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Assessing the Potential of Moringa Oleifera Production for Socio-Economic Development in Osun State, Nigeria

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ABSTRACT

Abstract
The research was carried out in Osun State, and a thorough investigation was made into the production, processing, marketing and utilisation of the Moringa plant as a whole in Egbedore local government of Osun State, Nigeria. Data for the study was collected using a well-structured questionnaire and field observations from 120 Moringa farmers that were selected using a random sampling technique. We used descriptive statistics to analyse the data. The results indicate that the mean age of the respondents was 16.67 years, the mean years of Moringa production experience was 25.00 years, and the mean farm size cultivated by the respondents was 1.2 hectares; they were all married, with 54% literate. The mean person's day of family labour was 5.03, and that of hired labour was 1.25 persons per day per month in three months. The majority of the respondents planted Moringa on a small scale using the land tenure system, probably due to the problem of unavailability of transportation, storage, processing, and preservation facilities. Processing and preservation are carried out using the traditional techniques of pounding (using a mortar and pestle), air-drying, and grinding. After pounding and air-drying, they store Moringa leaves in gourds, containers, and clay pots for future use. It is recommended that governments and non-governmental bodies encourage Moringa production, consumption, and value-added activities with the ultimate aim of nutritional security, youth empowerment, the liberation of rural communities from existing poverty traps, and export diversification in Nigeria.
Keywords: Moringa Projects, Moringa Plantation, Miracle Trees, Production-Capability, Processing.

Aims Research Journal Reference Format:
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1. INTRODUCTION

The Moringa tree, believed to be one of the most useful trees worldwide, is a multi-product, multi-functional, multi-dimensional tree. It's known variously as the horseradish tree, the drumsticks tree, the ben oil tree, and popularly called the miracle tree. In Africa, a multipurpose crop, such as the Moringa tree, will benefit food, biofuel, and several other industries (Toma & Deyno, 2014). Several reliable reports from Southern Africa strongly support that this "miracle tree" would benefit rural communities in Africa by establishing large-scale plantations that will create substantial employment opportunities and provide a sustainable income for marginalised groups. *Moringa oleifera* Lam belongs to a monogeneric family of shrubs and trees, Moringaceae. *M. oleifera* is cultivated throughout the Middle East and in most of the tropical belt. It was introduced in Eastern Africa from India at the beginning of the 20th century. *M. oleifera* is a medium-sized tree that reaches about 10m in height (Pandey, Pandey, Tripathi, Gupta, Haider, Bhatt, & Singh 2012). It has a straight trunk about 10-30cm thick with bark that is whitish grey, corky, and with longitudinal cracks.

It also has a tuberous taproot to tolerate drought conditions (Tayo, Pone, Komtangi, Yondo, Ngangout, & Mbida, 2014). The umbrella-shaped tree comes with a loose crown of feathery foliage. The foliage is evergreen or deciduous depending on the environment. In season, the tree is covered with creamy, white, honey-scented flowers arranged in drooping panicles. Flowers are insect pollinated and require a large number of insect visitations, with bees the most common (Upadhyay, Yadav, Mishra, Sharma, & Purohit, 2015).

Moringa oleifera has numerous advantages that render it significant for nutritional and economic purposes. It is exceptionally nutritious, comprising vital vitamins, minerals, and proteins that aid in the prevention of malnutrition. The plant exhibits potent therapeutic attributes, with its leaves, seeds, and roots utilised to address conditions such as hypertension, inflammation, and infections. The cultivation of Moringa offers income-generating prospects for farmers and small-scale entrepreneurs via the sale of its products. Moreover, it enhances environmental sustainability by augmenting soil fertility and functioning as a natural pesticide, rendering it a vital crop for rural development.

Despite that Moringa oleifera is increasingly recognised as a valuable nutritional and economic resource, yet, its full potential is still mostly untapped in rural communities of Osun State, Nigeria. Because there is a vastly unexplored territory of using Moringa plantations as a veritable means towards improving the socio-economic conditions of rural communities and improve their healthy life (Toma, & Deyno, 2014). Therefore, this study aims to investigate how Moringa production can contribute to income generation, and health improvement in Osun State, thereby advancing local socio-economic development.

2. METHODOLOGY

The study was carried out in Egbedore Local Government Area of Osun State, Nigeria. It is located around the northwestern part of Osun State. Osun State has thirty local government areas, and out of them, Egbedore was the choice. It has a humid climate with a temperature of between 21.1 and 31.1°C and an annual rainfall of about 1000mm - 1200mm (OSSADEP, 2016). Egbedore is located in the transition zone of the state's savannah zone. The major occupation in the area is farming; meanwhile, other respondents maintain stable occupations among the people, such as trading, craftwork, palm oil production, etc. Major crops grown are millet, cassava, plantains, maize, cowpeas, and yams, as well as cash crops like cocoa, kernel fruits, and oil palm fruits.

The study area was chosen because the farmers here plant Moringa on a large scale, and it is believed this will make a fairly true representation of the study area. We selected 120 respondents from the Moringa farmer population using random sampling techniques. Data collected includes background information of the respondents, level of moringa production, methods of production, processing methods and utilisation. Data was collected through the use of a well-structured questionnaire and field observations. The data collected was analysed using descriptive statistics like mean, standard deviation and frequency distribution. Furthermore, inferential statistics like correlation and chi-square tests were used to test the hypothesis.

Climatic and Soil Requirements

Moringa grows best in well-drained soils with a pH of between 5.0 and 9.0 and in temperatures between 25 and 35°C. It can survive droughts (although yields drop under continuous water stress) as well as frost (Crosby, 2007; Palada & Chang, 2003). Despite this resilience, climatic conditions do have an impact on the Moringa tree. One study has shown that antioxidant activity (one of the main nutritional benefits of Moringa) is impacted by agro-climatic locations and seasons. Antioxidant activity is generally higher in cooler regions and during the coldest months (Iqbal & Bhanger, 2005).

In contrast, vitamin A content was observed to be higher during the hot/wet seasons, whereas iron and vitamin C content was observed to be higher during cool/dry seasons (Iqbal & Bhanger, 2005). Productivity is generally much higher during the wet season. However, a lack of adequate data indicating Moringa's response to climatic variation is one contributing factor to the slow commercialisation of the species.

Table: 1 **Moringa's response to climatic variation**

1	Elevation Range	Lower Sea Level Upper Sea Level: about 1,500m.
2	Mean Annual Rainfall	Lower : 250 mm. Upper: 4,000mm.
3	Rainfall Pattern	Moringa is adapted to monsoon rainfall patterns.
4	Dry Season duration(consecutive months with < 40mm rainfall).	Well established trees can tolerate long periods of drought, but leaf production suffers.
5	Mean Annual Temperature	Lower: 15^{o}C. Upper: 30 ^{o}C.
6	Minimum Temperature tolerated	Su cculent growth is frost sensitive and established trees can survive low temperature of 0 ^{o}C for short periods with the loss of new growth.

Propagation

Moringa can be planted from seeds or from cuttings (Radovich, 2011). Because the germination rate of Moringa seeds is high, direct seeding is usually the preferred choice (Saint Sauveur & Broin, 2010). Seeds generally germinate within two weeks of sowing, and seedlings are trimmed regularly to encourage branching (Amaglo et al., 2006; Radovich, 2011). Suggested planting techniques are detailed by Palada & Chang (2003).

Figure 1: Planting of Moringa Tree

Spacing

There are several cultivation techniques available for Moringa, and the choice of technique will largely depend on the product to be harvested (green pods, mature pods for seeds or leaves). For leaf production, Moringa can either be planted as intensive production, semi-intensive production or as part of an agroforestry system, with spacing ranging from 0.75 m x 1 m to intensive culture of 10cm x 10 cm (Radovich, 2011; Sanchez *et al.,* 2006). High-density planting of between 300,000 to 1 million plants per hectare is optimal for biomass production. At this density, harvests need to occur every 35 to 75 days (Amaglo, 2006; Sanchez *et al.*, 2006). For pod production, high density has a negative effect on yields, so recommended spacing is 2.5 m x 2.5 m.

Table: 2 Product Cultivation Technique Details and Spacing requirements for different Moringa productivity

Product	Cultivation Technique	Details
Leaves	Intensive Production	• Spacing: 10 cm x 10 cm to 20 cm x 10 cm. • Density: 1 million plants / ha. • Requires more maintenance skills.
	Semi-intensive Production	• Spacing: 50 cm x 1 m. • Good results with less maintenance.
	Agroforestry	• Spacing: 2 – 4 m distance between rows. • Orientation: East-West.
Fruit / Seeds / Pods	Low intensity Production	• Spacing: 2.5m x 2.5m

3. RESULTS AND DISCUSSION

Demographic characteristics of the respondents with respect to the age distribution of the respondents, 18.0% of the respondents were between the ages of 20 and 29 years, 11.0% of the respondents were between the ages of 30 and 39 years, 9% were between 40 and 49 years, 35.0% were between 50 and 59 years, 20.0% were between 60 and 70 years and 7.0% were above 70 years. The mean age of the respondents was 16.67 years, with a standard deviation of 3.33 years. This result indicates that the larger percentage of the respondents were above 50 years but below 70 years. Most of the young able-bodied men and women had migrated to the urban centres in search of better life and the older generation is now left to do the farming. The implication of this is that the future of agricultural production in the study area is uncertain and moringa production may become a thing of the past. All the respondents were males and were all married.

Table 3: Distribution of the respondents according to their age group

Age group in years	Frequency	Percentage (%)	Cumulative percentage (%)
20-29	21.60	18	18
30-39	13.20	11	29
40-49	10.80	9	38
50-59	42.00	35	73
60-69	24.00	20	93
70 and Above	8.40	7	100
Total	120	100	

Field Survey, 2016
Mean = 16.67 years; S.D = 3.33 years

Most women do not own their own farms, but they work with their husbands on the family farms. Women also participate in moringa farming but they do so at the processing, preservation and marketing levels more than at the production level. About 44.0% of the respondents did not have any formal education, 47.0% attended primary school, while only 6.0% had secondary school education and 3% of the respondents had tertiary education. Most of the educated farmers did not farm on full-time basis and they had better access to improved technology. This result showed very high level of illiteracy in the study area. The solution to the above problem is for the government to embark on rural development. Rural development will prevent migration of the young ones to the cities. Provision of good road and other social amenities is very important in this respect. Development of appropriate technologies for moringa processing taking into consideration gender-friendliness of such technologies will keep the women who occupy a major position at the processing stage.

Table 4: Distribution of the respondents according to their level of education

Level of education	Frequency	Percentage (%)	Cumulative percentage (%)
Non-formal	52.80	44	44
Primary	56.40	47	91
Secondary	7.20	6	97
Tertiary	3.60	3	100
Total	120	100	

Field Survey, 2016
Mean = 24.00 years; S.D = 4.38 years

Table 5: shows the distribution of years of moringa production. It could be observed that 40.0% of the respondents had been in the practice of moringa production for not more than 10 years, 29.0% of them had grown moringa between 11 and 20 years, 19.0% had grown moriga between 21 and 30 years, while 12.0% of the respondents had grown moringa between 31 and 40 years. The mean years of moringa production experience was 25.00 years with a standard deviation of 7.38 years. This result shows that moringa production is an age long profession of the people in the study area.

Table 5: Distribution of the respondents according to moringa production experience

Years of experience	Frequency	Percentage (%)	Cumulative percentage (%)
1-10	48.00	40	40
11-20	34.80	29	69
21-30	22.80	19	88
31-40	14.40	12	100
Total	120	100	

Field Survey, 2016
Mean = 25.00 years; S.D = 7.38 years

Return on Investment (ROI), Benefit Cost Ratio (BCR) and the **Net Present Value (NPV) analyses in the 10 years to come.**

The cost-benefit was reported using the Return on Investment (ROI), Benefit Cost Ratio (BCR) and the Net Present Value (NPV) analyses. Results indicated an estimated average net profit of N827,109 (USD 5,137) ha/annum from a total production cost of N1,371,360 (USD 8,580) ha/annum and a gross revenue of N2,200,000.00 (USD 13,750). This value indicates the relative profitability of the enterprise. Furthermore, at varying discount rates of 17.5%, 20%, 22.5%, and 25%, the BCR indicated that for every N1 invested in cost, the investor could realise N1.60 in returns; the ROI indicated a profit return turnover of 26.7% of the cost of investment, and an NPV estimate at the end of the 10-year period considered the project to be financially worthwhile.

Based on these findings, this study recommends the encouragement of Moringa production and value addition development due to the potential it portends for sustainable income generation (Toye & Animashaun 2013). Gross margin analysis of Moringa leaf production and processing and the depreciation schedule of inputs used in Moringa production and processing activity are presented in Table 6

Table 6: Depreciation Schedule for Fixed Inputs used in Moringa Leaf Production and Processing

Items	Expected lifespan (yrs)	Quantity	Unit cost (₦)	Total cost (₦)	Annual depreciation (₦)
Blender	10	1	150,000	150,000	15,000
Knapsack sprayer	10	1	20,000	20,000	2,000
Spade	10	2	1,000	20,000	200
Machetes	10	2	1,000	20,000	200
Hand trowels	10	5	500	2,500	250

Source: University of Ilorin Moringa Plantation, 2011/2012 season

As revealed in the Table above, the inputs are expected to have an average lifespan of 10 years and are assumed to possess zero salvage value at the end of their productive use.

Table 7: Showing Percentage Investment Cost

Items	Cost/Annum	% of total Investment Cost	Total
Land Lease	15,000	0.0542	813.00
Land Clearing	9,600	0.0347	333.12
Factory House Rent	120,000	0.4338	52,056.00
PlantationManagement and Logistics	84,710	0.3062	25,938.20
Pests & Disease Prevention & Control	30,000	0.1085	3,255
Blender	15,000	0.0542	813.00
Knapsack Sprayer	2,000	0.0072	14.40
Spade	200	0.0007	0.14
Machetes	200	0.0007	0.14
Hand Trowels	250	0.0009	0.225
Seedlings (₦100 each)	440,000	0.406	178,640.00
Labour (2 permanent workers for weeding, harvesting and processing).	432,000	0.395	170,640
Utility Bills	30,000	0.027	810.00
Labelling & Packaging	120,000	0.110	13,200.00
Fertilizer (@ 100/kg)	100,000		100,000
Fertilizer Application (2 man-day)	2,000	0.001	2.00
Miscellaneous (4% of Cost)	51,000		51,000
Total Operating Costs	773,844.78		773,844.78
Total Production Costs (TPC)			1,371,360

Source: University of Ilorin Moringa Plantation, 2012/2012 season

According to the Table 7, revenue is derived from the sales of the dried leafy part of the Moringa plant. Actual revenue from the sale of 1 kg of Moringa dried leaves was? 20,000.00, and at a saleable average of 110kg per ha, a gross revenue of ₦2, 200,000 ($13,750) is expected/ha/annum.

Table 8: By deducting costs from the gross revenue, a mean net profit of ₦828, 640 (USD 5,137) was obtained from 1hectare per annum.

	@17.5% Discount Rate		@20% Discount Rate		@22.5% Discount Rate		@25% Discount Rate.	
	Cash Inflow	Cost	Cash Inflow	Cost	Cash Inflow	Cost	Cash Inflow	Cost
1	1872340	1167114	1833333	1142800	1760000	1097088	1760000	1097088
2	1593510	993307	1527778	952333.3	1466667	914240	1410256	879076.9
3	1356350	845474	1271676	792693.6	1202186	749377	1128205	703261.5
4	1154249	719496	1062802	662492.8	977777.8	609493.3	901639.3	562032.8
5	982581	612487	887096.8	552967.7	797101.4	496869.6	721311.5	449626.2
6	836183	521231	735786	458648.8	650887.6	405727.8	577427.8	359937
7	711513	443518	614525.1	383061.5	531401	331246.4	461215.9	287496.9
8	605560	377475	512820.5	319664.3	433925	270485.2	369127.5	230094
9	515343	321236	427184.5	266283.5	354267.3	220830.9	295302	184075.2
10	438596	273397	355412	221544.4	289093.3	180205	236305	147299.7
	10066225	6274735	9228414	5752490	8463306	5275563	7860791	4899988
NPV	₦3,791,490		₦3,475,924		₦3,187,743		₦2,960,803	
BCR	1.604							
ROI	27.6%							

Source: University of Ilorin Moringa Plantation, 2011/2012 season.

As shown in Table 8, it is observed that the Moringa leaf production enterprise at discount rates of 17.5%, 20%, 22.5%, and 25% is feasible and viable.

The returns on Investment (ROI) of University of Ilorin Moringa Plantation were 27.6%. This implied that the investment (i.e., the cost) will generate a return (i.e., net benefit) that amounts to 27.6% of the cost of the investment. The ROI is a relative measurement of how much of the investment investor can expect to receive as a benefit.

If the ROI is positive, the benefits exceed the costs and the investment should be considered. A negative ROI means that the costs outweigh the benefits. An ROI of 0 means the benefits equal the costs.

Equally from Table 8, we estimated the BCR at 1.6 at the same prevailing discount rates. A benefit-cost ratio of 1.60 means investors can expect? 1.60 in benefits for every ₦ 1 in costs. Clearly, because the BCR is greater than 1, the benefits outweigh the costs and the investment is considered relatively feasible. Had the ratio been less than 1, the costs would outweigh the benefits and alternative advice would be followed as regards feasibility of project. If the BCR is equal to 1, the benefits equal the costs.

The estimated Net Present Value of a hectare of Moringa Plantation at 17.5%, 20%, 22.5% and 25% discount rates were ₦3,791,490 ($23,696), ₦3,475,924 ($21,999.11), ₦3,187,743 ($20,175), and ₦2,960,803 ($18,739) . This value reflects the absolute net benefits of the Moringa Plantation in Naira terms.

A positive NPV means that benefits outweigh costs and the investment should be considered. A negative NPV means that the costs outweigh the benefits. An NPV of 0 means the benefits are equal to the costs.

This result of our analysis confirms the economic sustainability prospect of the University of Ilorin, Moringa Plantation Management system. The returns on investment (ROI analysis), benefit cost ratio analysis and the NPV all confirmed positive and hence we accept the decision that the Moringa enterprise is a feasible enterprise at prevailing discount rates.

The analysis in this study is premised under the following modest and realistic facts:

1. A total of two (leaf)harvests is made each year and maintained for the 10 year period;
2. The analyses was based on discount rates of 17.5%, 20%, 22.5% and 25%;
3. The harvested part of the Moringa tree processed for sale was exclusively the leafy part, and the stalk, stem and other fibrous part were left out;
4. A total of 4,444 Moringa seedlings were established on 1 ha of plantation;
5. Based on the local market demand in University of Ilorin, a modest sale of 110kg of dried Moringa leaf is estimated to be absorbed each year and
6. A kilogram of dried Moringa leaf powder is sold for ₦20,000.00.

This study was conducted for a 10-year economic feasibility analysis of the production and processing of a leaf-based Moringa enterprise under a plantation system using primary data and simulated estimates from the University of Ilorin Moringa Plantation. The result indicated that a mean annual net profit of ₦828,640 (USD 5,137) was obtained from one hectare and cumulative net returns of ₦828,640. However, the benefit-cost ratio indicated that for every N1 invested in cost, an investor could realise N1.60 in returns at varying discount rates of 17.5%, 20%, 22.5%, and 25%, highlighting the relative profitability of the enterprise. Equally, the return on investment analysis indicated that the enterprise could generate a return (i.e., net benefit) that amounts to 27.6% of the cost of the investment. Finally, the NPV estimates reflect that the Moringa Production and Processing enterprise under the plantation system's benefits outweigh costs, and the investment should be considered.

4. CONCLUSIONS AND RECOMMENDATIONS

The following conclusions were made based on the findings of this study:
The mean age of the respondents was 16.67 years; the mean years of moringa production experience were 25.00 years; the mean farm size cultivated by the respondents was 1.20 ha; they were all married, with 49% literates. The mean family labour was 5.03 person-days, while the mean hired labour was 1.25 person-days per month over a three-month period. The majority of the respondents planted moringa on a small scale, likely due to the unavailability of storage, processing, and preservation facilities as well as the constraints of the land tenure system. The mean planted area for moringa production is 25.00.

This study, given the feasibility of this enterprise and the potential it carries for sustainable development, income generation, and job creation, recommends that governments and non-governmental bodies encourage Moringa production, consumption, and value-added activities with the ultimate aim of nutritional security, youth empowerment, the liberation of rural communities from existing poverty traps, and export diversification in Nigeria. The relatively high operating expenses of Moringa leaf value chain development could serve as a disincentive for would-be Moringa farmers who may be resource-poor; hence, commercial banks should be compelled by legislation to reserve a reasonable portion of their portfolios for Moringa value chain development at relatively low interest rates. In other words, this study advocates for a type of selective credit policy, which would make funds available to interested individuals who wish to venture into this enterprise. To facilitate this, farmers may be formed into cooperatives, with each group focusing on a specific part of the Moringa value chain, from input provision to production, processing, and marketing.

Furthermore, it is recommended that a follow-up study of the estimate of the true size of the Moringa leaf market, demand and supply elasticities and requirements for growth, which should be in line with any increase in production of the leaf product, be conducted.

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