



CROP RESIDUES COMPARATIVE PRICE AND QUALITY ANALYSIS IN WEST AFRICA - A CASE FROM NIGER

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Abstract

A survey was conducted in rural and urban fodder markets in Niger to understand better trading pricing and quality of crop residues. On fortnightly basis prices and feed, samples were collected from July 2014 to June 2015 from two rural (Gazaoua and Kollo) and two urban (Niamey, Maradi) markets. The sample analyzed for nitrogen, neutral detergent fibre (NDF), acid (ADF) detergent fibre, acid detergent lignin (ADL), *in vitro* organic matter digestibility (IVOMD) and metabolizable energy content. Data were analyzed using SAS GLM procedures for variance and correlation. Results indicated a total of 635 samples collected from the market. Faidherbia was the most expensive feed. Cowpea haulms (average 160 CFA/kg) were sold consistently at higher prices than groundnut haulms (120 CFA/kg). Fodder quality traits of cowpea haulm were always superior to those of groundnut haulms. Correlation between prices and between qualities ($p < 0.05$) for N, NDF, AFD, ME and IVMOD. Significant ($p < 0.05$) difference in prices in different markets. Among the analyzed legume residues cowpea haulms reported having better in N, NDF, ADF, ADL, IVMOD and ME traits than groundnut haulms. The high price premium of cowpea relative to groundnut haulm emphasizes attention to haulm fodder quality.

Key words : cowpea, haulm groundnut haulm, market.

Introduction

Food is the basic need for human, animal alike. It is spoke in the wheel driving crop-livestock farmers to the consumers through the food- feed, fodder value links for sustainable intensification in the West African region. Furthermore, traditionally farmers are growing crops and raising animals without better access to technologies and improved practices are unable to tackle the issues of insufficient quantity, quality and seasonality in the food-feed resources. Problems range from unsuitable cultivars, inefficient utilisation of resources, farmers malpractices and selective animal feeding of leaves, rejecting hard stalks, leading to extreme consequences, such as feed scarcity in the dry season when stems are plentiful, yet not utilised optimally. Burnt crop residues put pressure on biomass. Besides, urbanisation, population pressure, decreasing lands, the decline in crop-livestock

productivity, inadequate rainfall, disease, climate change, and other deterrence such as terrorism affect the region of Sahel. Notwithstanding such challenges, in West Africa like elsewhere, the market pulls and pushes crops and livestock for sustainable intensification. Farmers grow and market crops for food (grain) and fodder with anecdotal evidence suggesting that the latter becoming more important.

Often in case of dry arid lands, availability of feeds and fodder is limited. Quality, quantity and seasonality of the feeds pose important constraint in livestock feeding. Crop residues are waste products which are tradable commodity linking collection from the field, transport by intermediaries and trading by wholesaler and retailers, is remarkable (Samireddypalle *et al.*, 2017). Concurrently small scale crop-livestock farmers are unable to feed quality finding quality forage for their animals during the dry season.

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Pearl millet, sorghum, groundnut, and cowpea are valued highly for its grain and fodder are sold in markets. Besides, livestock farming is predominant, particularly in the West African Sahel cities. Dairy production and livestock (cattle, sheep and goat) fattening is popular among crop-livestock owners to meet the basic needs of the household in urban and rural areas. Consequently, there is increased demand for feedstuff, as fodder markets have sprung up in many cities and towns of West Africa's Sahel (Ayantunde *et al.*, 2014). The presumption is better quality demands more price. Besides a crucial aspect neglected concerning supply and trade of fodder is quality. Therefore, a study envisaged to better understand what seasonal feed types are available, what is pricing of different crop residues in markets, and what is the price and feed nutritional-quality relationships among various crop residues?

Materials and Methods

In four livestock feed markets from 2014 to 2015 two rural (Gazaoua, Kollo) and two urban (Niamey, Maradi), a market survey was conducted. Maradi and Tillabery districts were purposively selected. The criteria of selection of the villages were 0.35 aridity index (AI), 70 habitations km² population density (PD) index that is the criteria utilised for semi-arid zones. Feed sellers operate year around. Focus group discussion with randomly five traders and five farmers from each market conducted for 12 months. All four markets were accessible by roads. During the survey, we did not collect data on value chain analysis of the fodder market and traders but focussed mainly on data collection of feed prices and quality. Traders and farmers visually scored crop residues for quality. On fortnightly basis prices of crop residues (groundnut haulm, cowpea haulm, pearl millet stover and sorghum stover) and grains (groundnut, cowpea, pearl millet and sorghum) were collected. Thus, a total of 635 samples were collected and processed for analysis. The crop samples were collected, dried, grounded through 1 mm sieve and analysed for fodder quality traits using near-infrared spectroscopy (NIRS). Stover nitrogen content, *in vitro* digestibility and *in vitro* metabolisable energy were estimated using a combination of conventional chemical and *in vitro* laboratory analysis and NIRS. Fodder samples collected in paper bags and sun-dried at Sadore, Niger. All samples were analysed for nitrogen (N), neutral (NDF) and acid (ADF) detergent fibre, acid detergent lignin (ADL), *in vitro* organic matter digestibility (IVOMD) and metabolisable energy (ME) content by NIRS. Nitrogen represents the protein content (crude protein = N × 6.25), while IVOMD represents the potential digestibility of the fodder and is negatively

affected by the structural carbohydrates components (NDF, ADF, and ADL). The ME content of fodder estimates the energy available to the animal after accounting for faecal, urinary and methane losses. Nitrogen, IVOMD and ME are affirmative fodder nutritional quality traits while NDF, ADF, and ADL are undesirable ones. Data analysis performed using SAS procedures for variance and regression analysis. The level of significance was set up at $p < 0.05$.

Results

Fifteen feeds types sold in the markets. The composition was green forages (cowpea haulm, groundnut haulm, leaves of *Faidherbia*, *Acacia*, *Echinochola*, *Zornia*), concentrate (brans of wheat, maize, millet, sorghum and cowpea grain, faidherbia fruit, acacia fruit) and stovers (millet and sorghum) indicated in table 1. The most preferred feeds for fattening livestock in Niger were bran of grain (millet, sorghum), haulms of cowpea and groundnut and *Faidherbia albida* fruits and leaves, etc., but bran of grain are more preferred than others. Feed and fodder grouped into a) concentrates-brans; b) legume haulms-cowpea and groundnut; c) green forages - grasses collected from bushland, trees and d) Stover from sorghum and pearl millet. Most expensive fodder CFA/kg was *Faidherbia tree leaves*. The prices are lowest during harvest in September and gradually rise with the advent of the dry season. In Ghana (Konlan *et al.*, 2018) reported that "the feedstuffs found were crop residues (groundnut haulm and cowpea haulm), agro-industrial by-products (bran of maize, rice, and sorghum), fresh grasses (*Rotteboellia cochinchinensis*), and local browses (*Ficus* sp. and *Pterocarpus erinaceous*)" similar like the present study. It was reported in Ghana that prices of cereal bran were same ($P > 0.05$) in all seasons but that of crop residues were higher ($P < 05$) in dry period which was similar to the present study as cowpea and groundnut haulms came right after the concentrates.

Results from the feed survey of Niger indicated that Cowpea haulm (CH) had higher demand than Groundnut haulm (GH) followed by Sorghum stover (SS) and Pearl millet stover (PMS) in that order (Table 2). Cowpea haulm (CH) were sold consistently at higher prices than Groundnut haulm (GH), followed by Sorghum Stover (SS), and last in the order was Pearl Millet Stover (PMS). The prices of crop residues vary with availability. The demand for fodder was high during the dry period in Niger. Cost-wise cowpea and groundnut haulms followed after the concentrates having 78% (cowpea haulm) and 57% (groundnut haulm) of the average price of concentrates, confirming the high monetary value of legume haulms.

Table 1: Different types of feeds stuff available round the year.

S. No.	Fodder Items	Market Price (CFA/kg) where 1 CFA=					
		Gazaoua (rural)	Kollo (rural)	Average	Maradi (urban)	Niamey (urban)	Average
1	Cowpea haulm	88	129	108.76	138	301	219.47
2	Cowpea grain	172		171.68	214	305	259.62
3	Groundnut haulm	79	88	83.64	128	172	150.37
4	<i>Faidherbia fruit</i>	70	114	91.89	103	193	148.08
5	Sorghum stover	21	24	22.54	33	45	38.95
6	Pearl Millet stover	13	17	15	24	34	29
7	Wheat bran	188	209.83	198.83	176.91	247.75	212.33
8	Millet bran	143	173	158	227	299	263
9	Zornia	61	102	81.33	106	155	130.75
10	<i>Fadherbia leaves</i>	164	306	235.05	240	382	310.93
11	<i>Echinocloea spp</i>	0	36	18.16	0	79	39.25
12	Maize bran	162	220	191	203	274	238.5
13	<i>Acacia.radiaa</i> leaves	103	110	106.5	142	186	164
14	Sorghum bran	176	200	188	164		164
15	<i>Acacia radiana fruit</i>	113		112.5	147	109	128.25

Table 2: Monthly price variations for different feed types (CFA / kg DM, mean \pm standard error) in four markets monitored in 2014-2015 in Niger .

Month	Cowpea haulm	Groundnut haulm	Sorghum Stover	Pearl Millet Stover
Jul-2014	230.37 \pm 66.14	77.75 \pm 17.29	32.5 \pm 5.95	27.75 \pm 6.12
Aug-2014	170.37 \pm 77.17	136.25 \pm 32.10	41.25 \pm 7.46	34 \pm 6.96
Sep-2014	77.87 \pm 16.26	25.62 \pm 2.57	18.75 \pm 2.39	13.75 \pm 2.39
Oct-2014	91.62 \pm 20.71	49.5 \pm 5.72	18.75 \pm 2.39	13.75 \pm 2.39
Nov-2014	113.12 \pm 32.36	83.87 \pm 26.0	26.62 \pm 5.24	20.62 \pm 3.37
Dec-2014	122.75 \pm 38.88	109.37 \pm 32.44	31 \pm 6.46	24.5 \pm 4.94
Jan-2015	173.37 \pm 55.57	146.25 \pm 22.76	29 \pm 5.93	26.25 \pm 6.57
Feb-2015	198.75 \pm 54.67	159.37 \pm 25.70	33.12 \pm 7.17	20.75 \pm 5.102
Mar-2015	199 \pm 54.67	161.5 \pm 28.22	39 \pm 10.05	18.25 \pm 0.75
Apr-2015	95 \pm 0	193.75 \pm 14.19	35 \pm 8.89	29.66 \pm 7.31
May-2015	196 \pm 63.65	119.37 \pm 47.32	27.5 \pm 7.75	32.5 \pm 12.5
Jun-2015	230 \pm 58.34	141.5 \pm 19.21	37 \pm 0	32.5 \pm 12.5

Table 3: Nutritional quality (g/kg DM except for ME which is MJ/kg DM; mean and price (FCFA/kg DM) of different feed types sold at four feed markets in Niger.

Feed	^a NDM	Crude Protein	NDF ^b	ADF ^c	ADL ^d	ME ^e	<i>In vitro</i> OMD ^f	Average Price (^g CFA/kg)
Cowpea haulm	2.22	13.87	45.14	32.93	6.72	8.75	61.31	164.12
Groundnut haulm	1.66	10.43	44.69	36.15	6.83	8.43	58.35	119.01
Sorghum Stover	1.03	6.47	66.09	38.05	4.53	7.71	52.18	30.75
Pearl Millet Stover	0.98	6.12	71.76	46.24	5.75	7.14	47.18	23.5

^aNDM means=Nitrogen Dry Matter,^bNDF= neutral acid detergent fibre,^cADF=Acid detergent fibre,^dADL= acid detergent lignin,^eME= metabolizable energy,^fIVOMD= *in vitro* organic matter digestibility,^g1 CFA= 0.0016 US\$

Table 4: Correlation(r) between fodder quality traits and price.

Average price= 84.34 CFA/kg	NDM	NDF	ADF	ADL	ME	IVOMD
	0.79(0.00)	-0.76(0.00)	-0.64(0.00)	0.58(0.01)	0.75(0.00)	0.76(0.00)

1CFA= 0.0016 US\$

Table 5: Average fodder quality and prices at the different markets.

Fodder types	Fodder quality	Kollo (Rural)	Niamey (Urban)	Gazaoua (Rural)	Maradix (Rural)
Pearl Millet Stover	NDM	1.09	1.03	0.82	0.96
	NDF	68.50	70.89	75.42	72.22
	ADF	46.08	47.30	45.79	45.80
	ADL	5.97	5.95	5.40	5.71
	ME	7.13	6.96	7.30	7.16
	IVOMD	47.68	46.29	47.56	47.18
	Price (CFA/kg)	18.18	37.54	14.61	23.65
Sorghum Stover	NDM	1.10	1.03	1.06	0.93
	NDF	65.56	65.08	65.28	68.44
	ADF	36.31	36.35	38.58	40.95
	ADL	4.29	3.95	4.95	4.92
	ME	7.97	7.86	7.70	7.32
	IVOMD	53.54	53.02	52.13	50.04
	Price (CFA/kg)	24.40	44.90	20.68	33.00
Groundnut haulm	NDM	1.60	1.58	1.76	1.71
	NDF	42.97	45.59	45.94	44.27
	ADF	35.76	37.41	35.86	35.58
	ADL	6.55	6.93	7.07	6.77
	ME	8.50	8.30	8.54	8.38
	IVOMD	58.77	57.61	58.84	58.17
	Price (CFA/kg)	96.18	172.29	79.13	128.46
Cowpea haulm	NDM	2.30	2.26	2.13	2.18
	NDF	32.12	32.72	34.45	32.41
	ADF	32.12	32.72	34.45	32.41
	ADL	6.53	6.54	7.04	6.76
	ME	8.73	8.87	8.64	8.78
	IVOMD	61.36	61.95	60.55	61.37
	Price (CFA/kg)	129.36	301.18	88.17	137.77

1CFA= 0.0016 US\$

The average price of cowpea grain to haulm was twice (Fig. 1). Groundnut grain to haulm was four times (Fig. 2) while the average rate of sorghum grain to stover was six times (Fig. 3). And in case of pearl millet grain to stover was eight times (Fig. 4) indicating superior monetary value given to grains.

Grains are used for human consumption as well as for animal fattening. Significant variation in prices between rural and urban markets and haulm ($p=0.0034$) types was observed. A significant difference in average price mean (140.50 CFA/kg), in rural and urban markets ($p<.0001$), in cowpea and groundnut haulm ($p=0.0007$) was reported. The average price ratio of cowpea grain to haulm was

2.4:1 while that of groundnut grain to haulm was 4.0:1. Haulm prices were lowest after harvest. A significant difference in average price mean (140.50 CFA/kg), in rural and urban markets ($p<.0001$), in cowpea and groundnut haulm ($p=0.0007$). Significant variation in prices between rural and urban markets and haulms ($p=0.0034$) trading. Blummel and Rao (2006) reported different rates in sorghum stovers, wheat, and rice straws, traded at the same time and place, and similar findings were observed by Teufel *et al.*, 2010 while Erenstein *et al.*, 2013 suggested that crop residue fodder quality is essential in crop improvement programs. Similar finding was reported in study at Ghana, Prices of feeds differed ($P < 0.05$) among markets Konlan *et al.*, 2018 which is consistent to the present study findings.

Following table 3 indicated CH fodder quality traits were consistently superior to those of GH, SS and PMS in that order. Below Table 4 indicates that feed and fodder prices were significantly ($P < 0.05$) correlated with laboratory fodder quality traits such as nitrogen ($r = 0.79$), NDF ($r = -0.76$), ME ($r = 0.75$) and IVOMD ($r = 0.76$).

Further table 5 indicated that market location had a strong influence ($P<0.05$)

on feed costs for CH ($p<0.0001$), GH ($p=0.0009$), SS ($p<.0001$) and PMS ($p<.0001$). The prices were twice in urban markets than in rural markets. CH (average 162.43 CFA/kg) were sold consistently at higher prices than GH (119.50 CFA/kg) indicating their high demand. Demand indicates the consumption pattern. Trader and farmer perception on quality was green leafy haulm perceived to be high quality, yellow coloured medium and leaves infested with moulds, insects as low. Cowpea haulm fodder quality traits were consistently superior to those of groundnut haulm. The significant difference in haulm for N ($p<.0001$), ADF ($p=0.01$), ME ($p=0.03$), IVOMD ($p=0.00$) was observed. Nitrogen, IVOMD and ME are positive fodder nutritional quality traits. At the same time,

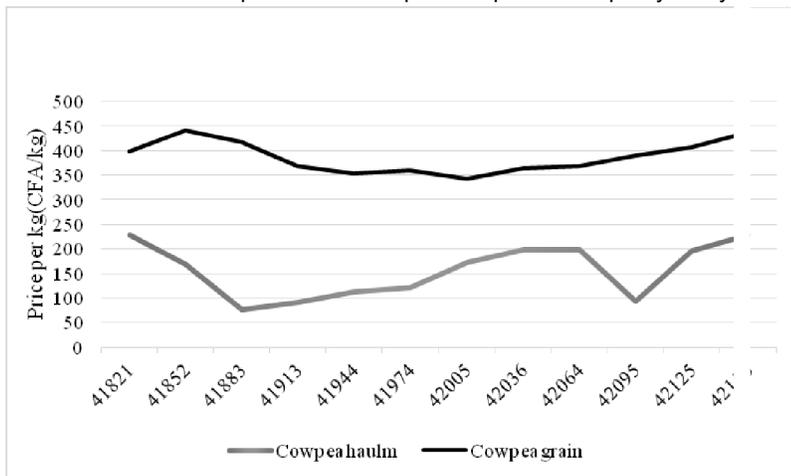


Fig. 1: Price comparison between cowpea grain and cowpea haulm.

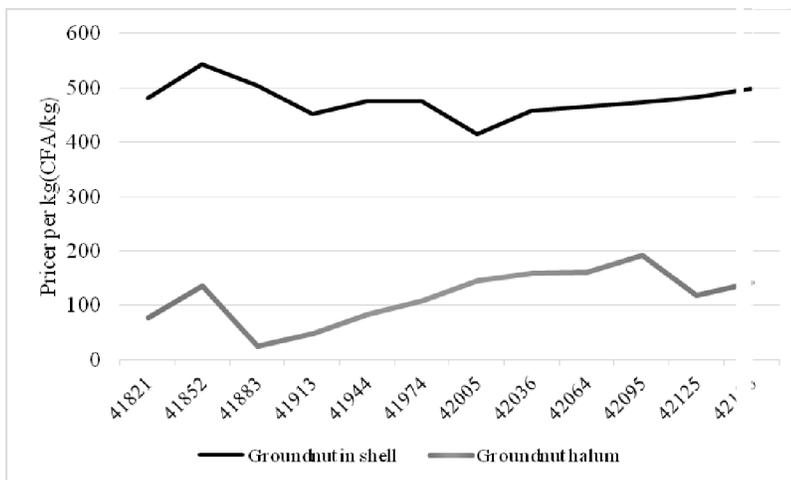


Fig. 2: Price comparison between groundnut in shell and groundnut haulm.

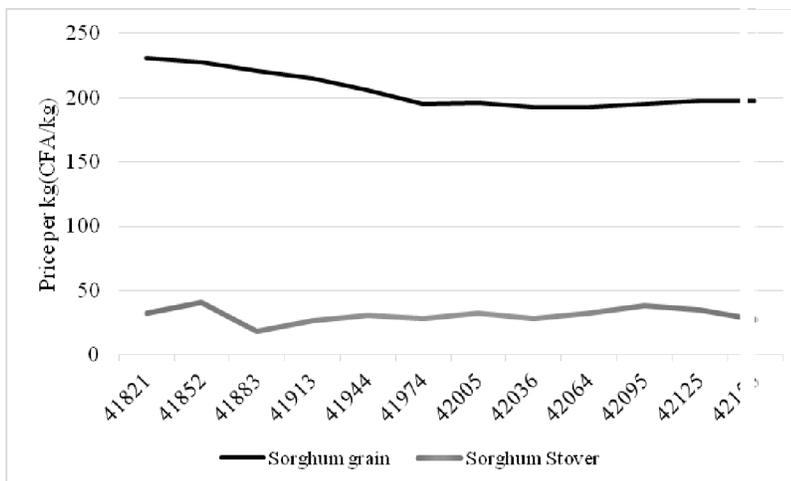


Fig. 3: Price comparison between sorghum grain and stover.

NDF, ADF, and ADL are undesirable ones. Farmers perceived that cowpea and groundnut haulm was the best feeds, particularly for animal fattening diets. In terms of groundnut in shell - had more value than cowpea, while in case of haulm, cowpea haulm was more in demand.

Cowpea haulm (average 162.43 CFA/kg) were sold consistently at higher prices than groundnut haulm (119.50 CFA/kg). Farmer perceived green and leafy as high-quality haulm, medium yellow coloured as medium quality during pest and mould attack haulm as low. Cowpea haulm fodder quality traits were consistently superior to those of groundnut haulm. Significant difference in haulm for NDM ($p < .0001$), ADF, ($p = 0.01$), ME ($p = 0.03$), IVMOD ($p = 0.00$) were observed. Samireddypalle *et al.*, 2017 reported that in fodder study in Nigeria “groundnut haulms were consistently priced higher than cowpea haulm and the value of cowpea relative to grain was 0.93 while that of the grain was 0.30”; opposite to findings of the present study, where cowpea haulms priced higher than groundnut haulms. Cowpea haulm prices were significantly ($P < 0.05$) correlated with laboratory fodder quality traits with nitrogen, ME, IVOMD, and NDF were superior to groundnut which is consistent with fodder study at Mali (Ayantunde *et al.*, 2014). The findings from Mali, Niger and Nigeria, show price, is accorded to quality

Conclusions

Farmers can make significant additional income from selling of cowpea, groundnut haulm. Cowpea and groundnut breeder must pay attention to haulm yields and disease resistance. The high price premium of cowpea relative to groundnut haulm suggests focus to haulm fodder quality. More work is required to understand the perceptions of farmers, traders, buyers on feed quality. The growing demand for livestock products along with feed shortage in the West African region calls for attention and action by plant breeders and livestock nutritionists for collaboration. The high price premium of cowpea relative to groundnut haulm suggest focus to haulm fodder quality.

Acknowledgements

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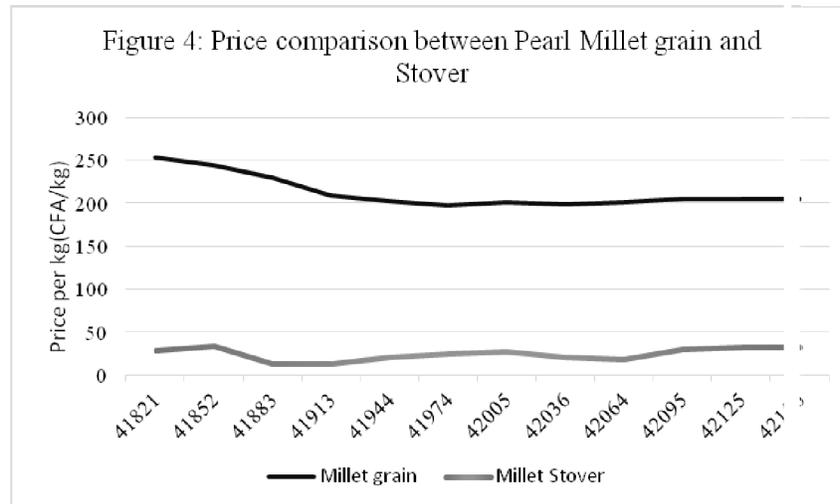


Fig. 4: Price comparison between pearl millet grain and stover.

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