

COMPARATIVE ANALYSIS OF ECONOMIC VIABILITY OF NEEM (*Azadirachta indica*) AND GUM ARABIC (*Senegalia Senegal*) PLANTATIONS FOR DESERTIFICATION CONTROL AND REVENUE GENERATION IN YOBE STATE, NIGERIA

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ABSTRACT

This paper compared the economic viability of Neem (*Azadirachta indica*) and gum Arabic (*Senegalia Senegal*) plantations involved in desertification control and revenue generation projects in Yobe state. Specifically, it assessed the socioeconomic characteristics of the marketers, economic viability including establishment and management costs of plantations of both species. Multistage sampling technique was used. First; was purposive sampling of three plantation areas of Afunori, Nangere and Damaturu, established in 1999. Second; was a random sampling of 250 marketing respondents based on Yero Yemenis model. Two questionnaires were used to collect data from the plantation managers and the sampled marketers. Results have shown that gum Arabic plantations were economically viable with BC-R values greater than 1 and with positive NPV and LEV values. The opposite was the case with the corresponding neem plantations. Similarly, Gross Margin and profitability analyses for both enterprises have shown that gum Arabic recorded significant profit margin of up to ₦2, 403.09 net profits per ton per marketer from 685.41 ton of gum Arabic marketed within 5 years against only ₦970.84 net profit per ton per marketer realized from 673.13 ton of neem seed marketed within the same period. However, establishment cost per hectare for gum Arabic (₦337, 515.63) was significantly higher than neem (₦127, 686.68). Differences between management costs per hectare for both species were not significant. Creation of market and awareness about economic potentialities of neem, formation of neem associations as well conversions of Jawa gum Arabic substation into full fledged gum Arabic Research Institute were the major policy recommendations made.

Key words: Economic viability, *Azadirachta indica*, *Senegalia senegal*, Desertification control, Revenue generation

INTRODUCTION

Yobe state grapples with severe environmental degradation (UNDP, 2005) attributed to the consequences of climate change (NIMET, 2014). This culminates into cyclical drought with catastrophic development of arid and semi-arid conditions (Iloeje, 1992). Apart from climatic variability; deforestation has taken its toll in recent times. Consequently, desert encroachment is eating up the marginal lands at the rate of 0.6 km/annum (FAO, 2009). This is apparent in Kaska, Tulotulo, Kumaganam and Gumsi community settlements encroached by large masses of sand dunes besides farmlands and infrastructure overtaken by the desert (Muhammad, 2016). Thus, the environment is highly degraded and this requires aggressive and sustainable environmental management programs (YBSES, 2008). Resuscitation and

maintenance of the degraded environment gulps huge sums of money that cannot be afforded by the State. This is due to its total dependence on inadequate fund allocation from the Federal Government occasioned by dwindling oil revenues (CBN, 2006). The need to diversify the State's economy therefore becomes apparent (Ogbeba, 2009). It is for this reason that the federal government directed all States to look inwards with a view to finding alternative sources of revenues for all forms of development in their respective domains. To achieve this, the National Raw material Research and Development Council (NRRDC) and the National Economic Empowerment and Development Strategy (NEEDS) have been mandated to identify important renewable and non-renewal resources available in each State for subsequent investment into the sector (YBSES, 2008).

Yobe state endowed with favorable agro-ecology for neem and gum Arabic resources is considering large-scale investment in plantation forestry for desertification control and revenue generation. *Azadirachta indica* is (Neem) a versatile multipurpose tree suitable for urban greening, Agroforestry, wood and fuel wood production and for a variety of other purposes including biopesticide production (Stoney, 2005). Its xyrophytic properties make it more reliable for desertification control. In contrast, *Senegalia senegal* (gum Arabic) is leguminous multi-purpose African tree highly valued for its Gum Arabic produce – the desert gold. It is one of the most versatile trees with positive Agroforestry function (Fact Net, 2000). It is also a xyrophytic species and therefore suitable for desertification control (Fact Net, 2002). The use of both species to achieve both objectives could be a right strategy. However, there is a need for critical analysis of their economic viability with respect to the attainment of the set objectives (Wilkinson and Elevitch, 2012). A prior research work is therefore necessary. The choice of these species from among tens of other species was based on the findings of the Yobe State Afforestation Project (YBSAP) and the Food and Agriculture Organization (2008). That both species are highly adapted to the prevailing Sudano-Sahel agro ecology of the State and that both have products of high market value and can therefore serve as other sources of revenue. Which of the species is more economically viable when involved in environmental management and revenue generation projects in the state?

Objectives

This work compares the economic viability of neem and gum Arabic plantations involved in desertification control and revenue generation projects in Yobe state, Nigeria. Specifically, it assessed and compared: i) the socioeconomic characteristics of neem seed and gum Arabic marketers, ii) economic viability of plantations both species iii) the profitability of neem seed and gum Arabic marketing as well as iv) establishment and management costs of both gum Arabic and neem plantations in the State.

METHODOLOGY

The study area

Yobe State is located between latitudes $10^{\circ} 27^1$ and $13^{\circ} 23^1$ North and longitudes $9^{\circ} 40^1$ and $12^{\circ} 30^1$ East of the Equator. It occupies the North Eastern part of the country and is bounded on the north by the Niger republic, on the east by Borno state, Bauchi on the southwest and Jigawa state on the Northwest (Encyclopedia Britannica, 2006). It covers a total land area of 45,502 square kilometers. The dominant ethnic groups are Manga, Fulani, Ngzim, Bade, Bolewa, Karei-Karei. Their major occupations are farming and marketing. Among the popular cash crops grown in the State are gum Arabic, groundnut, onion, cotton, and tomatoes. Other crops commonly grown in the State include millet, guinea corn, maize, rice, beans and sesame.

Sample and Sampling Procedure

The state is divided into three plantation areas of Afunori (APA), Nangere (NPA) and Damaturu (DPA) established in 1999 National Tree Planting Program with each covering 6, 4 and 7 Local Government Areas respectively. This is based on the existing zoning arrangement of the Yobe State Afforestation Project (YSAP). APA covered a total land area of 16,059.52 Square kilometers, whereas NPA and DPA had 10,706.35 and 18, 736.12 square kilometers respectively (YBSES, 2008). Multi stage sampling technique was used. The first stage was a purposive sampling of neem and gum Arabic plantations in each of the plantation areas of APA, NPA and DPA. The second stage relates to the sampling of neem and gum Arabic marketing respondents. Of the 364 total number of neem seed and gum Arabic marketers in the state (YBSES, 2008), a sample of 250 was drawn: 125 respondents each for neem seed and gum Arabic marketers. The size of the sample was determined using Yero Yemeni's sampling model at 5% (equation I) in the order of 88, 58 and 104 neem seed and gum Arabic marketers at APA, NPA and DPA respectively.

Method of data collection

Two structured questionnaires were used in the collection of data. One was specifically directed to the marketing respondents, while the

other was restricted to the plantation managers. A total of 300 questionnaires were produced for data collection but 250 copies were correctly filled, returned and used in data analysis.

Model specifications

The outline of Yemeni's formula as used in Buba (2012) is given below:

$$n = \frac{N}{(1+Ne^2)} \dots\dots\dots (I)$$

Where:

n = Sample size

N = Population size

e = Sampling error (0.05)

GM and profitability analysis model was used in determining the profitability of neem seeds and gum Arabic marketed from 2009 to 2013 in the three plantation areas. This work adopts Umar et al. (2014) method of GM calculation as follows:-

$$GM = TR - TVC \dots\dots\dots (II)$$

$$NP = TR - TC \dots\dots\dots (III)$$

Where: GM = Gross Margin for neem seed and gum Arabic Marketing (₦)

TR = Total Revenue realized from the sales of neem seed and gum Arabic produce (₦)

TVC = Total Variable Cost incurred in marketing neem seed and gum Arabic produce (₦)

NP = Net Profit realized from the marketing of neem seeds and gum Arabic produce (₦)

TC = Total Cost incurred in the marketing of neem seeds and gum Arabic produce (₦).

Benefit Cost Ratio (BC-R) was calculated in order to compare the flows of benefits and costs involved in the establishment and management of plantations of *Azadirachta indica* and *Senegalia senegal* in the three plantation areas studied. For any project to be economically viable, the benefit/cost ratio (BC-R) must be greater than 1 i.e. $BC-R > 1$; and when deciding between alternative projects, the one with the highest BC-R should be selected. This work adopts Sinden and Thampapillai (1995) method for calculating BC/R as follows:

$$BC/R = \frac{\sum B_t(1+r)^t}{\sum C_t(1+r)^t} \dots\dots\dots (IV)$$

Where:

BC/R = Benefit Cost Ratio of neem and gum Arabic plantations

B_t = Total Value of Benefit derived from the sales of neem and gum Arabic products in the 11th – 15th year of the project (₦)

C_t = Total Value of costs incurred in the Establishment and Management of Neem and gum Arabic plantations in the 1st – 10th year of the project (₦)

t = Time (5 years)

r = Interest rate (24% based on cost of borrowing capital in the study area)

$\sum$ = Summation sign

The Net Present Value (NPV) was used in this work to assess the economic viability of neem and gum Arabic plantation projects in the state. To determine NPV, all cash flows were discounted since it stands for the sum of all discounted costs and benefits. This sum reflects how much the projects would earn. A project with negative NPV is not viable because the costs associated with it outweigh the benefits. This work adopts Sinden and Thampapillai (1995) method of NPV computation as follows:

$$NPV = \frac{\sum B_t(1+r)^t - \sum C_t(1+r)^t}{(1+i)^t} \dots\dots\dots (V)$$

Where:

NPV = Net Present Value of neem and gum Arabic plantations

B_t = Total Value of Benefit derived from the sales of neem and gum Arabic products in the 11th – 15th year of the project (₦)

C_t = Total Value of costs incurred in the Establishment and Management of Neem and gum Arabic plantations in the 1st – 10th year of the project (₦)

t = Time (5 years)

r = Interest rate (24% based on cost of borrowing capital in the study area)

$\sum$ = Summation sign

Land Expectation Value (LEV) is the net present value of income from an infinite sequence of harvests and it represents the value of bare land used to grow trees. LEV was considered relevant in this work because it assesses financial returns from the management

of even-aged plantations of *Azadirachta indica* and *Senegalia senegal* as well as its suitability in valuation forest land that can be used for growing timber. Since this work involved even-aged plantations, it adopts Thomas and Steven (1991) method of LEV calculation as follows:

$$LEV = \frac{\sum B_t(1+r)^t - \sum C_t(1+r)^t}{(1+i)^t - 1} \dots \dots \dots (VI)$$

Where:

LEV = Land Expectation Value of neem and gum Arabic plantations

B_t = Total Value of Benefit derived from the sales of neem and gum Arabic products in the 11th – 15th year of the project

(₦)

C_t = Total Value of costs incurred in the Establishment and Management of Neem and gum Arabic plantation in the 1st – 10th year of the project (₦)

t = Time (5 years)

r = Interest rate (24% based on cost of borrowing capital in the study area)

$\sum$ = Summation sign

RESULTS AND DISCUSSION

Socioeconomic characteristics of neem seed marketers

Gender

The male gender dominated the marketing scenarios of both products. It constituted 72% and 80% of the total respondents engaged in neem seed and gum Arabic marketing respectively (Table 1.0). The respective balances of 28% and 20% represented female participation in both businesses. This contravenes the principle of gender equality enunciated in the Millennium Development Goals (UNDP, 2008).

Age distribution of respondents

Results have shown that the sampled neem seed and gum Arabic marketers were mainly youths with mean ages of 36.88 and 30.60 years respectively (Table 1.0). Therefore, as youth, they vigorously handled and endured all hectic marketing activities involved in the business. This agrees with UNDP (2008) stipulations of direct involvement of able bodied individuals in economic activities. Those onerous tasks included movement from one plantation to another or from one village market to another,

grading, drying and bagging of produce. The result further indicates the willingness of both youth and matured persons to accept and manage risk as established in the earlier work of Giroh, Umar and Yakubu (2010).

Marital Status of respondents

The married sub variable constituted 76% and 80% of the total neem seed and gum Arabic marketers respectively. Singles, widows, divorcee and separated individuals collectively formed the respective balances of 24% and 20% (Table 1.0). In other words, neem seed and gum Arabic marketing engaged persons with many and varied marital statuses. However, the extent was greater among married marketing respondents of both products compared to other sub-variables in the same category. This might have an adverse effect on the quantity of both products marketed and hence the marketing margin realized. Clearly, this also contradicts UN's stipulations of high involvement of varied classes of individuals in economic activities (UNDP, 2008).

Educational background of respondents

Majority of the neem seed marketers (70%) had no access to formal education whereas only 30% of such individuals formed the gum Arabic marketing group (Table 1.0). Thus, the collective balances of 30% and 70% represented neem seed and gum Arabic marketers with varying levels of education respectively. This could probably be part of the reason for the higher net profit/tonne/marketers realized by gum Arabic marketers compared to their neem seed counterparts. This agrees with Eboh (2006) who asserted that education is a crucial factor to higher performance in any business activity.

Major occupation of the respondents

Farming was the major occupation (76%) of the neem seed marketers whereas public service (52%) dominated the gum Arabic business scenario (Table 1.0). The farming occupation comprised individuals in abject poverty and high illiteracy level. The public service on the other hand was made of at least average income earners with varying literacy levels. Thus, both businesses were not the major occupations of the respondents. This means that

both marketing groups ventured into both businesses to supplement income for improved livelihood (UNDP, 2008).

Marketing experience

Results indicate low marketing experience among both marketing groups. However, the extent was greater among gum Arabic marketers (80%) compared to the neem seed dealers (70%) (Table 1.0). Why was the marketing performance of gum Arabic respondents significantly higher than their counterparts with higher marketing experience in neem seed business? Gum Arabic attracted global market prices; therefore, its economic potentials were very much understood particularly among the public servants.

This awareness coupled with their varying educational levels positively influenced the profits generated by the gum Arabic marketing group. This agrees with Wood's (2008) assertion that experience and education create behavioral changes and confidence in business. The low profitability of neem seed marketers was attributed to illiteracy and ignorance of the economic potentialities of neem in the study area.

Table 1.0 Socioeconomic characteristics of neem and gum Arabic marketers at APA, NPA and DPA

Variable of comparison	Neem seed marketers	Gum Arabic marketers
Gender		
Male	90 (72.00)	100 (80.00)
Female	35 (28.00)	25 (20.00)
Total	125 (100.00.)	125 (100.00)
Age Class		
20 – 30	20 (16.00)	40 (32.00)
31 – 41	80 (64.00)	75 (60.00)
42 – 52	20 (16.00)	05 (04.00)
53 – 63	05 (04.00)	05 (04.00)
Total	125 (100.00)	125 (50.00)
Marital Status		
Married	95 (76.00)	100 (80.00)
Single	15 (12.00)	10 (08.00)
Widow	10 (08.00)	10 (08.00)
Divorcee	05 (04.00)	05 (04.00)
Total	125 (100.00)	125 (100.00)
Educational Qualification		
No Formal Education	70 (56.00)	30 (24.00)
Primary	20 (16.00)	26 (21.00)
Secondary	25 (20.00)	44 (35.00)
Tertiary	10 (08.00)	25 (20.00)
Total	125 (100.00)	125 (100.00)
Main Occupation		
Farming	95 (76.00)	50 (40.00)
Trading	10 (08.00)	10 (08.00)
Civil Servant	20 (16.00)	65 (52.00)
Total	125 (100.00)	125 (100.00)
Marketing experience		
05 – 08	70 (56.00)	100 (80.00)
09 – 12	40 (32.00)	15 (12.00)
13 – 16	15 (12.00)	10 (08.00)
Total	125 (100.00)	125 (100.00)

Source: Field Survey, 2014.

Figures in parenthesis are in percentages.

Economic viability of Neem and Gum Arabic Plantations at APA, NPA and DPA Benefit Cost Ratio (BC- R)

BC-R assessed all cost and benefit elements of each of the sampled plantation at the prevailing borrowing rate of 24%. Results have shown that neem plantations had 0.55, 0.61 and 0.56 BC-R value sat APA, NPA and DPA respectively. Corresponding BC-R values in the respective plantation areas were 1.56, 1.40 and 1.10 (Table 2.0). Based on the decision rule governing BC-R regulations, all the gum Arabic plantations studied were economically viable. This agrees with the stipulations of the Department of Finance and Administration of Australia (2006) which requires acceptance of any policy, project or program with BC-R value $\geq$ 1.

Net present value (NPV)

Similarly, NPVs for all the three plantation studied were computed by subtracting discounted costs from discounted benefits (Thampapillai, 1995) at 24% interest rate (Table 2.0). Accordingly, the values of -N67, 060.30/ha, - N61, 572.47/ha and - N79, 559.29/ha were computed for neem plantations at APA, NPA and DPA respectively. Therefore, neem plantations were not economically attractive for generating negative NPV values in all the plantation areas studied. On the contrary, gum Arabic plantations had corresponding values of N163, 036.60/ha, N106, 835.09/ha and N57, 101.57/ha in the same plantation areas. Thus, gum Arabic plantations

were economically viable for yielding positive NPV values. This confirms the global recognition of its economic potentials widely reported by Acacia Market Report (2006) and the Daily Trust (2006).

Land expectation value (LEV)

Land Expectation Value (LEV) otherwise known Soil Expectation Value (SEV) or Bare Land Value (BLV) was used in the same way as BC-R and NPV. LEV computations for neem projects were based on even-aged situation and at 24% rate of interest. Table 2.0 revealed LEV values for neem plantations as follows:- N62, 673.18/ha, N57, 544.36/ha and N74, 354.48/ha compared to N152, 370.65/ha, N99, 845.88/ha and N53, 365.95/ha LEV values for gum Arabic at APA, NPA and DPA respectively. Positive LEV values connote economic viability of investment entities. What was responsible for positive NPV and LEV values for gum Arabic plantations in the state? The global attractive market prices led to the establishment of functional markets across the State. This further led to the formation of the National Association of Gum Arabic Producers, Processors and Exporters of Nigeria (NAGAPPEN). Thus, the availability of functional markets and supportive services created fertile ground for gum Arabic business in the state (FAO, 2009). This confirms the interdependence of production and marketing severally reiterated by Abbott & Makeham, (1990); Muhammad (2005) and Adegeye and Dittoh (2005).

Table 2.0 Compares Economic viabilities of both species at the three plantation areas

Economic tool	Plantation Area	Computed value <i>Azadirachta indica</i>	Computed value <i>Senegalia Senegal</i>	Decision
BC-R (24%)	APA	0.55	1.56	GAPEV
BC-R (24%)	NPA	0.61	1.40	GAPEV
BC-R (24%)	DPA	0.56	1.10	GAPEV
NPV (24%)	APA	-N67, 060.30	N163, 036.60	GAPEV
NPV (24%)	NPA	-N61, 572.47	N106, 835.09	GAPEV
NPV (24%)	DPA	-N79, 559.29	N57, 101.57	GAPEV
LEV (24%)	APA	-N62, 673.18	N152, 370.65	GAPEV
LEV (24%)	NPA	-N57, 544.36	N99, 845.88	GAPEV
LEV (24%)	DPA	-N74, 354.48	N53, 365.95	GAPEV

Source: Field Survey, 2014.

Key: GAPEV = Gum Arabic plantations economically viable

Profitability of neem seed marketing

Table 3.0 compares gross margin and profitability analyses for neem seed and gum Arabic marketing in the state. Between 2009 and 2013, a total of 673.13 tones of neem seeds were marketed generating ₦273, 988, 479.25 against ₦923, 898, 717.93 realized from 685.41 tones of gum Arabic marketed within the same period. Total GM realized by neem seed marketers was ₦95, 603, 879.80 as oppose to ₦222, 923, 159.65 generated by gum Arabic marketers. Thus, GM per ton stood at ₦407, 036.50 and ₦325, 240.60 for neem seed and gum Arabic marketers respectively. Similarly, respective GM values per ton per marketer were ₦1, 136.23 and 2, 601.92. Total net profit realized by neem seed marketers was ₦121, 355.10 against ₦300, 387.30 generated by gum Arabic marketers. The net profit per ton per marketer for neem seed was only ₦970.84 whereas each gum Arabic marketer

realized 2, 403.09 per ton within the same period. This means that neem seed marketing was not an attractive business due to insignificant profit margin received by the marketing participants.

On the contrary, the gum Arabic marketing was a lucrative business venture in the study area. In other words, all the participants receive significant profit margin favorable for both increased future production and marketing. This confirms the direct relationship between production and marketing observed earlier by Abbott and Makeham (1990). Thus, neem product business could only make giant strides in revenue generation drive if functional markets and awareness could be created in the state. With its declaration as the tree of the 21st century, researches unveiling its economic potentials are on the increase and receiving global attention.

Table 3: GM and Profitability Analyses for neem seed and gum Arabic marketing in the three plantation areas

Variables (Items/Activities)	Value/tonne (₦) Neem Seed	Value/tonne (₦) Gum Arabic
Depreciated Fixed Cost		
Scales	13, 334.10	16, 752.05
Head pans	5, 786.55	6, 240.85
Measures/Modus	1,553.10	1, 860.35
Total Fixed Cost	20, 673.75	24, 853.25
Variable Cost		
Labor	24, 371.35	26, 719.40
Operating Cost	32, 164.95	73, 156.55
Purchasing Cost	208, 471.35	922, 833.95
Total Variable Cost	265, 007.65	1, 022,709.90
Total Cost	285, 681.40	1, 047, 563.15
Total Revenue (TR)	407, 036.50	1, 347, 950.45
Gross Margin (D – B)	142, 028.85	325, 240.60
GM/tonne/Marketer	1, 136.23	2, 601.92
Net Profit (D – C)	121,355.10	300, 387.30
NP/tonne/Marketer	970.84	2, 403.09
Total Number of respondents	125	125
Total Quantity Marketed	673.13 tones	685.41

Source: Computed from data collected from the field, 2014.

Establishment and Management costs of both species at APA, NPA and DPA

Establishment cost

Azadirachta indica had considerably lower establishment expenditure compared to *Senegalia senegal* and other xyrophytic species in the study area (Table 4.0). This was attributed to two factors. First, was its ability to establish and grow well without the necessity for fencing. The bitterness of the leaves repelled animals and that significantly reduced the total establishment cost

per hectare by 59%, thus, confirming earlier computations of FAO & UNEP (2003), Fact Net (2005) and Orwa et.al (2009) on same. Second; its insecticidal property and high toxicity to several microorganisms reduced the cost of chemical inputs against insect pest and disease damage. This explains the establishment expenditure of only ₦127, 686.68 per hectare incurred. On the contrary, *Senegalia senegal* had very high establishment expenditure attributed to

two factors. First, was its high palatability to small ruminants thus necessitating the need for fencing which accounted for more than 59% of the total establishment cost (Muhammad, 2016). Second; its susceptibility to pest damage requiring substantial expenditure on chemical inputs against insect damage. This explains why the total establishment cost per hectare of gum Arabic (~~N~~337, 515.63) was 2.64 times the establishment cost per hectare for neem plantation (~~N~~127, 686.68). Thus, fencing expenditure and its associated maintenance costs were not incurred in neem plantations.

Management cost

The management costs per hectare for both species were grossly lower than the corresponding establishment cost. The difference between the management costs per hectare for both species was not significant. The management costs were variable in nature and covered day-to-day expenditure incurred on services essential for proper maintenance of the plantations. These services included replacement of dead stands, construction of micro-catchment, fire terracing, security patrol, pruning, seed harvesting and parking as well as trimming operations. All these operations cost ~~N~~56, 166.67 and 57, 583.33 per hectare for neem and gum Arabic plantations respectively (Table 5.0).

Table 4 Summarizes Establishment Expenditure for both species at APA, NPA and DPA

Expenditure type	Year Incurred	Mean cost/ha (₦) Gum Arabic	Mean cost/ha (₦) Neem	Difference between	
				Mean values (₦)	%
Land	1999	12, 666.67	12, 666.67	0.00	0.00
Fencing	1999	199, 309.54	0.00	199, 309.54	100
Land preparation	1999	27, 257.02	23, 316.67	3, 940.35	07.79
Seedlings (cost & transport)	1999	5, 833.34	5, 000.00	833.34	07.69
Borehole (cost & maintenance)	1999	60, 533.33	59, 166.67	1, 366.66	01.14
Inputs (tools equipment & chemicals)	1999	9, 081.50	6, 553.34	2, 528.16	16.17
Micro Catchment Construction	1999	1, 833.33	1, 483.33	350.00	10.55
Fire terraces	1999	5, 000.00	4, 500.00	500.00	05.26
Security patrol	1999	16, 000.00	15, 000.00	1, 000.00	03.23
Total	-	337, 515.63	127, 686.68	209, 828.05	45.10

Source: Field Survey, 2014.

Table 5 Summarizes Management Expenditure of plantations of both species at APA, NPA and DPA.

Expenditure type	Expenditure type	Year Incurred	Mean cost/ha (₦) Gum Arabic	Mean cost/ha (₦) Neem	Difference between	
					Mean values (₦)	%
1	Replacement of dead stands	2000	1, 916.67	1, 500.00	416.67	12.19
2	Micro catchment construction	2000	3, 833.33	3, 000.00	833.33	12.19
3	Fire terracing	2000	16, 500.00	16, 000.00	500.00	01.54
4	Security patrol	2000	28, 000.00	27, 000.00	1, 000.00	01.82
5	Pruning	2003	2, 833.33	2, 500.00	333.33	06.25
6	Seed harvesting and parking	2006	4, 500.00	4, 166.67	333.33	03.85
7	Trimming operations	2007	0.00	2, 000.00	- 2, 000.00	-.100.00
8	Total	-	57, 583.33	56, 166.67	1, 416.66	01.25

Source: Field Survey, 2014.

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Senegalia senegal plantations involved in both desertification control and revenue generation projects in Yobe state were economically viable. Results generated from the three plantation areas confirm this. For instance, BC/R values were greater than 1 in all the three areas studied. This was further concurred by positive NPV and LEV values computed from the same areas. This work recommends conversion of gum Arabic substation of the Rubber Research Institute of Nigeria at Jawa into a full fledge gum Arabic Research Institute. Environmental laws that can protect it and other trees species with physical and economic potentials need to be enacted. Based on these shortcomings, this work therefore recommends the need for creating awareness on economic potentialities of neem. This should be extended to both policymakers and other citizens in rural and urban areas. A functional market for its products be established to stimulate high level production and marketing operations. This may require establishment of neem processing industry. Neem product associations need to be formed to provide supportive, promotional and motivational services to producers, processors and exporters of neem and neem based products in the state.

REFERENCES

- Abbot, J.C. and Makeham, J.P. [Ed.] (1990). Agricultural Economics and Marketing in the Tropics. Longman Group limited, United Kingdom.
- Adegeye, A.J. & Dittoh, J.S. (2005). Essentials of Agricultural Economics. Impact Publishers (Nig.).Ltd, Ibadan, Nigeria.
- Acacia Market Report (2006, May 18).Grade 1 *Acacia senegal*. Article 102.Retrieved August 22, 2006, from: <http://www.agricproducts.com/whatsnews/news-2000-03-acacia-market-report.html>.
- Buba, A.A. (2012) Tools for Educational Measurement and Probability. Boga Press, Ibadan, Nigeria.
- Central Bank of Nigeria (CBN) (2006). Annual Reports and statement of Account for the Yearended 31st December 2005. Central Bank of Nigeria, Abuja, Nigeria.Department of Finance and Administration of Australia (2006). A Handbook of Cost-Benefit Analysis; Financial Management Reference No. 6, PDF file accessed <https://www.pmc.gov.au/regulation/guidance-policy-makers/cost-benefit-analysis> on 14/03/2020 at 3:13 pm
- Daily Trust (2006). Nigeria: Growing potential of 'desert gold'. Retrieved May 09, 2006, from:<http://www.allafrica.com/ries/20060427177.htm>
- Eboh, E. (2006). Economic Competitiveness across Nigerian states: The Challenges of Infrastructure and Utilities. BECANS Working Paper 2. African Institute for Applied Economics. pp 30.
- Encyclopaedia Britannica (2006). Yobe State. Retrieved January 07, 2007, from: <http://www.britannica.com/es/articles-9077978/yobe>
- Food and Agricultural Organization (FAO) (2009). An Economic Analysis of the Value of Shelterbelts to Northern Nigeria's agricultural production. FAO forestry development paper No 18 Rome.
- FAO and United Nations Environmental Protection (UNEP)(2003). Notes on Trees and Shrubs in Arid and Semi-Arid Regions. EMASAR Phase II
- Fact Net, (2005). *Azadirachta indica*: A versatile Tree for Tropics and Subtropics. Retrieved April 20, 2004, from: <http://www.winrock.org/farm/factnet/aetPub/FACTSH-NEEM.HTML>.
- Fact Net, (2000). *Acacia senegal*: Gum Tree with Promise for Agroforestry. Retrieved May 26, 2004, from: <http://www.winrock.org/farm/factnet/aetPub/FACTSH-senegal.html>
- Fact Net, (2002). *Acacia senegal*: Nitrogen Fixing Trees. Retrieved May 18, 2004, from: <http://www.winrock.org/farm/factnet/aetPub/FACTSH-senegal.html>.
- Giroh, DY, Umar, HY, Yakubu, W. (2010). Structure, Conduct and Performance of Farm gate Marketing of Natural Rubber in

- Edo and Delta states, Nigeria. *International Journal for Sustainable Development* 1(2),22 – 27.
- Iloeje, M. (1992) Regional Geography for West Africa; Impact Publishers, NIG.Ltd., Ibadan, Nigeria.
- Muhammad, Y. K. (2005). Production and Marketing of Tomatoes in Jakusko Local Government Area of Yobe State: Problems and Prospects for improvement. An Unpublished dissertation submitted to the Department of Agricultural Economics and Extension, Federal University of Technology, Yola, Adamawa state, Nigeria.
- Muhammad, Y. K. (2016). Comparative Analysis of Gum Arabic (*Acacia senegal*) and Neem (*Azadirachta indica*) for Desertification Control and Revenue Generation in Yobe state, Nigeria. An Unpublished PhD thesis submitted to the Department of Forestry and Wildlife Management, Modibbo Adama University of Technology, Yola, Adamawa state, Nigeria.
- National Meteorological Agency of Nigeria - NIMET (2014). Summary of meteorological Records of Weather Variables from 1999 - 2013 retrieved from Nguru, Coordinating office, Yobe state, Nigeria
- Ogbebu, D. (2009). Global Recession: Its Implications on Nigeria's Economy and the Way Forward. Retrieved July16, 2009, from: <http://www.nigeriansinamerica.com/articles/articles/3505/1/Global-Recession-Its>
- Orwa C, Mutua A, Kindt R, Simons A, (2009). Agroforestry Database. A Tree Reference and Selection Guide version 4.0. Retrieved February 09, 2011, from: <http://www.worldagroforestry.org/af/treedb>
- Sinden, J. & Thampapillai, D. (1995). Introduction to Benefit-Cost Analysis. Longman Australia, Melbourne.
- Stoney, C. (2005). *Azadirachta indica*. A Versatile Tree for Tropics and Subtropics. *FACT Sheet*; FACT 97 – 05, September 1997.
- Thomas J. Straka and Steven H. Bullard (1991). Valuation of Timberlands: LEV Criterion. PDF file Retrieved August 22, at www.timbertax.org/getstarted/appraisal/papers/pdf/ajoct96.
- United Nation Development Programme (UNDP) (2005). Poverty and the Dry lands: (online) last accessed 24/09/2006 at URL: <http://www.botany.uec.ac.za/Envfacts/afforestation.htm>.
- UNDP (2008). Millennium Development Goals. Retrieved May 15, 2009, from: <http://www.undp/mdg/goal1.html>.
- Umar, H.Y., Otitolaiye, J.O. and Grace, A.A. (2014) Factors Influencing Profitability among Gum Arabic Marketers in Jalingo, Taraba State, Nigeria. *Global Advanced Research Journal of Social Science*.3, 001 – 007,.
- Wilkinson, K. and Elevitch, C. (2012). Multipurpose Trees. Retrieved December 31, 2012, from: *ejournal of Agroforestry @ www.Overstory Online No. 16*
- Woods, H.E (2008). Event Marketing: Measuring Experience. Seventh International Trends Congress. January 17th – 19th Venice, Italy.
- World Neem Conference (2012). Neem for Sustainable Development and Environmental Conservation. Retrieved May 2, 2013, from: <http://www.neemfoundation.org/neem-foundation/world-neem-conference-2012/74->
- Yobe State Economic Submit (YBSES) (2008). The Yobe Environment: Problems and Proposed Intervention. Spectrum Books Limited Ibadan, Nigeria.