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EVALUATION OF RURAL HOUSEHOLDS DEMAND FOR NON-TIMBER FOREST PRODUCTS (NTFPS) IN OYO STATE: A QUADRATIC ALMOST IDEAL SYSTEM (QUAIDS) APPROACH

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Abstract
Non-timber forest products (NTFPs) are essential components of rural household livelihood strategies and contribute immensely to household nutrition and health. This paper therefore, evaluated household consumption for selected NTFPs in Oyo State. A total of 240 respondents were interviewed with the aid of well-structured questionnaire and interview guide. Data were analysed using the Quadratic Almost Ideal System (QUAIDS) model. Results showed that the own price elasticities for all the NTFPs captured in this study were all negative in accordance to a priori expectation. The uncompensated elasticity showed that fat, fruit and vegetable were complement while animal, condiment and herb were substitute. The compensated elasticity revealed that complementarity was detected between the fruit -fat, condiment – vegetable and vegetable – fat pairs, while substitution appeared in fruit – animal, fruit – condiment, fruit – herb, and fruit – vegetable. The expenditure elasticity has the predicted sign for all the food items captured in the study. These were fruit, fat, vegetables, herbs, animal and condiment. The expenditure elasticities for fruit, fat, herb and vegetable were less than one, implying that they were necessity foods while animal and condiments were luxuries because their expenditure elasticities were greater than one. The budget share showed that the largest percentage of the respondents' total expenditure was on animal products.

Key Words: *Compensated elasticity, NTFPs, Cross price, Expenditure, QUAIDS*

Introduction

Non timber forest products are goods of biological origin other than timber derived from the forest, other wooded land and trees outside forest Non-Wood News (NWN, 2000). Non timber forest products play a vital role in contributing to food security of the rural dwellers by providing a wide range of foods which supply essential nutrients and vitamins. Non-timber Forest Products (NTFPs) include products used as food and food additives (edible nuts, mushroom, grass-cutters, snails, fruits, herbs, spices and condiments, aromatic plants, game and, animal products used for medicine,

cosmetics or cultural purpose for human use (Ahenkan and Boom, 2011). The contribution of non-timber forest products to food security is even more significant as they provide not only the staple foods that help to overcome hunger but a number of dietary substances through supplemental foods (Vinceti *et al*., 2013). Non-Timber Forest Products species are used as food in the form of wild fruits, vegetables, and nuts, edible roots, bush meat, snails, edible insects and honey. Others are used as food additives in form of spices, flavorings, food colorants and as fermentation agents, various animal foods such as folder for livestock, straw, baits to catch animals and bee plants (Andel, 2006).

Similar reports on the use of NTFPs as food and food condiments have been made by Jimoh and Haruna (2007) and Tee and Amonum (2008). Other edible food materials found in the forest include insects, rodents, wild game and fish and these have been found to have superior nutritional quality, when compared with domesticated varieties. Besides, processed and stored forest food products help to insure a year-round food supply (Jimoh and Adebisi, 2005). Odebode (2003) maintained that NTFPs include a vast number of edible and non-edible products gathered from the forest by forest edge people or a team of urban people for subsistence or for local and external trade. Awe *et al.,* (2011) maintained nearly all (98%) of the respondents affirmed that they collect and use NTFPs as food. The species used as food are in the form of wild fruits (*Chrysophyllum albidum*), vegetables (*Vernonia amygdalina*), and bush meat (*Thryonomys swinderianus*); honey, nuts, snails, edible insects as well as edible roots. Amusa and Jimoh (2012) reported that non-timber forest products are particularly important in ensuring food security, maintaining nutritional balance in people's diets and contributing to health care system. They are also essential to human survival during famine and 'hungry season.

These vegetables are available at the time when most cultivated vegetables are off-season. In addition, Oladele *et al.* (2013) maintained that daily diet is dominated by starchy staple food in most developing countries such as Nigeria, while wild vegetables are the cheapest and most readily available sources of important proteins, vitamins, minerals and essential amino acid. Species such as *Pipper guineense* (wild pepper), *Occimum gratismum*, *Allium sativum* (onion), *Tetrapleura tetrapera* (oil bean) and *Aframomum meligueta* are added to food to impact certain characteristic aroma or taste on the food.

The important roles of NTFPs which includes income generation for rural development, more equitable sharing of forest benefits and local participation in forest management was part of the documentation of Food and Agricultural Organisation's (FAO) experience in community forest management most especially in developing countries (FAO, 2001). Despite these potential benefits that are derived from the forest in contributing to food intake of rural populations, they are perceived to be poorly understood, under-estimated and not adequately considered in policy decisions related to food security and nutrition. This research is therefore aimed at bridging the identified knowledge gap by estimating the expenditure pattern of the NTFPs in the study area emphasizing on the price effect on the demand of NTFPs.

Materials and Method

Study Area

The study was carried out in Oyo State, Nigeria. Ọyọ State is an inland state in south-western Nigeria, with its capital at Ibadan. It is bounded in the north by Kwara State, in the east by Osun State, in the south by Ogun State and in the west partly by Ogun State and partly by the Republic of Benin. Oyo State covers approximately an area of 28,454 square kilometers and is ranked 14th by size. The landscape consists of old hard rocks and dome shaped hills, which rise gently from about 500 meters in the southern part and reaching a height of about 1,219 metre above sea level in the northern part. Some principal rivers such as Ogun, Oba, Oyan, Otin, Ofiki, Sasa, Oni, Erinle and Osun River originate in this highland. The population of Oyo state according to a recent estimate from the National Population Commission (2006) is 5,591,589 Million. The climate and soil of the state are suitable for the cultivation of a wide range of crops.

The Climate is equatorial, notably with dry and wet seasons with relatively high humidity. The dry season lasts from November to March while the wet season starts from April and ends in October. Average daily temperature ranges between 25 °C (77.0 °F) and 35 °C (95.0 °F), almost throughout the year. Some people engage in agriculture while some engage in civil service and trading (Oyo state official website).

Fig. 1: Map of study Area

Method of Data Collection

Primary data was used for this study and this was collected with the aid of a well-structured questionnaire / interview guide. Data collected from 240 household heads through a multistage sampling method. The first method involves the purposive selection of three Agricultural Development Program (ADP) zones and this were Ibadan / Ibarapa, Oyo and Shaki ADP zones. Next to this was the purposive selection of two local government areas (LGAs) from Oyo ADP zone and three local government areas (LGAs) from Ibadan / Ibarapa and Saki zones to make eight local government areas. Two villages were selected from Oyo local government and three local government areas each from Ibadan / Ibarapa and Saki zones respectively. The last stage was the selection of sixty (60) respondents from Ibadan / Ibarapa zone, ninety-six (96) from Saki zone and eighty-four (84) from Oyo agricultural zone.

Model Specification

Quadratic Almost Ideal Demand System (QUAIDS)

The quadratic almost ideal demand system developed by Banks *et al.* (1997) which has budget shares that are quadratic in log total expenditure is an example of the empirical demand systems that have been developed to allow for expenditure non-linearity. The empirical specification of QUAIDS budget share equation is given below:

$$Wi = \alpha i + \sum_{j=1}^{k} \delta ij\ 1npj\ +\ \beta i 1n\ \left[\frac{m}{a(p)}\right] + \frac{\lambda}{b(p)\left[1n\frac{m}{a(p)}\right]2} + \sum_{s=}^{l} \delta LsZs\ \ldots + £i$$

The expenditure elasticity are derived by

$$ei = 1 - \frac{Ni}{Wi} \text{----------(1)}$$

The uncompensated price elasticity are derived by:

$$ei = 1 - \frac{Ni}{Wi} \text{----------(2)}$$

Where

Wi= household's expenditure share of ith food group, for 1,2,3,4,5 and 6

W_l= share of fruits food basket (fruit)

W_2 = share of vegetable food basket (vegetable)

W_3 = share of meat protein food basket (animal protein)

W_4 = share of fish protein food basket (animal protein)

W_5 =share of fats and oils food basket (fat and oil)

W_6 = share of herbs food basket (herbs)

Pi= price of food i^{th} (N 1 grain equivalent (G.E) kg, for i=l, 2, 3, 4,5 and 6

P_l= price of a basket of fruits (PF) (₦ / kg)

P_2 = price of basket of vegetables (PV) (₦ / kg)

P_3= price of a basket of meat protein (PMPR) (₦ / kg)

P_4 = price of basket of fish protein (PFPR)

P_5 = price of a basket of fat and oil (PFAOL) (₦ / kg)

P_6 = price of a basket of herbs (PHEB) (₦ / kg)

M= household's total expenditure on all food in the demand system (₦ /week)

Zi= socio-economic variables

Z_1 = Age of household head (head count)

Z_2= Years of education of household head

Z_3= gender of household head (male=l, female=0)
Z_4= land ownership (own land=l, otherwise=0)
Z_5= Forest-home distance
Z_6= Marital status of the respondents (married = 1, otherwise = 0)
£i= error term.

Results and Discussion

Table 1 shows the estimated parameters of the Quaids model with demographic variables age, sex, years of education, land ownership, distance of home from the forest and marital status. The table revealed that gender was statistically significant at 5% level and positively related to the expenditure share of fruit and animal products. Also, the findings revealed that land ownership has positive coefficient and indicating that they are different from zero at 5% level. In contrast, the coefficient of age, years of education and fore-home distance were negatively significant in the model, showing decline in expenditure share of some of the group of NTFPs identified. This suggest that there is much quantity response to movement in relative price (Olorunfemi, 2013).

The result further showed that the coefficient of expenditure share on fruit, fat, condiments and vegetable were negative and significant variables in the model; denoting decrease in expenditure on these class of non-timber forest products as there is increase in the per capita income of the respondents. The coefficient of the expenditure share on fruit was significant at 10% level, expenditure on fat share was significant at 5% level; the expenditure share on condiment was also negative but significant at 1% level and the expenditure share on vegetable was negative and significant at 1% level. On the other hand, the expenditure share on animal products was positive and significant at 5% level, indicating that expenditure on animal products increases as per capita increases. Likewise, the expenditure share on herb was positive and significant at 1% level an indication that more herbs were consumed as the respondent's income increases.

The expenditure squared on all the classes of NTFPs in this study were statistically significant. The coefficient of fruit, fat, condiment and vegetable were negative; suggesting that there was reduction in the consumption of these group of NTFPs as income increases. But the expenditure squared on herb and animal products were positive and significant at 1% and 10% level respectively, suggesting that more herbs and animal product are consumed when there is increase in the income of the respondents in the study area.

Table 1: Estimated parameters of the Quaids model

Parameters	Coefficient	Std err	Z	P>/Z/
Constant				
α_1	0.1339782	0.0333071	4.02	0.000***
α_2	-0.0448622	0.0212965	-2.11	0.035**
α_3	0.5936908	0.0492512	12.05	0.000***
α_4	-0.0092897	0.0360818	-0.26	0.797
α_5	0.3717314	0.0494511	7.52	0.000***
α_6	-0.0452484	0.041241	-1.10	0.273
Expenditure				
β_1	-0.1004073	0.0391841	-2.56	0.010***
β_2	-0.0689594	0.024318	-2.84	0.005***
β_3	0.1917956	0.0540668	3.55	0.000***
β_4	-0.1452334	0.0408507	-3.56	0.000***
β_5	0.2939999	0.0460261	6.39	0.000***
β_6	-0.1711953	0.0455427	-3.76	0.000***
Price				
γ_{11}	0.1037419	0.0056802	18.26	0.000***
γ_{21}	-0.0023039	0.00349	-0.66	0.509
γ_{31}	-0.0465493	0.0077665	-5.99	0.000***
γ_{41}	-0.0074363	0.0068543	-1.08	0.278
γ_{51}	-0.0402323	0.0082072	-4.90	0.000***
γ_{61}	-0.0072201	0.0061755	-1.17	0.242
γ_{22}	0.0072044	0.0040911	1.76	0.078*
γ_{32}	-0.0141766	0.0051411	-2.76	0.006***
γ_{42}	0.012869	0.0051755	2.49	0.013***
γ_{52}	-0.0105299	0.005595	-1.88	0.060*
γ_{62}	0.0069371	0.0044574	1.56	0.120
γ_{33}	0.0907552	0.0181489	5.00	0.000***
γ_{43}	0.0050395	0.0107687	0.47	0.640
γ_{53}	0.0078346	0.0117267	0.67	0.504
γ_{63}	-0.0429034	0.0114951	-3.73	0.000***
γ_{44}	0.0241997	0.0124939	1.94	0.053**
γ_{54}	-0.0307699	0.0112562	-2.73	0.006***
γ_{64}	-0.0039021	0.0081565	-0.48	0.632
γ_{55}	0.1262359	0.0201263	6.27	0.000***
γ_{65}	-0.0525384	0.0125476	-4.19	0.000***
γ_{66}	0.0996269	0.0126788	7.86	0.000***
Expenditure squared				
λ_1	-0.018709	0.0115114	-1.63	0.104*
λ_2	-0.017163	0.0072144	-2.38	0.017**
λ_3	0.0256883	0.015539	1.65	0.098*
λ_4	-0.0447555	0.012348	-3.62	0.000***
λ_5	0.0996359	0.0150291	6.63	0.000***
λ_6	-0.0446966	0.0138343	-3.23	0.001***
Demographic variables				
Age1	0.0001991	0.0001072	1.11	0.063*
Age2	0.0000747	0.0000676	1.11	0.269
Age3	-0.0000645	0.0002698	-0.24	0.811
Age4	-0.0002339	0.0001497	-1.56	0.118
Age5	-5.64e-06	0.0001845	-0.03	0.976
Age6	0.0000302	0.0001513	0.20	0.842
Yearsofeducation 1	0.0009512	0.0003806	2.50	0.012**
Yearsofeducation 2	-0.0000782	0.0002376	-0.33	0.742

Yearsofeducation 3	-0.0007939	0.0009572	-0.83	0.407
Yearsofeducation 4	-0.000166	0.0004994	-0.33	0.740
Yearsofeducation 5	-0.0005127	0.0006489	-0.79	0.429
Yearsofeducation 6	0.0005995	0.0005275	1.14	0.256
Gender 1	-0.0014366	0.0022956	-0.63	0.531
Gender 2	0.0016977	0.0014235	1.19	0.233
Gender 3	-0.0123056	0.0058083	-2.12	0.034**
Gender 4	0.0083182	0.0033006	2.52	0.012***
Gender 5	0.000707	0.0041529	0.17	0.865
Gender 6	0.0030192	0.0033006	2.52	0.012***
Landownership1	-0.0019412	0.0022026	-0.88	0.378
Landownership 2	0.0026559	0.0013498	1.97	0.049**
Landownership 3	-0.0065887	0.0054549	-1.21	0.227
Landownership 4	0.00196	0.0029461	0.67	0.506
Landownership 5	0.0030186	0.0037345	0.81	0.419
Landownership 6	0.0008953	0.0030026	0.30	0.766
Forest-home distance 1	0.0012733	0.0006213	2.05	0.040**
Forest-home distance 2	0.0002965	0.0003963	-0.75	0.454
Forest-home distance 3	-0.0013823	0.0015109	-0.91	0.360
Forest-home distance 4	0.0024243	0.0008631	2.81	0.005***
Forest-home distance 5	-0.0014008	0.0009814	-1.43	0.153
Forest-home distance 6	-0.0006179	0.0008706	-0.71	0.478
Marital status 1	-0.0049217	0.0023565	-2.09	0.037**
Marital status 2	-0.0023909	0.0014442	-1.66	0.098*
Marital status 3	-0.0031323	0.0057827	-0.54	0.588
Marital status 4	0.005131	0.0032625	1.57	0.116
Marital status 5	0.0063377	0.0041025	1.54	0.122
Marital status 6	-0.0010239	0.0032167	-0.32	0.750
Rho				
Rhoage	0.0037013	0.0039184	0.94	0.345
Rhoyearsofeducation	0.0338093	0.0162536	2.08	0.038**
Rho gender	0.1817666	0.0888926	2.04	0.041**
Rholandownership	0.1195848	0.0830498	1.44	0.150
Rho forest-home distance	-0.0089262	0.0193437	-0.46	0.644
Rho marital status	-0.1727076	0.0795208	-2.17	0.030**

Marsharllian / uncompensated elasticity (Quaids)

The Marshallian / uncompensated own and cross elasticity is shown in Table 2. The own price elasticities were all negative as expected and conformed to the *a priori* expectation. The own price elasticity for animal share was the most elastic (-0.917), followed by condiment share (-0.896), fat share (-0.801), herb share (-0.632), fruit share (-0.527) and lastly vegetable share (-0.233). Since the own price elasticity was less than one for all the products, they were price inelastic. This implies that the respondents in the study area were insensitive to changes in the price of these products. The implication is that if the price of these products comes down, or there is an increase in the per capita income, household consumption will not be so much affected.

The cross-price elasticities were recorded as non-diagonal elements in Table 2. Fat, animal, condiment, herb and vegetable had a negative sign with respect to fruit which showed that they bear a complementary relationship with fruit. For fat, fruit and vegetable were complement while animal, condiment and

herb were substitute. Fruit, fat, animal, condiment and herb had a negative relationship with vegetable. This implied a complementary relationship with vegetable. This result goes in line with the findings of Olorunfemi (2013).

Table 2: Uncompensated elasticity

	Fruit	Fat	Animal	Condiment	Herb	Vegetable
Fruit	-0.5269	-0.0290	-0.1203	-0.0636	-0.0865	-0.0729
	(0.0286)	(0.0148)	(0.0152)	(0.0229)	(0.0228)	(0.0196)
Fat	-0.2113	-0.8014	0.0018	0.3646	0.3256	-0.0366
	(0.1688)	(0.1810)	(0.1118)	(0.1993)	(0.1634)	(0.1441)
Animal	-0.1366	-0.0167	-0.9170	0.03656	-0.1060	-0.0746
	(0.0147)	(0.0062)	(0.0203)	(0.0147)	(0.0185)	(0.0148)
Condiment	-0.1997	0.0643	0.2110	-0.8963	-0.0209	-0.2509
	(0.0602)	(0.043)	(0.0513)	(0.0895)	(0.0659)	(0.0576)
Herb	-0.0841	0.0264	-0.0775	0.0141	-0.6323	-0.0672
	(0.0284)	(0.0158)	(0.0294)	(0.0289)	(0.0518)	(0.0282)
Vegetable	-0.1238	-0.0148	-0.1003	-0.1828	-0.1121	-0.2331
	(0.0444)	(0.0261)	(0.0445)	(0.0484)	(0.5417)	(0.0657)

Figures in parenthesis are standard errors

Hicksian/compensated elasticity (Quaids)

The Hicksian/compensated elasticity own and cross price elasticity is presented in Table 3. Compensated own price elasticity of all the six food items carried negative signs in accordance with the *a priori* expectation and were statistically significant at 5% level. These were condiment (-0.799) which was the most elastic, followed by fat (-0.795), herb (-0.482), animal (0.447), fruit (-0.331) and vegetable (-0.153).The cross-price effect was also presented. Among the six non timber forest products items (fruit, fat, animal, condiment, herb and vegetable) complementarity was detected between the fruit -fat, condiment – vegetable and vegetable – fat pairs, while substitution appeared in fruit – animal, fruit – condiment, fruit – herb, and fruit – vegetable. This conforms to the findings of Olorunfemi (2013), Asagunla and Agbede, 2018.

Expenditure Elasticity

Table 4 showed that the expenditure elasticities were all positive and statistically significant at 1% level except for fat suggesting that all the non-timber forest products were normal goods whose consumption will increase with increasing total expenditure on these products. The expenditure elasticities for fruit, fat, herb and vegetable were less one. This implies that these products were expenditure inelastic. The consumption of each of these will decline as per capita income increases. The expenditure elasticities for animal and condiment were greater than one and thereby expenditure elastic. This aligns with the findings of Adetunji and Rauf (2012), Molina and Gil (2005).

Table 3: Compensated elasticity

	Fruit	Fat	Animal	Condiment	Herb	Vegetable
Fruit	-0.3311	-0.0117	0.2280	0.0160	0.0779	0.0209
	(0.0283)	(0.0147)	(0.0169)	(0.0225)	(0.0206)	(0.0189)
Fat	-0.1335	-0.7945	0.1402	0.3963	0.3909	0.0006
	(0.1663)	(0.1795)	(0.1216)	(0.1996)	(0.1484)	(0.1399)
Animal	0.1277	0.0066	-0.4466	0.1441	0.1159	0.0520
	(0.0095)	(0.0060)	(0.0234)	(0.0131)	(0.0143)	(0.0131)
Condiment	0.0382	0.0854	0.6341	-0.7995	0.1787	-0.1369
	(0.0554)	(0.0434)	(0.0572)	(0.0880)	(0.0587)	(0.0553)
Herbs	0.0945	0.04223	0.2402	0.0868	-0.4823	0.0183
	(0.0247)	(0.0157)	(0.0306)	(0.0285)	(0.0460)	(0.0274)
Vegetable	0.0432	-0.0000	0.1967	-0.1149	0.0280	-0.1530
	(0.0394	(0.0258)	(0.0489)	(0.0469)	(0.0477)	(0.0635)

Figures in parenthesis are standard errors

Table 4: Expenditure elasticity

Fruit	Fat	Animal	Condiment	Herb	Vegetable
0.89955002	0.35738535	1.2146046	1.0926659	0.82063845	0.76724947
(0.03424068)	(0.24982382)	(0.04552673)	(0.11498836)	(0.06805286)	(0.09816744)

Figures in parenthesis are standard errors

Budget Share

Table 5 revealed that 21.77% of the respondents' total expenditure was on fruit, while 1.93% was spent on fat, 38.73% was on animal products, 8.85% on condiment, 18.28% accounted for herbs and 10.44% on vegetables. This is an indication that the largest percentage of the respondents' total expenditure was on animal products.

Table 5: Budget share

NTFPs Food group	Percent (share)
Fruit	21.77
Fat	1.93
Animal products	38.73
Condiment	8.85
Herb	18.28
Vegetables	10.44
Total	100

Conclusion

In conclusion, the study shows that the own price elasticities for all the NTFPs captured in this study were all negative in accordance to a priori expectation. The expenditure elasticity has the predicted sign for all the NTFPs food items captured in the study. These were fruit, fat, vegetables, herbs, animal and condiment. The expenditure elasticities for fruit, fat, herb and vegetable were less than one, implying that they were necessity food while animal and condiments were luxuries because their expenditure elasticities were greater than one. This implies that the proportion of expenditure on these products is much higher than all other food items especially when there is increase in income. Also, the budget share revealed that the largest percentage of respondents' expenditure was on animal products.

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