, this study sought to sets out to provide answers to the following research questions

- Is Jatropha cultivation viable?
- What products are derivable from the Jatropha plants?
- Are these products relatively profitable?
- What constraints limit the development of these products?

Objectives of the Study

The broad objective of the study was to investigate Jatropha bio-diesel and allied products firms in Nigeria. Specifically the study seeks to:

- examine the viability of prospective Jatropha based firms in Nigeria
- examine the costs and returns structure to Jatropha plant cultivation
- identify the various Jatropha based products
- estimate the costs and returns that accrue to the production of Jatropha-based products
- assess constraints limiting profitable production of these products

Methodology

The area of study is Nigeria while the target population respondents for the study are producers of Jatropha based products in Nigeria. Jatropha based activities: both its cultivation and industrial level use is yet to be popularized in Nigeria. In particular Jatropha based researchers at the University of Ilorin were surveyed and interviewed. These various

researchers under the Unilorin Jatropha Research Group have produced various Jatropha-based products including bio-diesel via chemical as well as mechanical approach, glycerine, soap, charcoal, floor tile and house ceiling board. These researchers' activities were viewed/proxied as infant Jatropha-based firms for the Nigerian economy. It is expected that activities involved in the production of these products could be disseminated to the masses for adoption so as to enable them improve their welfare or otherwise

Data Analysis

Tools of analysis employed for analyzing study data collected were means, gross margin, net income and the straight line depreciation approaches. Means were used to arrive at the averages of economic variables including costs and returns to Jatropha based products, Gross margin were used to estimate the costs vis-à-vis returns to jatropha production and jatropha based products activities, a budget analysis was employed as used by Fakayode (2009). The gross margin was estimated as

$$GM = TVP - TVC \quad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \quad (1)$$

Where GM = Gross Margin, TVP = Gross Value of Production which was obtained by adding the revenue from direct sales of Jatropha seeds valued at market prices in naira, TVC = Total Variable Cost which comprised of expenses (direct and imputed) on seed/seedling, weeding, fertilizer, agro-chemicals and labour, transportation others but excluding non-paid family labour. For the Net income tool, this was used to estimate the net returns from jatropha and jatropha based products activities. Net income is given as

$$NI = GM - FC \quad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \quad (2)$$

Where NI=Net income, GM is the gross margin while FC is the Fixed cost incurred.

Results and Discussion

₦

From Table 3, a total sale, of Jatropha fruits produced valued at a prevailing market price of ₦2100 per 50kg bag was used and computed for the study. The estimated summary showed that Jatropha carcus l production is profitable at a gross margin of ₦151,500 per hectare. Average total costs were ₦88,500 per hectare while the fixed costs were ₦1,500 per hectare. The variable costs of production dominated the total costs, constituting about 98.3%. The labour costs therefore constituted the most expensive input in the cultivation of Jatropha. The fixed cost estimated included

depreciated costs of farming implements including those for hoes, cutlasses and other capital items. The straight line method of depreciation was used to depreciate each capital item over its useful life. Additionally, the average rate of returns to total investment was 266% implying that ₦2.66 will be gained on every naira invested into the Jatropha plantation venture

Table 3: Summary of Costs and Returns estimate to Jatropha Production (₦/Ha)

Items	(₦/Ha)
(a)**Gross Revenue**	**240,000**
less	
(b)**Variable Costs**	**88,500**
Nursery	25,500
land preparation	13,000
labour	**50,000**
for weeding	27000
fertilizer application	3000
pesticide application	2000
harvesting	9000
pesticide	5500
fertilizer	3500
Equals	
(c) Gross Margin (GM)	151,500
plus	
Fixed costs	
Depreciations on hoes, cutlass, and other farm tools	1500
Equals	
Net Farm Income	**150,500**

Source: Field Survey Data, (2010)

Jatropha Bio-diesel

Based on findings, it was revealed that the Jatropaha biodiesel is still expensive especially when extracted using the petroleum ether method. When considered at the private entrepreneur point of view it costs about ₦300 to produce a litre of diesel while the pump price in our country Nigeria is still as low as ₦90 per litre. It is however expected that with further researches and under large scale production/refinery with good technical and management skills, the cost of production will be reduced considerable. Also the pump price of diesel in Nigeria though lower than that of Jatropha diesel as at now will definitely rise in the near future as

the nation marches towards the liberalisation of its petroleum sector. The expectation therefore is that the price of Jatropha biodiesel will fall far below that of fossil, diesel in the nearest future. The Jatropha biodiesel aside its eventual low price incentive, is also environmentally friendly so that its antecedental social value far surpasses that of the fossil fuel. Additionally the other bye products including glycerine make the Jatropha biodiesel firm a profitable one. The glycerine products have numerous uses both as preservatives for fruits and vegetables and as sweetener and solvents.

Other Jatropha Products

The costs and returns to Jatropha based products including those for Jatropha Kernel cake Livestock feed, Jatropha Laundry Soap, Jatropha Laundry Soap, Jatropha Seed-coat Cement Sheet, Jatropha Pigments and Dye as well as Jatropha Seed-coat Cement tile were also investigated. The results are as presented in Tables 4-8.

Jatropha Laundry Soap

Table 4 indicates that the cost of producing a sizable 3cm height 6cm circumference conical washing soap from the Jatropha oil is ₦17. This was found to be below the price of other brands of washing soap brands in Nigeria. The implication of this is that, the Jatropha based washing soap firm is profitable and viable given a favourable business environment. This is more so considering the fact that the kind of firm analysed in the study is still a small scale one. Larger firms/manufacturers are therefore expected to take advantage of economies of scale, thereby capable of producing the Jatropha soap more cheaply. In any case, given the current estimated cost of Jatropha soap, it could be advocated that the poor masses in the country: rural dwellers and the numerous unemployed Nigerian youth could be stimulated to engage into the Jatropha soap venture

Table 4: Summary of Costs and Returns estimate for Jatropha Laundry Soap (₦/Tablet:3cm

height by 3cm circumference)

Materials	Unit price in Naira ₦	Value of Product in Naira ₦
Jatropha oil	100/litre	5
Caustic soda		3
Perfume		3
Dye		3
phosphoric acid & other chemicals		3
Total costs		**17**

1 us dollar equals 150 naira

Source: Field Survey Data, (2010)

Jatropha Kernel cake Livestock feed

Table 5 indicates that it will take very small affordable sums of about ₦25 to produce a kilogramme of livestock feeds from the Jatropha Kernel cake that is extracted as bye product of Bio-diesel production from Jatropha. However the sales price of a unit Kg of similar non-Jatropha brands costs ₦30. It is therefore implied that stake-holders can stimulate large scale production of these feeds in a bid to reduce the usage and avert cost incurred in the use of conventional expensive, human competing feed ingredients like soybean and groundnut for livestock feed manufacture. Further enquiry on the Jatropha livestock feed produced revealed that the major costs item needed were those for the production of the potato Dextrose Agar which is cheap and was used to culture fungi used in the production of the Jatropha based feed.

Table 5: Summary of Costs and Returns estimate to Jatropha Kernel cake Livestock feed (₦/kg)

Materials	Unit price in Naira ₦	Value of Product in Naira ₦
Variable costs		
Jatropha kernel cake	10/kg	10
Fungi	10	10
Potato Dextrose Agar (PDA)		
Fixed Costs		
Depreciation on Petri-dishes, shovel etc	2	2
Total costs		**22**

1 US dollar equal 150 naira

Source: Field Survey Data, (2010)

Jatropha Pigments and Dye

Table 6 indicates that inks pigments and dye from the Jatropha leaves is worth ₦5455 per batch while same quantity of the popular pigments and dyes in the markets sell for ₦5900. The Jatropha ink pigments were of various colours (Figures 5 and 6). The Jatropha source of dye and pigment is therefore a viable option for substituting the popular higher price ink pigment and dye in the Nigerian markets, The Jatropha pigments and dye are expected to be more relatively cheaper with further research and large scale production that could enhance economies of scale.

Table 6: Summary of Costs and Returns estimate to Jatropha Pigments and Dye (₦/batch)

Materials Naira	Unit price in Naira ₦	Value of Product in ₦/batch
Variable costs		
Jatropha leaves	free	
HNO3	4000	60
NaNO2	4000	60
HCl	7000	60
Zn dust	5000	100
Ice block	100	100
Aniline	14,500	75
NaOH	5000	500
Ethanol	8600	1500
Acetone	8500	3000

1 US dollar equal 150 naira

Source: Field Survey Data, (2010)

Jatropha Seed Coat-Cement Sheet

Another product from Jatropha is the Jatropha seed coat-cement sheet which can serve as ceiling board in houses, especially in the low-income countries.. The sheet can be used to replace the common asbestos roofing sheets that is said to cause cancer. In fact the later type has been abandoned in some of the advanced nations. Table 7 indicates that the Jatropha sheet produced costs only about ₦210 which is far below the price of the common asbestos sheet in the market which sell for as much as between ₦650-₦900

Table 7: Summary of Costs and Returns estimate to Jatropha

Seed-coat Cement Sheet (₦/300 x 300 x 4 mm)

Materials	Unit price in Naira ₦	Value of Product in Naira ₦
Variable costs		
Jatropha seed coat	free	
Cement	1600/bag	200
Fixed Costs		
Depreciation on pressing & milling machines		10
Total costs		**210**

1 US dollar equal 150 naira

Source: Field Survey Data, (2010)

Jatropha Seed-coat Cement Tile

The manufacture of Jatropha seed-coat cement floor tiles for covering floors of houses was also investigated as in Table 8. It was estimated that it costs as low as ₦550 to produce a square meter of the Jatropha tile. However the price for the common tile ranges between ₦1700-₦6000 per square meter. The price of the Jatropha tile is thus very low and affordable for the common man. A major constraint reported as regards the production of the Jatropha sheet and tile was the low availability of the Jatropha seed-coat.

Table 8: Summary of Costs and Returns estimate to Jatropha Seed-coat Cement Tile (₦/m²)

Materials	Unit price in Naira ₦	Value of Product in Naira ₦

Variable Costs			
Jatropha seed coat	free	-	
Cement	1600		500
Fixed Costs			
Depreciation on Implements, shovel, milling machine and press			50
Total Costs			**550**

1 US dollar equal 150 naira

Source: Field Survey Data, (2010)

Conclusion and Recommendations

This study examined the viability of prospective Jatropha based firms in Nigeria specifically the study identified the Jatropha bio-diesel and other allied products that were been researched into in Nigeria, estimated the costs and returns structure to Jatropha cultivation and the production of Jatropha based products. The results of the study revealed that Jatropha based products manufactured include bio-diesel, Jatropha kernel cake livestock feed, Jatropha ink pigment and dye, glycerine and Jatropha seeds-coat cement sheet and floor tiles. All the various parts of the Jatropha seeds are useful either for one or two of these products. Jatropha cultivation, was shown to be very profitable. Among Jatropha products, only the costs of the biodiesel Jatropha fuel is relative expensive when compared with the common fossil diesel. However, economics of scale from possible large seale Jatropha diesel production are expectedly pointers to considerable cuts in the Jatropha bio-diesel production costs. The Jatropha biodiesel has greater social value items of it environment friendliness nature. Glycerine is also an invaluable by-product of Jatropha bio-diesel production. The other Jatropha products were relatively cheap to produce.

Based on the study findings, the study calls for the mobilisation of the Nigerian farmers to appreciate the usefulness of Jatropha, so that they could cultivate the crop intensively on the vast marginal lands in the country. Alongside this, training to intimate the masses of the numerous products and benefits from Jatropha is necessary. They should be trained to manufacture simple Jatropha based necessities like those highlighted in the study. Market accessibility training to farmers and other stakeholders involved should also be embedded in the training programme. There is also the need to popularize the practicality of using Jatropha to produce these products via workshops and seminars. It is also necessary to step-

up steps at introducing these products to the markets so as to enhance the marketability and competitiveness of the Jatropha based firms. Government and also other individuals and stake-holders need ensure the availability of supporting infrastructures for these small holder industries to thrive in the long-run

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APPENDIX

Figure 1: *Jatropha* seed coat ceiling sheet 300 x 300 x 4 mm

Figure 2: *Jatropha* seed coat

Figure 3: *Jatropha* seed coat floor tile 150 x 300x 10 mm

Figure 4: Jatropha *curcas* L leaves

Figure 5: White pigment

Figure 6: Red Pigment

JATROPHA SEED COAT FLOOR TILE
150 X 300X 10 MM

White pigment

Red pigment