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Practices of the shea nut collectors as a measure of the sustainability of shea tree in north-central, Nigeria

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Abstract: Shea tree is highly valued because of its nuts. Traditionally North-central rural people are involved in shea fruit collection. It is an economic venture for rural households. The fact remains that the shea fruit is mostly collected from the wild and regulations to control harvest are not yet in place. Similarly, the pressure on shea tree from individuals as a quick source of income has devastating effect on the sustainability of shea tree. Shea nut tree is important economically, but the practices of the shea collectors and how they affect the sustainability of the shea tree in North-central Nigeria is not widely documented. This study examined the practices of shea nut collectors on the sustainability of shea tree and the level of sustainability. A three-stage sampling technique was used to select 100 respondents drawn from five Local Government Areas across the two States of Kwara and Niger. And the responses from 78 respondents were used for the study. Descriptive statistics and multinomial logit were adopted for data analysis. The results showed majority of shea nut collectors (73.07%) have practices that were at least moderately sustainable. And with a mean score of 4.0, showing high composite sustainability index, the shea nut collectors have the favourable practices toward shea tree sustainability. Age, household size, gender, awareness of conservation, educational level, marital status, membership of association, labour and extension contacts were the factors affecting the level of sustainability of shea tree and were all significant at ($p<0.05$). The practices of the actors were sustainable, and these positive effects depict how the production of shea resource can be sustained. The study recommends that extension agents should further sensitize communities on the values of sustaining the shea tree and the effect of the actors' unfavourable practices on shea tree sustainability. Stakeholders in the shea industry should also collaborate with NIFOR to provide improved shea seedlings to curtail the reliance on the natural regeneration of shea.
Keywords: North-central, shea tree, multinomial logit, sustainability index.

INTRODUCTION

Shea tree is one of the major components of the agro parkland in the dry zone of sub-Sahara Africa. Its natural habitat also engulfs the semi-arid zones. Shea tree is the main indigenous butter oil producing plant in these regions. In Nigeria, shea is mostly found in the savannah province. Nigeria has the largest shea tree density in the world (FAO, 2013). Shea tree belongs to the family *sapotaceae,* with subspecies (*Vitellaria nilotica* and *V. paradoxa*). The wild shea has a long gestation period and can fruit for several years once productive. The tree can produce 15-20 kilogrammes of shea fresh fruits; and can attain optimum yields of up to 45 kilogrammes per annun while some can produce between 50 and 100kg. The kernels are made up of 40 to 50% oil (Nde Bup *et al.*, 2013). Shea nut tree contributes to foreign exchange revenues. It has a unique resource for societal development. Shea fruit collectors are the first group along the shea value chain, and they are sometimes referred to as nut traders. Traditionally, rural people in North-central Nigeria are involved in shea fruits collection, which they process into dried or fried shea nut. Though, they occasionally process the nuts into butter. These activities are economic ventures for alleviating poverty in the region (Olife, 2013).

Shea tree fruiting is seasonal, which do not allow the nut traders to continue to earn income throughout the year (AbdulMoomin *et al.*, 2016). Similarly, the threat poses by the nut collectors themselves and the practices of chopping down shea tree by other users further contribute to the reduction in yield of the natural growing shea. Collectors heavily burn down shea logs during processing and the menace from other loggers has destructive effect on the environment and the sustainability of the shea tree. The United Nations Sustainable Development Solutions Network UNSDSN (2013) and International Survey of Corporate Responsibility KPMG (2011) have increased the attention given to social and environmental sustainability worldwide. The sustainability of the shea nut collection will however depend on the sustainability of shea tree itself. The sustainability principle on shea tree is intended for guiding human activities towards a secure future of continued shea fruit harvesting, for controlling dynamics and the living systems. Shea trees are vulnerable species which make their domestication very crucial. The tree, because of the resourcefulness of its nuts in tropical Africa was recommended among other trees as product of priority that need funding for development (FAO, 1991). There is therefore the need to diversify the nation's economy through maximizing the utilization of the vast shea resources in a more sustainable manner. Recognizing the potentials of sustained shea nut tree in the North-central Nigeria would result to an increase in the establishment of sustainable shea resources for greater benefits soon.

The fact remains that the shea nut is mostly collected from the wild and regulations to control harvest are not yet in place. However, the pressure on shea tree from individuals as a quick source of

income has devastating effect on the sustainability of shea tree and fruit processor's activities. And the livelihood of rural households on shea tree will also be threatened. The practices of the shea collectors on the sustainability of the shea tree in North-central Nigeria are not extensively documented. These practices and how they affect the sustainability of the shea tree need to be investigated. This information will give a sense of direction to private and policymakers for planning toward the sustainable use of shea tree resources.

The broad objective of this study is to assess the sustainability of shea tree among the shea nut collectors in the North-central, Nigeria. And the specific objectives were to:

1. determine the practices of shea nut collectors toward the sustainability of shea tree;
2. examine the determinants of the level of sustainability of shea tree.

METHODOLOGY

North-central, Nigeria is situated geographically in the middle belt of the country. The region is vital for the study due to the abundant concentration of shea trees (Olaoye, 2001). Kwara and Niger State have large density of shea tree and shea nut activities in North-central (Odebiyi, *et al*., 2004, Suleiman 2008) therefore; the two states formed the study area.

Three-stage sampling technique was used in the selection of respondents. The first stage involved the purposive selection of 2 States in North-central Nigeria, specifically Kwara and Niger based on the highest density of shea tree. The second stage involved the purposive selection of 5 LGAs across the 41 LGAs in the 2 States based on the concentration of shea activities. The third stage involved the selection of 20 respondents through random sampling technique in each LGA from the sample frame. The study sampled the total of 100 respondents that were randomly selected from 2 LGAs in Kwara State and 3 LGAs in Niger State. The responses from 78 respondents were found useful for data analysis.

The study was based on primary data elicited with the aid of a well-structured questionnaire.

Inferential and descriptive statistics were employed to analyse the data. Multinomial logistic regression was adopted, and the descriptive tools used were means, cross-tabulations, frequencies, ratios, percentages and Likert scores.

Multinomial logistic model

Determinants of the level of sustainability of shea tree

$$\Pr[Y_i = j] = \frac{\exp(X_i^{'}\beta_j)}{\sum_{j=0}^{J}\exp(X_i^{'}\beta_j)} \quad \text{.....(1)}$$

$$= \frac{\eta_j}{\eta_0 + \eta_1 + \eta_2 + \eta_3}$$

Where: *Pr [Y_i = j]* = is the probability that any household's practice on the sustainability of shea tree is ranked as not sustainable, moderately sustainable, poorly sustainable, and sustainable as *j =0, 1, 2, 3,* ……..… (2)

the last category and the baseline or reference of shea sustainability category,

j = is the level of sustainability of shea tree in the choice set with respect to practices.

X_i = is a vector of the predictor (exogenous) social and other production factors (variables)

β_j= is a vector of the estimated parameters.

Equation (1) can be estimated by the method of maximum likelihood. In this model, the Probability is obtained as follows:

$$P_i(Y=1) = \frac{1}{1+\sum_{J-1}^{J}\exp(X_i\beta_j)} \quad \text{.....(3)}$$

$$P_i(Y=j) = \frac{\exp(X_i\beta_j)}{1+\sum_{J=1}^{J}\exp(X_i\beta_j)} \quad \text{.....(4)}$$

Where j = 1, 2, …. J and i= 1, 2, ……, N and therefore,

$$P_i(Y=J) = \frac{\exp(X_i\beta_j)}{1+\sum_{J=1}^{J}\exp(X_i\beta_j)} \quad \text{.....(5)}$$

However, the Likert score of the practices of the shea nut collectors was averaged and a Composite Sustainability Index (CSI) ranging from 0 to 1 was determined, CSI < 0.25 was categorized as unsustainable (0); from 0.25 - 0.5 as poorly sustainable (1); from 0.51 - 0.75 as moderately sustainable (2); and > 0.75 as sustainable (3), Kaushalya (2016). Where Y= j_i, and j = sustainability level of shea tree; then *i* = Actor

J_i= sustainability level [Unsustainable (0), poorly sustainable (1), moderately sustainable (2), sustainable (3).]

X_1 = age (years)

X_2= households' size (number of persons in the household)
X_3= educational level (number)
X_4 = extension contacts (number of times)
X_5 = labour (family and hired man-days/hrs)
X_6 = experience (years)
X_7= shea nut quantity (kg)
d_1= marital status (married = 1, otherwise = 0)
d_2= sex (dummy: 1 for male and 0 for otherwise)
d_3 = awareness of shea tree conservation (aware 1, otherwise 0)
d_4= land ownership (own 1, otherwise 0)
d_5 = membership of association (member = 1, otherwise = 0)
d_6= occupation (shea nut collector 1, 0 for otherwise)

RESULTS AND DISCUSSION

Socioeconomic characteristics

The socioeconomic variables of the sample respondents are presented in Table 1. The modal age of the shea nut collectors' falls within the age range of 31-40 and this constitutes 44.87% of the respondents. The mean age was reported to be 40 years, while the minimum to be 21 years and maximum (66 years). This implies that majority of the shea nut collectors are still within their productive age. The modal years of experience of the respondents falls within the range of 11-20 years, constituting 46.15% of the actors and 15 years as the mean years of experience. Experience in the shea fruits activities could define the efficiency and productivity of the individual actor.

The result shows that most shea nut collectors (42.31%) had no formal education, while more than 20% and 30% attained both secondary and primary education. This is in line with the findings of Osewa (2012), which stated that more than 40% of shea nut processors had no formal education. Illiteracy could be a barrier for respondents to accept innovation that will ensure the utilization of shea resources in a sustainable manner. The mean household size of the respondents was 12 people, with minimum household size of 2 persons and maximum of 22. The study reported 94.87% shea nut collectors to be women. This is in line with the study of Chalfin (2004) which reported 96.7% shea collectors to be women. Majority (80.77%) of the respondents were married. Marriage is regarded as mark of honour and dignity which is held in high esteem in the study area. The result further revealed that shea nut collectors (53.85%) and (17.95%) have their other income sources from trading and farming respectively. This is because earnings from other sources could help in boosting their productive capital. Majority of the shea nut collectors (62.82%) had access to credit, mainly from friends, relatives and local cooperatives. The result revealed that 58.98% of shea nut collectors belong to an association and majority (57.69%) had access to extension services. Extension service is relevant to the sustainability of shea tree in terms of transferring results of scientific research to rural people (Macadam, 2000).

Table 1: Socioeconomic Characteristics of Shea Nut Collectors

Variables	Categories	%	Variables	Categories	%
Age	20-30	14.1	Gender	Male	5.13
	31-40	44.87		Female	94.87
	41-50	29.49	Marital status	Married	80.77
	51-60	10.26		Otherwise	19.23
	>60	1.28	Other occupation	None	1.28
Experience	1- 10	37.18		Civil servant	5.13
	11-20	46.15		Trading	53.85
	21-30	14.1		Artisan	11.54
	> 30	2.56		Money lending	6.41
Education	None	1.28		Farming	17.95
	Non-formal	42.31	Credit access		62.82
	Primary	30.77	Membership of Ass.		58.98
	Secondary	20.51	Extension service		57.69
	Tertiary	5.13			
Household size	1-5	7.69			
	6-10	32.05			
	11-15	44.87			
	16-20	14.1			
	21-25	2.56			
	>30	00.00			

Field survey (North-central Nigeria)

Practices of the Shea Nut collectors on the sustainability of shea tree

Table 2 presents the practices of the shea nut collectors on the sustainability of shea trees. The

analysis revealed that 91.03% of shea nut collectors disagreed that shea tree is a threatened species. This could be because they are ignorant of the implication of their activities on the shea tree parklands. Shea nut collectors burn down shea logs during shea fruit processing without realizing its implication on the shea tree they always treasured for its nut. Shea log is the most important input heavily consumed during nut processing Suleiman (2008). Though the responses of the respondents were favourable, further analysis depicts that the collectors have the right practices toward shea tree sustainability, having a mean score of 4.0. This implies that they have positive practices that are sustainable. As shown in the result, on the level of sustainability, 33.33% and 39.74% of the respondents' practices were found to be moderately and completely sustainable with 0.51 - 0.75% and > 0.75% composite sustainability index respectively. It can be deduced that majority of the actors (73.07%) have their practices that are at least moderately sustainable for shea tree.

Table 2: Practices of the Shea nut collectors on the sustainability of shea tree

Variables	SA %	A %	N %	D %	SD %
Shea is a threatened species of plant	2.56	2.56	3.85	29.49	61.54
Preserving shea tree for sustainable use (weeding around shea tree)	35.9	41.03	5.13	3.85	14.1
Making efforts to keep shea tree on farmland (care for young shea tree)	34.62	42.31	3.85	3.85	15.38
Establishment of shea tree plantation to sustain the plant species (domestication)	42.31	35.90	1.28	3.85	16.67
Destroying shea tree as a threat to its survival	37.18	35.90	7.69	2.56	16.67
The benefits derived from shea tree warrant its cultivation	60.26	19.23	1.28	3.85	15.38
Give equal protection to shea tree as other tree crops	51.28	20.51	1.28	3.85	23.08
Shea tree for fruit production only	35.9	39.74	2.56	6.41	15.38
No collection of unripe shea fruit	43.59	33.33	2.56	6.41	14.1
Cutting of only dead shea tree for domestic energy	38.46	32.05	1.28	10.26	17.95
Avoidance of bush burning around shea tree vegetation	30.77	58.97	3.85	2.56	3.85
No cutting of standing shea tree during farm cultivation & other purposes	1.28	2.56	3.85	28.21	64.1
Cutting of shea tree as a threat to its management & sustainability	39.74	32.05	5.13	5.13	17.95
Replanting of shea tree	32.05	25.64	19.2	12.82	10.26
Level of sustainability of shea tree					
< 0.25	12.82%				
0.25 – 0.50	14.10%				
0.51 – 0.75	33.33%				
> 0.75	39.74%				

Field Survey (North Central Nigeria

Determinants of level of sustainability

Table 3 presents the multinomial logistic regression on the level of sustainability of shea tree with respect to the practices of the shea nut collectors. The analysis presented a chi-square of 71.65 and was retained having shown a significant value of 0.0011, indicating a high interaction effect between the response variable and combination of explanatory variables included in the model. This is because the presence of relationship between the response variable and combination of explanatory variable is based on the statistical significance of the final model's chi-square. Furthermore, Relative Risk Ratio (RRR) was generated to predict how any change in variable will increase the likelihood of the actors' practices to fall in one sustainability group or move to the other. The model is also highly satisfactory with pseudo R^2 of 0.3428 that falls within the recommended and highly satisfactory pseudo R^2.

Age, educational level, gender, awareness of shea tree conservation and membership of association were all significant in the first equation of Prob [Y= 0]; i.e. the unsustainable group. This confirms that shea nut collector's practices have great influence on shea tree sustainability. Their corresponding relative risk ratios were > 1 except for gender and awareness of conservation. This infers that as age, educational level and membership of association activities increase, the risk of the of the shea nut collector's practices falling in the unsustainable group relative to the reference group increases. While the risk of their practices to be unsustainable for the sustainability of shea tree decreases with increase in the number of male as well as awareness of shea tree conservation.

In the poorly sustainable group of Prob [Y= 1], total household, extension contact, labour and gender were significant but their corresponding RRRs were all < 1. The implication of this is that any increase in any of the variable, the risk of the shea nut collector's practices falling in poorly sustainable group will decrease, which shows that the outcome of their practices on shea tree sustainability is more likely to be in the sustainable group.

Equally, the corresponding RRRs of household size, marital status, awareness and gender were all < 1 in the moderately sustainable group of Prob[Y= 2], this is an indication that the risk of the shea nut collector's practices toward the shea tree to remain moderately sustainable will decrease, suggesting that as the variables increase, their practices toward shea tree sustainability is likely to become completely sustainable. This suggests that the practice of increasingly destroying shea trees for other purposes than harvesting the fruits must be regulated. The right practices toward preserving the shea tree will ensure its sustainability as the majority of the actors' practices were at least moderately sustainable on shea tree. This study on determinants of level of sustainability of shea tree and all the findings reported above follows the studies of Kadiri *et al*. (2014), Nwaiwu *et al*. (2013), Simon *et al*. (2016) and Mgbada *et al*. (2016) all showed the relationship that exist between socioeconomic variables, production resources with sustainability and how they affect sustainability at different levels.

Table 3: Determinants of Level of Sustainability of Shea Tree

Variables	Coef.	Std. Err.	z	P>|z|	RRR	
Constants	3.8392	5.1471	0.75	0.456		Prob[Y= 0]
Age (X_1)	0.2350	0.1088	2.16	0.031**	1.2649	Unsustainable group
TotalHH (X_2)	0.0882	0.2272	0.39	0.698	0.9156	
Edulevel (X_3)	0.7786	0.4729	1.65	0.100**	2.1784	
ExtenC (X_4)	0.0846	1.2947	0.07	0.948	0.9189	
Labour (X_5)	0.0810	0.0686	1.18	0.238	0.9222	
Exp. (X_6)	0.2029	0.1577	1.29	0.198	0.8163	
Shnutqnty (X_7)	2.65E-06	0.0002	0.02	0.987	1.0000	
Mart.st. (d_1)	0.4582	1.4080	0.33	0.745	0.6324	
Gender (d_2)	5.4902	1.6356	3.36	0.001**	0.0041	
Awarn.Cn. (d_3)	3.8341	1.5409	2.49	0.013**	0.0216	
Landownp. (d_4)	1.8933	1.6175	1.17	0.242	6.6413	
Memb.assoc. (d_5)	2.6897	1.3288	0.02	0.043**	14.728	
Occupation (d_6)	2.4471	1.4094	1.74	0.083	0.0865	
Constants	8.6572	3.4055	2.54	0.011* *		Prob[Y= 1]
Age (X_1)	0.0285	0.0622	0.46	0.647	1.0289	Poorly sustainable group
TotalHH (X_2)	0.4735	0.1676	2.83	0.005**	0.6228	
Edulevel (X_3)	0.3505	0.2814	1.25	0.213	1.4198	
ExtenC (X_4)	1.9958	0.8829	2.26	0.024**	0.1359	
Labour (X_5)	0.1078	0.0486	2.22	0.026**	0.8978	
Exp. (X_6)	0.0233	0.0856	0.27	0.785	1.0236	
Shnutqnty (X_7)	5.83E-05	0.0002	0.29	0.773	0.9999	
Mart.st. (d_1)	1.2931	0.9395	1.38	0.169	0.2744	
Gender (d_2)	2.7445	1.0542	2.60	0.009* *	0.0643	
Awarn.Cn. (d_3)	1.0307	0.9052	1.14	0.255	0.3568	
Landownp. (d_4)	0.2875	0.8477	0.34	0.735	0.7502	
Memb.assoc. (d_5)	1.1175	0.8643	1.29	0.196	3.0573	
Occupation (d_6)	0.3483	0.9157	0.38	0.704	1.4167	
Constants	7.6207	3.5836	2.13	0.033**		Prob[Y= 2]
Age (X_1)	0.0348	0.0637	0.55	0.584	1.0355	Moderately sustainable
TotalHH (X_2)	0.4648	0.1709	2.72	0.007**	0.6283	
Edulevel (X_3)	0.1529	0.2889	0.53	0.597	1.1652	
ExtenC (X_4)	0.7437	0.9945	0.75	0.455	2.1037	
Labour (X_5)	0.0387	0.0439	0.88	0.378	0.9620	
Exp. (X_6)	0.0598	0.0791	0.76	0.45	1.0616	
Shnutqnty (X_7)	0.0007	0.0014	0.51	0.611	0.9993	
Mart.st. (d_1)	2.0312	0.9342	2.17	0.030* *	0.1312	
Gender (d_2)	2.0435	1.0572	2.30	0.021**	0.0876	
Awarn.Cn. (d_3)	2.6510	0.9925	2.67	0.008**	0.0706	
Landownp. (d_4)	0.7779	0.9302	0.84	0.403	0.4594	
Memb.assoc. (d_5)	0.0251	0.8908	0.03	0.978	0.9752	

Variables	Coef.	Std. Err.	z	P>|z|	RRR
Occupation (d_6)	0.6965	0.9339	0.75	0.456	0.4983
Number of obs = 78 LR $chi^2(39)$ = 71.65 Prob > Chi^2 = 0.0011					
Pseudo R^2 = 0.3428, Log likelihood = -68.691502					

Field Survey (North Central Nigeria) *Sustainable as the baseline or reference of shea sustainability category

CONCLUSION

The shea collectors have sustainable practices toward shea tree sustainability with a mean score of 4.0. The levels of sustainability of shea tree amongst the shea actors were influenced by their socioeconomic characteristics and production resources. Age, household size, gender, awareness of conservation, educational level, marital status, membership of association, labour and extension contacts were the factors affecting the level of sustainability of shea tree ($p<0.05$). In order to sustain the use of shea resources, there is the need to sensitize the communities on the right practices toward the sustainability of shea tree. Enlightenments on the values of sustaining the shea tree and the effect of the actors' unfavourable practices on shea tree sustainability. Federal and State governments as well as all the stakeholders in the shea industry need to collaborate with NIFOR to provide improved shea seedlings to encourage shea trees planting, which will curtail the reliance on the natural regeneration, and ensure the sustainability of the shea nut collector's activities and their source of income.

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