Continental J. Animal and Veterinary Research 5 (2): 1 - 11, 2013 ISSN: 2141 – 405X
© Wilolud Journals, 2013 http://www.wiloludjournal.com
Printed in Nigeria doi:10.5707/cjavres.2013.5.2.1.11

ECONOMIC ANALYSIS OF SORGHUM (*Sorghum bicolor* (L) moench) STOVER PRODUCTION AND UTILIZATION BY SHEEP IN ADAMAWA STATE, NIGERIA.

T F Mbahi, Z A Gworgwor and P M Yalma
Department of Animal Science and Range Management, Modibbo Adama University of Technology, Yola, Nigeria

ABSTRACT
The experiment was conducted to investigate the economic aspect of sorghum (pele pele) production and utilization of the sorghum stover by sheep in Adamawa State, Nigeria. The main plot was divided into three sub-plots and replicated three times measuring 30 x 30m in randomized complete block design. Plots were sown with sorghum and three sub-plots were intercropped with groundnut (ex-Dakar) and another three with lablab purpureus while the remaining as sole sorghum. Growth were significantly higher (p<0.05) in the intercropped sorghum than sole. Dry matter yield of sorghum with legume intercrops were significantly higher (P<0.05) than sole sorghum. The chemical composition sorghum with legume intercrops were higher in dry matter content, crude protein, calcium and phosphorus, while the Acid detergent fibre and Neutral detergent fibre with sole sorghum were higher than with legume intercrops. Dry matter intake were significantly higher (p<0.05) in treatments 5, 3 followed by 4, 2 and lowest in 1. Liveweight gain were higher (p<0.05) in treatments 5, 4, 3, 2 and least in 1. The total cost of production of sorghum and livestock feeding was N68, 185.00, while the amount realized in sales of grain, surplus feed and sheep was ₦78, 832.00 and gain realized was ₦10, 647.00. Therefore, it is recommended for farmers to use cereal-legume intercrops in order to enhance grain yield, quality of stover as feed for livestock production especially during dry season in Nigeria.

KEYWORDS: Crop residues, feeding trial, groundnut haulms, intercropping, lablab hay,

Received for Publication: 05/05/13 Accepted for Publication: 24/08/13
Corresponding author: tfmbahi@yahoo.com

INTRODUCTION
In high and medium potential areas of most towns of Africa, animal production is shifting from extensive grazing to more intensive systems due to diminishing farm sizes resulting from population growth and competition for land from food crops as the human and livestock population densities increases. This has led to less land remaining for livestock production (Jaetzold and Schmidt, 1982). Therefore, developing more intensive systems of rearing animals becomes a necessity as zero-grazing maximizes land use through the production of high yielding fodder crops and their efficient utilization (Ibrahim, 1988) and example of this is smallholder mixed crop/livestock farming with land ranging from 0.5-4.0ha (Gryseels and Anderson,1983).

In Nigeria, the Northern part is the most important cereal producing area which include sorghum and millet and have been important stapples in the semi-arid of tropics of Africa. The crop residues largely available here are sorghum, millets and maize stovers and are mainly used as feed for livestock during the dry season season. The crop residues despite their abundance, it is usually grossly deficient in available protein and energy and must be supplemented to enhance their nutritive value (Alhassan *et al*., 1987).

Therefore, integration of cropping systems and livestock production was as a result of the continued interest from the public and policy makers in the profitability and competitiveness in livestock production (Bailey, 2001 and Muriuki *et al.*, 2003).

The study of fodder production and feeding trial involved intercropping sorghum with groundnut and lablab to enhance the feeding value of sorghum stover as feed for Yankasa sheep and also to determine the return of investment to support application by farmers to secure credits facilities and assist in making input-output cost-price adjustment for small holder sheep production. The fodder production and feeding trial was conducted in Adamawa State of Nigeria to evaluate the cost and return benefit of smallholder sheep production in the year 2004.

Materials and methods

Experimental site

The experiment was carried out at the Teaching and Research Farm, Federal University of Technology, Yola. It is located within latitude 90^o 19^- N and longitude 120^o 301^- E, at an altitude of 185.9m above sea level and lies within Northern Guinea Savanna Zone of Nigeria (Bashir, 2002). The soil is sandy loam and the mean rainfall records for 2004 were 582.40mm with maximum and minimum temperatures of 30.5 and 22.4^oc respectively (Department of geography, Federal University of Technology, Yola, Meteorological unit, 2004).

Experimental design

A Land area of 94 x 94m was cleared, ploughed and harrowed to soften the soil for ease of planting and germination. The main plot was divided into three sub -plots and replicated three times measuring 30 x 30m with inter and intra row spacing of one metre each in a randomized complete block design (RCBD). The treatments were as follows:

SS = Sole sorghum
SL = Sorghum + lablab
SG = Sorghum + groundnut

The plots were all sown to sorghum at seed rate of 10kg/ha at 75 x 50 cm spacing. Three sub- plots of sorghum were randomly intercropped with lablab at 60 x 60cm at seed rate of 15kg /ha and another three sub - plots were intercropped with groundnuts at 60 x 30cm at seed rate of 60kg/ha, while the remaining three sub-plots were left sole sorghum as control. The planting was done on 22nd June, 2004, while weeding was done at two, six and ten weeks and the sorghum were harvested on 5th November 2004 respectively.

Feeding trial

Experimental diets

The sorghum stover, groundnut haulms and the lablab hay used here were collected from the same plots according to the experimental design. Sorghum stover was fed as basal diet 936kg and supplemented with lablab hay or groundnut haulms with five treatments. The treatment diets were sole sorghum stover (SS) which is 5% of the animals weight, sorghum stover plus 200g and 400g of lablab hay (SL1 and 2), sorghum stover plus 200g and 400g of groundnut haulms (SG1 and 2) respectively.

Treatments and experimental design which

Fifteen Yankasa sheep initially weighing between 15-18kg and ages between 5-12 months old were allotted to five treatment diets in a randomized block design (RBD). The treatment diets were T1 sole sorghum stover (control), T2 and T3 were sorghum stover plus 200g and 400g of lablab hay while T4 and T5 were sorghum stover plus 200g and 400g of groundnut haulms respectively which are the treatment diets.

T1=sole sorghum stover
T2=sorghum stover + 200g of lablab

T3=sorghum stover + 400g of lablab hay
T4=sorghum stover + 200g of groundnut hauls
T5=sorghum stover = 400g of groundnut haulms

Animals management
The animals were treated against endo and ecto-parasites using ivermectin injection before the commencement of the experiment. The animals were allowed fourteen days adjustment period by giving them same experimental feeds before the commencement of measurements.

Measurements
Feed intake
The feeds were offered twice daily in the morning and evening (8.00am and 4.00pm), while the salt lick and water were given ad-lib. The leftover of feed were weighed every morning before the next feeding.

Growth rate
The growth rates of the animals were determined by weighing them on weekly basis with the aid a weighing scale which lasted for 11weeks.

Digestibility study
The digestibility study commenced immediately at the end of feeding trial. Five sheep were selected among those used for feeding trials and confined in metabolism crates and fitted with collection bags to facilitate faecal collection, while the urine collection was done using zinc sheets constructed under the metabolism crates which directed it into plastic containers. The animals were allocated to the same diets used in the feeding trials and this was followed by seven days adjustment and then five days collection periods and feed offered and rejected were weighed daily. Total faecal output was collected daily, weighed and sub samples taken for chemical analysis.

Chemical analysis
The proximate composition of feeds and faecal samples was determined by standard methods (AOAC, 1984). The acid detergent fibre (ADF) and neutral detergent fibre (NDF) were analysed according to Goering and Van Soest (1990) method.

Statistical analysis
The data obtained were subjected to analysis of variance of a randomized block design (Steel and Torrie, 1980). The treatment means were separated using Duncan Multiple Range Test (DMRT).

RESULTS AND DISCUSSION
Dry matter yield
The dry matter yields of sorghum stover were presented in Table 1. The dry matter yields ranged from 2555.5 to 18468.2 kg, 2369.8 to18617.0 kg and 2466.4 to 18575.9kg for sole sorghum, sorghum intercropped with lablab and sorghum intercropped with groundnut respectively. However, sole sorghum produced the highest dry matter from week 6 to 12, while at week 14, the highest yield was produced by sorghum intercropped with lablab followed by sorghum intercropped with groundnut. The higher dry matter recorded in sorghum intercropped with lablab and groundnut which could be due to the nodulation activity of the legumes which increases the soil nitrogen (Nnadi and Haque, 1986). This agrees with the report by Hosmani *et al.*, (1986) and Kawamoto *et al.* (1988) that sorghum intercropped with some fodder legumes resulted in higher dry matter yield than sole sorghum. Also, Haque (1984) and Chetty (1983) reported similar findings that fodder legume – intercrops increase the yield of sorghum dry matter. Fleischer and Tackie (1993) recorded a range of 550 to 10,070kg DM/ha and reported that cereal – legume intercrop increases the dry matter yield with stage of growth under ideal situations.

The stem/leaf ratio is presented in table 2. Stem/leaf ratio ranged from 1:2 and 2:2 for all the treatments. The sorghum intercropped with legumes gave higher stem/leaf ratio of 2:2. The higher stem: leaf ratio could be as the result of nitrogen increase in the soil due to increased in N-fixation activity of the legumes. The stem/leaf ratio values obtained were higher than 1:1 recommended with sorghum for ruminant feeding by Mcdonald *et al* (1988).

Table1: Effects of sorghum/legume intercrop on dry matter yield of sorghum stover (KgDM/ha).

WK	SS	SL	SG	SEM
6	2555.6^{g}	2369.8^{h}	2466.4^{gh}	± 14.90
8	4596.2^{f}	4769.5^{f}	4685.1^{f}	± 20.68
10	6636.0^{d}	6407.1^{e}	6484.9^{de}	± 24.20
12	11851.0^{b}	11787.7^{bc}	11795.5^{bc}	± 32.53
14	18468.2^{a}	18617.0^{a}	18575.9^{a}	± 40.86

Means within columns and rows with different superscripts are significantly different (P<0.05)
KEY: SS = Sole sorghum stover,
SL = Sorghum stover with lablab intercrop,
SG = Sorghum stover with groundnut intercrop,

Table 2: Stem/leaf ratio and grain yield (Kg/ha)

Yields	SS	SL	SG	SEM
Stem/leaf ratio	1:2	2:2	2:2	-
Sorg.Grain yield kg/ha	1981.5^{c}	2322.0^{b}	2592.0^{a}	±46.56

Means within columns and rows with different superscripts are significantly different (P<0.05)
KEY: SS = Sole sorghum stover,
SL = Sorghum stover with lablab intercrop,
SG = Sorghum stover with groundnut intercrop,

Chemical composition of sorghum forage at different stages of growth (%DM).

The result of the chemical composition of sorghum was presented in Table 3. The dry matter content of sorghum ranged from 30 to 82. 10%, 31.65 to 86.30% and 32.10 to 89.05% for T1, T2 and T3. The dry matter increased with stage of growth and was highest with sorghum intercropped with groundnut, followed by sorghum intercropped with lablab and lowest with sole sorghum. The high dry matter obtained in the intercropped sorghum agreed with the earlier report Lamidi *et al.*, (1997) who stated that delay in harvest of most crops but prominent in lablab or groundnut beyond 12weeks after planting progressively decreased leaf yield by about 50.48%, 55.77% and 68.71% respectively at 14, 16 and 18weeks. Also, the maximum value obtained is similar to 94.12% reported by Bogoro *et al.,* (2006) for sorghum stover without legume intercropping.

The crude protein content of sorghum ranged from 6.00 to 9.15%, 8.06 to 10% and 8.90 to 11.25% in T1, T2 and T3. The crude protein content decreased with stage of growth and was higher in sorghum intercropped with groundnut, followed by sorghum intercropped with lablab and lowest with sole sorghum. The higher crude protein obtained in sorghum intercropped with lablab or groundnut could be due to the legume intercrop which were higher than that in sole sorghum. This was similar to the report by Ofori and Stern (1987), who stated that legume intercrop, contributed nitrogen to the sorghum through nitrogen fixation. The crude protein obtained was similar to the report by Bogoro *et al.,* (2006) who recorded higher values of crude protein in sorghum – legume intercrop than sole sorghum.

The ash content ranged from 4.15 to 8.10%, 4.75 to 9.30% and 5.10 to 10.05. The ash content increased with stage of growth and was higher in sorghum intercropped with groundnut and followed with lablab and least in sole sorghum. The values obtained are similar to 8.4% reported by Kiflewahid and Mosimanyana (1987) and 7.33% reported by Bogoro *et al.,* (2006).

The calcium content of sorghum ranged from 0.30 to 1.30%, 0.36 to 1.55% and 0.47 to 1.35%. The calcium content reduced with stage of growth and was higher in sorghum intercropped with groundnut followed by lablab and least in sole sorghum. The values obtained were similar to the earlier report by Siulapwa and Simukoko (1998), who obtained minimum value of 0.34% for sole sorghum.

The phosphorus content ranged from 0.07 to 0.14%, 0.80 to 0.18% and 0.09 to 0.22% in T1, T2 and T3. The phosphorus content reduced with stage of growth. The obtained values are similar to a range of 0.06 to 11.00% reported by Siulapwa and Simukoko (1998).

The acid detergent fibre (ADF) content ranged from 18.00 to 38.15%, 17.34 to 37.06% and 16.12 to 35.53%. The acid detergent fibre content increased with stage of growth for all the treatments and was highest with sole sorghum. The obtained values were similar with the report by Fleischer and Tackie (1993) who recorded 48.35% in sorghum, and also similar to 48.35% reported by Bogoro *et al.*, (2006) for sole sorghum, while the neutral detergent fibre (NDF) content of sorghum ranged from 25.50 to 60.13%, 23.18 to 56.00% and 19.87 to 50.13% for T1, T2 and T3. The neutral detergent fibre content generally was higher than acid detergent fibre in sorghum in all the treatments. The obtained values were similar to the report by Fleisher and Tackie (1993) who gave maximum value of 73.5% for sole sorghum, while Bogoro *et al.,* (2006) gave a lower value of 46.51%.

Table 3: Chemical composition of sorghum stover at different stages of growth (% DM) in 2005 Season**.**

WK	Feed	DM	CP	Ash	Ca	P	ADF	NDF
6	SS	30.30	9.15	4.5	1.30	0.14	18.00	25.50
	SL	31.65	10.00	4.75	1.55	0.18	17.34	23.18
	SG	33.08	11.34	5.60	1.32	0.20	17.32	17.80
8	SS	37.18	9.80	4.97	1.30	0.12	22.06	28.10
	SL	41.10	10.12	5.78	1.38	0.14	19.30	25.65
	SG	43.23	10.75	5.99	1.33	0.18	21.82	22.30
10	SS	54.60	7.88	7.30	0.88	0.15	32.18	37.70
	SL	59.30	9.11	6.45	1.00	0.13	26.15	34.40
	SG	60.31	9.45	7.13	1.10	0.16	28.31	30.48
12	SS	78.65	7.61	6.63	0.55	0.12	35.20	37.70
	SL	80.10	8.80	7.27	0.78	0.11	30.17	34.40
	SG	82.42	8.65	7.85	0.62	0.13	30.50	30.48
14	SS	84.23	6.11	7.95	0.28	0.08	37.12	58.50
	SL	87.35	8.41	8.10	0.48	0.09	35.40	53.12
	SG	86.82	8.25	8.61	0.40	0.10	34.28	48.60

KEY: SS = Sole Sorghum Stover, SL = Sorghum Stover with Lablab intercrop,
SG = Sorghum Stover with Groundnut intercrop

Grain yield

The grain yield of sorghum was shown in Table 2. The grain yields were 1981.5kg/ha, 2322.0kg/ha and 2592.0kg/ha for sole sorghum, sorghum intercropped with lablab and sorghum intercropped with groundnut respectively. Grain yields were significantly higher ($P<0.05$) in sorghum intercropped with lablab and sorghum intercropped with groundnut than in sole sorghum. Sorghum intercropped with groundnut gave the highest yield. The higher yields recorded in sorghum intercropped with lablab and sorghum intercropped with groundnut could be due to the increase in nodulation and nodule activity of the legume intercrops. The result obtained was similar to the report by Egunjobi (1984) who stated that maize grown in association with cowpea or groundnut gave higher seed yields. Also, Adetiloye (2001) recorded higher dry matter and seed yields in maize intercropped with legume, While Onweme and Sinha (1991) reported that in Africa, sorghum grain yields vary between 300-1200kg/ha with an average of about 750kg/ha for rain fed sorghum and under irrigation was about 2000kg/ha. Onweme and Sinha (1991) reported that in experimental plots in Samaru, Zaria, yields of upto 4000kg/ha have been obtained. The values obtained in this work were similar to the values reported by Onweme and Sinha (1991).

Growth trial

Performance of sheep fed sorghum stover supplemented with lablab hay or groundnut haulms

Dry matter intake

The daily sorghum stover intake of sheep was summarized in Table 4. The daily and weekly sorghum stover intake ranged from 566.08 to 635.40gDM/head/day. The sorghum stover intake were apparently higher ($P<0.05$) in SG2 (635.08g) and SG1 (619.53g) followed by SL1 (610.34g), SL2 (609.84g) and least in SS (566.08g). While the intake of legume in SL2 (380.92g), SG2 (382.80g) were not different ($P>0.05$) and that of SL1 (184.37g) and SG1 (185.40g) were not different ($P>0.05$). The higher intake with sheep fed sorghum stover with lablab hay or groundnut haulms above that of the control could be attributed to the supplements inclusion as the activities of the rumen microbes increases with increased nitrogen of the feed. Higher intake was recorded in treatments where sorghum stover was supplemented with 400g and 200g groundnut haulms, followed by 400g and 200g of lablab hay respectively. This agrees with the earlier reports by Adebowale (1985) that supplementation of untreated stover with leguminous forages have beneficial effects to ruminants animals including increased metabolizable energy and nitrogen intake, improved palatability, increased available minerals and vitamins, better rumen function and a laxative influence on the alimentary system. Also, Mosi and Butterworth (1985) found that addition of 20-25% of *Trifolium tubenose* hay to teff (*Erogrostis teff*) straw increased feed intake of sheep by 20-30%. Similarly Aboud *et al.,* (1990), Waheed *et al.,* (1990) and Yao-Ming Wu and Jian-xin l.u., (1995) observed that intake and liveweight gain were improved when quantity of sorghum stover offered was doubled. Also, Ojo *et al.,* (2001) reported that supplementation of cereal residues increase total dry matter intake. Mosi and Butterworth (1985) in another separate work reported, decreased consumption of maize and wheat straws with *Trifolium tubenose* hay, but increased digestibility of dry matter, crude protein and phosphorus compared to sole cereal residue. Adebowale (1985) reported that supplementation or treatment of cereal residues decrease intake by 25% but increases digestibility.

The total dry matter intake of the sorghum stover and legume ranged from 566.08 to 1018.20gDM/head/day. The intake was higher ($P<0.05$) in SG2 (1018.20g), followed by SL2 (990.76g), SG1 (804.95g) and SL1 (794.71g), and it was least with the SS (566.08g). The total dry matter intake increased as the quantity of supplements increases for all the treatments. The total dry matter intake agreed with the earlier report by Adebowale (1985) that intake of stover increases with increased in levels of supplements and Mosi and Butterworth (1985) also reported that addition of 20-25% *Trifolium tubenose* hay to teff (*Erogrostis teff)* straw increased feed intake of sheep by 20-30%. Babayemi *et al.,* (2006) and Ndemanisho *et al.,* (2007) reported a similar work with goats and sheep fed *Panicum maximum* and maize stover and reported that total dry matter intake increased with the level of supplementation.

Liveweight gain

The results of the liveweight gain of sheep were summarized in Table 4. The liveweights gain ranged from 18.30 to 41.70kg. The liveweight gain of sheep on experimental diet SG2 (4.17kg) was higher ($P<0.05$) followed by SG1 (3.83kg) and SL2 (2.93kg) and SL1 (2.77kg) with the least obtained in the control (1.80 kg). The higher liveweight gain obtained in the treatments with supplements could be due to increased in nitrogen intake that enhanced digestibility and utilization of the nutrients by the body. The results obtained were similar to the report by Smith *et al.,* (1990); Ncube and Mubaiwa (1994); Preston and Leng (1987); Manyuchi *etal.,* (1992); Mupeta and Makombo (1995) separately stated that locally available protein sources such as legume residues have part to play in dry matter intake and digestion and were reflected in changes of liveweight. Also, Ummuna *et al.*, (1995) and Okagbare *et al.*, (2005) reported similar works that using lablab as a supplement to animals fed oat hay, showed that average daily liveweight gain almost doubled than those fed sole oat hay. Ndlovu and Sibanda (1996) reported that using legumes as supplements resulted in threefold gain than those fed stovers as sole diets. Also, Makembe and Ndlovu (1996) reported that maize stover supplemented with lablab hay resulted in better body weight changes of does, higher kids birth weights, faster growth rates, shorter post-partum anaestrus periods and more milk compared to traditional small holder practices in which no supplementation was used.

Table 4: Dry matter intake and liveweight gain of sheep fed sorghum stover supplemented with lablab hay or groundnut haulms.

			Diets			
Variables	**SS**	**SL1**	**SL2**	**SG1**	**SG2**	**SEM**
Dry Matter intake						
Stover (gDM/head/day	566.08^{c}	610.34^{ab}	609.84^{ab}	619.55^{a}	635.40^{a}	±7.50.
Legume(gDm/head/day)	0.00^{c}	184.37^{b}	380.92^{a}	185.40^{b}	382.80^{a}	±0.40
Total DMI(g)	566.08	794.71	990.76	804.95	1018.20	±2.00
Initial Weight(kg)	16.3	17.0	18.0	18.5	19.0	±0.75
Final Weight (kg)	18.17^{c}	19.77^{c}	20.93^{b}	22.33^{b}	23.17^{a}	±0.12
Weight Gain (g)	1830^{c}	2770^{b}	2930^{b}	3830^{a}	4170^{a}	±1.76

Means in the same row with different superscripts are significantly different (P<0.05).
SS= Fed sole sorghum stover – control
SL1 and SL2= Fed sorghum stover + 200g and 400g lablab hay
SG1 and SG2= Fed sorghum stover + 200g and 400g groundnut haulms

Economic analysis

Cost of production

The cost of production of fodder and sheep production in Adamawa State was presented in Table 5. The result showed slight difference between the cost of production and profit realized. The cost of inputs including the animals and labour is not all that high in this environment which is also similar to the demand for the products. The total cost of inputs and fodder production was fourteen thousand, four hundred Naira (₦14, 400.00). The cost of purchasing the sheep, sorghum stover, drugs, salt licks, lablab hay and groundnut haulms, labour and transport was fifty-six thousand, seven hundred and eighty-five naira only (₦56,785.00). It was discovered that most of farmers here uses family labour because the demand for the products especially the sheep and farm residues are not all that high despite the scarcity of meat consumed per house hold and animal feeds in environment during the dry season which may be attributed to poverty and knowledge.

Sales price

The market prices are reflective based normally on the supply, demand and policy factor (Muriuki *et al*., 2003). It was discovered that demand for the sheep is seasonal or during festivities which are the main obstacle to the farmers. The sales of the fifteen Yankasa rams after the 11weeks of feeding trial was fifty-nine thousand, seven hundred and eighty four naira (₦59,784.00), while the leftover of sorghum stover, lablab hay and groundnut haulms were valued at the market prevailing situation(March – May) at six thousand, six hundred and forty eight naira (₦6648.00). The sales of the sorghum grain produced (255.5kg) at the market prevailing price of ten thousand, two hundred naira only (₦10, 200.00). The sales of groundnut seeds (14kg) and that of lablab seeds (10kg) was two thousand, two hundred naira only (2,200.00). The total return from the sales was seventy- eight thousand, eight hundred and thirty-two naira (₦78, 832).

Profit
The revenue accrues from the sales of sheep and leftover feeds showed no significant difference from the cost of production. The profit realized after substituting the cost of production of fodder and feeding trial (₦68,185.00) from the total sales (₦78,832.00) was ten thousand, six hundred and fourty seven naira (₦10, 147.00). The low returns from this study could be due to the low demand for the sheep in this region which used to be seasonal and the inability of the buyers to transport them to higher demanding regions for better prices.

CONCLUSION
The economic analysis of sorghum stover production and utilization by sheep in Adamawa State was conducted. It was discovered that the cost of sorghum stover production was not high and the demand is seasonal for the Yankasa ram in this region normally during festivities. The same trend was observed with the leftover of the feed which were sold at relatively cheaper rate. The result revealed that a farmer can drastically reduce the cost of livestock production by improving the quality of stover through intercropping of cereals especially sorghum with legume crops which may be a solution or relief to livestock producers by reducing the problem of feed scarcity and quality during the dry season and increase the output of protein to consumers in Adamawa State.

Table 5: Economic analysis of fodder and sheep production in Adamawa State

Items	Quantity	Value
A Cost of production		
Sorghum seed	4kg	₦ 400.00
Lablab seed	6kg	₦ 400.00
Groundnut seed	8kg	₦ 600.00
Labour		
Ploughing	2hrs	₦ 1500.00
Sowing	2days	₦ 1500.00
Weeding	10days	₦ 5000.00
Harvesting	2days	₦ 2500.00
Feeding trial		
Sorghum Stover	936kg	₦ 4736.50
Drugs	100 thiabendazole bolus	₦ 800.00
Salt lick	3packets	₦ 600.00
Lablab and Groundnut hay	280.8kg	₦ 3648.50
Labour	2hrs	₦ 1000.00
Transport	5Trips	₦ 1000.00
Cost of Sheep	15 yankasa rams	₦ 45000.00
Total cost		**₦ 68185.00**
B Sales price		
Grains	255.5kg	₦ 10200.00
Surplus stover + lablab hay +groundnut haulms		₦ 6648.00
Sheep	15 sheep	₦ 59784.00
Groundnut seeds	14kg	₦ 1400.00
Lablab seeds	10kg	₦ 800.00
Total sales		**₦ 78832.00**
Total profit		**₦ 10647.00**

ACKNOWLEDGEMENTS
The authors are grateful to the farm staff of the Federal University of Technology, Yola, for their assistance, also to the Department of Geography of same University for providing the rainfall records for the study.

REFERENCES
alhassan, w. s., ehoche, o.w. and adu, i. f. (1987). a note on molasses addition to untreated millet straw for sheep and goats. journal of animal production research (in press).

Aboud, A. A.O., Reed, J. D., Owen, E. and McAllan, A. B. (1990). Feeding sorghum stover to Ethiopian sheep: Effect of stover variety and amount offered on growth, intake and selection. Summary. *British Society of Animal Production* 50:592.

Adetiloye, P. O. (2001). Effects of Maize plant and Nitrogen level on the Performance of Maize/Cowpea intercrop: Asset Series, vol. 1(2) 105-113.

Alhassan, W. S., Ehoche, O. W. and Adu , I . F. (1987). A note on molasses addition to untreated Millet straw for sheep and goats. *Journal of Animal Production Research* (In press).

AOAC (1984). Official methods of analysis, 12th edition. Association of Official Analytical Chemists, Washington DC. 11th edition.

Babayemi, O. J., Ajayi , F. T., Taiwo, A. A., Bamkole, M. A. and Fajimi , A. K . (2006). Performance West African dwarf goats fed *Panicum maximum* and concentrate diets supplemented with Lablab, Leucaena and Glircidia. *Nigerian Journal of Animal Production* .33 (1):102-111

Bailey, k. (2001). The fundamentals of forward contracting, hedging and options for dairy producers in North East. Staff paper #338, June5, 2001. College Agricultural Sciences, The Pennsylvannia State University,UAS. http:#agmarketing extension psu edu/Commodity/PDFs/Dry RiskMgt pdf

Bashir, A. B. (2002). Water Quality and out break of Disease in Yola, Area of Adamawa State. An M. Sc Thesis submitted to the Department of Geography Federal University of Technology, Yola (Unpublished).

Bogoro, S., Manshap, C., Kalla , D. J. U. (2006). Effect of quality of diets on the in-Sacco in-viro rumen degradability of cotton seed cake and soya bean stover. *Journal of Arid Agriculture*, 200 16,121 -128. (2006).

Chetty, C. K. R.(1983). Research on intercropping systems. Project Bulletin No. 7. All India coordinated Research project for Dryland Agriculture, Hyderabad, India. 124 Science 51: 276 – 284.

Egunjobi, O. A.(1984). Effects of intercropping maize with grain legumes and Fertilizer treatment on populations of *Pratylenchus brachyurus* Godfrey Nematoda) and on the yield of maize. (*Zea mays* L) Protection Ecology, 6:13-167

Fleischer, J. E. and Tackie, A. M. (1993). Studies into the productivity and ensilage of "Wild Sorghum" (*Sorghum arandina* ceum) for dry season ruminant feeding. Proceedings of the second African Feed Resources Network (AFRNET) workshop, 89 -92.

Goering, H. K. and VanSoest, P. J. (1990). Forage fiber analysis. Agriculture Hand Book No. 379, AR, USDA, Washington, D. Gryseels, G. and Anderson, F.M. (1983). Research on farm and livestock productivity in the Central Ethiopia Highlands: 20 (4): 159-195.C.

Gryseels, G. and Anderson, F. M. (1983). Research on farm and Livestock productivity in the Central Ethiopian highlands: Initial results, 1977–80. ILCA Research Report No. 4.

Hague, I. (1984). Effect of Intercropping Lablab on dry matter grain yield and crude Protein of maize and sorghum In: potentials of forage legumes in farming systems of sub-Saharan Africa. Proceedings of a workshop held at ILCA, Addis Ababa, Ethiopia 16-19 September, 1985

Hosmani, S. A.,Hunshal, C. S. and Rangaswamy, K .T.(1986). Intercropping of fodder Legumes in sorghum in the transitional belt of North Karmataka. *Journal of Farming Systems*, 2(3-4): 4-9.

Jaetzold, R. and Schmidt,H. (1983). Natural conditions and farm management information: Farm management Hand bookof Kenya, Volume 11. Part B, Central Kenya,, Ministry of Agriculture, Nairobi, Pp510.

Kawamoto, Y., Masuda, Y. and Goto, I. (1988). Sorghum-legume mixed cropping for high yields in high quality forage. *Japan Agricultural Research Quarterly*, 22 (2): 114-120.

Kiflewahid, B. and Mosimanyana, B. (1987). *Dolichos lablab* (lablab pumpers) in by-product-based diet for lactating cows in Botswana. Utilization of agricultural by-products as livestock feeds in Africa in proceeding of workshop held at Ryall's Hold, Blantyre, Malawi, September 1986, 155-172 (Eds D.A Little and A.N. said). Adacts Kseha, Ethiopia: International Livestock centre for Africa ILCA African Res. Network for Agricultural products ARNAB).

Lamidi, O. S, Abdullahi, B. and Omokanye, A. T. (1997). Effect of spacing and Phosphorus land on forage and seed yield of crops. *Nigeria Journal of Animal Production* 24{2}: 161- 16.

Manyuchi ,B.Orskov, E .R. and Kay, R. N. (1992).Effect of treating or supplementing maize stover with urea on its utilization as feed for sheep and cattle. *Animal Feed Science and Technology*. 49: 11.

Makembe, N. E. T. and Ndlovu, L. R. (1996). *Doliches lablab* (lablab purpureus cv. "Rongai") as supplementary feed to maize stover for indigenous goats in zimbabwe. Small ruminant Research 21: 31 – 36.

Mcdonald, P. Edwards, R. A. and Greenhalgh, J. F. D. (1988). Animal Nutrition. Longman Scientific and Te

Mosi, A. K. and Butterworth, M. H.(1985). The voluntary intake and digestibility of diets containing different proportions of tef (Eragrostis tef) straw and Trifoliumtembense hay when fed to sheep. Tropical Animal Production. Association of Nigeria. September 17 – 19. Maiduguri.

Mupeta, B. and Makombo, E. (1995). Milk production from crossbred dairy. Cows on farm roduced dairy diets and a commercial dairy meal. Annual report 1994 – 95 Division of livestock and pastures, Department of Research and Specialist Services, Harare, Zimbabwe, 9 – 13.

Muriuki, H., Omore, A., Hooton, N.,Waithaka, M., Ouma, R., Staal, S. J. and Odhiambo, P., (2003). The policy of environment in Kenya dairy sub-sector. A review Smallholder (Research and Development) Project Report No. 2. Smallholder Dairy (R and D) Project Nairobi, Kenya, Pp8

Nnadi, L. A. and Hague, I., (1986). Performance of forage legume – maize intercrops on low –nitrogen soil of Ethiopian highlands. Field crops Research.

Ndemanisho, E. E.,Kimoro, B. N., Mtengeti, E. J. and Muhikambele, V. R. M. (2007). In vivo digestibility and performance of growing of goats fed maize stover supplemented with browse leaf meals and cotton seed cake based concentrates. *Livestock Research for Rural Development* .19(18)

Ncube, S. and Mubaiwa, E. (1994). The nutritive value of wild friuts and their Use as supplements to hay. *Zimbabwe Journal of Agricultural Research*, 32:56-62.

Ndlovu, L. R. and Sibanda, L. M. (1996). Potential of D*olichos lablab* (lablab Purpureus) and *Acacia tortolis* pods in small goat kid feeding system In semi – arid areas of South Africa. *Small Ruminant Research* 21:273-276.

Okagbare, G. O., Akpodiete, O. J. and Osaiyuwu,H. O.(2005). Feed intake and nutrient utilization by West Africa Dwarf Goats fed Gmelina arboreal leaves supplemented with grasses. *Tropical Journal and Science* 2005, Vol 8, No 2 17 – 22.

Ofori, F.and Stern, W. R. (1987). Cereal – legume intercropping system. *Advances in Agronomy* 41:41 –85.

Ojo, E., Kibon, A., Abbator, F. I. and Mohammed, I. D. (2001). Effect of Browse and cotton seed cake supplementation on intake and digestibility of sorghum stover. Proceedings of 6th Annual Conference of Animal Science Association of Nigeria

Onweme, I. C. and Sinha, T. D. (1991). Field crop production in the tropical Africa. CTA,Wageningin , Netherlands.

Preston, T. A. and Leng, R. A. (1987). Matching ruminant production systems with Available resources in the tropics and sub – tropics. Penam

Siulapwa and Simukoko 1998 Status of crop residues and Agro-Industrial by-products as supplement feed in Zambia. *Journal of Agricultural Science*, 32:207-213 Cambridge University Press.

Smith, T,, Manynchi,B. and Mikayiyi, S. (1990). Legume supplementation of maize Stover in:(eds. B. H. Dzowela, A. N. said, Asrat Wendem – Agenehu and J. A. Kategile). Utilization of research results on forage and agricultural by – product materials as animal feed resources in Africa. ILCA, Addis Ababa, 302 – 320.

Steel, R. G. and Torrie, J. H. 1980 Principles and procedures of statistics. McGraw-Hill Books Co.

Ummuna, N. N., Osuji, P. O., Nsahlai, I. V., Khalili, H. and Mohamed – Saleem, M.A.(1995). Effect of supplementary oat hay with lablab, sebania, tagasaste or wheat middlings on voluntary intake. N utilization and weight gain of Ethiopian Menz sheep. Small Rumina

Waheed, R. A. J., Owen, E. J. and Hosking, B. J. (1990). Feeding straw to small ruminants. Effect of amount offered on intake and selection of barley straw by goats and sheep. *J. Annual Production* 51: 208 – 289.

Yao-Ming Wu and Jian-xin Liu (1995). The kinetics of fibre digestion, nutrient digestibility and nitrogen utilization of low quality roughages as influenced by supplementation with urea-mineral blocks. *Livestock Research for Rural Development*. Volume7, no 13 pp1-7