# Farmers' Knowledge of *Jatropha Curcas* as a Renewable Energy Crop in Oyo State, Nigeria

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**ABSTRACT**

*Development of sustainable bio-energy from energy crops is considered an important factor in reducing green house emission, acid deposition in soil and chemical runoff, and improvement of the environment for both man and wildlife. This study was necessitated by persistent degradation of the environment resulting from heavy consumption of fossil fuel, agrochemicals and high level of deforestation resulting in depletion of forest resources. The study thus examined farmers' knowledge of Jatropha curcas as a renewable energy crop in Oyo state, Nigeria. Simple random technique was used to select 120 farmers from 243 Jatropha farmers trained in the study area. Parameters assessed include respondents' socio-economic characteristics, awareness, perception and knowledge of Jatropha curcas as renewable energy crop. Information was obtained with the use of a structured questionnaire. Both descriptive and inferential statistics were used to analyse the data. Results show that majority of farmers were male (66.7%), had mean age of 44.4±10.8, married (90.0%), had formal education (91.7%), crop and livestock farming (86.7%) were the main livelihood activities. Awareness of Jatropha curcas as renewable energy crop was mainly through participation (52.5%) in a seminar organized for farmers by a non-governmental organization. Most farmers (62.5%) had favourable disposition and high knowledge (75.5%) toward Jatropha curcas cultivation. Cultivation practice ($r = 0.453$, $p<0.05$) was significantly related to knowledge of Jatropha curcas as a renewable energy crop. Institutionalizing framework by government and non-governmental organizations to promote cultivation of Jatropha curcas will foster healthy environment and consequently mitigate accumulation of green house effect caused by fossil fuel and industrial activities.*

**Keywords**: *Jatropha curcas,* Farmers' knowledge, Renewable energy

## BACKGROUND TO THE STUDY

The current challenge experienced throughout the world is the issue of environmental degradation through widespread consumption of fossil fuels. This has prompted the imperative development of alternative energy sources that can lead to sustainability of energy and environment system (Raghuvanshi, Raghav, and Chandra, 2007). The consumption of these energy resources has resulted into climate change and breakdown of the ozone layer, thereby militating against the environment. The participation of the farmers in the production of *Jatropha*crop has become inevitable in Nigeria and other developing countries of the world. The increased cultivation of this energy crop has been adaptable by society for reduction of greenhouse gas emission, soil erosion, and other environmental breakdown (Jonsson, Ostwald, Asphund, and Wibeck, 2011). *Jatropha* is promoted as a drought resistant crop with high potential growth on degraded soils which has positive environmental impact from bio-diesel production (Ostwald, Axelsson, Franzen Berndes, and Ravindranath, 2011). Hence, the accessibility of farmers to adequate information and capacity building training on *Jatropha* cultivation as a potential renewable energy crop will contribute to environmental mitigation and production of bio-fuel for enhancement of a sustainable environment.

In view of these environmental problems, studies have been carried out on the impact of energy crops for environmental sustainability. Development of sustainable bio-energy from energy crops is considered an important factor in reducing greenhouse emission, acid deposition in soil and chemical runoff, and improvement of the environment for both man and wildlife through deliberate forestation project (Olaoye, 2009). Sustainable environment according to Achten (2010) is possible based on the production of bio-diesel which considerably reduces non-renewable energy requirement and greenhouse gas emissions due to fossil fuel consumption, and the pressure on the ozone layer is also abated. *Jatropha curcas* as a potential renewable energy crop is a perennial crop known for its invasive growth, fertility, and adaptability to all soil types. This energy crop is relatively drought resistant with soil erosion control potential, and provides better habitat for man and wildlife. *Jatropha*

*curcas* has many potential contributions to sustainable environment in the area of wind and soil erosion, serves as good source of organic fertilizer for the soils, facilitates water erosion control, and help in solving deforestation problems in the developing countries (Chachage, 2003).

Consequently, in Nigeria focus still hinges on fundamental issues of food security and sustainable agriculture which has devoted large hectares of land to cultivation of arable crops with militating factors like the use of obsolete cultural practices, scanty plants stands, poor weed control, usage of inorganic fertilizers, with poor management accounting for low productivity of the farmers (Osabuomen, and Okoedo-Okojie, 2011). In a bid to tackle the issue of food insecurity, environmental degradation has become inevitable through the management practices engaged in the production of arable crops. Food crop farmers in Nigeria with their bulk production and provision of arable crops for both local consumption and regional supplies have placed a heavy burden on the environment (Apata, Samuel, and Adeola, 2009)

*Jatropha curcas* is one of the inedible renewable energy crops which are very critical to ensuring that the environment becomes sustainable for its habitation. The pressing problem of environmental degradation, land deformation, agricultural stagnation, and population explosion in Nigeria can be combated and overcome by agro forestry innovation whereby annual crops interspersed with trees and shrubs (Bankole, Adekoya, and Nwawe,, 2012). However, farmers' knowledge of *Jatropha* cultivation as a potential renewable energy crop will be essential to ensure its deployment for a sustainable environment. Sequel to the foregoing, this research sought to assess farmers' knowledge of*Jatropha* as a renewable energy crop in Oyo State, Nigeria with the following objectives

1. examine the socio-economic characteristics of the respondents in the study area;
2. assess respondents' knowledge of Jathropha cultivation practices, and;
3. assess the knowledge of the respondents on *Jatropha* cultivation as a renewable energy crop.

## METHODOLOGY

The study was carried out in Oyo State which is an inland state in the southwestern Nigeria. It covers the land area of approximately 32,241.8 square kilometers. The total population in Oyo stateaccording to the 2006 population census is 5,591,589. It is bounded in the north by Kwara state, in the east by Osun state, in the south by Ogun state and in the west partly by Ogun state and Republic of Benin. The state is made up of thirty-three (33) Local government areas. Oyo state is mainly agrarian and the climate favours the cultivation of crops like maize, yam, cassava, millet, rice, plantain, cocoa tree, palm tree and cashew.

The population for this study constitutes all trained *Jatropha* farmers in Oyo state. There are 243 trained *Jatropha* farmers in all the 33 Local Government Areas (LGAs) in the state. Ido (51), Akinyele (50), and Lagelu (58) were purposely selected due to high number of trainees from the LGAs. Proportionate sample to size was used to select 76% from Ido and Akinyele, while 74% from Lagelu LGAs. This represents 39, 38, and 43 respectively to give a total of 120 farmers interviewed for the study.

Major variable (dependent) measured was knowledge of *Jatropha* cultivation as a renewable energy crop**.** This was measured using a 2-point scale of yes or no for eleven knowledge test items. Correct response attracted 1, while incorrect response was scored 0. The maximum score was 11, while the minimum was 0. Total score for each respondent was computed and mean score 7.5±1.2 determined. Respondents below the mean were regarded as having low knowledge, while those above the mean were categorized as having high knowledge.

## RESULTS AND DISCUSSION

### Socio-economic characteristics of respondents

Table 1 shows that the mean age was 44.4±10.8. This implies that farmers were dominated by people who are still in their active working age. This result agrees with Adiel (2004) who opined that middle age group (30-45 years) formed the bulk of agro forestry technology adopter in Nigeria. Results on sex reveal that majority (66.7%) were male, while 33.3% were female. This finding is consistent with Adenegan, Adams and Nwauwa, (2013) who asserted that male participation in agricultural production was more than that of the female in Oyo state, Nigeria. This could be as a result of intense women engagement both in house chores and marketing, while male practice farming.

Table 1 further shows that majority (90.0%) were married. This implies that farmers cherished marriage institution and at the same time could have access to family labour. This result agrees with Akangbe et al. (2013) who found that 97.3% of farmers in agricultural development in Moro Local Government Area of Kwara state, Nigeria were married and have access to family labour for their various agricultural enterprises. On household size, majority (64.1%) had between 4 and 6 household members . The implication of this is that the members of their household could be of immense assistance on the farm through their contribution to the farm work. In a related study, Toluwase and Apata (2011) found that 60% of the farmers have household size between

1 and 5 and their participation in agriculture could increases agricultural productivity.

On education, majority (91.7%) had one form of formal education or the other. This implies that level of literacy could have significant influence on their knowledge of *Jatropha* cultivation as a renewable energy crop. This finding agrees with Gordon and Craig (2001). They opined that education increases level of skills and foster access to information on improved agricultural practices. Yasmeen et al., (2011) corroborated this finding in a related study where they found that education may boost farm productivity by refining the quality of labour, increasing the aptitude to regulate disequilibrium for increased rate of total acceptance of agricultural innovation. On occupation, 48.3% of the respondents practiced farming as their major occupation, 29.2% of the respondents were traders, while majority (77.5%) were both farmers and traders. This result is related with the findings of the United States Development Agency (2007) which established that only 45% of farmers claimed farming as their principal occupation and a similar number of farmers agreed on having some other forms of occupation.

Results on respondents' years of farming experience on Table 1 indicate that 25.8% had 13-16 years of farming experience. This is likely to have a positive implication on *Jatropha* cultivation. This report agrees with Babasanya *et al*. (2013); they found that reasonable number of farmers had long years farming experience in cassava production. The number of years of farming experience could have a positive effect on knowledge of *Jatropha* as a renewable energy crop. Consequently, farming experience will affect farm management expertise and decision-making process (Ani et al., 2004). On farm size cultivated, more than half (53.3%) cultivated between 1.2-2.4 hectares This is consistent with Anyaegbunam, Nto, Okoye, and Madu , (2012); who found that average land possessed by farmers for cultivation is about 2.4 hectares.

**Table 1**
**Respondents' distribution by socio-economic characteristics**

| Socio-economic Characteristics | Frequency | Percentage | Mean |
|---|---|---|---|
| **Age** | | | 44.4± 10.8years |
| ≤30 | 9 | 7.5 | |
| 31-40 | 39 | 32.5 | |
| 41–50 | 39 | 32.5 | |
| 51-60 | 22 | 18.3 | |
| >60 | 11 | 9.2 | |
| **Sex** | | | |
| Male | 80 | 66.7 | |
| Female | 40 | 33.3 | |
| **Marital Status** | | | |
| Single | 10 | 8.3 | |
| Married | 108 | 90 | |
| Window(er) | 2 | 1.7 | |
| **Educational Status** | | | |
| No formal education | 8 | 6.7 | |
| Adult education | 2 | 1.7 | |
| Primary | 9 | 7.5 | |
| Secondary | 42 | 35.0 | |
| Tertiary | 59 | 49.2 | |
| **Farming Experience** | | | |
| 1-4 years | 3 | 2.4 | |
| 5-8 years | 12 | 10.0 | |
| 9-12 years | 25 | 20.9 | |
| 13-16 years | 31 | 25.8 | |
| 21-24 years | 13 | 10.9 | |
| 25-28 years | 8 | 6.7 | |
| 29-32 years | 5 | 4.1 | |
| 33-36 years | 3 | 2.5 | |
| >37 years | 2 | 1.7 | |
| **Farm size** | | | |
| 0.5 – 2.5 acres | 43 | 35.9 | |
| 3 – 6 acres | 64 | 53.3 | |
| 7 – 10 acres | 9 | 7.5 | |
| 11 – 15 acres | 2 | 1.6 | |
| 16 – 25 acres | 2 | 1.7 | |

**Respondents' knowledge of *Jathropha* cultivation practices**

The result on Table 2 shows that all (100%) indicated that *Jatropha* cultivation begins from the nursery through planting of its seeds on the bed. Majority (91.7%) specified that *Jatropha* seedling spend 2 months in the nursery before it is transplanted to the field. Saverys et al., (2008) and Parajuli (2009) corroborated the above results; they confirmed that *Jatropha curcas* is pre-cultivated in the nursery beds as seedlings before being transplanted into the field but at the same time propagated on small scale by seed and stem cuttings directly on the field. Substantial farmers (71.7%) subscribe to planting of 1000 seedlings per 1 acre with the planting distance of either 2m x 2m or 3m x 3m. Many (90.8%) understood the essence for regular weeding operations and pruning. This is in line with Gour (2006) who opined that pruning of *Jatropha curcas* stands as intervention in field management practices which enhances production of more branches, stimulates healthy fruiting and seed yield.

The result further shows that all (100%) indicated *Jatropha* seeds harvesting begins at 10 months, (79.2%) said 1 ton (1000kg) of *Jatropha* is harvested in the first year of cultivation and 80.8% opined that 2 tons of seed harvested in the second year. About 98.3% of the respondents indicated that *Jatropha* oil (bio-fuel) is extracted either manually or by specially-made machine. This result corroborates with the submission of Achten (2010) who reported that the economic life of *Jatropha* curcas varies between 35 years and 40. This result implies that training obtained has immersed enhance respondents' knowledge of *Jatropha* cultivation practices.

**Table 2**
**Distribution of respondents based on cultivation practices of *Jatropha* for sustainable environment in the study are (N = 120).**

| Cultivation practices | Yes | | No | |
|---|---|---|---|---|
| | F | % | F | % |
| 1. *Jatropha* cultivation begins from the nursery practice is done early in the morning. | 120 | 100 | | |
| 2. This nursery practices is done early in the morning. | 110 | 91.7 | 10 | 8.3 |
| 3. Germination of *Jatropha* seeds starts on the 6th day in the nursery bed. | 118 | 98.3 | 2 | 1.7 |
| 4. *Jatropha* seedlings speed 2 months in the nursery before it is transferred to the field. | 110 | 91.7 | 10 | 8.3 |
| 5. I prefer to plant hybrid species of *Jatropha* than local breeds. | 119 | 99.2 | 1 | 0.8 |
| 6. Manual clearing is enough for me as a peasant farmer. | 89 | 74.2 | 31 | 25.8 |
| 7. Ploughing is done once or twice based on soil types. | 97 | 80.8 | 23 | 19.2 |
| 8. Ploughing for heavy soils is deep while it is shallow for light soils. | 37 | 30.8 | 83 | 69.2 |
| 9. I like to use seeds for *Jatropha* cultivation | 23 | 19.2 | 97 | 80.8 |
| 10. I prefer using seedling for cultivation of *Jatropha*. | 115 | 95.8 | 5 | 4.2 |
| 11. I buy my planting stock for *Jatropha* cultivation from an NGO. | 111 | 92.5 | 9 | 7.5 |
| 12. I plant between 600 and 1000 seedling per 1 acre. | 86 | 71.7 | 34 | 28.3 |
| 13. The planting distance of 2m x 2m or 3m x 3m is used to allow intercropping. | 117 | 97.5 | 3 | 2.5 |
| 14. Regular weeding is crucial to fruiting of *Jatropha* crop. | 117 | 97.5 | 3 | 2.5 |
| 15. The weeding of 3-4 times is enough to keep the field free from weeds until the crop crosses the growth period stage. | 92 | 76.7 | 28 | 23.3 |
| 16. Pruning enhances quick fruiting of the plant | 109 | 90.8 | 11 | 9.2 |
| 17. Fruiting of *Jatropha* crop is between 6-8 months on its establishment in the field. | 119 | 99.2 | 1 | 0.8 |
| 18. The plantation site must be cleared of weeds and shades because *Jatropha* required sufficient sunlight to increase fruiting. | 120 | 100 | | |
| 19. Harvesting of *Jatropha* seeds begins at 10 months. | 120 | 100 | | |
| 20. One (1) ton – (100kg) of *Jatropha* seeds is harvested in the first year of cultivation. | 95 | 79.2 | 25 | 20.8 |
| 21. Two (2) tons of seeds are harvested in the first year. | 97 | 80.8 | 23 | 19.2 |
| 22. The four (4) tons of *Jatropha* seeds are harvested in the third year. | 103 | 85.8 | 17 | 14.2 |
| 23. The *Jatropha* oil is extracted manually or by special made machine. | 118 | 98.3 | 2 | 1.7 |

**Respondents' knowledge of *Jatropha* as a renewable energy crop**

The result on Table 3 shows that the majority (100%) asserted that *Jatropha* cultivation under proper management produces fruits with high oil content, removes carbon from the atmosphere (99.2%) and does not contribute to carbon (IV) oxide and sulphur (IV) oxide emission into atmosphere (97.5%). This is consistent with Jain and Sharma (2010). The duo opined that *Jatropha curcas* is drought resistant crop which can be cultivated on waste lands and helps the soil to regain nutrients and assists in carbon restoration and sequestration. The result further shows that all farmers (100%) knew that bio-fuel produced from *Jatropha* is already in use for both domestic and industrial purpose. It can be used for powering generating sets, diesel engines and

cooking stoves which enhances reduction in global warming. Other by- products identified in use for renewable energy source include; *Jatropha* cake being used as organic fertilizer and organic pesticides which prevents contamination of the soil and underground water. It implies that the trained farmers acquired sufficient knowledge of *Jatropha* plant as a renewable energy crop. In a related study, Achten (2010) emphasized that sustainable environment is possible through biodiesel which has the potential to reduce non-renewable energy requirement and greenhouse gas emission. Maingi (2010) also found that majority of *Jatropha* curcas adopters have high knowledge of *Jatropha* curcas for controlling soil erosion, soil fertility enrichment and aforestation.

**Table 3**
**Distribution of respondents' knowledge on cultivation of *Jatropha* for sustainable environment**

| Knowledge Statements | Yes | | No | |
|---|---|---|---|---|
| | F | % | F | % |
| 1. *Jatropha* crop has no potential for environmental mitigation because it is only useful as a protective plant in driving away evil spirit. | 18 | 15.0 | 102 | 85.0 |
| 2. The renewable energy crop is drought resistant which makes it non-seasonal plant. | 105 | 87.5 | 15 | 12.5 |
| 3. *Jatropha* crop can produce its fruits /seeds for fifty (50) years at 4 tons per annum. | 118 | 98.3 | 2 | 1.7 |
| 4. *Jatropha*curcas removes carbon from the atmosphere | 119 | 99.2 | 1 | 0.8 |
| 5. It does not contribute to carbon (IV oxide, $CO_2$, and sulphur (IV) oxide emission into atmosphere. | 117 | 97.5 | 3 | 2.5 |
| 6. Biofuel produced from *Jatropha* is already in use in the country for both domestic and industrial purpose. | 120 | 100 | | |
| 7. The biofuel from *Jatropha* is used for powering generating sets, diesel engines, lanterns, and cooking stoves which enhances reduction in global warming. | 120 | 100 | | |
| 8. The by-products "*Jatropha* cake" is used as organic fertilizers as well as organic pesticides instead of inorganic fertilizer and synthetic pesticides. | 119 | 99.2 | 1 | 0.8 |
| 9. The oil cake from *Jatropha* seeds is rich in nitrogen, phosphorus and potassium which make it useful for replenishment of infertile soils. | 119 | 99.2 | 1 | 0.8 |
| 10. *Jatropha* cultivation with proper management produces fruits with high oil content. | 120 | 100 | | |
| 11. *Jatropha* cake does not contaminate the soil and the underground water as compared to inorganic fertilizer. | 119 | 99.2 | 1 | 0.8 |

**Respondents' socio-economic characteristics and knowledge of *Jatropha* cultivation as a renewable energy crop**

The result on Table 4 shows that there were significant relationships between respondents' age ($r = 0.891$, $p<0.05$), marital status ($\chi^2 = 18.782$, $p<0.05$), occupation ($\chi^2 = 47.169$, $p<0.05$), household size ($\chi^2 = 46.650$, $p<0.05$) and knowledge of *Jatropha* cultivation as a renewable energy crop. This implies that respondents' selected socio-economic characteristics have some degree of influence on respondents' knowledge of *Jatropha* cultivation as a renewable energy crop. Corroborating this finding, Olatokun and Ayanbode (2009) opined that the indigenous knowledge of Malian rural women has helped in the traditional handling of *Jatropha* curcas for the production of oil for raw material and biofuel. Furthermore, Nyamai and Omuodo. (2007) established that *Jatropha* curcas lends itself greatly to many rural households due to its multiple uses that directly respond to the needs of smallholders.

**Table 4**
**Relationship between respondents' socio-economic characteristics and knowledge of *Jatropha* cultivation as a renewable energy crop**

| Variables | r-value | Df | $\chi^2$ | p-value |
|---|---|---|---|---|
| Age | 0.891* | | - | 0.000 |
| Sex | - | 1 | 2.644 | 0.450 |
| Marital status | - | 3 | 18.72 | 0.005 |
| Educational level | - | 4 | 15.066 | 0.238 |

*significant @ $p<0.05$

**Respondents' cultivation practices and the knowledge of *Jatropha* as a renewable energy crop**

The result on Table 5 reveals that there is significant relationship between the respondents' cultivation practices and knowledge of *Jatropha* as a renewable energy crop ($r = 0.453$, $p<0.05$). The result shows that the training has impacted the farmers to understand the rudiments of cultivation practices and *Jatropha* as a renewable

energy crop. Maingi (2010) confirms that majority of *Jatropha* curcas adopters have high knowledge of *Jatropha* curcas for controlling soil erosion, soil fertility enrichment and aforestation. Contrary to this result, Obiero et al. (2013) opined that smallholder *Jatropha* farmer in Kenya have limited knowledge of *Jatropha* agronomic practices.

**Table 5**
**Respondents' cultivation practices and the knowledge of *Jatropha* as a renewable energy crop**

| Variable | r-value | p-value |
|---|---|---|
| Farmers' knowledge of *Jatropha* | 0.453* | 0.000 |

*significant @ p<0.05

## CONCLUSION AND RECOMMENDATIONS

From the foregoing, it can be concluded that there is high knowledge of *Jatropha* as a renewable energy crop. To enhance the knowledge, production and utilization of *Jatropha*, non-government organisationsand relevant research institutes should embark on deliberate sensitization campaign to ensure farmers involvement in cultivation practices and utilization of its biofuel in Nigeria.

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