Prospects and problems of using Jatropha cake as organic fertiliser among crop farmers in Oyo State, Nigeria

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Abstract: The study investigated prospects and problems of Jatropha cake as organic fertiliser in Nigeria. All members of Jatropha Farmers Group in Ibadan metropolis, Oyo State, Nigeria (106) were purposively selected for the study. Interview schedule was used for data collection while frequency counts and percentage were used for data analysis. Results showed that average yield of Jatropha was 2.94 kg/ha while the quantity of Jatropha cake processed per farmer was 11.9 kg. Majority (76.5%) of the farmers indicated that Jatropha cake supported high crop yield. Also, 79.3% were favourably disposed to continuous use of Jatropha cake, indicating acceptability of the cake and prospects for market availability. Availability of Jatropha seeds ranked highest amongst constraints to Jatropha production followed by inadequate processing technologies. In conclusion, Jatropha cake was adjudged as having potentials to fill the gap of farmers' fertiliser requirements through increased availability of Jatropha cake via sustained Jatropha cultivation.

Keywords: low fertiliser application; organic fertiliser; mechanised processing; improving Jatropha seed yield.

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1 Introduction

Jatropha curcas, commonly known as physic nut, belong to the euphorbiaceous family. It is a hardy plant, thrives on degraded land and requires limited amount of nutrients and water. The seeds can be used as a fuel directly or, in its trans-esterified form, as a substitute for diesel (Yadav et al., 2014).

Jatropha curcas is currently gaining lots of interests for biofuel production and reclaiming marginal lands. *Jatropha curcas* (L) or physic nut is a multipurpose and drought resistant large shrub or small tree and can be grown without much effort (Kumar and Sharma, 2008; Kumar et al., 2010; Kumar and Satyawati, 2011). Seed production from plants propagated from seeds can be expected within 2–3 years. Seed of the plant is the most valuable product and used for production of biodiesel. Seed cake of Jatropha is

a major by-product of the bio-diesel extraction process. The cake is rich in nitrogen (3.2%), phosphorus (1.4%) and potassium and can be used as manures (Keremane et al., 2003; Olowoake, 2014). In practicality, 4 kg of fresh Jatropha seeds can yield only 1 kg of Jatropha oils. Therefore, this creates a large amount of solid waste left after an oil extraction. The deoiled *Jatropha curcas* seedcake, hereafter referred as JSC, contained up to 58% of crude protein by weight (Srinophakun et al., 2011; Olowoake, 2017). The large amount of de-oiled seed cakes produced by oil-extraction process is valuable as organic manure due to its high nitrogen content and can be used to maintain fertility of soil (Chaturvedi and Kumar, 2012).

Soil fertility depletion in the smallholder farms is the fundamental biophysical root cause for declining per capita food production in Nigeria. The study area has suffered gross soil nutrient mining due to continuous cropping coupled with low levels of nutrient inputs and poor nutrient conservation practices (Ewulo et al., 2015). Moreover, the high cost of synthetic fertiliser coupled with unavailability of its use by the local farmers constitutes a major challenge. As one of the solutions to the problem, the application of Jatropha cake has been paid attention, and the enhancement of farmers' application of the cake is increasingly important. The greater awareness about Jatropha has sensitised the public and stakeholders in Nigeria to look into the development of Jatropha growing and use as organic fertiliser source. This has led to the formation of National Jatropha Biofuel Development Associations (NJBDA) in different states of Nigeria. The Oyo State farmers became one of the foremost Jatropha based associations across Nigeria formed in 2009. The association's headquarter office is located in Ibadan, Nigeria (Abolaji et al., 2014). The Oyo State NJBDA was a legal stakeholder in the sustainable development of Jatropha in Nigeria; association members met every month at their various wards. Members of this association are farmers who were passionate about growing, processing, marketing, and using Jatropha cake as fertiliser for their crops. This study therefore aims at providing baseline information about the prospects and problems associated with the use of Jatropha cake as organic fertilisers among farmers using NJBDA in Oyo State, Nigeria as a case study.

The primary objective of the study was to examine the prospect of application of Jatropha cake as organic fertiliser in the study area. The specific objectives include to:

1 describe the socio-economic characteristics of farmers in the study area,

2 determine quantity of Jatropha seed produced and amount processed into Jatropha cake for application on the farm,

3 investigate the level of utilisation of Jatropha cake by farmers for crop production,

4 ascertain prospects for continuous utilisation of Jatropha cake for crop production and

5 investigate the existing constraints on processing and application of Jatropha cake as organic manure.

2 Methodology

The study area was Ibadan metropolis in Oyo State, Nigeria. Oyo state is located on the coordinates 8°N and 4°E. The area was purposively chosen for the study because of presence of existence of Jatropha farmer group which was formed as far back as in 2009. Jatropha cultivation is relatively new in Nigeria. Farmers cultivating the crop and cooperating with one another in an established group therefore placed them at vantage position for the study.

All members ($N = 106$) of the Jatropha farmer group in Ibadan metropolis constituted the sample of the study. Questionnaire was used for data collection in March 2014. This research tool was used because preliminary interaction with the processors revealed they had acquired some level of formal education to read, interpret and provide written answers to the questions. All the members of the group were administered the survey instrument. Questions included in the survey instrument sought to determine quantity of Jatropha seed produced by farmers and proportion processed into Jatropha cake for application and utilisation on the farm; investigate the level of utilisation of Jatropha cake for crop production. Others questions bothered on ascertaining the prospects for continuous utilisation of Jatropha cake for crop production and investigating existing constraints militating against successful processing of Jatropha cake and its utilisation as organic manure. Data were analysed using descriptive statistics. Specifically, frequency count, percentages and mean were used to describe the data obtained.

Figure 1 Processing of Jatropha seed into cake



3 Result and discussions

3.1 Socio-economic characteristics of crop farmers

Result in Table 1 revealed that majority (92.5%) of the farmers were in 21 and 60 years age bracket while a small proportion (7.52%) were over 61 years of age. The mean age of the farmers was 50.4 years with standard deviation of 6.9 years. At this age bracket, respondents are expected to be relatively venturesome, willing to take risk and easily adopt innovations. This explained the curiosity of these farmers which fell within the age bracket categorised as youth by Akangbe (2004) to venture into Jatropha production and processing to increase crop base for income generation and poverty reduction. The result also provided a hint that farmers of this age category should be targeted for introduction of innovation designed to improve on the living conditions of farmers. The result also revealed that 84% of the respondents were married with an average of 10.9 members and standard deviation of 2.5. The wives and other members of the household would be ready source of farm labour required for the cultivation of Jatropha as most farm operations for Jatropha production and processing are labour intensive (Ismaila et al., 2010). Availability of labour or mechanised system is a condition for adoption of innovation. Extension agency should take cognisance of these requirements when introducing innovations to farmers. It was also revealed that a small (3.8%) proportion of farmers were females. Females should be involved in agricultural programs that can address the nation's food insecurity and poverty situation in the country since female is about half of the population of Nigeria according to 1996 census. The low level of female participation in Jatropha farming is in line with the report of Agbamu (2005) that discrimination against women in the extension service delivery in Nigeria still exists. Addressing the economic problems of the female equates to solving the problems about half the population of the study area and the country at large since women were about half the population of the study area and the country as a whole. More than half (69%) and 22.6% of the respondents had primary school and junior secondary education. The level of educational status is an important factor in adoption of innovation according to Anka (2014) who report that schooling provides external benefits by shifting production frontier outwards and that education is important to the timing of adoption. Farmers' educational attainment also has implications on their involvement in Jatropha production which influenced their level of innovativeness. However, 2.8% of the respondents had tertiary education. This shows that the educated elite in the country are now venturing into agriculture as a means of livelihood rather than depending on white collar job. The farmers' average farm size was 4.08 hectares with standard deviation of 1.85. This showed an appreciable increase over the national average of 0.57 hectares (Ingawa, 2005). An increase in hectarage of farmland would lead to a higher level of income resulting from higher level of production *ceteris paribus*. The diffusion of Jatropha production within an average of 4.2 years of farmers' mobilisation to grow the crop was impressive. The cultivation of the plant also cut across various tribe Yoruba (84%). Baruba (23.6%), and Fulani pastoralists (11.2%) located in the study area (Table 1). This was a ray of prospect for the plant and an indication that farmers of diverse tribes and agricultural enterprises built hope in Jatropha farming to address their economic woes.

Table 1 Socio-economic characteristics of the crop farmers

Characteristics	*Frequency*	*Percentage*	*N=106*
Age (Years)			
21–40	9	8.5	Mean =50.4
41–60	89	84.0	Std. dev. =6.9
61 years and above	8	7.5	
Gender			
Male	102	96.2	
Female	4	3.8	
Marital Status			
Single	3	2.8	
Married	89	84.0	
Widowed	10	9.4	
Divorced/ Separated	4	3.8	
Household Size (in Numbers)			
1–10	55	51.9	Mean =10.9
11–20	51	48.1	Std. dev. =2.5
Educational level			
Nomadic education	1	0.9	
Primary School	73	69	
Junior Secondary school	24	22.6	
Senior Secondary school	5	4.7	
Tertiary education	3	2.8	
Farm size (hectares)			
1–5	85	80.1	Mean =10.9
6–10	19	17.9	
11 and above	2	1.9	
Ethnic group			
Yoruba	89	84	
Fulani	12	11.3	
Baruba	25	23.6	

3.2 Quantity of Jatropha seed produced and processed into Jatropha cake for application on the farm

The report of the study Table 2 revealed slightly above half (56.6%) of the respondents produced less than 3 kg/ha of Jatropha. Few (12.3%) produced between 3.01 and 6.00 kg/ha while a total of about 8.5% produced above 6 kg/ha of Jatropha. Mean yield was 2.94 kg/ha with a standard deviation of 2.57 kg/ha. The yield was comparatively lower

than the yield of other perennial crops like cassava, 15,000 kg/ha. The plausible reasons for the low yield might be due to lack of high yielding varieties of *Jatropha curcas.* There are currently no agronomic improved varieties available for *Jatropha curcas* commonly found in Nigeria and that the plant still remains as hedge or living fence around homesteads, gardens, and crop fields to protect against invasion by roaming animals. Similarly, majority (79.2%) processed less than 10 kg of Jatropha cake. While about 15% processed between 11 and 20 kg, very few (5.7%) processed between 21 and 30 kg. Average Jatropha cake processed was 7.6 kg per farmer. This would be extremely low to meet the fertiliser need of a farmer with an average farm size of 4.08 hectares. Although the result (Table 2) revealed that there were individuals that processed 31 kg of Jatropha cake, it was an average of 7.6 kg or 63.9% of the processed cake that was applied on the farm. This quantity was grossly inadequate to meet fertiliser requirements of a farmer with an average farm size of 4.08 hectares of arable crops. The focus therefore is to concentrate on the development of high yielding variety and agronomic husbandry practices for optimal production of Jatropha seeds which can be processed to fill the gap of fertiliser needs of farmers in the study area. Similarly, an efficient processing technique devoid of drudgery should be developed to process the seed to cake and other by-products to increase the revenue base of farmers.

Table 2 Quantity of Jatropha seed produced and processed into Jatropha cake

	Frequency	*Percentage*	*Mean*
Quantity of Jatropha seed produced (kg/ha)			
0.01–3.00	60	56.6	
3.10–6.00	13	12.3	
6.01–9.00	5	4.7	2.94 kg/ha
9.01 +	4	3.8	
NR	24	22.6	
Quantity of Jatropha cake processed (kg)			
1–10	84	79.2	
11–20	16	15.1	7.6
21–30	6	5.7	
31 and above			
Quantity of Jatropha cake applied on the farm (kg)			
1–10	80	75.5	
11–20	16	15.1	8.63
21–30	6	5.7	
NR	4	3.8	

Source: Field survey, 2014

3.3 Prospects for utilisation of Jatropha cake for crop production

The promotion of research into the use of Jatropha for bio-fuel and cake processing was recent in Nigeria. However with the promotional efforts by the Universities, Federal Ministries and Energy Commission of Nigeria, 67% of the respondents were aware of the potentials of Jatropha cake as an organic fertiliser. The first stage in the adoption process

is awareness. Farmers can only adopt innovations that are made available to them. If farmers were convinced that an innovation would satisfy a felt need, interest would be developed. Then, an attempt would be made to evaluate the innovation for trial and subsequent mass adoption. It desirable to increase the tempo of awareness creation on the potentials of Jatropha especially over the radio, workshops, demonstrations and conferences so that majority of the farmers are aware of application of Jatropha cake as a convenient substitute of inorganic fertiliser capable of emitting greenhouse gases (GHG) linked with global warming and climate change with deleterious effects on physiological performances of crops. More than half 57.5% of the farmers (Table 4) can be assumed to have moved from awareness stage of Adoption Process to trial stage by applying small quantity of the processed cake on their farm, apparently to observe the performance on their crops. Fortunately, many (76.5%) revealed that Jatropha cake supported high yield of their crops. Consequently, 79.3% of the farmers were favourably disposed to continuous use of Jatropha cake on their farms. At present majority of the farmers reported a high demand for Jatropha cake, probably it was the most easily available form of fertiliser for use by the farmers in the study area. With this development, it could be inferred that there is a ready- made market for Jatropha cake.

Table 3 Level of utilisation of Jatropha cake for crop production by farmers

Proportion of Jatropha cake to other fertiliser	*Frequency*	*Percentage*
One quarter	1	1
One third	4	3.8
Half	26	25
Three-quarters	66	63.5
Non-application of Jatropha cake	7	6.7

Source: Field survey, 2014

Table 4 Prospects for utilisation of Jatropha cake for agricultural production

Parameters of measurement	*VH*	*H*	*MH*	*L*	*VL*	*Mean*	*Ranking*
Awareness of Jatropha cake as organic fertiliser	3 (2.8)*	71 (67)	27 (25.5)	2 (1.9)	3 (2.8)	3.7	4
Applied Jatropha cake as organic fertiliser	9 (8.5)	61 (57.5)	13 (12.3)	10 (9.4)	13 (12.3)	3.4	6
Interested in continuous use of Jatropha cake as organic fertiliser	14 (13.2)	84 (79.3)	6 (5.7)	1 (0.9)	2 (1.9)	3.6	5
Effect of Jatropha cake on crop yield	18 (17)	81 (76.5)	1 (0.9)	1 (0.9)	5 (4.7)	4.0	2
Demand for Jatropha cake as organic fertiliser	6 (6.6)	88 (83.1)	5 (4.7)	3 (2.8)	3 (2.8)	3.9	3
Processing of biodiesel from Jatropha seeds at the local level	72 (67.9)	27 (25.5)	2 (1.9)	4 (3.8)	1 (0.9	4.6	1

Source: Field survey, 2014

Notes: *Figure in parentheses represents percentages.

VH (very high), H (high), MH (moderately high), L (low), VL (very low).

3.4 Constraints on application of Jatropha cake as organic fertiliser

The study (Table 5) indicated, in descending order of importance, that availability of Jatropha seeds, technologies for processing Jatropha cake and cost of Jatropha cake compared with other forms of fertiliser as limiting factors to continuous use of Jatropha cake as substitute for existing inorganic or other organic fertilisers. The availability of Jatropha cake is determined among others by the availability of Jatropha seeds. This was reported to be inadequately available for processing. Similarly, inadequate availability of appropriate technologies for processing might have contributed to the high cost of the cake compared with existing forms of fertilisers in the study area. In addition, high demand of Jatropha cake by the farmers and inadequate supply partly explained high cost of the cake, obeying the existing law of demand and supply. The higher the demand and the lower the supply, the higher the cost of the product provided the substitutes are equally not available. Therefore, it is desirable to improve on the current low yield of Jatropha species to step the supply of the seed or raw material for the processing systems in order to augment the supply of the cake and bring down the price to an affordable level by the majority of farmers. Awareness on the potential of processing Jatropha into organic fertiliser should be intensified so that virtually all farmers in the study area would be intimated with this development, more so that bio-fuel is also an additional derivable product from the plant. Nigerian petroleum is not a renewable resources, this calls for intensification of research for other alternative sources of bio-fuel and fertiliser of which Jatropha has shown a prospect of being a potential substitute. The farmers should constitute themselves into viable cooperatives or association for capital formation which can be used to acquire effective and efficient processing equipment for large scale processing and cost minimisation. While scientific improvement of Jatropha should be intensified to accelerate level of seed yield.

Table 5 Constraints on application of Jatropha cake as organic fertiliser

Parameters of measurement	*VA*	*A*	*MA*	*LA*	*VIA*	*Mean*	*Ranking*
Jatropha seeds availability	3 (2.8)	4 (3.8)	2 (1.9)	61 (59.5)	36 (34.0)	1.8	1
Availability of processing technology	2 (1.9)	7 (6.6)	4 (3.8)	70 (66.0)	23 (21.7)	2.0	2
Cost of Jatropha cake compared with inorganic fertiliser	4 (3.8)	3 (2.8)	3 (2.8)	90 (86.6)	6 (5.8)	2.1	3

Source: Field survey, 2014

Notes: VA (very adequate), A (adequate), MA (moderately adequate), IA (inadequate), VIA (very inadequate).

4 Conclusion

It was established that Jatropha processing into bio-fuel and cake had increased the plant's cultivation in Oyo State, Nigeria and several other parts of the world. The production and processing of Jatropha species especially *Jatropha curcas* was on the increase due to high demand and continuous use of the cake as an organic fertiliser. Lack of improved and highly yielding varieties of Jatropha made the seeds to be inadequately

available for processing into cake to fill the gap of demand for inorganic fertiliser. Although the price was reportedly higher than other forms of existing fertiliser in the study area, there was an increasing demand and continuous interest for the use of the cake as a substitute for other for forms of fertiliser. This indicated a prospect for Jatropha cake as an organic fertiliser. However, there should be an increasing effort to improve the genetic makeup of Jatropha species in favour of high level of seed production. Thus, large scale processing of Jatropha cake through the use of mechanised processing system would be feasible, and the cake would be made available to farmers at comparative competitive price with other forms of fertiliser.

References

Abolaji, G.T., Yusuf, O.J. and Olooto, F.M. (2014) 'Determination of capacity level of Oyo State National Jatropha Biofuel Development Association for integration into value chain system', *International Journal of Phytofuels and Allied Sciences*, Vol. 3, No. 1, pp.100–116.

Agbamu, J.U. (2005) 'Problem and prospects of agricultural extension services in developing countries', in Afolayan, S.F. (ed.): *Agricultural Extension in Nigeria*, AESON Ilorin, Nigeria, pp.159–169.

Akangbe, J.A. (2004) *Impact of Guinea worm intervention strategies on crop production in Kwara and Niger States*, Thesis, Department of Agricultural Extension and Rural Development, University of Ilorin, Ilorin, Nigeria.

Anka, L.M. (2014) 'Assessment of factors affecting the acceptance of agricultural innovations in Zurmi, Local Government Area, Zamfara State Nigeria', *Global Journal of Science Frontier Research: Agriculture and Veterinary*, Vol. 14, No. 3, pp.33–40.

Chaturvedi, S. and Kumar, A. (2012) 'Bio-diesel waste as tailored organic fertilizer for improving yields and nutritive values of *Lycopercicum esculatum* (tomato) crop', *Journal of Soil Science and Plant Nutrition*, Vol. 12, No. 4, pp.801–810.

Ewulo, B.S., Sanni, K.O. and Adesina, J.M. (2015) 'Response of tomato (*Lycopersicum esculentum* var. mill) to different levels of nitrogen and phosphorus fertilizer in South Western Nigeria', *International Journal of Applied and Pure Science and Agriculture*, Vol. 1, No. 10, pp.13–20.

Ingawa, S. (2005) 'New agricultural technologies adopted from China', *Paper presented at Workshop for North East and North West States of Nigeria*, *Nigerian Tribune*, 1 September, Vol. 13, No. 714.

Ismaila, U., Gana, A.S., Tswanya, N.M. and Dogara, D. (2010) 'Cereals production in Nigeria: problems, constraints, and opportunities for betterment', *African Journal of Agricultural Research*, Vol. 5, No. 12, pp.1341–1350.

Keremane, B.G., Hegde, G.V. and Sheshachar, V.S. (2003) *Jatropha curcas: Production Systems and Uses*, BAIF, Tiptur.

Kumar, A. and Satyawati, S. (2011) 'Non-edible oil seeds as biodiesel feedstock for meeting energy demands in India', *Renewable and Sustainable Energy Review*, Vol. 15, pp.1791–1800.

Kumar, A. and Sharma, S. (2008) 'An evaluation of multipurpose oil seed crop for industrial uses (*Jatropha curcas* L.): a review', *Industrial Crops and Products*, Vol. 28, No. 1, pp.1–10.

Kumar, A., Sharma, S. and Mishra, S. (2010) 'Influence of arbuscular mycorrhizal (AM) fungi and salinity on seedling growth, solute accumulation andmycorrhizal dependency of *Jatropha curcas* L.', *Journal of Plant Growth Regulation*, Vol. 29, pp.297–306.

Olowoake, A.A. (2014) 'Evaluation of different rates of Jatropha (*Jatropha curcas*) seed cake on the growth of *Amaranthus caudatus*', in Rahmann, G. and Aksoy, U. (Eds): *Proceedings of the 4th ISOFAR Scientific Conference. 'Building Organic Bridges', at the Organic World Congress 2014*, 13–15 October, Istanbul, Turkey, pp.855–858.

Olowoake, A.A. (2017) 'Nutrient release pattern from compost supplemented with Jatropha cake on Alfisol of Ilorin, Nigeria', *International Journal of Plant and Soil Science*, Vol. 15, No. 5, pp.1–11.

Srinophakun, P., Saimaneerat, A., Sooksathan, I., Visarathanon, N., Malaipan, S., Charernsom, K. and Chongrattanameteekul, W. (2011) 'Integrated research on *Jatropha curcas* plantation management', *World Renewable energy Congress*, Linkoping, Sweden.

Yadav, N., Kumar, R., Rawat, L. and Gupta, S. (2014) 'Physico-chemical properties of before and after anaerobic digestion of Jatropha seed cake and mixed with pure cow dung', *Journal of Chemical Engineering and Process Technology*, Vol. 5, No. 2.