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Prioritization and cost and returns analyses of selected non-timber forest products in Yobe State, Nigeria

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This article describes cost and returns analysis of first five preferred Sahel savanna non-timber forest products (NTFPs) in Yobe State, Nigeria. The results demonstrate that households in Yobe State could realize NGN2,898.48 and NGN142,615.49 from the NTFPs as the least and maximum gross margins (household incomes) respectively. Gross margin ratio of households across all the study sites ranged from 0.925 to 0.980, and that from individual study sites 0.903 to 1.000 respectively. Thus, trade in these NTFPs was profitable to stimulate their domestication.

Key words: Cost and returns analysis, gross margin, gross margin ratio, non-timber forest products, sahel savanna.

INTRODUCTION

Non-timber forest products (NTFPs) are the wide range of species; both flora and fauna that are produced by forests and woodlands, and which are available to humans for use other than commercial timber (Cavendish, 2001; Sunderland et al., 2003; Jimoh, 2006). Dohrenbusch (2006) defined NTFPs as 'all products derived from biological resources found on forest land but not including timber, fuelwood or medicinal plants harvested as whole plants'. Ecosystem services such as water purification and prevention of soil erosion are all considered as NTFPs (Jimoh, 2006); and are among the very vital human livelihood opportunities.

The foregoing definitions indicate that NTFPs do not have a clear-cut definition. For example, the definition by Dohrenbusch (2006) excludes fuel-wood and a whole harvested medicinal plant from the list of NTFPs. Fuel-wood is however a NTFP since it is not used for timber. But it is not a non-wood forest product because it contains lignin. The authors therefore suggest that in defining NTFPs, all forest products like fuel-wood, which contain lignin (wood) and are not used as timber could be classified as woody NTFPs, while those without lignin, like mushroom, could be classified as non-wood forest products (NWFPs). This means NTFPs in general may include the numerous forest extracts such as bark, roots, tubers, leaves, fruits, flowers, seeds, resins, honey as

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well as medicinal plants, oils and mushroom. They may also include fuel-wood, edible seeds/fruits and vegetables, edible oils, spices, fodder, rattan, bamboo, cork, ornamental plants, chemical components, edible animal products, and terrestrial animals. Furthermore, fish, aquatic invertebrates, insects and insects' products, and wildlife products may all be listed among NTFPs.

Based on estimates from the European Tropical Forest Research Network, up to 2000 non-timber forest products can be listed today and many more are being discovered (Gopalakrishnan et al., 2005). In this study, NTFPs are forest tree components like flowers, fruits, leaves, roots, bark, and stems of the Sahel savanna tree species in Yobe State, Nigeria. The cost and returns analysis was limited to only the edible components of these NTFPs with market benefits.

Earlier research findings have shown that NTFPs contribute substantially to the livelihood of the rural poor in the developing economies (Chandrasekharan, 1992; FAO, 2002; Jumbe et al., 2007; Kafeero et al., 2011; Mwema et al., 2012). These contributions are numerous among which include food supply, medicine/health services, income and job opportunities to the members of the rural and urban households. The NTFPs provide essential dietary supplements, especially during lean agricultural production periods and times of emergency (Shackleton and Shackleton, 2004; Belcher et al., 2005; Mwema et al., 2012). They also provide food for man, livestock and wildlife; and trade in them provide alternative sources of cash incomes to man (Shackleton and Shackleton, 2003, 2006; Stark et al., 2006). Thus, they are very useful instruments to tackling poverty and food security challenges of the rural economies of developing countries (Taylor et al., 1996; Popoola and Galaudu, 2000; Anamayi et al., 2005; Tella et al., 2008; Tee et al., 2009). In Nigeria, the inhabitants within the guinea and Sahel savannas of Nigeria also rely appreciably on these NTFPs for income, sustenance, health, and general wellbeing (NEST, 1991; Tella et al., 2008; Tee et al., 2009).

Although they are socio-economically very important to the rural economies, there is paucity of empirical documentations on these benefits, and so, NTFPs are undervalued during national accounting (Popoola and Oluwalana, 2001; Jimoh, 2006; Amusa et al., 2012). Consequently, the sector often receives very meager budgetary allocations from government. Mithofer (2005), however, asserts that economic and financial analyses of natural resources (NTFPs inclusive) are vital empirical evidences that enhance choice among competing investment and development opportunities. They are the fundamental management tools to evaluate, select, and monitor investment opportunities towards maximizing utility and minimizing costs (Queensland Government, 2000; Elevitch and Wilkinson, 2000; Mechler, 2005; Chilvers and Smith, 2009; Cubbage et al., 2012). Paucity of information on economic potentials of Sahel savanna NTFPs in Nigeria, and particularly in Yobe State (Tee et al., 2009) has therefore negatively influenced its effective planning, policy decisions as well as sustainable management and utilization. This study is therefore very important since it provide additional empirical data and economic evidence to enhances the proper placement of the forestry sector during national development planning.

Another concept of importance employed in this study is prioritization. It is the ranking or ordering of things by their importance or urgency. Prioritization as applied in this study will enhance the validity and workability of information the study produces. The concept is very significant to economists in decision making and choice among the limited available resources that are often open to so many alternative uses. The concept facilitates the choice of opportunities to follow, problems to resolve as well as causes to address and solutions to implement. In fact, it is one of the best approaches in making objective decisions (Gosenheimer et al., 2012).

In forest management and utilization, the public most often have diverse opinions and perspectives on how and why forests should, or should not, be managed and utilized (Meldrum et al., 2013). Through prioritization such diverse opinions and perspectives would be harmonized to produce more widely acceptable and universal decisions. Approaches to prioritization usually expose people's value judgment of the existing alternatives and in the process ease-up choice and decision making. Popoola and Galaudu (2000), for instance, applied prioritization approach to identify and select indigenous spices for inclusion into agroforestry systems and practices in the semi-arid zone of Nigeria. Criteria for prioritization of the spices were acceptability, range of products and services, income level from them, interaction with other crops, and farmers' willingness to plant them. The final spices selected for improvement and introduction into the agroforestry practices in the area was therefore a product of local peoples' participation.

Background to the study

A number of researchers have studied NTFPs in Nigeria (Popoola and Oluwalana, 2001; Jimoh, 2006; Tella et al., 2008; Tee et al., 2009; Babalola, 2011). However, these studies have focused mostly the general livelihoods and socio-economic benefits with very little analysis on cash income to households. Nevertheless, studies on the values of NTFPs are critical to empowering and informing stakeholders; regulators, policy makers and development agencies for useful, equitable and sustainable interventions (Ingram and Bongers, 2009).

In addition, paucity of information exist on economic analyses of NTFPs in Nigeria, but the Sahel savanna

Table 1. Sampling Frame and procedure.

Senatorial zones in Yobe State	Number of LGAs in a senatorial zone	30% of the LGAs selected in a zone	30% of the Council wards selected per LGA	Villages purposively selected per council ward (2 per council ward)	Households randomly selected per council ward (5 households per ward)	Survey respondents (2 per household)
Zone A	7	2	6	12	60	120
Zone B	4	1	3	6	30	60
Zone C	6	2	6	12	60	120
Total	17	5	15	30	150	300

species are worst hit than those of the guinea savanna and rainforest ecosystems. Aside, Nwema et al. (2012) noted that the recurrent crop failures and livestock losses to drought in the arid regions make the integration of NTFPs in their farming systems imperative. Usually, NTFPs with proven economic potentials for livelihood sustainability elicits farmers' wider acceptability for inclusion in their farming systems (Tee and Amonum, 2008; Ingram and Bongers, 2009; Cubbage et al., 2012). This study will provide information to assist the selection and inclusion of the Sahel savanna NTFPs in domestication programmes of the region to complement the naturally occurring wild NTFPs (UNDP, 2003; World Bank 2004; Kalinganire, 2008). Also, economic studies to generating quantitative and incisive information on NTFPs for effective policies to boost their availability, accessibility, and sustainability, are imperative. This study will therefore prioritize NTFPs in Yobe State and further evaluate their economic potentials to households in the study area.

METHODOLOGY

Description of the study area

Yobe State is located in the Northeastern geopolitical zone of Nigeria between latitudes 10º and 14º North and longitude 11º 30´ to 14°45´East. The climate of the area shows a dry season stretching from October to June and the rainy season between July and September. The mean annual rainfall is; 275 mm, and mean annual temperature varies between 35 and 40ºC (YOSADP, 1992). The major vegetation type is the Sahel savannah. It consists of open thorny savannah with short trees and grasses. The trees are about 5 to 10 m high. The State comprises seventeen (17) Local Government Areas (LGAs) namely: Bade, Busari, Damaturu, Fika, Fune, Geidam, Gujba, Gulani, Jakusko, Karasuwa, Machina, Nangere, Nguru, Potiskum, Tarmuwa, Yunusari and Yusufari. The human population of both male and female in Yobe State is 2,532,395 (NPC, 2006). The major ethnic groups include the Kanuri, Hausa, Fulani, Kerekere and Nufundi, who are predominantly farmers. They also depend on forest products and hunting for their livelihoods.

Population and sampling of observational units

The study population comprises the male and female household members in Yobe State involved with NTFPs as producers, traders or consumers. A multistage random sampling technique, using 30% sampling intensity, was applied in determining sample size and also selecting observational units.

The State was stratified into three Senatorial Zones; A, B and C with the Local Government Areas (LGAs) distributed as seven, four and six respectively for Zones A, B and C. Thus, applying a 30% sampling intensity (SI), five LGAs out of 17 were selected for the study; two LGAs in Zone A, one in Zone B, and two in Zone C. These LGAs comprises 10 council wards each. Thus from every of the 10 council wards in each of the five LGAs selected, three council wards each were sampled using 30% SI. In the end 15 council wards were selected for the study. From these 15 council wards, two villages each were selected for the study based on the prevalence of NTFPs. In the end 30 villages were covered and five households each were sampled at regular intervals from these villages to elicit data. Thus, 150 households were sampled and administered with the copies of the questionnaire; two respondents (one male and one female) each per household to elicit data. A total of 300 respondents were therefore sampled at the end of the process to elicit data. The sampling frame is as shown in Table 1.

Data collection

Data were collected in a survey administered as part of a broader study on the proximate and economic analysis of selected Sahel savanna NTFPs in Yobe State, Nigeria (Bugh, 2014). A reconnaissance survey was carried out between July and August, 2011 to ascertain the reliability of the study area, identify the study sites and contact persons. A list of the most commonly available NTFPs in Yobe State was also produced during the reconnaissance survey. This list was incorporated into the primary data collection instrument; the semi-structured questionnaire, which was validated through a pre-test and editing by social scientists and foresters at seminars and private consultations. This procedure eliminated ambiguities and also made the questionnaire more simple and relevant for the kind of data this study required. Personal observations and focus group discussions were also adopted to ensure good data collection. Three hundred copies of the validated questionnaire were then administered on 300 respondents in the study area; 120, 60 and 120 respectively in zones A, B and C. However, 279 copies out of the 300 copies of the administered questionnaire were valid while twenty one were not valid due to communication problems some field assistants encountered. Thus the twenty one copies of the questionnaire did not provide the desired information, and were therefore not utilized during analysis. Markets were also visited weekly to establish the prices of the selected NTFPs per unit of measurement. These were then aggregated to determine mean market price. All measurements were standardized in kilograms. Respondents were asked to score

the identified species of NTFPs based on their preferences using a scale of 0 to 5, with score '5' as the most preferred. This was to obtain data for the prioritization of NTFPs in Yobe State.

Questionnaire administration was completed in 8 weeks, and only 93%, that is, 279 of 300 individuals contacted completed the questionnaire without problems. The remaining 7% (that is, 21) survey respondents truncated the completion of the questionnaire as they could not provide adequate information on their incomes and quantities of products they marketed. The truncated questionnaire copies were not analyzed.

Data analyses

Prioritization of NTFPs in Yobe State

The prioritization of the NTFPs identified during data collection was carried out by ranking. Respondents' opinion poll for ranking the NTFPs was elicited using a five point scale corresponding with the five top priority NTFPs species to be selected for cost and returns analysis. Each respondent was then asked to select and rank five top priority NTFPs species out of the 16 identified in Yobe State. The first preferred species were to score five, while the fifth and less preferred species scored one. The rating was based on respondents' perceived level of importance of each of the NTFPs for income, food, and health needs. The first most preferred NTFP species were scored 5 points, and the fifth most preferred species 1 point. All NTFPs had equal opportunities of being selected by every respondent among the top five priority species. Thus, any species that was not rated among the first five NTFPs species by a particular respondent was scored zero (0). Since 279 respondents participated in this rating exercise, any NTFP that was rated first (5 points) by every respondent could score 1395 points; that is, 100% of the respondents. The mean preference values were then computed using these scores and respondents' frequencies.

Cost and returns of NTFPs using gross margin analysis

Respondents were requested to indicate the plant species they produced, edible products of the species sold, and the monthly quantities produced and sold with the unit prices and expenses incurred. The prevailing market prices were also obtained through personal observations and market surveys to authenticate the information respondents provided. All quantity measurements were standardized in kilograms. Prices and costs were also determined using such standards. Budgetary tool; gross margin was then applied to estimate costs and returns of the Sahel savanna NTFPs. The gross margin analysis, following Cubbage et al. (2012), is specified as follows:

$$GM = GI - TVC$$

Where; GM = Gross Margin; GI = Gross Income (Quantity of NTFPs sold per month × prevailing market price); TVC = Total Variable Cost (Cost incurred in the use of variable inputs, that is, transportation and taxes paid per unit quantity sold); Profitability was estimated using Gross Margin Ratio (GMR) specified as:

$$GMR = (GI - TVC)/GI$$

The higher the ratio, the more profitable is the returns from the products. The mean results of the G.M of the selected Sahel savanna NTFPs were then estimated. Significant differences in mean GMRs were tested using a two-way Analysis of variance (ANOVA) at 5% level of significance to measure the effect of locations and the different species.

RESULTS AND DISCUSSION

Prioritization of NTFPs in Yobe State, Nigeria

Table 2 presents the summary of NTFPs prioritization in Yobe State, and this shows that 16 species of NTFPs trees identified can produce products of economic, health and nutritional value to the people in the area. Based on respondents perceived preferences, the first five priority species in the study area were: *Phoenix dactylifera* (3.043±0.118), *Moringa oleifera* (2.455±0.119), *Adansonia digitata* (2.373±0.107), *Tamarindus indica* (1.219±0.091) and *Diospyros mespiliformis* (1.186±0.113) respectively. The corresponding percentages acceptability were 60.9, 49.1, 47.5, 24.4 and 23.7% respectively. *Haematostaphis barteri* with mean score of 0.122±0.034 and percentage acceptability of 2.4% was the least preferred species in the study area. The scores by the other species were as shown in Table 2.

The prioritization of these NTFPs species was based on respondents' perceived level of the combined importance of each of these NTFPs species for income, food, and health needs. This means *P. dactylifera*, *M. oleifera*, *A. digitata*, *T. indica* and *D. mespiliformis* respectively were the first five most preferred species to the people in terms of usefulness. However, current exploitation pressure on the preferred species in the study area is threatening their sustainability, and there are no established plantations of these species to support their natural populations.

NTFPs exploitation without concomitant regeneration efforts may lead to scarcity and even extinction (Kalinganire et al., 2008; Tee et al., 2008). Policy interventions are therefore necessary to ensure that forest resources exploitation and regeneration operate concomitantly to maintain their numbers in the wild. Since prioritization processes harmonize varying opinions and perspective in management decisions (Gosenheimer et al., 2012), the promotion of the first five preferred NTFPs species (particularly *P. dactylifera* and *M. oleifera* with higher prioritization values) reported in this study for domestication and commercialization would attract wide acceptability.

Cost and returns of the NTFPs studied in Yobe State

Table 3 presents cost and returns analysis of the first five preferred NTFPs in Yobe State. All the variables in the table are ranked based on GMR values in column 8. These GMR values were significantly different ($P<0.05$) with *P. dactylefera* fruits producing the highest GM of

Table 2. Prioritization of NTFPs in Yobe State.

Scientific name	Common Name	Hausa name	Total score	Score as % of 1395*	Mean Score±SE
Phoenix dactylifera	Dates tree	Dabino	849	60.9	3.043±0.118
Moringa oleifera	Horse radish tree	Zogale	685	49.1	2.455±0.119
Adansonia digitata	Boabab tree	Kuka	662	47.5	2.373±0.107
Tamarindus indica	Tamarind	Tsamiya	340	24.4	1.219±0.091
Diospyros mespiliformis	African Ebony	Kanya	331	23.7	1.186±0.113
Balanites aegyptiaca	Soapberry tree	Aduwa	309	22.2	1.108±0.092
Ziziphus mauritiana	Jujube tree	Magarya	230	16.5	0.824±0.079
Parkia biglobosa	Locust bean tree	Dprawa	207	14.8	0.742±0.083
Hyphaena thebaica	Dum palm**	Goruba	118	8.5	0.423±0.067
Vitex doniana	Black pluru	Dinya	99	7.1	0.355±0.058
Vitellaria paradoxa	Shea butter tree	Kadanya	61	4.4	0.219±0.049
Borassus aethiopum	African fan tree	Giginya	58	4.2	0.208±0.045
Ziziphus spinachristi	Christs thorn	Kurna	56	4.0	0.201±0.044
Detarium micropum	Tallow tree	Taura	54	3.9	0.194±0.043
Ximenia Americana	Wild olive	Tsada	40	2.9	0.143±0.036
Haematostaphis barteri	Blood plum	Danya	34	2.4	0.122±0.034

1395* is the Maximum score any NTFP species can score. N = 279. Dum palm** is also known as Ginger bread palm, and Egyptian doum palm.

Table 3. Cost and returns analyses of the first five prioritized NTFPs studied in Yobe State.

Selected NTFPs	MMQS (kg)/Resp. (a)	MPMP (NGN)/Kg (b)	MVC (₦)/ month/Kg (c)	GI (NGN)/month (a)×(b) = d	TVC (NGN)/month (a)×(c) = e	GM (NGN)/month d-e = f	*GMR Mean ± SE f ÷ d= g
P. dactylifera (fruits)	621.31	234.17	4.63	145,492.16	2,876.67	142,615.49	0.980±0.00^{a}
D. mespiliformis (fruits)	79.65	38.06	1.67	3,031.48	133.02	2,898.48	0.956±0.003^{b}
A. digitata (leaf powder)	448.11	29.06	1.48	13,022.08	663.20	12,358.88	0.949±0.006^{c}
*M. oleifera (*leaves)	141.61	90.00	6.21	12,744.90	879.40	11,865.50	0.931±0.006^{bc}
T. indica (fruits*)*	103.08	47.94	3.61	4,941.66	372.12	4,569.54	0.925±0.023^{abc}

MMQS = Mean monthly quantity sold, MPMP = Mean prevailing market price, MVC = Mean variable cost, GI = Gross Income, TVC = Total variable cost. GM = Gross margin, GMR= Gross margin ratio. One US$ is equivalent to NGN156. *Value in the same column followed by different superscripts differ significantly (P<0.05).

NGN142,615.49, followed by the GM values of *A. digitata* leaf powder (NGN12,358.88), *M. oleifera* leaves (NGN11,865.50), and *T. indica* fruits (NGN4,569.54) respectively. *D. mespiliformis* fruits generated the least GM of NGN2,898.48. The differences in the mean GM values were explained by mean monthly quantities sold (MMQS), mean prevailing market price (MPMP), and the mean variable cost (MVC) of the NTFPs (Table 3).

Respondents' relative MMQS of NTFPs included: *D. mespiliformis* fruits; 79.65 kg, *T. indica* fruits; 103.08 kg, *M. oleifera* leaves; 141.61 kg, *A. digitata* leaf powder; 448.11 kg, and *P. dactylifera* fruits; 621.31 kg (Table 3). The relative GM of the NTFPs per month also followed a similar order above. Thus, MMQS of NTFPs and their GMs are connected; the higher the MMQS of NTFPs, the greater the GM realized, *ceteris paribus*. The MMQS of NTFPs may also indirectly signify the levels of availability, preferences, and demand for the NTFPs. These factors may also influence GM to be realized.

Although the MPMP did not follow the same ranking, it influenced the GM values realized from the NTFPs. According to Armstrong and Kotler (2000), if other things are equal, the higher prices of commodities will generate greater income or GM from NTFPs sales and vice versa. The price of NTFPs in the study area ranged from NGN29.06/kg of *A. digitata* leaf powder to NGN234.17/kg of *P. dactylifera* fruits. Thus, *P. dactylefera* fruits attracted the highest market price among the NTFPs in this study.

Table 4. Mean Gross Margin ratios of the first five priority NTFPS in Yobe State.

LGA's	*P. dactylifera*	*M. oleifera*	*A. digitata*	*T. indica*	*D. mespiliformis*
Potiskum	0.986±0.008^{a}	0.962±0.003^{a}	0.960±0.005^{a}	0.944±0.011^{a}	1.000±0.00^{a}
Gujba	0.969±0.006^{a}	0.903±0.017^{c}	0.955±0.005^{a}	0.954±0.013^{a}	0.922±0.004^{b}
Damaturu	0.977±0.006^{a}	0.926±0.037^{bc}	0.943±0.008^{ab}	0.960±0.009^{a}	0.944±0.016^{b}
Bursari	0.977±0.007^{a}	0.915±0.009^{bc}	0.956±0.009^{a}	0.934±0.017^{a}	0.989±0.007^{a}
Bade	0.993±0.000^{a}	0.946±0.011^{b}	0.925±0.013^{b}	0.828±0.119^{a}	0.924±0.025^{b}

Values in the same column followed by different superscripts differ significantly (P<0.05).

A. digitata leaf powder attracted the least market price. According to Arnold and Dewees (1999), high market values of NTFPs stimulate their selection for domestication programs. Furthermore, Adeyoju (1993) asserts that prices are signals to both producers and consumers in their production and consumption decisions. Price is also a strong indicator of value and success in business, level of income generation and distribution (Armstrong and Kotler, 2000). The high income benefits of the NTFPs reported in this study would build farmers' confidence and desire in these plants for domestication.

The mean variable cost of NTFPs in the study area ranged from NGN1.67 to NGN6.21 per kilogram per month. These were from *D. mespiliformis* fruits and *M. oleifera* leaves respectively. It is worthy to note that in production theory, increase in production cost will result to a decline in the level of benefits. Thus, the disparity in the mean variable costs of NTFPs studied also influenced their GM values differently. Respondents attributed this to the differences in the monthly quantities sold of the NTFPs, their nature (leafy or fruity), and seasonality. Increasing mean variable cost will produce decreasing GMs.

Generally, the differences in the nature of NTFPs, level of demand, location, and availability could explain variations in MMQS, MPMP, and MVC or Marginal costs of the NTFPs studied. Besides, some NTFPs are seasonal through the year (Mithofer and Waibel, 2008). These factors could jointly influence the GM from NTFPs in the area.

The highest GMR of 0.980 was obtained from *P. dactylefera* fruits (Table 3). This was followed by 0.956, 0.949, and 0.931 from *D. mespiliformis* fruits, *A. digitata* leaf powder, and *M. oleifera* leaves respectively. The least GMR of 0.925 was obtained from *T. indica* fruits. Although *P. dactylefera* fruits have the second highest MVC, its relatively higher MMQS explains why its GMR is higher than all the other NTFPs. *D. mespiliformis* fruits have the second highest GMR probably because of the relatively very low and least MVC (NGN1.67) than the other NTFPs studied. *M.oleifera* leaves have the highest MVC and a corresponding third least MMQS of it than the other NTFPs studied. These in part explain why its GMR ranked the fourth out of the five NTFPs studied albeit it's high MPMP second only to *P. dactylefera* fruits. *T. indica* fruits have the least GMR perhaps for the combined high MVC and low MMQS of it. GMR is an approximate estimate of profitability (Cubbage et al., 2012). Thus, the highest and least profit from NTFPs in Yobe state was from *P. dactylefera* fruits, and *T. indica* fruits respectively.

Gross margin ratio (GMR); an approximate estimate of NTFPs profitability in Yobe State

Gross margin ratio (GMR) was utilized to estimate and compare profit margins of the preferred NTFPs across the study sites in Yobe State. Table 4 presents the mean GMRs of the five Sahel savanna NTFPs studied. There was significant different (P<0.05) in the mean GMRs of *M. oleifera* leaves, *A. digitata* leaf powder, and *D. mespiliformis* fruits among the five LGAs, while no significant difference (P>0.05) was observed in the mean GMRs of *P. dactylefera* fruits and *T. indica* fruits. This implies that the NTFPs with significant difference in the mean GMR similarly differ significantly in their profit margins across the LGAs, while those with no significant differences generated very close profit margins. Thus, for *M. oleifera* leaves, the GMR of 0.962±0.003 at Potiskum LGA was significantly higher (P<0.05) than its GMRs in the other four LGAs. However, its GMRs in Bade (0.946±0.011), Damaturu (0.926±0.037) and Busari (0.915±0.009) were similar, while that of Gujba (0.903±0.017) was less than Bade. This means that *M. oleifera* leaves were significantly more profitable at Potiskum than the other four LGAs.

In the case of *A. digitata* leaf powder, the GMRs of 0.960±0.005, 0.956±0.009 and 0.955±0.005 at Potiskum, Busari and Gujba LGAs, respectively, were similar (P>0.05), but significantly higher (P<0.05) than the GMR of 0.925±0.013 at Bade LGA. The GMR of 0.943±0.008 realized from *A. digitata* leaf powder, at Damaturu LGA, was similar (P>0.05) to all the other four LGAs. This means, of all the five LGAs studied, profit margin from *A. digitata* leaf powder was least at Bade LGA; except Damaturu. The GMRs of 1.000±0.00 and 0.989±0.007 realized from *D. mespiliformis* fruits at Potiskum and

Table 5. Supply dynamics of the first five prioritized NTFPs in Yobe State.

Prioritized NTFPs	Jan	Feb	Mar	Apr.	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
P. dactylifera (fruits)	NAA	NAA	*	*	*	NAA	NAA	NAA	NAA	NAA	NAA	NAA
D. mespiliformis (fruits)	NAA	NAA	NAA	NAA	NAA	NAA	NAA	NAA	NAA	NAA	*	*
A. digitata (leaf powder)	*	NAA	NAA	NAA	NAA	NAA	NAA	NAA	NAA	*	*	*
*M. oleifera (*leaves)	NAA	NAA	NAA	NAA	NAA	NAA	*	*	*	*	*	NAA
T. indica (fruits*)*	*	*	NAA	NAA	NAA	NAA	NAA	NAA	NAA	NAA	NAA	⟷

'NAA' means 'Not Adequately Available'. *The times products from species are mostly available.

Busari LGAs, were similar (P>0.05), but significantly higher (P<0.05) than the GMRs of 0.944±0.016, 0.924±0.025 and 0.922±0.004, respectively, at Damaturu, Bade and Gujba LGAs. Thus, the highest profit margins, realized from *D. mespiliformis* fruits, at Potiskum and Busari LGAs were more than those from Damaturu, Bade and Gujba LGAs.

The GMRs realized from *P. dactylefera* fruits, and *T. indica* fruits, were respectively not different (P>0.05) among the LGAs studied. The GMRs of these two NTFPs- *P. dactylefera* fruits and *T. indica* fruits respectively, ranged from 0.969±0.006 to 0.993±0.000 and 0.828±0.119 to 0.960±0.009. The variation in the level of profit generated from these NTFPs among the LGAs studied could be explained, among others, by the differing volumes of sales, prevailing market prices, level of demand, and trading costs, respectively. The generally high GMRs of the NTFPs studied in Yobe State showed that investment in these commodities with higher GMRs is more profitable than the NTFPs with lower GMRs. However, the GMR of *D. mespiliformis* fruits at Potiskum LGA (1.000 ± 0.00) looks spurious. This could be explained on account of the low and negligible MMQS of *D. mespiliformis* fruits at Potiskum LGA that attracted very negligible transportation cost and tax after sales. Since the two factors were the only items of variable cost estimated in this study, the MVC was negligible and hence its effect on GMR was also negligible.

Since profitability is often the overriding objective of businessmen and women, survey respondents may likely prefer investing in the NTFPs with higher profits (Mithofer and Waibel, 2008). In this study, all the NTFPs yielded high GMRs and thus, are all profitable. Traders will only have to study the spatiotemporal variations in the level of profit realized from these NTFPs to determine when and where to sell their products. However, emphasis should be on spatiotemporal variations in *M. oleifera* leaves, *A. digitata* leaves, and *D. mespiliformis* fruits, whose mean GMRs were significantly different (P<0.05) across the LGAs studied. The result presented in Table 5 shows the months of the year that the first five preferred NTFPs species were mostly available in Yobe State. *M. oleifera* was reported to be mostly available from July to November (5 months period). *A. digitata* was reported to be mostly available for four months (October to January). Both *P. dactylifera* and *T. indica* were mostly available over three month periods (March to May and December to February) respectively. The least distributed species was *D. mespiliformis,* which was reported to be mostly available for only two months (November-December). The result therefore shows that none of the species was available all-year-round; however, there were overlaps and successions (Table 5) in their availability and distribution throughout the year. Due to variations in the maturity period of species, most of the species were noted to be more abundant during their harvest seasons and very scarce and even absent off harvest seasons.

Other reasons for the relatively more abundant supply of the species during the harvesting seasons than the non-harvesting seasons were:

1. Fear of wastages due to the perishable nature of some of the species, example Moringa leaves.
2. Immediate desire for income to address household economic and financial challenges like paying school fees and hospital bills.
3. Poor storage and processing culture amongst the households in the area.
4. Inadequate processing and storage facilities as well as poor knowledge the need to process and store products for future use.
5. Drought, poor rainfall and other weather challenges also influenced their availability.

For products like *P. dactylefera* fruits and *A. digitata* powdered leaf which could be sundried and stored for some time, their supply were relatively stable. Moringa leafs were also more stable because it was possible to sun-dry and store them for some months. The all-year-round supply of any of these species would only be ensured through processing, storage and other sustainable management approaches (Kalinganire et al., 2008). Adequate planning and policy interventions to improve processing, storage and domestication of the species would enhance the availability, distribution and utilization of these NTFPs.

Conclusion

The selected Sahel savanna non-timber forest products

(NTFPs) studied provided alternative income sources to the rural households at Yobe State. The monthly gross margins realized by the households at Yobe from these NTFPs were NGN142,615.49, NGN12,358.88, NGN11,865.50, NGN4,569.54 and NGN2,898.48 from *P. dactylifera* fruits, *A. digitata* powdered leaf, *M. oleifera* leaves, *T. indica* fruits and *D. mespiliformis* fruits respectively. Thus the highest gross margin of NGN142,615.49 was realized from *P. dactylifera* fruits, and the lowest monthly gross margin of NGN2,898.48 from *D. mespiliformis* fruits. By virtue of the gross margin ratios, all the selected NTFPs studied in Yobe state, are profitable; however, *P. dactylifera* fruits are the most profitable with a gross margin ratio of 0.980 (Table 3), followed by *D. mespiliformis* fruits with gross margin ratio of 0.956. The variable cost components of the NTFPs were not fully estimated, particularly that the family labor cost was not imputed. This may have inflated the GI, GM, and GMR values observed in this study.

The selected Sahel savanna NTFPs studied are profitable, and highly valued by the households in Yobe state. They can therefore be developed and promoted for domestication. Improved marketing strategies and processing of the products from these species for value adding will make significant improvement in the economic life of households at Yobe state.

Conflict of Interest

The authors have not declared any conflict of interest.

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