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Research Paper

Characterization of the peri-urban system of animal feed based on cowpea by-products in the sub-Sahelian area: The case of Niamey Region (Niger)

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ABSTRACT

A stakeholders survey was conducted using cowpea by-products in the Niamey region. The aim of the survey was to determine the different practices, the usage and trading of cowpea by-products in animal feed. A total of one hundred and fifty (150) breeders and one hundred and twenty-five (125) resellers of cowpea by-products were surveyed. The results showed that Djermas aged 40-59 were the majority of farmers (48.7%) and resellers (88%) of cowpea haul, while the Hausa trade on cowpea pods (56%). The tops and pods were distributed in bulk and in kind. The lost of tops lopes of the range 170 to 210 g (approximately 5%) during the transport of tops was recorded. The semi-wholesalers mainly supply the users of cowpea by-products after harvest, depending on their storage and working capital. The storage of tops was done on worn tires, while the pods were laid on canvas. In urban areas, livestock was practiced much more for sacrifice while in peripheral areas, it is practiced to meet the daily needs. All these data increase hope and provide good prospects on the valuation of cowpea by-products in livestock food for which it is necessary to envisage a long-term monitoring and especially to evaluate the effect of the valuation of these products.

Key words: Tops, pods, cowpea, food, Niamey.

INTRODUCTION

Livestock farming plays an important role in the south Sahara countries. In Niger, it contributes about 13% of the national GDP (INS, 2008). Urban and peri-urban livestock entirely dependent on food resources (bush hay and crop residues) from rural areas. Among the food resources there are cowpea by-products (hay and cowpea pods). The tops are the aerial parts of the plant after separation of the pods and the pods correspond to the set of both pod valves after seed separation (Kaboré, 1992). These cowpea by-products are foods of good nutritional quality with a good supply of both energy and nitrogen (Rivière, 1991; Gongnet et al., 1995; Kaasschieter 1996; Mame, 1998; Siddo, 2002). Tops account for 26% of bush hay (36%) in the livestock ration of urban and peri-urban livestock (Maimouna, 2012). In practice, loams distributed in bulk, without transformation, generate considerable foliar losses during the animal's meal. Unfortunately, these losses are not noticed by the breeders (Guerin, 1988). While knowledge of the diversity and use of crop residues and agro-industrial by-products is almost achieved in Africa as was the case in Mali (Camara, 1996), Nigeria (Onyeonagu, 2010), Ethiopia (Beyene, 2011) and recently in Niger (Chaibou et al., 2012; Habou, 2013; Lawal, 2014). The fact remains that cowpea pods are still poorly documented as regards their nutritional characteristics and the possibilities of optimizing their use in animal feed. The growing interest in cowpea by-products, as well as their socio-economic role for farmers has raised a major concern: What are the forms of use of haulms and cowpea pods for urban and peri-urban livestock farmers in

Table 1: Distribution of resellers of cowpea by-products.

	Town	Resellers of cowpea vines	Resellers of cowpea pods
Resellers of cowpea by-products (N=234)	I	15	10
	II	15	10
	III	15	10
	IV	15	10
	V	15	10
Total		75	50

Table 2: Distribution of livestock households using cowpea by-products.

Neighborhoods *(n=20)*	**Breeders surveyed in Niamey**	**Breeders surveyed in the peripheral zone**
Households / Neighborhoods	**5**	**-**
Peripheral agricultural villages	**-**	**5**
Households / outlying villages	**-**	**10**
Total	**100**	**50**

Niamey?

MATERIALS AND METHODS

Investigation method

The survey took place in the city of Niamey and the surrounding agricultural villages. The sampling favored the resellers of cowpea by-products, households using cowpea by-products, and cowpea haulers. A rapid and comprehensive inventory of resellers was conducted throughout the urban community of Niamey (UCN). As a result, two hundred and thirty-four (234) resellers of cowpea by-products were identified and listed. Twenty-five (25) resellers including fifteen (15) haulers and ten (10) cowpea pods were randomly sampled in each commune from the established lists (Table 1).

The collection of data on users of cowpea by-products was conducted in two stages: The first step was a two-week summary investigation. The aim was to identify and identify neighborhoods with more livestock farms. Thus, one hundred and ninety-three (193) households from twenty (20) neighborhoods in five districts of Niamey were listed. Overall, one hundred (100) households of five (5) households per neighborhood were randomly selected and surveyed in Niamey (Table 2). The second stage was a two-week survey of 10 households per peripheral agricultural village (five villages) in 5 UCN districts, randomly sampled from the list of beneficiary households from small ruminant distributions. Overall, 50 households were surveyed in outlying agricultural villages. Data collection at the level of cowpea haul carriers was conducted for 10 days simultaneously at the level of six main axes of exit and entry of Niamey namely Ouallam, Fillingué, Kollo, Say, Torodi and Tillabery.

Questionnaires

The questionnaire containing four (4) major points according to Loste (1984) was used as a survey medium. The information was collected along the following lines:
Breeder pole: The information concerned with the social status of pastoralists who use cowpea by-products in their households. These are ethnicity, age, sex, marital status, educational levels and main activities.

Breeder-territory interface: The information collected concerned forage collection and storage practices.

Herd pole: Information on herd composition and how animals were acquired by farmers using cowpea by-products was sought.

Breeder-herd interface: We have selected some practices that are combined in the production process (Lhoste, 1984 and Landais, 1994). These practices focus on the different forms of use and conservation of cowpea by-products, as well as the management of food. In relation to the supply and management of cowpea by-products, the information sought is related to the social status of resellers and carriers of cowpea by-products, but also among other things are the availability and accessibility of by-products, the qualitative choice and the quantitative flows of by-products drained to the urban center by axis, the perception of the strengths and constraints of the marketing of cowpea by-products, the various means of

transport used to transport haulms to urban centers.

Measurements of losses of cowpea leaves

During transport, there is a very high loss of cowpea leaves at the point of collection, during loading, transportation and unloading. For this, we proceeded to weigh the bundles of haulms instead of loading before transport to urban centers and on arrival at unloading. The work was done on two roads:

1). Ouallam axis: Ten (10) bunches of cowpea fane were identified and weighed from the loading site on small carts (village of Simiri, about 60 km from CUN).

2). Say axis: Ten (10) bunches of cowpea fane were identified and weighed from the loading site on donkey carts (village of Sadoré, about 45 km from CUN). The losses observed vary quantitatively according to the season and the state of conservation. This exercise, to monitor the losses of materials recorded on the haulms transported, was conducted in October and November (post-harvest period).

Data analysis

The SPSS 17.0 software was used for the descriptive analysis of the data and the Excel spreadsheet was used for the production of tables and figures. All the survey responses were grouped into sections and subsequently expressed as percentages of responses (%).

RESULTS AND DISCUSSION

Social situation of the respondents

The main socio-economic activities on the outskirts of Niamey are livestock farming, agriculture and trade. Table 1 shows the social characteristics of the actors of the cowpea-based feed system on the outskirts of Niamey. In this study, four socio-cultural groups stood out among the peri-urban farming actors of Niamey. The Djerma were more vine sellers (88%) and breeders (49%) than the Haoussa who trade on cowpea pods (56%) and very little on breeding (25%). The Fulani (33%) and Tuareg (7%) minority groups were entirely devoted to breeding (Table 3). This is probably related to the fact that the import areas of this food are dominated by Haoussa and Djerma. Similar results have been reported by Mani (2013) and Lawal (2014) who pointed out that the predominance of Haoussa and Djerma reflects the ethnolinguistic configuration of the city of Niamey. Globally, livestock occupy more adults (48%) than young people (20-39 years old: 39%) and old people (≥ 60 years old: 13%). In the present study, while adults were more involved in raising and trading on cowpea haul, young people were increasingly confined to the trade on vines (41%) and cowpea pods (56%). Singles (27%) were carpet in these resellers; the latter were mostly illiterate, while 14% of the breeders had primary education. A minority of the women (30%) reported to pastoralists, the majority of whom were educated (48.0% of traditional literates and 27.3% of modern literates), while a minority of resellers were literate (20%). These breeders, however, had fewer executives (10.6%) despite the lack of time and the high costs inherent in the practice of this activity.

According to Ali et al. (2003), the low rate of officials practicing small ruminant husbandry is related to the instability of this professional category, which is subject to change.

Characteristics of farms using cowpea by-products

The urban community of Niamey and the surrounding areas are localities that comprised several types of animals. There are uniform or mixed flocks of goats, sheep and cattle. Households with fewer than ten (10) heads are the most numerous. They represent 90 and 95% respectively in the city of Niamey and the outlying villages of Niamey. Breeders surveyed with a majority of less than 10 animal heads can then keep the animals in permanent housing while valuing the available agricultural by-products. The small size of the herd per household could be linked to insufficient space for livestock breeding in Niamey town and the social status of pastoralists surveyed in outlying villages that are almost from vulnerable households. Our results corroborate with those of Wane et al. (2005) who showed that about 61% of rural households own at least 1 to 5 heads of small ruminants including goats and Moustapha (2015) found an average size in the city of Niamey of 6.67 ± 5, 74 of sheep and 7.25 ± 6.36 of goats.

Breeder's production objective

The main factors behind livestock farming at Niamey urban community level are sacrifices (27%), followed by fattening (23%). At the level of the outlying villages, the population practices breeding to meet the daily needs (47%) and also for reproduction (31%) (Figure 1). The objective of breeding is relative to the study area. In fact, CUN breeders favor sacrifice and fattening thanks to intense social activities. For the breeders of the surrounding villages, they are much more contented with their income for survival.

Table 3: Sociodemographic characteristics of the respondents.

		Breeders		Resellers (F.N)		Resellers (C.N)	
		N	**(%)**	**N**	**(%)**	**N**	**(%)**
Ethnic	Hausa	37	24.7	9	12.0	28	56.0
	Zarma	73	48.7	66	88.0	19	38.0
	Peul	33	22.0				
	Touareg	7	4.6			3	6.0
	Total	**150**	**100.0**	**75**	**100.0**	**50**	**100.0**
Gender	Male	105	70.0	75	100.0	50	100.0
	Female	45	30.0				
	Total	**150**	**100.0**	**75**	**100.0**	**50**	**100.0**
Age	[0 à 19 years [			5	6.7	3	6.0
	[20 à 39 years [	58	38.7	31	41.3	29	58.0
	[40 à 59 years [	72	48 .0	35	46.7	13	26.0
	≥ 60 years	20	13.3	4	5.3	5	10.0
	Total	**150**	**100.0**	**75**	**100.0**	**50**	**100.0**
Marital status	Married	138	92.0	68	90.7	40	80.0
	Single			7	9.3	9	18.0
	Widower/widow	12	8.0			1	2.0
	Total	**150**	**100.0**	**75**	**100.0**	**50**	**100.0**
Level of education	Arabic or traditional alphabetized	37	24.7	11	14.7	7	14.0
	Illiterate	72	48.0	46	61.3	37	74.0
	Primary	22	14.7	3	4.0	2	4.0
	Secondary	11	7.3	1	1.3	1	2.0
	Superior	8	5.3				
	No			14	18.7	3	6.0
	Total	**150**	**100.0**	**75**	**100.0**	**50**	**100.0**
Core business	Agriculture	24	16.0	28	37.3	6	12.0
	Breeding	49	32.7	9	12.0	4	8.0
	Trade	41	27.3	5	6.7	12	24.0
	Trade SPN			33	44.0	28	56.0
	Official	16	10.6				
	Household	13	8.7				
	Craft	7	4.7				
	Total	**150**	**100.0**	**75**	**100.0**	**50**	**100**

SPN: Cowpea sub products, F.N: Niébé Fanes, C.N: cowpea pods; (%): Percentage; N: Number

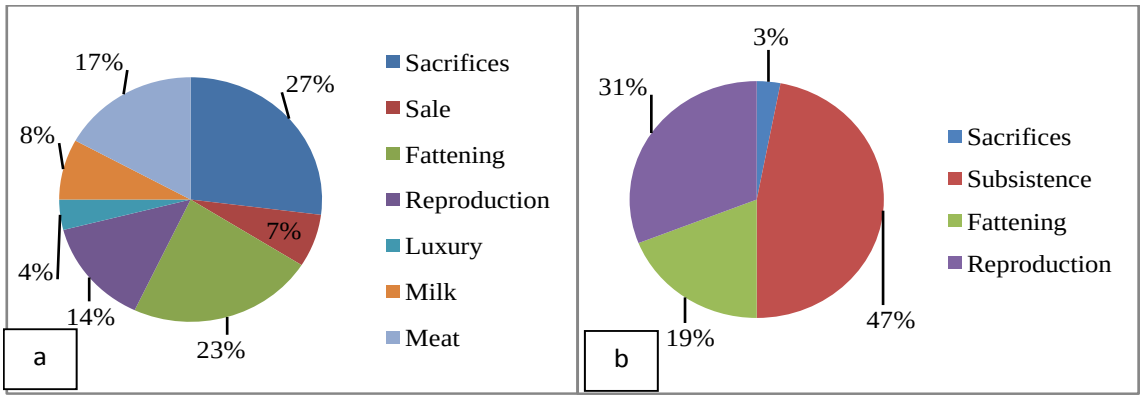

Figure 1: Objectives of livestock in Niamey City (a) and the periphery (b).

Table 4: Herd driving pattern.

Type	N=150	%
Aggregation		
All together (flock)	132	88.0
By species	12	8.0
By category	4	2.7
By species and categories	1	0.7
By type of production	1	0.7
Total	**150**	**100.0**
Housing		
Covered habitat in final materials	20	13.3
Covered habitat in non-permanent materials	107	71.3
Mesh fence	16	10.7
No habitat	7	4.7
Total	**150**	**100.0**
Stalling		
Free	11	7.3
hampered	93	62.0
Free and shackled	46	30.7
Total	**150**	**100.0**

Livestock is a means of subsistence and a factor of social integration according to Boutonnet (1992). It values family work and helps to create employment and profits.

Modes of eating

The mode of driving varies according to the season. Two main modalities have been described: pasture driving and feeding at the trough. The latter was observed in 30.7% of cases in the cold season, 39.3% in the hot season and 35.3% in the winter season. The exploitation of peri-urban pastures is practiced by 26, 15.3 and 34.7% of the respondents, respectively in cold season, rainy season and hot season. With the urbanization and the occupation of the agricultural lands, the breeders can practice, in their majority, only the food at the trough.

Accessibility of cowpea by-products

Accessibility of tops varies according to the periods. Thus, 54% of the respondents buy cheaper cowpea vines in the cold season (from November to January) but 42 and 61.3% of the households were paid dearly for the foliage, respectively in the hot season (from February to April) and rainy season (from May to August). The cowpea pods are mostly affordable throughout the year, about 1 kg costs 200 to 225 FCFA. The cost of a haul of tops in post-harvest period is also affordable (500 CFA per boot). However, the periods of the religious festivals which pave the way sacrifices of a large number of sheep make show these prices. The increase can be of the order of 300 to 500% (Karimou et al*.,* 2002). Accessibility is a parameter related to the purchasing power of farmers on the one hand and secondly to the price, that is, the selling prices of these products. As compared with the prices of these products, they are changing at the end of their availability on the market, which availability decreases as we move away from the rainy season, with the production of cowpea being a 95% rainfed production.

Herd management

The analysis in Table 4 shows that 88% of households drove their animals in association regardless of the sex of the species or type of production (Table 4). The dwelling is 71.3% of habitat type covered in non-definitive materials. In 62% of households, animals were kept in staggered housing, while 30.7% of households practiced free and restricted stabling.These types of herd management (association of animals, type of habitat, etc.) reflect the problem of organization but especially the insufficiency of the premises in order to practice breeding.

The surveys showed that 52% of cowpea haulers were sourced from semi-wholesalers (Table 5). However, some

Table 5: Source of supply and storage of by-products by type of reseller.

	Resellers FN		Resellers CN	
	N	**%**	**N**	**%**
Source of supply				
producers	16	21.3	8	16.0
Wholesalers and semi-wholesalers	39	52.0	34	68.0
markets			8	8.0
Street hauliers	20	26.7		
Total	**75**	**100.0**	**50**	**100.0**
Frequency of refueling				
Once a week	11	14.7		
Before the stock runs out	9	12.0	12	24.0
When the stock runs out	48	64.0	30	60.0
At any time	7	9.3	8	16.0
Total	**75**	**100.0**	**50**	**100.0**
Packaging method and quantity by supply				
0-30 boots of tops	13	17.3		
31-50 bunches of foliage	19	25.3		
Half-cart (51-60 boots)	26	34.7		
Whole cart (100-110 boots)	17	22.7		
0-20 bags of pods			21	42.0
21-40 bags of pods			27	54.0
41-100 bags of husks			2	4.0
Total	**75**	**100.0**	**50**	**100.0**
Storage mode				
On ground	5	6.7		
On plastic	10	13.3		
On used tires	40	53.3		
On wooden pallet	12	16.0		
On shed	8	10.7		
Used wheel bags			16	32.0
Bags on tarpaulin spread on the ground			26	52.0
Bags in store			8	16.0
Total	**75**	**100.0**	**50**	**100.0**

F.N: Cowpea leaves; C.N: cowpea pods; (%): Percentage; N: Number.

were supplied either at the level of producers (21.3%) or at the level of hauliers (26.7%). In the case of cowpea pods, a significant proportion (68%) of pod dealers also obtained their supplies from semi-wholesalers. They are indeed actors who have fixed places and who do not only sell the tops and pods in detail but also supply retailers or street vendors. A similar study was conducted by Habou (2013) where he showed that the feed supply is at the various outlets located in different neighborhoods and markets of the Urban Community of Niamey from wholesalers and semi-wholesalers. The quantity of boots supplied during the supply varies according to the storage capacity, but also the working capital of resellers. The dealers of haulms and pods refueled when their stocks have exhausted. The supply capacity of cowpea bean boots ranged from 51 to 60 bales for 34.7% of the dealers surveyed. In contrast, 13% cannot buy 30 boots. As for the pod dealers, 54% of them have the capacity to buy up to 21 to 40 bags. Regarding the storage method, the used tire deposit with plastic covers were used with proportions of 53.3 and 32% respectively for the retailers of haulms and cowpea pods. The supply locations and storage modes of

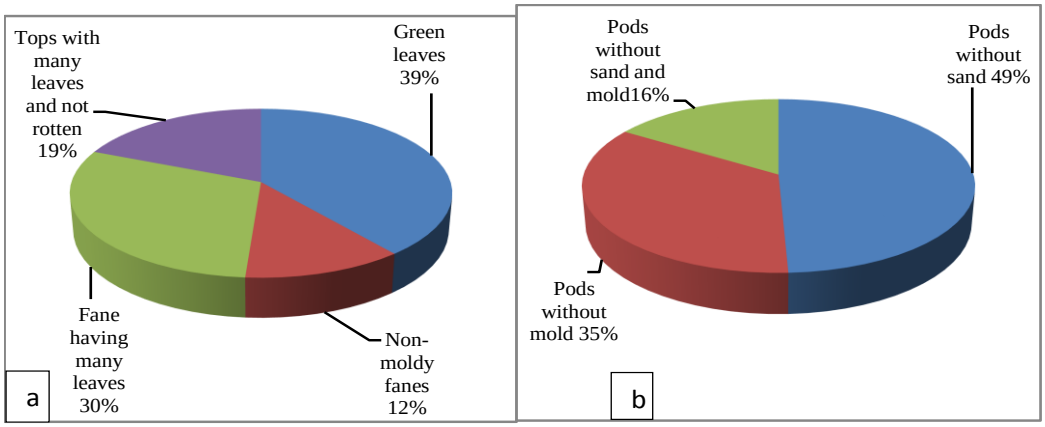

Figure 2: Requirement of quality of tops (a) and pods (b).

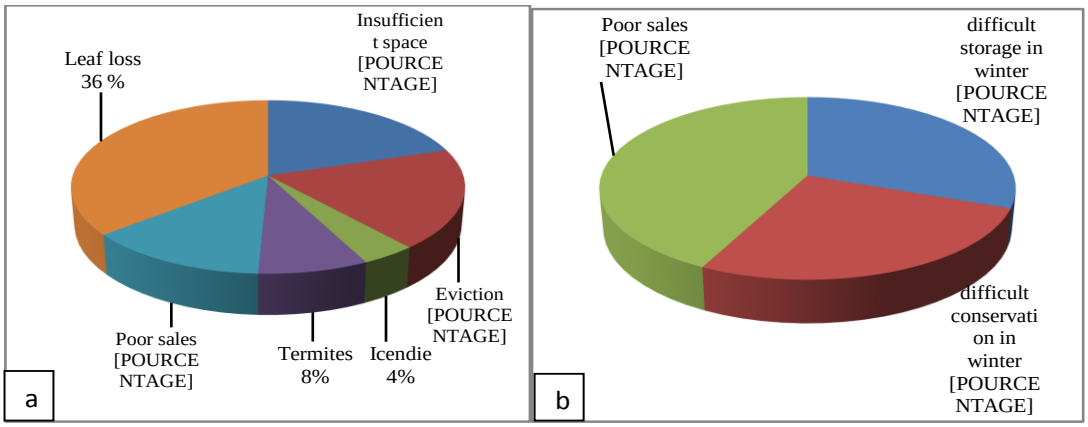

Figure 3: Difficulties of haulers (a) and pods (b).

cowpea by-products in the CUN are functions of proximity to source of supply (producers, semi-wholesalers, markets or hawkers) and storage facilities available.

The sale of cowpea by-products constitutes more than 50% of the respondents first source of income. A similar study was conducted by Maimouna (2012) where more than 80% of haulers in the urban and peri-urban area of Niamey claim that this income-generating activity enables them to support household expenses financially. However, the study conducted by INRAN (1997) showed that many of the producers (18 to 52%) sell tops to meet their food needs and 39 to 83% use it to supplement the ration of their animals.

Qualitative choice of cowpea by-products

Large quantities of cowpea by-products are valued by resellers according to their quality. These have requirements for the quality of tops or pods (Figure 2). A significant proportion of haulm sellers (39%) prefer green leafy tops, and pod sellers prefer sand less pods (49%). For traders, tops with green leaves are considered of high quality, followed by those of yellow color and finally having mold.

Constraints related to the marketing of cowpea by-products

The sale of cowpea by-products, like any other activity, is easy. According to the respondents, the loss of cowpea leaves (36%) was the main constraint, followed by a shortage (20%) of cowpea hay dealers. In pod dealers, the most common difficulty is the failure followed by storage problems in particular local insufficiency (31%) and the difficulty of conservation especially in the rainy season (27%) due to the prolonged effect of moisture causing the attack by molds. 19% of resellers have been victimized many times by the communal police (Figure 3).

Table 6: How to use cowpea by-products in CUN farms.

Modalités	Cowpea fane		Cowpea pod	
	N	%	N	%
Proxy				
Purchase	99	66.0	138	92.0
Production	8	5.3	00	00.0
Purchase and production	22	14.0	5	3.3
Any	21	14.7	7	4.7
Total	**150**	**100.0**	**150**	**100.0**
Form of use / method of distribution				
In bulk and in kind	115	75.7		
In nature	16	10.7	136	90.7
Crushed	4	2.7	5	3.3
No	14	9.3	9	6.6
Total	**150**	**100.0**	**150**	**100.0**
Association with other foods				
Stalk of millet or sorghum, grain cereal Gao	4	2.7	-	-
Cereal bran	-	-	79	52.7
Rest of cooking	-	-	11	7.3
Cereal bran and cooking residue	-	-	51	34.0
Any	146	97.3	9	6.0
Total	**150**	**100.0**	**150**	**100.0**
Advantage				
Well appeased by the animal	72	48.0	**-**	**-**
Easy to ingest by the animal	36	24.0	-	-
Give the animals an overweight	37	24.7		
No	5	3.3	7	4.7
Available anytime	-	-	44	29.3
Cheap	-	-	99	66.0
Total	**150**	**100.0**	**150**	**100.0**
Disadvantage				
Loss of leaves with handling	26	17.3	**-**	**-**
Loss of leaves or husk by the animal	23	15.3	9	6.0
It's expensive	66	44.0	**-**	**-**
Not always available	17	11.3	**-**	**-**
Rots and yellows easily	13	8.7	-	-
No	5	3.3	132	82.0
Mold with moisture	-	-	18	12.0
Total	**150**	**100.0**	**150**	**100.0**

How to use cowpea by-products in farms in the urban community of Niamey

Of those surveyed, 76.6% distributed natural hays in bulk and did not associate them with any other category of food (Table 6). However, young green leaves are used by man as a green vegetable (Laghetti et al., 1990). The combination of cowpea fane with cereal straw has already been recommended intensively and reared to optimize milk production (Singh et al., 1997). Cowpea pods were offered to natural animals (90.7%) or mixed with only cereal bran (52.7%). A proportion of 34% of breeders

Table 7: Daily flow of cowpea haul bunch per axis.

Registration day	Daily flow of cowpea haystacks per axis					
	Ouallam	**Fillingué**	**Kollo**	**Say**	**Torodi**	**Tillabery**
1st day	0	0	165	0	100	200
3rd day	659	410	310	110	210	0
6th day	0	212	0	198	0	200
10th day	456	180	198	260	475	105
14th day	400	450	190	0	200	0
21st day	150	300	0	295	380	200
28th day	700	260	700	306	189	100
36th day	600	717	300	400	75	100
45th day	400	500	300	200	100	0
55th day	800	220	450	300	200	300
Total	**4165**	**3249**	**2508**	**2069**	**1929**	**1205**
Avg / day	**416.5±286.7**	**324.9±200.6**	**250.8±183.4**	**206.9±133.9**	**192.±142.7**	**120.5±103.1**

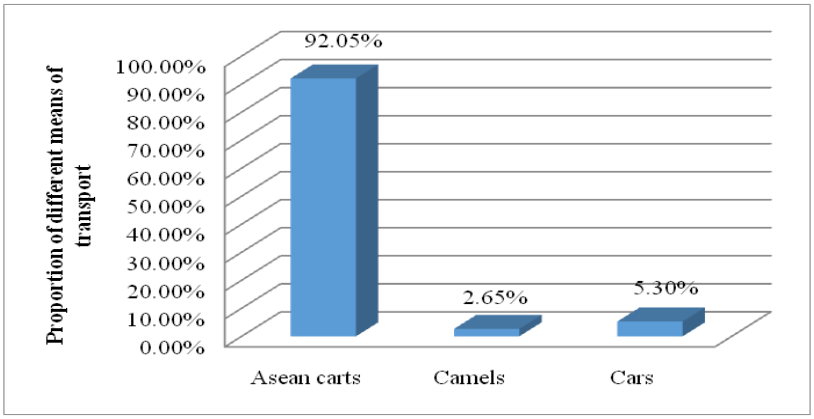

Figure 4: Means of transport used to haul the vines in the CUN.

distribute pods as a mixture with two ingredients namely cereal bran and cooking waste. In the same vein, cowpea pods are largely used during the dry season (Lawal, 2014) to supplement rations.

A proportion of 41.3% of stock breeders store the tops on sheds, 30.7% on the roofs of houses and 28% do not stock but buy small amounts for consumption daily. In terms of storage, the most stored foods in household concessions were cowpea haulms for 61.3% of respondents. The stocks were found during the period from October to January, following the harvest of cowpeas in the fields. For 28% of breeders, there was no preferential storage period, this depends on the quantity and quality offered by the dealers.

Flow and means of transport of cowpea haul

Transport flow of cowpea fane

The control carried out at the six axes (Ouallam, Fillingué, Kollo, Say, Torodi and Tillabery) made it possible to record the daily flows of cowpea haulm at these axes (Table 7). This control showed that the largest quantities of haulms were recorded on the Ouallam road followed by the axis of Fillingué and Kollo with respectively 416 ± 286.7, 324.9 ± 200.6 and 250.8 ± 183.4 bundled boots transported daily to CUN despite the same means of transport per axis. This can be explained by the fact that the producers of these localities produce cowpea for the vines and therefore have a lot more availability. The amount of tops conveyed to the CUN was higher during the harvest period and varies according to the season.

Means of transport

Figure 4 shows the means of transport of cowpea vines to CUN in order of importance. The donkey cart was the most used means of transportation (92%). It far surpasses other means of transport used including cars (5%) and camels (3%). This is due to the fact that the donkey cart is the

Table 8: Loss of prefanned leaves of haulms during transport.

N	Loading zone	Initial weight (kg)	Way of transport	Distance (km)	Final weight (kg)	Loss (kg)	Percentage (%)
Ouallam axis							
10 boots	Simiri	4.98 ±0.46	Cart	60 km	4.81±0.45	**0.17±0.08**	**3.38**
Say's axis							
10 boots	Sadoré	4.48±1.07	Cart	45 km	4.47±1.09	**0.24±0.11**	**4.78**

means of transport available to most producers and resellers. Similar studies have been conducted by Rio-Rio (2009) on the flow of green fodder from peri-urban areas to the city of Niamey. Garba (2008) and Dan Gomma and Ruppol (2000) have shown that several types of transport are used to transport livestock feed in the city. They are donkeys, carts, trucks and dromedaries.

Loss of cowpea leaves

The losses of leaves observed are shown in Table 8. Losses of 170 ± 0.08 g at 240 ± 0.11 g were recorded during the delivery of haul bales to the Urban Community of Niamey (CUN). They vary according to the condition of the tops, the distance, the state of the road handling during loading, and unloading.

Conclusion

In this study, the interviewed actors were adult men with a predominance of Djerma ethnicity among breeders and vine sellers, but at the level of pod sellers, the Hausas predominate. With grazing and feeding at the trough, animals are followed in association regardless of their sex or type of production in habitats covered by non-definitive material. The tops and pods are stored in various ways and especially from October to December, a period following the cowpea harvest. The distribution of haulms was in bulk and in kind, while cowpea pods were offered to animals in the wild or mixed with only cereal bran. There were losses of hay leaves depending on the place of loading, the means of transportation of the handling during the routing of the tops of the CUN. In order to better reduce losses of tops during handling and feeding of the animal and thus to optimize the use of cowpea by-products, a presentation of cowpea by-products otherwise than usual is necessary.

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