Economic Analysis and Constraints of Traditional Processing of African Locust Bean in Kwara State, Nigeria

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ABSTRACT

The African locust bean (*Parkia biglobosa*) is mostly a wild-growing crop-tree whose fruit possesses widespread food and nonfood usefulness throughout West Africa. In Nigeria, the processing of African locust bean seeds (ALBS) into a soup condiment is a source of income among many rural households. Incidentally, ALBS processors are somewhat associated with poverty despite the widespread demand for the product. This study examined the economics and constraints of ALBS processing, with a view to identifying the interventional imperatives. The study was conducted in late 2011 in Kogi State, Nigeria—well known for the production of ALBS condiments. A systematic random sampling technique was used to select 139 respondents from a list of processors compiled with the assistance of leaders of the typically informal associations of ALBS processors. A structured questionnaire was used to collect data, while a reconnaissance survey of the study area was also conducted. A test-retest method was used to determine the reliability of the questionnaire, yielding a coefficient r value of .89, implying that the instrument was reliable. The results revealed that ALBS processing was dominated by middle-aged women, having little or no formal education, and mainly using labor-intensive traditional techniques. Cost-benefit analysis however revealed a relatively high profit margin. Regression analysis revealed that the cost of seeds, labor and water availability contributed most significantly to the output of ALBS processing among respondents. Major production constraints were ALB tree felling/burning, low technology application, and storage. The study recommended, *inter alia*, development of appropriate ALBS processing technology (such as a de-pulping machine) and virile extension and credit intervention.

Keywords: locust bean, agricultural processing, cost-benefit analysis, production constraint

บทคัดย่อ

พืชในกลุ่มสะตอ (African locust bean tree; *Parkia biglobosa*) เป็นไม้ป่าซึ่งให้ผลที่ใช้ประโยชน์แพร่หลายในเขตอัฟริกาตะวันตก ทั้งในด้านอาหารและด้านอื่นๆ ในประเทศไนจีเรียนั้น การแปรรูปเมล็ดของพืชชนิดนี้ (ALBS) เป็นเครื่องปรุงซุป จัดเป็นอุตสาหกรรมที่เป็นแหล่งรายได้หนึ่งของชาวชนบท แต่แม้ว่าจะมีความต้องการสินค้าชนิดนี้มาก ชาวชนบทผู้ผลิตก็ยังเผชิญความยากจนอยู่ การวิจัยครั้งนี้ มุ่งศึกษาปัจจัยด้านเศรษฐศาสตร์และปัญหาอุปสรรคของกระบวนการแปรรูป ALBS เพื่อนำไป

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สู่การพัฒนาต่อไป การวิจัยดำเนินการในปี ค.ศ. 2011 ในรัฐ Kogi ประเทศไนจีเรีย ซึ่งเป็นเขตที่มีชื่อเสียงในการผลิตเครื่องปรุง ALBS ทำการเก็บข้อมูลจากกลุ่มตัวอย่างจำนวน 139 คน ซึ่งได้มาโดยการสุ่มอย่างมีระบบจากประชากรผู้ผลิต ALBS ตามรายชื่อที่รวบรวมโดยหัวหน้ากลุ่มผู้ผลิต รวบรวมข้อมูลด้วยแบบสอบถามชนิดมีโครงสร้าง ร่วมกับการสำรวจพื้นที่เป้าหมาย ความเชื่อมั่นของแบบสอบถามโดยวิธีการทดสอบซ้ำมีค่าสัมประสิทธิ์เท่ากับ .89 ซึ่งอยู่ในระดับเชื่อถือได้

ผลการวิจัยสรุปได้ว่า กระบวนการแปรรูป ALBS ดำเนินการเป็นหลักโดยผู้หญิงวัยกลางคนในหมู่บ้าน ซึ่งไม่มีการศึกษาหรือมีการศึกษาต่ำ การผลิตใช้แรงงานคนตามแบบดั้งเดิมเป็นหลัก การวิเคราะห์ต้นทุนและผลตอบแทน พบว่าการผลิตมีผลตอบแทนค่อนข้างสูง ผลการวิเคราะห์การถดถอยสรุปได้ว่าต้นทุนราคาเมล็ด ปริมาณแรงงานที่ใช้ และการมีแหล่งน้ำในการผลิต เป็นปัจจัยที่มีอิทธิพลอย่างมีนัยสำคัญต่อผลผลิตของกลุ่มตัวอย่าง ส่วนอุปสรรคในการผลิต ได้แก่ การล้มหรือตายของต้น locust bean การใช้เทคนิคการผลิตที่ไม่ทันสมัย และการเก็บรักษาผลผลิต จากผลการวิจัย มีข้อเสนอแนะให้มีการพัฒนาเทคโนโลยีการผลิตที่เหมาะสม เช่น ใช้เครื่องกะเทาะเปลือกเมล็ด พร้อมทั้งการส่งเสริมด้านการผลิตและแหล่งเงินทุนสนับสนุนการผลิต

คำสำคัญ: ถั่วกลุ่ม locust การแปรรูปผลิตผลเกษตร การวิเคราะห์ต้นทุน-ผลตอบแทน อุปสรรคการผลิต

INTRODUCTION

A major concern of developing countries in Africa and other regions has been to significantly reduce poverty among the masses. Poverty is still a common feature of rural communities that constitute the dominant population in developing countries. According to International Fund for Agricultural Development (IFAD, 2009), rural people constitute about 72 percent of the people living in extreme poverty (less than USD 1.25 per day) in developing countries, down from about 80 percent ten years ago. About 51 percent of all the people in developing countries live in poverty (less than USD 2.00/day), while 27 percent live in extreme poverty. At the macro, community, and household levels, the necessity to combat poverty and its effects in African countries has become compelling over the past few decades (Clempson, 2012).

Exploitation of the usefulness of the African Locust Bean tree (*Parkia biglobosa)* has been an age-long income-generating venture among rural households in Nigeria and other African countries. Its relatively low input requirements have made the tree a veritable means of rural household poverty alleviation. As a wild-growing crop in most cases, the African Locust Bean (ALB) tree is found between 5°N and 15°N, from the Atlantic coast in Senegal to southern Sudan and northern Uganda. The belt is widest in West Africa (800 km) as it narrows to the east. Introduced to the Caribbean region over 200 years ago, it also grows in São Tom é and Principe, and in Guyana, while trial plantations have been established in Tanzania (Sina & Traoré, 2002). Its seeds are used as a coffee substitute and in making local doughnuts, while its leaves serve as vegetables in combination with other foods. The bark of the ALB tree is used medicinally and its young flowers are mixed with salads. Furthermore, the fruit pulp and seed residues are used in making animal feeds. Indeed, the ALB tree is a multipurpose tree that is as highly valued as the Shea butter tree, *Vitellaria paradoxa,* (Shao, 2002; Sina & Traoré, 2002).

In West Africa, particularly Nigeria, the most common use of the tree is the fermentation of its seeds to make condiments for soups and foods (Appiah, Oduro, Ellis, & Adu, 2012). The process involves labor-intensive stages such as harvesting, de-podding, removal of the yellow pulp, cleaning, boiling, de-hulling, rewashing, and fermentation (Akande, Adejumo, Adamade, & Bodunde, 2010).

Traditional processing of ALB seed among the processors in the study area still remains 'tedious, time-consuming, and energy-sapping for the women and children involved' (Olaoye, 2011). In spite of the heavy labor involvement, especially during the dry season that is usually associated with water scarcity, ALBS processing has remained attractive to rural households in Nigeria, perhaps due to the fact that little financial outlay is involved since most processors harvest from wild-growing ALB trees (Campbell-Pratt, 1980). Unfortunately, increasing importation of foreign seasonings and the manufacture of local ones have continued to undermine the traditional processing of ALB seeds (Beaumont, 2002; Akande et al., 2010). Furthermore the African Locust Bean tree has attracted firewood and charcoal entrepreneurs who fell and burn the trees, thus further threatening the livelihood of ALB seed processors, apart from adversely affecting the ecosystem. The traditional processors, however, claimed (during oral interviews with the researchers) to respond to these challenges by adopting some hygienic and aesthetic practices such as improved packaging, and planting more ALB trees.

According to Agbamu and Fabusoro (2001), inadequate knowledge of the economic system used by the producers is a major impediment in the agricultural system in Nigeria. Thus, they consider it important to study the economics of processing ALB seeds, with a view to advising processors on "management strategies, sustainable production systems, profitability, and appropriate resource use". The specific objectives of the current study were to:

1. Investigate the socioeconomic characteristics of ALB seed processors in the study area,
2. Determine the profit levels of processors,
3. Ascertain the independent variables that significantly contribute to output, and
4. Examine the constraints encountered by the processors.

METHODOLOGY

Sampling and data collection procedure

The study was conducted between July and September, 2011 in Kogi State, Nigeria. For representativeness, three local government areas (LGAs) were randomly selected from a list of six LGAs that are well-known for the production of ALB condiments. The selected LGAs were Ijumu, Bunu, and Lokoja. Then, from each LGA, five villages (representing about 25% of the villages) were randomly selected from the list of villages obtained from the respective LGA offices. Respondents were randomly selected from the respective lists of processors (serving as a sample frame) prepared by the researchers with assistance from leaders of the typically informal associations of ALB seed processors and agricultural extension agents from the State's Agricultural Development Project. A total of 139 respondents constituted the sample, with 50 and 49 respondents from the Ijumu and Bunu LGAs respectively, while the remaining 40 were from the Lokoja LGA.

Primary data were collected from respondents with the aid of a structured interviewer-administered questionnaire. Data collection was preceded by a reconnaissance survey of the study area, while the instrument of data collection was also pretested among 20 ALB processors who were not included in the study sample. This was carried out in order to have an insight into the time it took to complete the questionnaire and to make necessary adjustments to question wording, responses to the categories, and other emerging issues before drawing up the final questionnaire. The test-retest technique was used to ascertain the reliability of the instrument with the coefficient (r) value being .89, signifying that the instrument was reliable, because any level of correlation between .7 and 1.0 is acceptable, although it is very rare to have a perfect correlation (r =1.0) according to Shuttleworth (2009). Trained and well-motivated enumerators and interpreters

formed part of the data collection team.

Data analytical procedure

Data were analyzed with descriptive and inferential statistics. Regression analysis was used to determine the factors that contributed significantly to ALB processing among respondents. Three production functional forms were employed and the equations are given as follows:

Linear equation: $Y = a + a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4 + a_5X_5 + a_6X_6 + U$ (1)

Semi log: $Y = a + a_1\ln X_1 + a_2\ln X_2 + a_3\ln X_3 + a_4\ln X_4 + a_5\ln X_5 + a_6\ln X_6 + U$ (2)

Double log: $\ln Y = a + a_1\ln X_1 + a_2\ln X_2 + a_3\ln X_3 + a_4\ln X_4 + a_5\ln X_5 + a_6\ln X_6 + U$ (3)

Where,

Y = ALB paste output kg/100 kg of ALB seeds;

X_1 = cost/kg of ALB seeds in Nigerian naira currency (NGN),

X_2 = cost/male-worker-equivalent-day of household labor (NGN),

X_3 = cost/male-worker-equivalent-day of hired labor (NGN),

X_4 = water availability (measured as a dummy variable: 0 = not easily available; 1 = easily available),

X_5 = transportation cost in NGN,

X_6 = Cost of utensils in NGN, and

U = Unexplained variables.

The input costs were determined using the prevailing 2011 market prices in Kogi State.

The three models were included in the econometric analysis in order to determine the best production function that would predict contributions of the independent variables to the output of ALB seed paste among the respondents. According to Olayemi (1998) and Agbamu and Fabusoro (2001), the lead equation (that gives the best fit) could be selected based on the following criteria: relative magnitude of adjusted R^2 , relative F-value of the regression models, and where there were more factors having statistically significant coefficients.

Furthermore, gross margin and net profit were used to determine the profit level of the processors, while percentages, means, and standard deviations were also used to present other findings of the study.

REUSLTS AND DISCUSSION

Socioeconomic characteristics of respondents

Table 1 summarizes the socioeconomic characteristics of respondents. ALB processing was overwhelmingly dominated by women, with men accounting for less than 10 percent of the total producers. Indeed, in most parts of Nigeria, ALB processing is seen as a feminine occupation. About 81 percent of the respondents were above 30 years of age, and nearly two-thirds of the sample had no formal education, suggesting that the occupation offered less attraction to younger and well-educated people in the study area (Table 1). While about 30 percent of the respondents were heads of their respective households, the majority of households (about 76%) were made up of between 6 and 15 members, signifying large family sizes and thus more people to be supported by the household head. This is probably responsible for the fact that a majority of the household heads (about 83%) were engaged in at least one additional income-generating activity. Another factor might be the fact that less than 15 percent of the respondents each earned more than NGN 80,000 (USD 500) annually from their respective ALB processing enterprise. Involvement in alternative occupations was thus a strategy employed by the ALB processors to combat poverty; otherwise, most of them would have earned less than USD 1.50 daily.

Table 1 further shows that nearly three-quarters of the respondent have been involved in ALB processing for more than ten years, implying that the average processor in the study area has sufficient experience in the profession and could be expected to give reliable information concerning ALB processing.

Table 1 Socioeconomic characteristics of African locust bean seed processors in Kogi State Nigeria, August 2011

(n= 139)

Variable	n	%	$\bar{x}$	SD
Sex				
Female	126			
Male	13			
Age(years)			46.4	1.24
≤20	12	8.6		
21-30	14	10.3		
31-40	33	23.7		
41-50	44	31.7		
51-60	20	14.4		
>60	16	11.5		
Family status				
Head	41	29.5		
Non-head	98	70.5		
Education (in years)			3.1	1.02
0	81	58.3		
1-5	27	19.4		
6-10	14	10.1		
11-15	10	7.2		
16-20	7	5.0		
Family size			8.2	0.93
1-5	19	13.7		
6-10	59	42.4		
11-15	47	33.8		
16-20	10	7.2		
>20	20	14.4		
Job experience (years)			14.2	0.79
1-5	12	8.6		
6-10	25	18.0		
11-15	61	43.9		
16-20	21	15.1		
>20	20	14.4		
Other jobs				
None	23	16.5		
Have one	56	40.3		
Have two	30	21.6		
Have three	18	13.0		
Have > three	12	8.6		
ALBS income			42, 327	1.10
≤ 10,000 NGN	14	10.1		
10,000-20,000 NGN	21	15.1		
20,001-40,000 NGN	36	25.9		
40,001-60,000 NGN	31	22.3		
60,001-80,000 NGN	19	13.7		
>80,000 NGN	18	12.9		
Other income			17, 239	0.81
Not applicable	23	16.5		
≤ 10,000	21	15.1		
10,000-20,000 NGN	28	20.1		
20,001-40,000 NGN	29	20.9		
40,001-60,000 NGN	26	18.7		
60,001-80,000 NGN	9	6.5		
>80,000 NGN	3	2.2		

NGN = Nigerian naira currency, (USD 1.00 = NGN 160 at August 2011)
ALBS= African locust bean seeds

Labor utilization

Table 2 shows that ALB seed processing is labor intensive. Most respondents (64%) adopted the use of family labor only, primarily to cut the production cost. However, the use of hired labor was also practiced by the respondents because 36 percent of the respondents either adopted it fully or in combination with household labor. The study adopted the measurement of labor utilization of Agbamu and Fabusoro (2001), in which a standard-day measure of labor equals eight hours for an adult male, while one adult male standard-day equals 1.25 units of adult female standard labor and 1.5 units of child standard-day labor. This means that, for instance, a standard-day job done by four men would require five adult females or six children.

Table 2 reveals that school-age children supply 19.4 standard-days of labor during the annual production cycle. The implication of heavy reliance on family labor suggests greater involvement of children and the associated risks of poor school enrollment and attendance, as confirmed in the study by Adisa and Adekunle (2007). Women however supply more than 70 percent of the required labor, implying that ALB processing remains a female-dominated occupation in Nigeria both in number and supply of labor.

Cost-revenue structure

An investigation of the cost-revenue structure among respondents yielded the data contained in Table 3. Total returns from the sale of processed locust bean per 100 kg amounted to NGN 21,347.50 and it can be deduced from Table 3 that the cost of value addition (Total Cost) to locust bean seeds in the study area was NGN 13,200, while the gross margin was NGN 10,547.50.

The total labor cost accounted for about 38 percent of the total variable cost (TVC) and 31 percent of the total cost (TC) of processing ALB seeds in the study area. This indicates that the traditional processing technique adopted by the respondents was labor intensive. However, Table 3 further indicates that the technique was profitable in the short run, as the gross margin and net income were NGN 10,547.50 and NGN 8,147.50, respectively. While the gross margin was 49.4 percent, the net income was 38 percent of the total returns from processing 100 kg of ALB seeds among the respondents.

Regression analysis of production factors

Table 4 presents a summary of the regression analysis of production factors in the processing of ALBS among respondents. The

Table 2 Average labor utilization among African locust bean processors in Kogi State, Nigeria, August 2011

(n=139)

Labor type	Utilization (standard male worker days)	%
Household labor		
Adult male	24.0	13.4
Adult female	101.5	56.9
Children (≤16)	19.4	10.9
Hired labor (100% Female)	33.6	18.8
Total	178.5	100.0
	n	%
Family labor only	89	64.0
Hired labor only	11	7.9
Family + Hired labor	39	28.1

double log production function was selected as the lead equation because of its high F-value and the fact that it possessed the highest number of factors that have statistically significant coefficients. It also has the highest R^2 value (0.691), although, according to Gujarati (2006), a low R^2 may not necessarily indicate that a model is bad or *vice versa*. It is discernible from Table 4 that seeds, hired labor, household labor, and water contributed most significantly to the output of ALBS processing among respondents. This finding confirms that labor has a significant marginal contribution in the output of ALB seed processing and that, after seeds, it is the most important input in ALB seed processing.

Table 3 Revenue-cost profile for African locust bean processing in Kogi State, Nigeria, (August 2011)

Factor	Amount (NGN)*
Total Returns (TR)	**21,347.50**
Variable Cost	
Hired labor	1,400.00
Household labor	2,700.00
Seeds	5250.00
Water	400.00
Firewood	450.00
Transportation	500.00
Total Variable Cost (TVC)	**10,800.00**
Gross Margin = TR – TVC	**10,547.50**
Fixed Cost (FC)	
Knives	300.00
Sieves	200.00
Bags	100.00
Buckets	400.00
Bowls	250.00
Cooking Pots	800.00
Calabashes	350.00
Total Fixed Cost (TFC)	**2,400.00**
Total Cost (TC) = TVC + TFC	**13,200.00**
Net Income (NI) = TR – TC	**8,147.50**

* NGN = Nigerian naira currency, (USD 1.00 = NGN 160 at August 2011)

Table 4 Regression analysis of the production factors in African locust bean processing in Kogi State, Nigeria, August 2011

(n=139)

Production function	Constant	X_1	X_2	X_3	X_4	X_5	X_6	R^2	F
Linear	1.72	.018	.009	.033	.012	.044	.085	.084	3.13
t-Value			1.14	.39	.83	1.11	1.18	1.33	
Semi log	-4.54	.037	.015	.009	.086	.111	.081	.104	2.66
t-Value		.888	.092	.0022	1.12	.085	1.013		
Double log	12.48	.112*	.156*	.133*	.118*	.082	.019	.691	22.94*
t-Value		5.69	4.33	2.88	2.19	.331	.274		

* $p < .05$

ALBS processing constraints

An investigation of the constraints encountered in ALBS processing yielded the data contained in Table 5. Ten constraints identified during the reconnaissance survey were presented on a 5-point Likert-type scale. The mean score for each constraint was computed by dividing the sum of the scores of all respondents on a particular constraint by the respective number of respondents. Table 5 shows that the respondents' greatest constraint was burning/felling of locust bean tree. It was ranked first, with a mean score of 4.60. This might not be unexpected because the majority of processors depended on wild-growing locust bean trees for the seeds used for producing ALB paste. Because of their suitability, locust bean trees are becoming increasingly burnt or felled by charcoal and firewood merchants across the country. Respondents generally identified low processing technology as the second most important problem they faced. The traditional processing procedures adopted by respondents were arduous, time-consuming, and generally devoid of any modern technology. Respondents also identified storage as a major constraint in the processing of African locust bean seeds. The final product easily deteriorates if not stored at the right temperature, resulting in losses from spoilage (Yusuf and Rahji, 2012). Inadequate operating capital and low pricing of the final product were also among the problems faced by the processors. These problems could not only limit their scale of operation, but could also perpetuate household poverty among the processors. Despite widespread demand, historically, consumers are not willing to pay a 'good' price for the product, probably due to the fact that the processors still use traditional processing and packaging methods. While transportation and social stigmatization (processing and marketing of the product is somewhat associated with poor people) are the least of the constraints according to the respondents, the other constraints were competition from other (industrially manufactured) seasonings and increasing labor demand.

CONCLUSION AND POLICY IMPLICATIONS

Older people, particularly women, still dominate ALB seed processing. This signals that there is an opportunity for the involvement of younger people. It is therefore worthwhile for governments (local, state, and federal) and non-governmental organizations to encourage greater youth participation in ALB seed processing as a way of arresting youth unemployment, particularly in rural communities.

Table 5 Constraints to African locust bean processing in Kogi State, Nigeria, August 2011

(n=139)

Constraints	SD	Rank	$\overline{X}$
Low technology	4.35	0.726	2
Low price	3.70	0.623	5
Transportation	2.45	0.667	10
Labor	2.60	0.743	8
Storage	4.25	0.656	3
Locust bean tree felling/burning	4.60	0.703	1
Inadequate operating capital	3.90	0.691	4
Competition from other seasonings	3.45	0.755	6
Decreasing patronage	2.65	0.553	7
Social stigmatization	2.50	0.565	9

Traditional processing of ALB seed as a poverty-alleviation livelihood alternative is labor intensive—often involving several male-worker-equivalent-days of family labor that could affect the education of school-age children. Considering the finding in this study that the venture is generally profitable, it is imperative to invest in the acquisition and dissemination of modern and appropriate ALB processing technology through virile extension service delivery among the processors. The processors should also be assisted to further exploit the profitability of the venture by providing easier access to credit facilities and modern processing and preservation techniques that would enhance their scale of operation. Processors should also be encouraged to form strong associations and cooperative organizations, through which they should be given credit to acquire modern tools that would enable them to achieve optimum production and living standard enhancement goals. Furthermore, the fact that respondents indicated low technology and storage problems as other major constraints further underscores the need and readiness of the processors to use modern processing techniques in the processing and preservation of ALB paste.

The major perceived constraints to ALB seed processing among respondents were ALB tree felling/burning, low technology application, and storage problems. The necessary improvement in the lives of the processors would be achieved if the identified constraints were adequately addressed and the potential benefits are effectively harnessed. Policy makers and other stakeholders should intervene constructively in order to enhance the living standards of the processors and their households. This could be achieved by making and effectively enforcing laws that would discourage indiscriminate felling of ALB trees. Furthermore, there should be a public education program on the need to stop indiscriminate tree burning and felling, especially among charcoal merchants, who should be encouraged to seek more environmentally sustainable livelihood options. At the same time, processors and other stakeholders too should be encouraged to plant more ALB trees through the provision of financial motivation and public education. Over-reliance on wild-growing trees for seeds should be actively and constructively discouraged through the provision of incentives for the processors to cultivate ALB trees. Research into high seed-yielding varieties of the ALB tree should also be encouraged to ensure greater seed availability. Finally, water is a critical ingredient in ALB seed processing and it should be made adequately available through increased investment in and improvement of rural water supply systems.

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