Exploratory survey of the production of non-timber forest products for sustainability of livelihoods: The case of *Irvingia* species in Nsukka agricultural zone of Enugu State, Nigeria

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Abstract. This study attempts to explore the production of non timber forest products for livelihood sustainability of rural dwellers using *Irvingia* seeds as a case study. Specifically, it investigated the various agroforestry practices in the area, the influence of socioeconomic characteristics of farmers on output and the major constraints to optimal output of *Irvingia* seeds.

Primary data were generated with a set of pre-tested questions which were administered to 80 farmers selected randomly from four local government areas in Nsukka agricultural zone of Enugu state. Data collected were analysed with both descriptive and inferential statistics.

The analysis identified eight different agroforestry practices undertaken by farmers in the area where Irvingia trees are among those planted. Specifically, the seed of the Irvingia is the basis for its planting. Farm size measured as the number of Irvingia trees planted, farming experience and access to credit were found to be statistically significant in their effect on Irvingia seed output. Inadequacy of labour, credit facilities and poor seed germination/fruiting combined as the major problems mitigating against optimal production of Irvingia seeds. It is recommended that a proper institutional framework to guarantee unhindered access to credit by the rural dwellers and the development of improved seeds/vegetative cultivars will guarantee increased output of Irvingia seeds.

Keywords: Non timber, agroforestry, *Irvingia* seeds, and Importance index.

Introduction

Non-timber forest products (NTFP) derived from the village agroforestry systems practiced in different agricultural zones of Nigeria are becoming of great importance. Demographic pressures on land resources for provision of food to meet the needs of a rising population and a decline in fallow periods have rendered the low-input farming system economically inefficient and ecologically unsustainable.

Agroforestry comprises a set of land use systems independent of both agriculture and forestry. Young (1989) described it as a collective name for land use systems in which trees are grown in association with agricultural crops and/or pasture either in a spatial arrangement or a time sequence with economic and ecological interaction between the tree and non-tree components of the system. It is a multiple land use system in which perennials are grown in conjunction with agronomic crops and/or livestock either simultaneously or in sequence with an ecological and economic interaction between the tree components of the system (King 1987; Young 1989).

Forests are the natural home to much of the world's biodiversity and terrestrial carbon and over the years there has been a growing concern about forest conservation, biodiversity issues and management of non timber forest products. More particularly there has been growing interest in NTFP whose extraction could meet the objectives of revenue generation for the forestry sector without affecting forest conservation measures and provide livelihood sustenance to forest dwelling communities (Mallik 2000).

Irvingia species *(wombolu and gabonensis)* are forest trees that are commonly found in the farm lands of the Nsukka agricultural zone of Enugu state. Referred to as dika nut/bush mango, the species are valued for their wood and edible nuts. They rank as the most important species for their food and commercial value in Cameron and other West African countries (Mbosso 1999). While the kernels (*ogbono*) are used as a thickening agent in traditional soups and stews in west and central Africa (Leaky et al. 2003), they are also a source of oil for making soap and for medicinal purposes (Abbiw 1990). *Irvingia* is thus one of the most preferred tree species for farmers in West and Central Africa for domestication in farm lands (Ayuk et al. 1999).

Irvingia gabonensis and *Irvingia wombolu* are two species that produce edible kernels. The fruit of the former has a sweet mesocarp and is eaten fresh while that of the latter is sour and is not consumed locally (Lapido 1999). They provide opportunities for achieving the goal of

sustenance and income diversification as a strategy to minimize risks associated with conventional practices (Ayuk et al. 1999).

Markets for *ogbono* products according to the International Center for Research in Agroforestry (ICRAF) (1995) are put at some US$50 million. Falconer (1990) put the quantity of *Irvingia* marketed in Nigeria annually at over 78,000 tonnes. Processed kernels of *Irvingia* are traded within Nigeria and between countries in west and central Africa. These products are also transported to Europe and the United States and to other areas where African immigrants abound in large numbers (Lapido and Boland 1994).

In spite of the economic value of *Irvingia* species, the Nigerian forestry department has not deemed it necessary to establish an Irvingia species forest. In Nsukka agricultural zone of Enugu state, *Irvingia* trees have traditionally grown in the wild, but with its increasing contribution to the economic growth and livelihood sustainability, rural farmers have over the years been adopting its planting through agroforestry systems.

Many farmers in the study area embark on the establishment of *Irvingia* agroforestry to sustain livelihood and secure food as there is ample evidence that poor households are vulnerable to shocks as a result of crop failure. However, if households are involved in employment, households would be able to offset the impact of shocks on consumption (Blundell and Preston 1998; Dercon and Krishnan 2000).

On the basis of the above the objectives of this study were to:

1. identify and examine the specific agroforestry practices at the farm level;
2. investigate the effects of socioeconomic characteristics of *Irvingia* farmers on output level;
3. identify and examine the constraints encountered by farmers in production of *Irvingia* seeds.

Methodology

The study area is in Nsukka agricultural zone of Enugu state. The state is located in the eastern part of Nigeria. Eastern Nigeria is a region often associated with high population densities and agroforestry intensification due to increased land scarcity. Nsukka agricultural zone comprise communities where indicative evidence of agroforestry patterns and practices already exist (Eboh and Agu 1994). The zone comprises seven local government areas of which four were selected for the study. The selected local government areas are Nsukka, Igbo eze south, Igbo eze north and Udenu. These local government areas were selected on the basis of the preponderance of *Irvingia species (wombolu and gabonensis)* trees in most of the farm lands in the area. Twenty farmers who are land owners were randomly chosen from each of the local government areas and this gave a total of 80 respondents utilized for the study.

The field survey was carried out in two successive phases; on the spot observations and questionnaire administration. With the assistance of local enumerators, a series of multiple visits were made to farmers' homes and farmlands. The questionnaire sought information on farmers' socioeconomic variables, agroforestry practices prevalent in the area, output level of *Irvingia* seeds and constraints in *Irvingia* seed production.

Analytical procedure

The data collected were analysed using descriptive statistics, regression techniques and importance indices. Simple frequency/cross-tab tables were employed as descriptive statistics in presenting the socioeconomic characteristics of the farmers and the various agroforesty practices in the area. Multiple regression was used to evaluate the impact of socioeconomic factors of the farmers on output of *Irvingia* seeds (*ogbono*).

The estimated equation is implicitly specified as: $Y = f(X_1, X_2, \ldots\ldots\ldots X_8, e)$, where, Y is the quantity of *Irvingia* seeds (*ogbono*) in kilograms, and X_1 to X_8 are the independent variables which include: Farm size measured as the number of *Irvingia* species trees owned by the farmer, Labour (man days), Age of producers in years, Gender, Farming experience in years, Access to credit, Education (Number of years spent in formal education system) and marital status. Gender, access to credit and marital status were all considered as discrete variables. The production function was fitted using three functional forms: linear, semi-logarithm and double-

logarithm. Of these, the semi logarithmic function was adopted on the basis of conformity with *a priori* expectations.

The model was expressed explicitly as:

$Y = \log \beta_0 + \beta_1 \log X_1 + \beta_2 \log X_2 + \beta_3 \log X_3 + \beta_4 \log X_4 + \beta_5 \log X_5 + \beta_6 \log X_{6+} \beta_7 \log X_7 + \beta_8 \log X_8 + e$

The *a priori* expectations of the parameters are given as:

$\beta_0 > 0, \beta_1 > 0, \beta_2 > 0, \beta_3 > 0, \beta_4 > 0, \beta_5 > 0, \beta_6 > 0, \beta_7 > 0, \beta_8 > 0$

where: βo is the intercept and β's are the coefficients of the independent variables X_1 to X_8, while e is the stochastic error term.

Importance indices

In order to study the relative importance of constraints to *Irvingia* seeds (*ogbono*) production, importance indices were constructed using the methodology employed by Mclean Meyinsse et al. (1994) and also adopted by Alimi et al. (2006). For construction of the indices, *Irvingia* seeds (*ogbono*) producers were asked to rank the identified production constraints on an ordinal scale (1 being assigned to the most important, 2 the next most important and sequentially in descending order of importance). For analysis, the scale was reversed for convenience of index construction. The mean score constructed for each of the identified constraints was multiplied by the percent of respondents identifying the constraint as the most important; to arrive at the importance index (Jose and Valluru 1997). The importance index was constructed using matrices D, E and F as indicated below.

Matrix D gives the distribution of *Irvingia* seed (*ogbono*) producers according to production constraint ranks. The matrix indicates that there are m constraints, to be put in n categories of rank.

$$D = \begin{bmatrix} f_{11} & f_{12} & . & . & f_{1n} \\ f_{21} & f_{22} & . & . & f_{2n} \\ . & . & . & . & . \\ . & . & . & . & . \\ f_{m1} & f_{m2} & . & . & f_{mn} \end{bmatrix}$$

Matrix E is the weight attached to each of the ranks, w_i is the weight attached to rank j, where i = j, i = 1,2…….m and j = 1, 2…….n. w_1 is the weight attached to rank 1, w_2 to rank 2 etc.

$$E = \begin{bmatrix} w_1 \\ w_2 \\ . \\ . \\ w_m \end{bmatrix}$$

Matrix F gives the product of matrices D and E (DE). It is the total value of importance attached to each production constraint.

$$F = DE = \begin{bmatrix} f_{11} & f_{12} & . & . & f_{1n} \\ f_{21} & f_{22} & . & . & f_{2n} \\ . & . & . & . & . \\ . & . & . & . & . \\ f_{m1} & f_{m2} & . & . & f_{mn} \end{bmatrix} \begin{bmatrix} w_1 \\ w_2 \\ . \\ . \\ w_m \end{bmatrix} \begin{bmatrix} c_1 \\ c_2 \\ . \\ . \\ c_m \end{bmatrix}$$

For example $F_3 = f_{31}w_1 + \ldots\ldots\ldots + f_{3n}w_m$ = total value of importance attached to constraint 3. F_1 is the total value of importance attached to production constraint i.

Importance rating for constraint i = $\frac{1}{\lambda_i} F_i$

where $\lambda_1 = f_i = n$ = total number of *Irvingia* seed (*ogbono*) farmers selecting constraint I as most important.

Importance index = $\frac{F_i}{f_i} \cdot \frac{f_{ij}}{\sum_{i=j}^{m} n}$

Such that f_i is the number of *Irvingia* seeds farmers (frequency) ranking constraint i as the most important (highest rank).

Results and discussion

Identification and characterization of agroforestry practices

Eight different types of agroforestry practices were identified in the study area. They comprise the following:

1. Planting of woody species and allowing them to grow during the fallow phase of the cultivation cycle;
2. Growing of woody species and arable crops during the early stages of establishment of trees;
3. Trees scattered haphazardly on arable fields in association with growing crops;
4. Trees growing according to a certain sequence or pattern in association with arable crops;
5. Trees planted and/or retained along field boundaries as demarcation for land security;
6. Intimate combination of multiple species (stands of growing trees along with crops) on homestead farms (home gardens);
7. Trees growing on erosion-control structures or along/beside earth structures like bunds, terraces, banks;
8. Trees for soil reclamation and/or rehabilitation along gullies or gully prone areas.

Traditional agroforestry was widely prevalent among the farmers in all the communities. The more common agroforestry practices were: home garden with scattered woody species, spatial mixed stands of trees and shrubs on croplands, boundary planting/retention of trees and shrubs, wooded fallows and contour planting or sometimes row arrangement of woody plants on arable fields.

Generally, the farmers agreed that the trees and shrubs were useful for supplemental cash income, hedging against a critical hunger period. Seventy-six farmers, representing 95% of the respondents, indicated that the sole aim of planting *Irvingia* tree species is because of the value of the seeds. However, the generally agreed reasons for engaging in agroforestry practice are the ability to generate different products such as fuel wood, animal fodder, construction materials, food shades and the supply of manure to the soils.

Socioeconomic characteristics of sampled Irvingia seed farmers

The values of the socioeconomic variables of the farmers are presented in Table 1. Over 50% of the respondents had between 1 and 5 *Irvingia* trees on their farms, while only two had more than 16 trees. The trees are scattered in the various fragments of land where the farmers lay claim to ownership. Most of these trees were also inherited along with the land in the traditional tenure inheritance. More than 70% of the farmers are aged between 45 and 65 years. The high proportion of older farmers associated with ownership of *Irvingia* trees could be explained as a result of the time that it takes for the trees to mature and produce fruits. In particular *Irvingia wombolu* species, according to the respondents, take 10 – 15 years or more before producing fruits and this leads to older farmers.

The dominant ownership of trees by male farmers (91%) is a reflection of traditional African ownership of tree crops which favours the man over the woman. These trees are part of the traditional inheritance of the man compared to the woman who does not have the same opportunity. Also, 75% of the respondents have been in the business of *Irvingia* seed

production for more than a decade. This could also be attributed to the fact that most of the farmers inherited these trees from generations before them.

It was also observed that while 65% of the respondents had primary or no formal education, over 60% made use of both family and hired labour in *Irvingia* seed production. Labour is employed in picking the fruits, which falls after ripening in the various fragments of farms under current cultivation in the cropping season or in bushes for those farms that are under fallow. The fruits are picked and carried to homes where they are broken with knives and the seeds extracted and dried under the sun. Alternatively, over ripened fruits are allowed to dry and the kernels broken with stones or big sticks and the seeds extracted. It is worthy to note that despite the use of both family and hired labour in *Irvingia* seed production, less than eight percent of the farmers accessed financial credit for that purpose. As a result of this dearth of financial credit, the farmers pay hired labour by way of a share in processed seeds (agreed portion).

Table 1: Socioeconomic characteristics of sampled Irvingia seed farmers

Characteristics	***Number of Respondents***	***Percentage***
Farm size (No. of Irvingia trees)		
1 – 5	43	53.75
6 – 10	27	33.75
11 – 15	8	10.00
Above 16	2	2.50
Labour Use		
Family labour only	25	31.25
Family/hired labour	49	61.25
Hired labour only	6	7.50
Age		
25 – 34	6	7.50
35 – 44	13	16.25
45 – 54	22	27.50
55 – 64	35	43.75
Above 64	4	5.00
Gender		
Male	73	91.25
Female	7	8.75
Farming experience		
1 – 5	9	11.25
6 – 10	11	13.75
11 – 15	15	18.75
16 – 20	25	31.25
Above 20	20	25.00
Access to credit		
Yes	6	7.50
No	74	92.50
Educational level		
No formal education	10	12.50
Primary education	42	52.50
Secondary education	19	23.75
Tertiary education	9	11.25
Marital status		
Married	78	97.50
Single	-	-
Divorced	2	2.50

Influence of socioeconomic factors on Irvingia seed production

Data on the socioeconomic characteristics of *Irvingia* seed producers that could exert influence on seed output in the study area were analysed. The results of multiple regression analysis using a semi logarithmic model are presented in Table 2. The results indicate that the equation has provided a reasonably good estimate of the underlying socioeconomic characteristics that affect the output of *Irvingia* seed in the study area (R^2 = 0.73). Examination of the individual characteristics revealed that farm size measured as the number of *Irvingia* trees planted, farming experience, labour and access to credit are statistically significant at the 0.05 level and they affect *Irvingia* seed output positively. This implies that increases in the socioeconomic variables will bring about increase in the output of *Irvingia* seeds in the given proportion.

Table 2: Determinants of Irvingia seed production

Variable	*Est. Coefficient (β)*	*Std. Error*	*t- statistics*
(Constant)	14255	1582.40	9.01
Labour	199.20	82.57	2.41*
Farm size (No. of trees)	540.21	144.44	3.74*
Age of producers	11.80	107.21	0.11
Gender	248.24	548.15	0.45
Farming experience	182.02	49.79	3.66*
Access to credit	192.47	79.26	2.43*
Education attainment	179.46	123.89	1.45
Marital status	-353.88	1310.14	-0.27
$R^{2`}$ = 72.90			
F-ratio = 60.48			

*Significant at 0.05 level

Ranking of production constraints

The constraints to *Irvingia* seed production identified by *Irvingia* seed farmers were poor seed germination/fruiting, labour demand in picking of the fruits and extraction of the seeds, lack of credit facility and irregular demand. The ranking of these constraints in descending order of importance (Table 3) is high labour demand, inadequate credit facilities, poor germination/fruiting and irregular demand.

Table 3.0: Relative ranking of production constraints in Irvingia seed production

Constraints	*Importance rating*		*Most important*	*Importance index*	
	Mean	*S.D.*	*constraint*		
Poor seed germination/fruiting	2.42	1.12	21.22	52.31	3rd
High labour demand	3.00	1.00	40.62	98.75	1st
Inadequate credit	2.88	1.35	25.98	75.24	2nd
Irregular demand	1.70	1.01	12.18	22.37	4^{th}

The importance indices of production constraints in *Irvingia* seed production show that labour demand is the most important constraint with an importance index of 98.75 followed by inadequate credit facility, poor seed germination/fruiting and lastly irregular demand for the *Irvingia* seeds. Labour is always a critical factor during the peak period of *Irvingia* seed production which is mostly in the months of April, May and June. This period coincides with the annual planting season of some major food crops in the area. It is also the period of harvest of other major cash crops such as oil palm in the area. With these competing farming activities, labour during this period of *Irvingia* seed production becomes a very important limiting factor.

The second important constraint is the lack of credit facilities to the *Irvingia* seed producers. This problem could be traced to the inadequacy of formal financial services in rural areas where most of the *Irvingia* seed production take place. Findings indicate that most of the various state and federal government micro credit interventions do not reach core rural dwellers. Several

authors have emphasized the pivotal role of micro credit in economic development and livelihood improvement of rural farmers (Ike and Chidebelu 2003; Saito 1994; Upton 1997).

Poor seed germination/fruiting ranked third among the major constraints to *Irvingia* seed production. Respondents were unanimous in agreeing that some *Irvingia* species particularly *Irvingia wombolu*, often fails to flower and produce fruits for several years and at times are only relevant for their woody products. The forestry department has not developed improved *Irvingia* cultivars despite its economic value and contribution to sustenance of livelihoods in countries of west and central Africa. This calls for a concerted effort on the part of the researchers to develop improved seeds and cultivars that will take a minimum number of years for maturity and also produce consistently. According to Leakey et al. (2003), with the recognition that farmers have started domestication of some indigenous fruit trees, the need now is to move to the next stage of domestication in which cultivars are developed using vegetative propagation techniques.

Conclusion

Different traditional agroforestry practices are undertaken by rural farmers in Nsukka agricultural zone of Enugu state. *Irvingia* species *(wombolu and gabonensis)* are common among the trees planted and their major importance to the farmers is the seed which is of significant economic value. Some identified socioeconomic factors of the farmers such as labour, farm size, farming experience and access to credit exert significant influence on the quantity of *Irvingia* seeds produced in the area.

Labour inadequacy, poor access to credit facilities and poor seed germination/fruiting play a dominant role in militating against optimal production of *Irvingia* seeds in the area. Proper institutional frameworks to guarantee unhindered access to credit by rural dwellers and the development of improved seeds/vegetative cultivars will guarantee increased output in *Irvingia* seeds and this will ultimately translate to an improved economic base and sustained livelihoods of the rural dwellers.

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