

# Small holder lamb fattening based on crop residues and agro-industrial by-products in northern Ghana

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## SUMMARY

In an on-farm study involving four sedentary mixed-farming communities in the Savelugu-Nanton District, a total of 29 intact rams (Djallonke × Sahelian) were fattened on two diets formulated from rice straw (urea-treated), pigeon pea waste, dry cassava peels and whole cottonseed. In Diet 1, cassava peels constituted the basal ingredient while in Diet 2, pigeon pea waste was major. Total daily dry matter (DM) intakes by rams were 958.0 and 852.3 g/head for Diet 1 and 2 respectively. Both diets supported appreciable body weight gain. Diet 1 appeared superior and ensured a significantly ( $P < 0.01$ ) higher average daily weight gain (ADG) of 130.0 g compared to 87.9 g recorded for Diet 2. Animals on Diet 1 had a feed efficiency ratio of 7.3 kg DM/kg gain as against 9.7 kg DM/kg gain by Diet 2. Economic considerations of the diets fed per ram indicated daily feed bills of ₵36.93 and ₵32.16 for Diet 1 and 2 respectively. The calculated profit margins per unit animal fattened were positive for both dietary options. The cassava peel-based option (Diet 1) yielded a profit margin 80 per cent higher than the pigeon pea waste-based diet (Diet 2).

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## Introduction

In northern Ghana, small ruminants (sheep and goats) can be found in almost every household in the villages. Sheep rearing is also common in the urban centres. Unlike cattle, small ruminant own-

## RÉSUMÉ

KARBO, N., ALHASSAN, W. S., ADONGO, S. A. & BRUCE, J.: *L'engraissement d'agneau de petit cultivateur basé sur les résidus de culture et les sous-produits d'agro-industriel au nord du Ghana*. Dans une étude sur-le-champs entraînant quatre collectivités de la polyculture sédentaire dans le district Savelugu-Nanton, une totalité de 29 béliers intacts (Djallonke × Sahelian) étaient engraisés sur deux régimes formulés de la pailles du riz (traitée d'urée), de déchet du pois de pigeon, de pelure sèche de manioc et de graine de coton intacte. Dans le régime 1, les pelures de manioc constituaient l'ingrédient basal alors qu'en régime 2 le déchet du pois de pigeon était majeur. Les consommations totales de la matière sèche (MS) quotidienne par les béliers étaient 958.0 et 852.3 g/tête pour les régimes 1 et 2 respectivement. Tous les deux régimes supportaient les gains appréciables du poids du corps. Le régime 1 apparaissait supérieur et assurait un gain de poids moyen quotidien (GMQ) de 130.0 g considérablement plus élevé, ( $P < 0.01$ ) comparé à 87.9 g enregistré pour le régime 2. Les animaux qui suivent le régime 1 avaient une proportion d'efficacité alimentaire de 7.3 kg MS/kg de gain contre 9.7 kg MS/kg de gain par le régime 2. Des considérations économiques des régimes consommés par bélier indiquaient un frais quotidien alimentaire de ₵36.93 et ₵32.16 pour le régime 1 et 2 respectivement. Les marges bénéficiaires calculées par unité d'animal engraisé étaient trouvées d'être positive toutes les deux options diététiques. L'option basée sur le pelure de manioc (Régime 1) rapportait une marge bénéficiaire de 80 pour cent plus élevée que le régime basé sur le déchet de pois de pigeon (Régime 2).

ership has no gender or age limitations (Gaari-Kweku, 1992). Small herd size holdings are predominant.

The West African Dwarf sheep, also known as Djallonke, is the dominant breed reared in the

region. Though prolific, this breed is known to have a slow growth rate. The adults attain mature body weights of 18 - 25 kg only in the second year of life (Alhassan, Karbo & Anamoh, 1995). Examining the potentialities and limitations of the Djallonke breed for mutton production in Ghana, Tuah & Abu (1988) advocated a cross-breeding programme if the animals in the forest belt are to reach a marketable weight of 20 kg in the year of birth (within 8 - 10 months).

At present, the use of Sahelian breeds of sheep (Uddah) for cross-breeding programmes involving the Djallonke in most parts of the northern Guinea savanna agro-ecological zone is on the increase. The cross-breeding is receiving government and external donor agency encouragement and support under various programmes such as the Smallholder Rehabilitation Development Programme (SRDP) in the Northern Region and the Land Conservation and Smallholder Rehabilitation Programme (LACOSREP) in the Upper East Region. These programmes are aimed at increasing meat production for consumption and maximizing rural income through the marketing of surpluses.

Djallonke × Sahelian crosses have improved body size compared to the local Djallonke. However, certain basic information on the fattening potential of these crosses (Djallonke × Sahelian) employing the Northern Guinea Savanna agro-ecology feed resources is conspicuously absent. Although about 70 per cent of the country is savanna grassland, there are serious feed shortage problems during the dry season. Crop residues can be used as feed during the dry season and it has been estimated that in the Savelugu-Nanton District of the Northern Region, the residues from groundnuts and cowpea alone could cater for 29 per cent of the feed requirements of the entire district (Tuah, Okai, Buadu, Asante-Kwatia & Smith, 1994). There is, however, a lack of information on the technical know-how otherwise much needed by the smallholder, mixed-farmer in the existing farming systems in the region to effectively utilize these resources. Quite a lot of residues and by-

products (rice straw, groundnut tops, pigeon pea waste, cassava peels, cottonseed, etc.) are generated from crop farming and processing activities by the farmers in the zone and these could be harnessed for the purpose.

The objective of the study was to formulate appropriate diets based on rice straw (urea-treated), pigeon pea waste (i.e. the pods, pieces of leaves and bits of grain), dry cassava peels and whole cottonseed for testing and possible adoption by farmers for fattening of surplus lambs on smallholder farms.

### Materials and methods

#### *On-farm project organization*

The Savelugu-Nanton District was selected for the project location for easy access. As such, the SRDP project sites of Nyong, Tinda, Tenkurugu, Nadigu and Kudeziegu which are well linked with the district capital (Savelugu) by feeder roads were initially visited to sensitize farmers and seek their mandate for a collaborative study in the fattening exercise of surplus lambs under the SRDP for marketing. Interested farmers in the Tendan, Nyong, Tenkurugu and Nagdigu communities indicated their preparedness to participate in the programme. On the average, the farmers at each of the sites agreed to contribute 5 - 10 surplus young rams of the Djallonke × Sahelian crosses for the exercise. In addition, they agreed to provide labour and appreciable quantities of dry cassava peels and pigeon pea waste for incorporation into the diets for fattening of the animals.

The project provided the technical know-how, wooden feeding troughs, dewormers and feed ingredients such as rice straw, urea, whole cottonseed, mineral salt licks and common salt.

#### *Formulated diets*

Rice straw was treated with urea (4 % W/W) according to the method described by Alhassan & Aliyu (1991). Samples of the various feed ingredients were collected and analyzed at the Animal Research Institute and Nyankpala Agricultural

TABLE 1  
*Composition of Diets Fed to Rams*

<i>Ingredients</i>	<i>Diet 1</i>	<i>Diet 2</i>
4% urea-treated rice straw, kg	0.276	0.276
Dry cassava peels, kg	0.607	0.205
Pigeon pea waste*, kg	0.100	0.606
Whole cottonseed, kg	-	0.273
Common salt, kg	0.006	0.006
<i>Calculated chemical content</i>		
Crude protein, %	15.2	15.7
Crude fibre, %	28.9	40.0
Phosphorus, g	2.8	2.4
Calcium, g	4.5	6.7

\* Pigeon pea waste is the by-product after threshing to obtain the grain and consists mainly of the pods, pieces of leaves and small amounts of grain.

Experiment Station Laboratories for their chemical composition. Proximate analysis was done according to the methods prescribed by the AOAC (1980). The data obtained was used in the formulation of two iso-nitrogenous diets to be fed to the animals. Diet 1 was based on dry cassava peel and Diet 2 on pigeon pea waste. Table 1 shows the composition of the diets.

#### *The on-farm feeding trial*

In an on-farm farmer-managed feeding trial, participating communities, viz. Nyong, Tenkurugu, Nagdigu and Tendan, were split into two groups and the animals in each group assigned to one of the two diets. Animals (*n*) at Tenkurugu (*n*=5) and Nagdigu (*n*=8) community locations were fed on Diet 1 and those at Nyong (*n*=6) and Tendan (*n*=10) received Diet 2. All the animals were intact males born in 1993 and were in the range of 6.5-9 months of age.

All the animals at each community site were put under complete confinement in pens roofed with thatch and group-fed *ad libitum* with respective diets. Drinking water and mineral lick were also provided *ad libitum*. The feeding exercise lasted for 33 days, between April and May 1994.

Before the start of the feeding trial, all the ani-

mals were dewormed with 'Nillzan' against endoparasites and initial body weights recorded. They were again weighed at the end of the feeding trial in order to determine any body weight changes to validate the participating farmers' visual assessment or opinion of the fattened condition of their animals.

Two weeks after the start of the feeding trials, feed intake was monitored. The refusals (leftovers) of the daily feed offered were collected for three consecutive days and weighed. Average feed intake was determined by taking the difference between the quantity offered daily and the daily leftovers. Furthermore, the leftovers were also sorted out into their component parts (straw, cassava peels, pigeon pea waste and cottonseed) in order to determine the percentage intake of the various individual ingredients.

#### *Data analysis*

The Excel Microsoft package was used to analyze data on the liveweights of the animals. Assuming equal variances, the t-test was used to test for any significant mean differences between diet treatment groups.

Cost-benefit analysis was carried out to determine the cost-effectiveness of the diets. Group farmer interviews were also held at three of the community sites to collate the views of both participating and non-participating farmers on the feeding programme.

## **Results and discussion**

### *Chemical composition and feed intake*

The chemical composition of the feed ingredients used in the diet formulation is presented in Table 2. Urea treatment of the rice straw (4 % W/W) increased the crude protein level in the straw three-fold. Quite characteristic of the crop residues, crude fibre levels were very high in the rice straw and pigeon pea waste. A judicious use of these resources in fattening diets will be required if feed intake and the digestibility of other nutrients are

TABLE 2  
*Chemical Composition of Feedstuffs, g/kg dry matter*

Parameter	4 % urea- treated straw	Untreated rice straw	Pigeon pea waste	Dry cassava peels	Whole cotton- seed
Dry matter (DM)	890.0	936.6	900.0	863.3	870.0
Crude protein (CP)	105.3	34.2	75.3	45.7	200.9
Crude fibre (CF)	339.3	362.2	310.5	107.6	189.7
Ether extract (EE)	8.1	17.1	-	8.7	158.3
Calcium (Ca)	3.8	3.5	6.5	3.2	1.1
Phosphorus (P)	0.71	0.46	0.54	0.60	5.5

not to be impaired.

Whole cottonseed, apart from being an important source of protein nitrogen and the lipids, could also be a vital source for phosphorus (P) supply to the animals for energy metabolism processes. Calcium (Ca) level in the pigeon pea waste was appreciable and agreed with previous findings (Karbo, Barnes & Rudat, 1993).

The average daily voluntary feed intake by rams is presented in Table 3. Of the four feedstuffs (ingredients) in the diets, only dry cassava peels

TABLE 3

*Mean Daily Feed Intake of Djallonke × Sahelian Rams Fed Pigeon Pea Waste and Cassava Peel Diets*

Parameter	Diet 1 (Cassava peels)	Diet 2 (Pigeon pea waste)
Total number of rams	13	16
4 % urea-treated rice straw, g	173.0	100.0
Dry cassava peels, g	608.5	210.0
Pigeon pea waste, g	100.6	467.1
Whole cottonseed, g	216.5	185.7
<i>Total intake/head/day</i>		
As fed basis, g	1098.6	962.8
DM basis, g	957.9	852.3
<i>Total nutrient intake/head/day</i>		
Crude protein, g	111.1	103.9
Crude fibre, g	221.6	262.3

and pigeon pea waste were familiar to the farmers. They were, therefore, of the opinion at the start of the trial that the animals would not eat the treated straw and the whole cottonseed. However, by the close of the feeding trials, the animals did eat. The pooled feed intake data revealed that 50 per cent of the straw and 65.5 per cent of the cottonseed was eaten.

Generally, both Diets 1 and 2 appeared palatable to the animals

and were well patronized. The overall daily voluntary intake of Diet 1 and 2 was 1.1 and 0.96 kg respectively. Correspondingly, the intake of feed dry matter (DM) and crude protein (CP) by animals on Diet 1 was higher. Though both diets were isonitrogenous, the higher level of crude fibre in Diet 2 (29.2 vrs 21.7%) most probably limited its intake.

#### *Liveweight performance*

Data on the liveweight performance of animals at the four community sites were pooled for each community pair receiving the same dietary treat-

TABLE 4

*Liveweight Performance of Djallonke × Sahelian Rams Fed Pigeon Pea Waste and Cassava Peel Diets*

Parameter	Diet 1 (Cassava peels)	Diet 2 (Pigeon pea waste)
Duration of feeding, days	33	33
Mean initial liveweight, kg	22.1 (s.e. 1.74)	20.4 (s.e. 1.85)
Mean final liveweight, kg	26.4 (s.e. 2.01)	23.3 (s.e. 1.79)
Total mean gain, kg	4.3 (s.e. 1.30)	2.9 (s.e. 0.84)
Mean daily gain, g	130 <sup>a</sup> (s.e. 0.019)	88 <sup>b</sup> (s.e. 0.008)
Feed efficiency kg DM /kg gain	7.30	9.70

<sup>a</sup> Means in a row with different superscripts are significantly different ( $P < 0.01$ ).

ment (Table 4).

The average daily weight gain was 0.130 kg (SE 0.019) for rams fed Diet 1 and 0.088 kg (SE 0.008) for those fed Diet 2. Considering the fact that both diets were high in fibre for this production group of animals, one could describe the growth performance recorded in the study, generally as quite good and encouraging. The provision of fermentable nitrogen from urea, by-pass protein from whole cottonseed, and easily hydrolyzable carbohydrate and possibly by-pass energy from the cassava peels, and minerals in the licks most probably positively influenced rumen function leading to the efficient utilization of such fibrous diets. This explanation is supported by the findings and views of many workers (Kempton, Nolan & Leng, 1977; Talavera, 1987; Preston, 1982) on the utilization of crop residues and agro-industrial by-products in tropical livestock feeding systems.

Due to the variety of cassava cultivated in northern Ghana and the method or technique of peeling the cassava roots, a lot of flesh is often left

attached to the skin. Since both diets in the study were iso-nitrogenous, the abundance of by-pass energy in the form of starch remaining in the cassava peels is suggested to have helped sway the feed utilization efficiency in favour of the cassava peel-based diet compared to the pigeon pea waste-based diet.

#### *Economic analysis*

The recorded indicators of feed intake and liveweight gains in the study were used in a cost-benefit analysis to ascertain profit margins (Table 5). Labour costs were not included in the analysis since farmer labour was not costed.

The profit margins appeared to be positive for both diets. However, the cassava peel-based diet yielded a profit margin of 80 per cent more than the pigeon pea waste-based diet. Based on current market prices, the calculated ingredient costs per unit diet was ₵37.33 and ₵30.05 for Diet 1 and 2 respectively. The inability of the least costing diet (Diet 2) to ensure an equal or higher profit margin

TABLE 5

*Economic Analysis of Short Duration Fattening of (Djallonke × Sahelian) Young Rams on Cassava Peels and Pigeon Pea Waste Diets*

Parameter	Cost unit (₵/kg)	Diet 1 Cassava peel-based		Diet 2 Pigeon pea waste	
		Quantity, g	Amount, Cedis	Quantity, g	Amount, Cedis
<b>Cost</b>					
1. Feed					
4% urea-treated rice straw	14.80	173.0	2.56	100.0	1.48
Dry cassava peels	20.00	608.5	12.17	210.0	4.20
Pigeon pea waste	19.00	100.6	1.91	467.1	8.87
Whole cottonseed	90.00	216.5	19.49	185.7	16.71
Common salt	150.00	6.0	0.90	6.0	0.90
Total cost/ram/day	-	-	36.93	-	32.16
Cost/ram for 33 days	-	-	1218.89	-	1061.28
2. Veterinary drugs					
Nillzan dewormer	1700.00	10 ml	170.00	10 ml	170.00
3. Total costs/ram (1+2)	-	-	1388.69	-	1231.28
<b>Benefit</b>					
Mean weight gain/ram	900	4300.0	3870.00	2900.0	2610.00
<b>Profit margin</b>					
Per ram	-	-	2481.31	-	1378.72
Percent margin over Diet 2	-	-	180.00	-	100.00

seems to suggest that decisions on the choice of diets for increased productivity should not always be based on unit cost considerations alone. It is essential to also consider the biological value of the diet or its ability to enhance higher animal performance.

#### *Farmer response*

A total of 14 farmers from the four communities (Tindan - 5, Tenkurugu - 3, Nyong - 1 and Nagdigu - 5) voluntarily contributed the total of 29 Djallonke × Sahelian young rams for the fattening exercise. When told to comment on the exercise in general, the views from community to community were not different. The diet used at each community was declared good since to the farmers the animals changed and gained weight appreciably.

The observation by the farmers was that, the animals were marketable in the first year of birth and the income from the sales was much higher than what they earlier received for their animals that had been on the farm for two or more years. A sample of some sales made revealed that ₵15,000.00 was the lowest and ₵27,000.00 the highest price received per ram sold. Apparently, with this scenario, the individual farmers, including those who did not participate in this particular exercise expressed their willingness to adopt the technology during the group discussions at all the centres.

#### **Conclusion**

The on-farm study has demonstrated that Djallonke × Sahelian young rams on smallholder farms in the village communities in northern Ghana can be fattened on the given practical diets incorporating cassava peels, rice straw (4% urea-treated), pigeon pea waste and whole cottonseed.

The two diets used in the study were all promising in terms of animal growth rate and the accruing profit margins.

The relatively short duration of fattening as a technology could prove beneficial to farmers who at times are called upon to sell their animals at short notice. However, there is still the need to conduct studies over a longer duration (2-3 months) in order

to further expose the potential of these crosses under such conditions. Furthermore, it will be pertinent to compare the fattening qualities (growth rate, slaughter weight, carcass quality, feed efficiency, etc) of the parent material—the Djallonke—with the crosses (Djallonke × Sahelian) on such practical diets.

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