VOL. 8, NO. 5, MAY 2013 ISSN 1990-6145
ARPN Journal of Agricultural and Biological Science


www.arpnjournals.com

ECONOMICS OF *Irvingia excelsa* "AGBONO" KERNEL PRODUCTION IN NSUKKA LOCAL GOVERNMENT AREA OF ENUGU STATE, NIGERIA

Ugwumba C. O. A[1]., Wilcox G. I[2]. and Aniaku C. O[1].
[1]Department of Agricultural Economics and Extension, Anambra State University, Igbariam Campus, Nigeria
[2]Department of Agricultural Science, Ignatius Ajuru University of Education, Ndele Port Harcourt, Nigeria
E-Mail: veecel326@yahoo.com

ABSTRACT

The study examined the economics of *Irvingia excelsa* "agbono" kernel production in Nsukka Local Government Area of Enugu State, Nigeria. Multistage and random sampling techniques were used to select 50 respondents for the study. Data were collected with the aid of pre-tested structured questionnaire and personal interview. Analyses of data were achieved using descriptive statistics, cost and return and multiple regression techniques. Majority of the respondents (92%) were females. The enterprise proved profitable given by the positive values of gross margin (₦5, 198, 905), net production income (₦5, 141, 329.75), mean net production income (₦102, 826.6) and net return on investment (2.97). Production output was significantly influenced by cost of labour and age of respondents, and weakly determined by extension visit, household size, educational level and agbono type. The serious constraints to agbono kernel production included finger wounds, high cost of labour, rough and stained palms. Government should intensify the provision of basic infrastructure and extension services to educate the women on good/modern methods of processing "agbono" fruits and preserving the kernels, so as to get high quality kernels that will attract better price and higher income.

Keywords: *irvingia excels* "agbono", productivity assessment, quantitative techniques, sustainability.

INTRODUCTION

Irvingia excelsa "agbono" commonly called "African mango", is an indigenous forest tree belonging to the group of plants classified as "Non-Timber Forest Product" (NTFPs). In Nupe, it is called "Pekpeara", "Ogwi" in Bini, "Ogbono/Ugiri" depending on the variety in Igbo, "Uyo" in Efik and "Oro" (tree) "Apon" (Kernel) in Yoruba. It belongs to Irvingiacea family of plants. It has a very sweet/bitter edible fruit and kernel. The species include: *Irvingia gabonensis*, "Var. *gabonensis*" and *Irvingia gabonensis*, "Var. *excels*" (Chinaka and Obiefuna, 1999). Irvingia species can be found in natural forests (wild), compound farm gardens and outlaying fields and, these days it is not uncommon to find irvingia plants in alley farming system (Orji *et al*., 2006) in cocoa, kola and coffee plantations. However, irvingia fruits, for fresh eating and for their kernels are collected from wild forest (60%) and from the compound farm garden (10%) and the outlaying fields (30%). Within the high forest areas, many families depend on this enterprise for survival (Ladipo, 1998).

Agbono kernels are produced for home consumption and for sale. Production of "agbono" kernels is seasonal and provides supplementary employment. The producers engage in other occupations such as trading, farming and wage employment. Field collection of irvingia from the wild takes place between December to April (*Irvingia gabonensis*) (Ladipo, 1998). Estimates of production of irvingia in a good year shows that over 750, 000 tons of fresh fruits are collected annually from high forest zones, and other sources and this means 120, 000 tons of kernels, which are then dried to help their storage. This figure does not include the processed kernels which are imported into Nigeria from other countries in west and central Africa. In all, over 1, 200, 000 tons of irvingia kernels are marked in Nigeria, representing about 40% West African total production (Ladipo, 1998).

Collectors of irvingia fruits can be classified into two group groups: children and women; young and adult males. The women and children are restricted to the compound farms and to near-by village forests where they make daily runs to collect fruits from specified trees. The adult and young males are involved in "long-terms" field collection. The latter groups go into the forest for two weekly fruit collection trips and they usually process the fruits in the bush so as to reduce the load to be carried out to the village at the end of the collection trips. Extraction of near home materials are usually the assignment for adult females and children, both male and female (Ladipo, 1998).

The pulp of "*Irvingia gabonensis* var. *excelsa*" is said to be eaten although, it is bitter and acrid with the flavor of turpentine and slightly slimy. That of "*Irvingia gabonensis* var. *gabonensis*" is sweet, smooth in the mouth and has brittle pulp (Chinaka and Obiefuna, 1999). The tree of irvingia is highly economical and that is why Ladipo (1998) reported in his work on *irvingia garbonensis* that food gathered and hunted in the wild are important and they will continue to be important in the diet of many farming families in Nigeria. *Irvingia gabonensis* (bush mango) is one of the most economically viable forest tree species in the rain forest zone of West Africa. It is a source of food, income, and essential raw material for the pharmaceutical industries and above all, a potential foreign exchange earner (Okafor, 1998; Okafor *et al*., 1994; Omoluabi, 1994; Omokaro *et al*., 1999). The

pulp from *irvingia gabonensis* is sweet and the trees are being selected for the sweetness of their fruits, size, colour and other desirable traits (Ladipo *et al*., 1996). The pulp can be used for preparation of juice, jelly and jam. The extraction rate of juice from pulp is 75% and sugar concentration of this juice is comparable with pineapple and oranges (Akubor, 1996).

The kernels of irvingia contain 54-67% of fatty matter, and with this, irvingia can be classified as an oil crop. The kernel serves as condiments used in thickening and flavouring soups. The more ground kernel of *irvingia gabonensis* var. *excels* "draws" in soup, the more acceptable (Chinaka and Obiefuna, 1990). The kernel is equally used in making fatty paste called "dika". This is the principal ingredient in making of "Gabon Chocolate" or "Dika Bread". Irvingia shells are used as firing materials when fully dried and the bark when added to palm wine serves as a preservative (Chinaka and Obiefuna, 1990). Ladipo (1998) also reported that irvingia leaf is used in treating dysentery and in dressing wounds.

The health and nutritional values of irvingia kernals have been highlighted. Production of the kernels in the study area is limited by many challenges especially the use of traditional processing techniques. This situation coupled with other problems associated with agricultural production enterprises such as small farm size, lack of capital, over-aged farmers, insufficient access to capital, poor extension services, and others reported by Chukwuji (2006) and Ugwumba (2011) have constrained productivity, output and income earned by the farmers. It is against this backdrop that this study was initiated to:

- Describe the socio-economic statistics of the "agbono" kernel producers in the study area;
- Ascertain the influence of the socio-economic factors on production output;
- Establish the profitability of "agbono" production in the area; and
- Identify constraints to production.

METHODOLOGY

The study was carried out in Nsukka Local Government Area (LGA) of Enugu State, Nigeria. It is one of the 18 LGAs of Enugu State and among the nine LGAs in Nsukka sentorial zone. It consists of 16 communities which include Nsukka urban, Okpuje, Edem, Ibagwa Ani, Okutu, Ehaalumonah, Lejja, Edeoballa, obimo, Anuka, Obukpa, Opi, Aro, Aro-agu, Isikpubeonu and Eziani. The LGA covers an area of about 3.961km^2. The estimated population was 922, 937 people in 2007 with a population density of about 233.01 persons per square kilometer (Chima and Oke, 2008). The area is located between latitudes 6^{o}18'E and 7^{o}07'E and longitudes 6^{o}52'E and 7^{o}54'E. It is bounded in the North by Benue State and in the East by Ebonyi state. Nsukka area is underlain by rocks whose geologic age ranges from coniacian to Paleocene which are sedimentary formations (Ofomata, 1975). The people produce crops like yam, maize, groun-nut, rice coco-yam, okra, pepper, tomato, agbono, vegetables and so on. Other economic activities include weaving, basket making knitting of grass, blacksmithing, pottery, craving etc (Chima and Okpe, 2008). Also, rearing of animals (goats, sheep and pigs), fishing and maintenance of oil palm plantations along with other tree crops are done by the people.

Multistage and random sampling techniques were used to select 50 respondents for the study. The first stage involved the selection of five communities out of the sixteen communities in the area by a simple random sampling technique. These communities include Ibagwa Ani, Okpuje, Obukpa, Okutu, and Nsukka Urban. Stage ii entailed a simple random selection of 2 villages from each of the five communities earlier selected to arrive at 10 villages. Simple random sampling method was used to select five agbono kernel producers from each of the 10 villages to obtain a total of 50 respondents. Primary data were collected using copies of pretested questionnaire which were administered to the respondents through trained enumerators and personal interview. The primary data included information on the socio-economic characteristics of the respondents such as age, marital status, gender, level of education, household size, years of experience, primary occupation, number of agbono tree and agbono species. Output and input variables and their current market prices were also obtained. Data were collected on variables that constrained agbono kernels production in the area. Secondary data were sourced from textbooks, journals, annual report and other publications used to complement the primary data.

Analytical framework

Descriptive statistics such as means, modes, percentages and range were used to analyze data on socio-economic characteristics of the respondents and constraints to production. Gross margin and net production income analysis were used to establish enterprise profitability. The method is stated as:

$$GM = TR - TVC$$

$$NPI\ (profit) = GM - TFC \text{ or } NPI = TR - TC\ (TVC + TFC)$$

Where

GM = Gross margin (₦)
TR = Total revenue (₦)
TVC = Total variable cost (₦)
NPI = Net production income (profit)
TC = Total cost

The multiple regression models used to establish the effect of respondents' socio-economic factors on production output is implicitly given as:

$$PDO = f\ (COL, PRT, AGE, ETV, HOS, EDU, PDE, TOA, e).$$

Explicitly, the model is given as:

$$PDO = \beta_o + \beta_1 COL + \beta_2 PRT + \beta_3 AGE + \beta_4 ETV + \beta_5 HOS + \beta_6 EDU + \beta_7 PDE + \beta_8 TOA + e$$

Where

PDO = production output of agbono kernel (kg)
COL = cost of labour
PRT = processing technology (dummy: traditional method = 1, improve technology = 2)
AGE = age of respondents (years)
ETV = extension visits (numbers)
HOS = household size (number)
EDU = educational level (year)
PDE = production experience (years)
TOA = agbono type (dummy; ado = 1, ugiri = 0)
e_i = error term

Four functional forms of the regression model (linear, exponential, semi-log and double-log) were tried with the data. The one that gave the best fit in terms of standard error, value of co-efficient of multiple determination, number of significant variables and other econometric test criteria was chosen as the lead equation. The functional forms are given as:

Linear: $PDO = \beta_o + \beta_1 COL + \beta_2 PRT + \beta_3 AGE + \beta_4 ETV + \beta_5 HOS + \beta_6 EDU + \beta_7 PDE + \beta_8 TOA + e$

Exponential: $\log PDO = \beta_o + \beta_1 COL + \beta_2 PRT + \beta_3 AGE + \beta_4 ETV + \beta_5 HOS + \beta_6 EDU + \beta_7 PDE + \beta_8 TOA + e$

Semi-log: $PDO = \beta_o + \beta_1 \log COL + \beta_2 \log PRT + \beta_3 \log AGE + \beta_4 \log ETV + \beta_5 \log HOS + \beta_6 \log EDU + \beta_7 \log PDE + \beta_8 \log TOA + e$

Double-log: $\log PDO = \beta_o + \beta_1 \log COL + \beta_2 \log PRT + \beta_3 \log AGE + \beta_4 \log ETV + \beta_5 \log HOS + \beta_6 \log EDU + \beta_7 \log PDE + \beta_8 \log TOA + e$

RESULTS AND DISCUSSIONS

Socio-economic statistics of the irvingia kernel producers

The socio-economic statistics of the irvingia kernel producers in the study area is shown in Table-1. It could be seen from the Table that the enterprise is gender biased in favour of women (92%). This implies that women play dominant role in irvingia kernel production and in other agricultural processing activities as reported by Adisa and Okunade (2011), Ugwumba and Uzuegbunam (2010) in agribusiness of soybeans processing (soymilk production) and Nenna and Ugwumba (2012) in palm fruit processing (palm oil production). Average age of the producers was 45.5 years; most (96%) of the respondents were married with mean household size of 6 persons; all the producers combined "agbono" kernel production with farming and non-farming activities; majority (78%) obtained one form of formal education or another, while a reasonable percentage (22%) had no formal education, which is a disadvantage to the enterprise in terms of access to information and modern techniques of production. About 70% of the respondents had 1-10 years experience in the business, and with 90% production labour sourced from the family, no contact with extension agents 44% and 54% of the fruits for processing sourced from the wild, lack of improved techniques of production will continue to pose serious threat to increase in production, while use of traditional processing methods would persist.

Table-1. Socio-economic statistics of the *Irvingia excelsa* kernel producers.

Item	Percentage	Mean/Mode
Gender	92	Female
Age	62	45.5 years
Marital status	96	Married
Household size	70	6 persons
Occupation of respondents	100	"Agbono" kernel production + farm + non-farm activities
Educational attainment	78	Educated
Years of experience	70	1-10 years
Source of labour	90	Family labour
Contact with extension agents	56	Visited by the agents
Source of "agbono" fruits	54	Wild
Processing technology	100	Traditional methods

Source: Field survey, 2012.

Costs and returns in "agbono" kernel production

Enterprise budgeting method was used in analyzing costs and returns in "agbono" kernel production in the area. Results obtained (Table-2) indicated a gross margin, net farm income, mean net farm income and net return on investment values of (₦) 5, 198, 905; (₦) 5, 141, 329.75; (₦) 102, 826.6; and 2.971 respectively. The net

return on investment value of 2.971 implies that the respondents returned (₦) 2.97 for every (₦) 1.00 invested in the business implying that "agbono" kernel production in the study area is profitable.

Table-2. Estimated profit for "agbono" kernel production.

Variable	Amount (₦)	Percentage of TC
Total revenue (TR)	5, 313, 949.25	
Variable costs: Agbono fruits	1, 485, 280	85.92
Labour	141, 540	8.19
Transport	38, 560	2.23
Miscellaneous expenses	5, 665	3.28
Total variable costs (TVC)	1, 671, 045	96.67
Fixed costs: knife	2, 471.65	1.43
Matchet	13, 527.9	7.83
Wheel barrow	21, 369.2	1.24
Basket/basin	12, 350.6	7.15
Storage container	7, 853.9	4.54
Total fixed cost (TFC)	57, 573.25	3.33
Total cost (TC=TVC+TFC)	1, 728, 620.25	100
Gross margin (GM=TR-TVC)	5, 198, 905	
Net Production Income (NPI=TR-TC)	5, 141, 329	
Mean Net Production Income (MNPI-NPI/n)	102, 826.6	
Net Return in Investment (NROI = NPI/TC)	2.971	

Source: Field survey, 2012. Notes: TC = Total cost. n = number of respondents

Effects of socio-economic characteristics of respondents on production output

The multiple regression analysis was adopted to predict the influence of respondents' socio-economic factors (independent variables) on production output (dependent variable). The selected predictors were cost of labour (COL), processing technology (PRT), age (AGE), extension visit (ETV), household size (HOS), educational level (EDU), production experience (PDE) and agbono type (TOA). Data were fitted to four functional forms of linear, exponential, semi-log and double-log regression, and analyzed using MINITAB statistical package. Out of the outputs of the four functional forms, the linear form's output was the best in terms of signs, magnitudes and number of significant parameter estimates and was therefore chosen as the lead equation.

Out of the eight regressors included in the model, two (cost of labour and age of respondents) were positively signed and statistically significant on production output at 5% probability level. One regressor (processing technology) was excluded because all the respondents were still using traditional methods of processing which resulted in problem of auto-correlation among observations of the variable. The rest five regressors (extension visit, household size, educational level, production experience, and agbono type) were not statistically significant.

The coefficient of cost of labour was positive and statistically significant at 5% probability level. The implication is that the engagement of more labour in sourcing agbono fruits and processing them into kernels will result in increased output, income and profit.

The coefficient of age of the respondents was also positive and statistically significant ($P \leq 0.05$). This implies that the older the producer, the more the production experience and resources that would be acquired to enable the producer invest more and thereby produce more kernels.

The estimated coefficients of extension visit, household size, educational level, and agbono type were positively related with production output but not statistically significant. This implies that increases in these explanatory variables will likely lead increases in production output. Also, the estimated coefficient of production experience was negative with production output of the respondent, implying a negative relationship with output.

Further result of the multiple regression analysis (Table-2) revealed the coefficient of multiple determinations (R^2) to be 0.998 (99.8%), implying that 99.8% of variation in production output of the respondents

was explained by the independent variables, while the remaining 2% was due to error. The F-statistic value of 3152.13 was significant and confirms the overall significance of the regression analysis. Also the Durbin-Watson statistic value of 2.15 indicated the absence of autocorrelation among observations of the factors considered.

Table-3. Estimated determinants of "agbono" kernel production output.

Variables	Linear	Exponential	Semi-log	Double-log
Constant	-5.804 (-2.38)	1.0271 (5.49)	-491.90 (-5.30)	-1.9882 (-8.01)
COL	0.0182083 (144.46)**	0.00009891 (8.11)**	114.88 (8.56)**	0.94598 (26.37)**
AGE	0.09333 (2.15)**	-0.004247 (-1.28)	116.50 (2.24)	0.2625 (1.89)**
ETV	0.6241 (1.51)	0.02328 (0.74)	1.679 (0.59)	0.011987 (1.59)
HOS	0.0742 (0.35)	0.01423 (0.86)	-14.25 (-0.43)	0.04178 (0.47)
EDU	0.00920	0.002442 (0.36)	3.679 (`1.09)	0.001773 (0.20)
PDE	-0.03188 (-0.90)	0.002985 (1.10)	-14.38 (-0.77)	-0.02345 (-0.47)
TOA	1.0592 (1.11)	0.32089 (4.39)**	-4.826 (-1.19)	0.01453 (1.34)
R^2	0.998	0.835	0.771	0.976
$\bar{R}^2$	0.998	0.807	0.733	0.972
F-Statistics	3152.13	30.33	20.22	241.66
Durbin-W-Stat	2.15	1.84	1.35	2.21

Source: Field survey, 2012. Notes: ** = Significant at 5% probability level. Durbin–W Stat = Durbin-Watson statistic. Figures in ( ) are t-statistic values.

Constraints to "agbono" kernel production in the study area

Problems militating against "agbono" kernel production in the area include lack of capital, high cost of labour due to intensive nature of the production process, high cost of transportation, finger wounds during cracking of the kernels, rough and stained palms due to squeezing of rotten monocarp, etc. The ranking of these problems collected by means of a 4-point Likert scale approach, showed that out of six possible constraints studied, three were considered to be serious factors militating against agbono kernel production in the area. They had mean scores above the critical mean of 2.50. At the top of the problems were finger wounds during cracking of the kernels with a mean score of 4.00, high cost of labour due to labour intensive nature of the production process (3.36) and rough and stained palms due to squeezing of rotten mesocarp (3.14). Lack of capital, others (such as waist pains, shoulder pains, headache, catarrh, etc) and high cost of transportation were moderate retardants to agbono kernel production with mean scores of 2.20, 2.08 and 1.74, respectively.

Table-4. Problems of "agbono" kernel production in the area.

Problem	Mean score	Rank
Finger wounds during cracking of the kernels	4.00	1st
High cost of labour due to intensive nature of the production	3.36	2nd
Rough and stained palms due to squeezing of rotten mesocarp	3.14	3rd
Lack of capital	2.20	4th
Others (waist pain, shoulder pains, catarrh, and others	2.08	5th
High cost of transportation	1.74	6th

Source: Field survey, 2012.

CONCLUSIONS AND RECOMMENDATIONS

Agbono kernel production was a profitable household enterprise in the study area. Most of the fruits collected for processing into kernels were sourced from the wild. The kernels were mainly consumed locally by the families, while excess was marketed for supplementary income.

Innovations in favour of modern processing equipment and storage facilities will ensure enhanced income and better life for the producers. Government should intensify the provision of extension services especially through women in agriculture (WIA) programme to educate the respondents on modern methods of production and preservation of the kernels, social infrastructures/amenities especially roads, and modern processing facilities for the fruits should be provided through community development efforts to improve productivity and shelf life of product. Again the producers can form cooperatives to pool their resources together for the provision of modern facilities, expansion of their business and to ensure enterprise sustainability.

REFERENCES

Adisa B. O. and Okunade E. O. 2011. Women in agriculture and rural development. In: M.C. Madukwe (Ed.), Agricultural Extension in Nigeria (2nd Ed). Agricultural Extension Society of Nigeria (AESON) AESON publication. C/o Agricultural and Rural Management Training Institute (ARMTI) Ilorin, Nigeria. pp. 90-100.

Akubor P. I. 1996. The sustainability of African bush mango juice for wine production. Plant, Foods, Human Nutrition. 49: 213-219.

Chima G. N. and Okpe V. C. 2008. Water quality in Nsukka Area of Southern, Nigeria. Journal of Environment. 2(1): 35-42.

Chinaka C. and Obiefuna J. C. 1999. Production and utilization of 'Ogbono' (*Irvingia gabonensis*). Extension Bulletin No. 140, Horticulture series No. 4. National Agricultural Extension and Research Liason services, Federal Ministry of Agriculture and Water Resources, Ahmadu Bello University, Zaria, Nigeria.

Chukwuji C. O. 2006. Factor productivity and technical efficiency in cassava- based food crop production system in Delta State, Nigeria. Ph. D. Dissertation, Delta State University, Abraka, Nigeria.

Ladipo D. O., Foundoun J. M. and Ganga N. 1996. Domestication of bush mango (*Irvingia spp*). Some exploitable intraspecific variations in West and Central Africa. In: R.R.B. Leakay, A.B. Temu, M. Melnyk and P. Vantomme (Eds.). Proceedings of the FAO/ICRAF-IUFRO International Conference on Domestication and commercialization of non-timber forest products in Agro-forestry systems. FAO No. 9. p. 297.

Ladipo D. O. 1998. Harvesting of *Irvingia gabonensis* and *Irvingia wombulu* in Nigerian forests, potentials for the development of sustainable system. Centre for Environment, Renewable Natural Resources Management, Research and Development (CENRAD) Ibadan, Nigeria. Retrieved from http://www.fao.org/ ./y4496E32.htm.

Nenna M. G. and Ugwumba C. O. A. 2012. Influence of socio-economic variables on palm oil production in Delta Central Agricultural Zone of Delta State, Nigeria. In: A.O. Aniebo and C.O.A. Ugwumba (Eds.). Environmental concerns and agricultural productivity: Addressing the challenges of food security. Proceedings of International Agricultural Conference of Anambra State University, Igbariam Campus, Anambra State, Nigeria. pp. 176-183.

Ofomata G. E. K. 1975. A Preliminary report on Recent Archaeological Field School. Retrieved from http://www.academic excellencesocr.

Omoluabi A. C. 1994. Trade in timber and non- timber forest products in Cross River State of Nigeria. Report prepared for Cross Rivers State forestry project (ODA Assisted). Forestry Department, Headquarters, Calabar, Nigeria.

Omokaro D. N., Nkanga A. and Nya P. J. 1999. Effects of dessication and rehydration on the germination of *Irvingia gabonensis* var. *gabonensis excels* seeds. Seed Science Technology. 27: 877-884.

Okafor J. C. 1989. Agroforestry aspect. A Study prepared by world fund for nature for Cross Rivers National park project (ODA assisted). Forestry Department, Headquarters, Calabar, Nigeria.

Okafor J. C., Omorrondion F. I. and Amaza F. 1994. Non-timber forest products. Draft Report prepared for the National Tropical Forestry Action Programme (NTFAP). Forestry Management, Evaluation and Cooperation Unit (FORMECU), Federal Department of Forestry, Abuja, Nigeria.

Ugwumba C. O. A. and Uzuegbunam C. O. 2010. Value addition to soybeans (*Glycine max*): A case study of traditional small scale soymilk production in Awka Capital Territory of Anambra State, Nigeria. In: Neils, Khode, Ja'afar-Furo, Futuless (Eds.). Entrepreneurship development and Nigerian agricultural transformation process: Prospects and challenges. Proceedings of the 24th National Conference of Farm Management Association of Nigeria (FAMAN), Mubi, Nigeria. pp. 283-287.

Ugwumba C. O. A. 2011. Technical efficiency and profitability of catfish production in Anambra State, Nigeria. Ph. D. Dissertation, Delta State University, Abraka, Nigeria.