

Evaluation of existing and potential feed resources for ruminant production in northern Ghana



Produced by:

Solomon P. Konlan¹, Augustine A. Ayantunde², Herbert. K. Dei¹,
and Franklyn K. Avorny³

¹Department of Animal Science, University for Development Studies, Tamale.

²International Livestock Research Institute

³Council for Scientific and Industrial Research, Animal Research Institute, Tamale

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Through action research and development partnerships, Africa RISING will create opportunities for smallholder farm households to move out of hunger and poverty through sustainably intensified farming systems that improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base.

The three projects are led by the International Institute of Tropical Agriculture (in West Africa and East and Southern Africa) and the International Livestock Research Institute (in the Ethiopian Highlands). The International Food Policy Research Institute leads an associated project on monitoring, evaluation and impact assessment.



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Summary

A survey was conducted in six communities to evaluate and document the existing and potential feed resources, their uses and seasonal gaps with respect to ruminant production in northern Ghana. The six project communities (Tingoli, Tibali, Gia, Bonia, Papu, and Guo) were selected based on small ruminant population in the communities

Qualitative and quantitative surveys were carried out using Feed Assessment Tool (FEAST). The data was collected through Participatory Rural Appraisal in community focus group discussions and individual interview using structured questionnaire.

Mixed crop-livestock farming system was found to be the common practice among the smallholder farmers in all communities. The crops grown in the area included cereals (maize, rice, sorghum and millet) and legumes (groundnut, cowpea, soya beans, and bambara groundnut). The animals reared were cattle, sheep, goats, donkeys, pigs, and poultry such as local chicken and guinea fowls. Livestock production constraints identified were poor housing, disease incidence with high mortality rates, inadequate feed in the dry season and high cost of veterinary drugs. Others were inadequate veterinary services, lack of improved breeds, inadequate technical knowledge and low farm gate prices of animals. Opportunities available in the study area included: availability of pasture / grazing land for ruminants, high market demand for livestock and livestock products, low animal theft cases and availability of labour for livestock husbandry (e.g. Fulani herdsman and household labour).

Feed resources found in the area for ruminant feeding were crops residues (groundnut haulms, cowpea hay, pigeon pea residue (mixture of pods and leaves), rice straw, sorghum heads, yam and cassava peelings), and natural pasture. Agro-industrial by-products like corn mill waste flour, brewers' spent grain, maize bran, and rice bran were found. Also, few households had stands of browse trees like *Leucaena leucocephala*, pigeon pea (*Cajanus cajan*), *Gliricidia sepium*, acacia and mango trees.

The study revealed that feedstuffs were more accessible to ruminant after crop harvest and shortage gap identified in dry season which becomes critical from February to April annually.

It was concluded that production constraints like high incidence of disease and mortality and dry season feed gaps were major factors affecting smallholder livestock production in Northern Ghana. The availability of grazing land, however, presented a good production opportunity if feed resources it contained could be well managed. Also, for improved livestock productivity, efforts should be made to reduce the incidence of diseases through health care service provision and good supplementary nutrition. Critical period of feed scarcity that occurs between February to May annually could be partly addressed through feed conservation.

Introduction

Livestock production is an important component of agricultural activities in developing countries and contributes substantially to smallholder farmers' livelihood and the sustenance of households (Mamabolo and Webb, 2005). It plays an important role in the farming system as a risk coping strategy options in farm diversification. Integrated crop – livestock farming is the predominant system of agricultural production among smallholder farmers in Sub-Saharan Africa (Oppong-Anane, 2013). In Ghana, livestock sector including poultry contributes about 6.1 percent of agriculture Gross Domestic Products (MoFA, 2011). The sector supplies not only meat, milk and eggs as a source of animal protein to enhance the nutritional status of the human population but also provides skins, bones, blood and horns for various uses. Manure from livestock is now an invaluable resource to crop and vegetable farmers for the maintenance of soil fertility and structure (Masikati, 2010; Awuma, 2012; Oppong-Anane, 2013).

Livestock production system in northern Ghana is constrained by many factors of which feed shortages in terms of quantity and quality during the dry season constitute a major challenge (Oppong-Anane, 2013). Accessibility of available feed in the wet season is another limitation in certain times of the year in some communities in northern Ghana due to the cultivation of arable crops (Awuma, 2012). This feed challenge together with high incidences of diseases and mortality contribute significantly to low livestock productivity.

In the savanna zone of northern Ghana, bush fires and decline in nutritive value of fodder resulting from senescence makes it difficult for livestock to meet their nutritional requirement in the dry season under the existing extensive and free range management systems practiced by most smallholder farmers. Indeed many of the animals reared in northern Ghana survive mainly on left over straw during the dry season. Such a situation has long been recognized to result in cyclic body weight gain in the rainy season and weight loss in the dry season (Annor et al., 2007). These have made feed for livestock to be the main constraint to improved productivity in smallholder systems. As a result of inadequate diagnosis, technological feed interventions tend to adopt a scattergun or trial-and-error approach which often fails to adequately address the feed and other related constraints and therefore livestock productivity remain marginally low (Duncan et al., 2012). It is therefore important to fully understand the spectrum of the feed constraints to enable the development of good and sustainable technological interventions to address the issue. This calls for detailed diagnosis of the livestock production system to identify the constraints that can be addressed alongside feed-related constraints.

Objectives

The main objective was to evaluate and document the existing and potential feed resources, their uses and seasonal gaps for ruminant production.

Specific objectives were:

1. To assess year-round feed availability and seasonal gaps.
- 2 To identify site-specific feed and other related livestock production constraints and opportunities.

Materials and methods

Study sites

The study was conducted in Northern Ghana (Northern, Upper East and Upper West regions of Ghana). The combined area of the regions is 97.702 km² and represents approximately 40.8 % of Ghana's landmass and contains 17.1% (3.346 million people) of Ghana's population with 34 persons / km² (GSS, 2012). The three regions are located within latitude 9.3758738 S and 10.235586 N and longitude 2.608257 W and 0.84398 E in the Guinea and Sudan Savannah agro - ecological zone with annual mean rainfall of 1204, 937 and 947 mm for Northern, Upper East and Upper West regions respectively with a zonal annual mean of 1029 mm. The rainfall is unimodal and begins in April/May to October (MoFA, 2011; Opong-Anane, 2013). Length of growing season is 150-200 days with dry spells of up to 10 days or more in rainy season. The vegetation consists of short, deciduous, widely spaced, fire-resistant trees and shrubs, which do not form close canopy and the general ground floral cover is solely grass of varying heights. More often, the soil surface is bare in the dry season after bush fire (Amankwah et al., 2012; Opong-Anane, 2010).

The communities where the study was conducted were Tingoli, Tibali, Gia, Bonia, Papu, and Guo within Africa RISING project selected sites in Northern Ghana. Tingoli is in Tolon district and Tibali in Savelugu district both in Northern Region, Gia and Bonia are both located in Kassena-Nakana district of Upper East Region while Papu and Guo are in Nadowli and Wa West districts respectively in Upper West Region.

The study sites were selected based on community and household typologies using a review of available bio-physical (land cover, length of growing period, slope, rainfall, agro-ecological zones, elevation) and socio-economic data (IFPRI, 2012). The communities were then stratified based on similarities in the length of growing period (LGP) into domains. The six study communities were then chosen at random within the domains covering the Savannah and Sudano – sahelian zones of northern Ghana.

The approach of the study

Qualitative and quantitative surveys were carried out using Feed Assessment Tool (FEAST) (ILRI, 2012). FEAST was chosen because it offers opportunity for identification of site specific livestock feed and other related production constraints and opportunities that were the main objectives of this work. This tool comprises Participatory Rural Appraisal (PRA) and structured questionnaire for individual interviews. Therefore, focus group discussions and individual interviews were carried out for data collection. PRA focus group discussions were conducted and handled by a facilitator, interpreter, two note takers and one observer in each session. The farmers (PRA participants) were selected based on information from the interaction of key informant with the community members through which crop and livestock farmers were identified and classified into three classes of wealth endowment (i.e. average, above average and below average) using the community standards (Duku et al., 2010). In each community, 18 farmers (12 men and 6 women) were selected for the survey, giving a total of 108 farmers in all the six communities. After the PRA, 12 farmers were selected in each community for quantitative data collection through semi-structured questionnaire. Some of the questions addressed included:

Animals – What types of livestock do you currently own? What is the approximate weight of each animal? What is the dominant breed?

Crops - What crops do you grow on your farm? How much would you normally expect these areas to yield? What do you do with the residue material?

Cultivated fodder - What plants (including deliberately planted forage trees) are grown on your farm for the sole purpose of feeding livestock? How much area is used to grow these crops?

Production per household - How many ruminants (cattle, sheep and goats) have been sold (or slaughtered for home consumption) over the past 3 years? What was the approximate weight of the animals sold?

Collected fodder - Do you collect any feeds for your animals? If so, how much does this source of feed contribute to the diet of the animals?

Purchased feed - What feeds do you purchase (if any) over a 12 month period? How much does it cost to purchase the feeds? How often do you purchase the feeds?

Grazing - Do the animals spend any time grazing? If so, how much does this source of feed contribute to the diet of the animal (as a percentage)?

Among the selected farmers, 4 of them were in each wealth group who responded to the individual questionnaire interview for their households. The duration of the data collection was six weeks from mid-September to end of October, 2013.

Data analysis

The data analysis was done using FEAST data template version 1.051 (Duncan et al., 2012). Data collected were entered into FEAST data template and produced output in the form of figures and tables to summarize the results using FEAST data template in build formulae.

The estimated values of farmlands, households' sizes and average livestock ownership collected during PRA sessions and the mean areas of dominant crops extracted from the FEAST excel analysis were inputted into SPSS statistical program (PASW statistics version 17) and analyzed with the procedure of general linear model, univariate analysis of variance and means compared using Least Significant Difference (LSD) at 0.05 level.

Results and discussion

Household characteristics, land holdings and sources of income

The results show that all the studied communities do not have landless households except in Bonia where landless households constituted 2% of total households (Table 3.1) and were attributed to the movement of farmers from different communities to Bonia to utilize the irrigation facility.

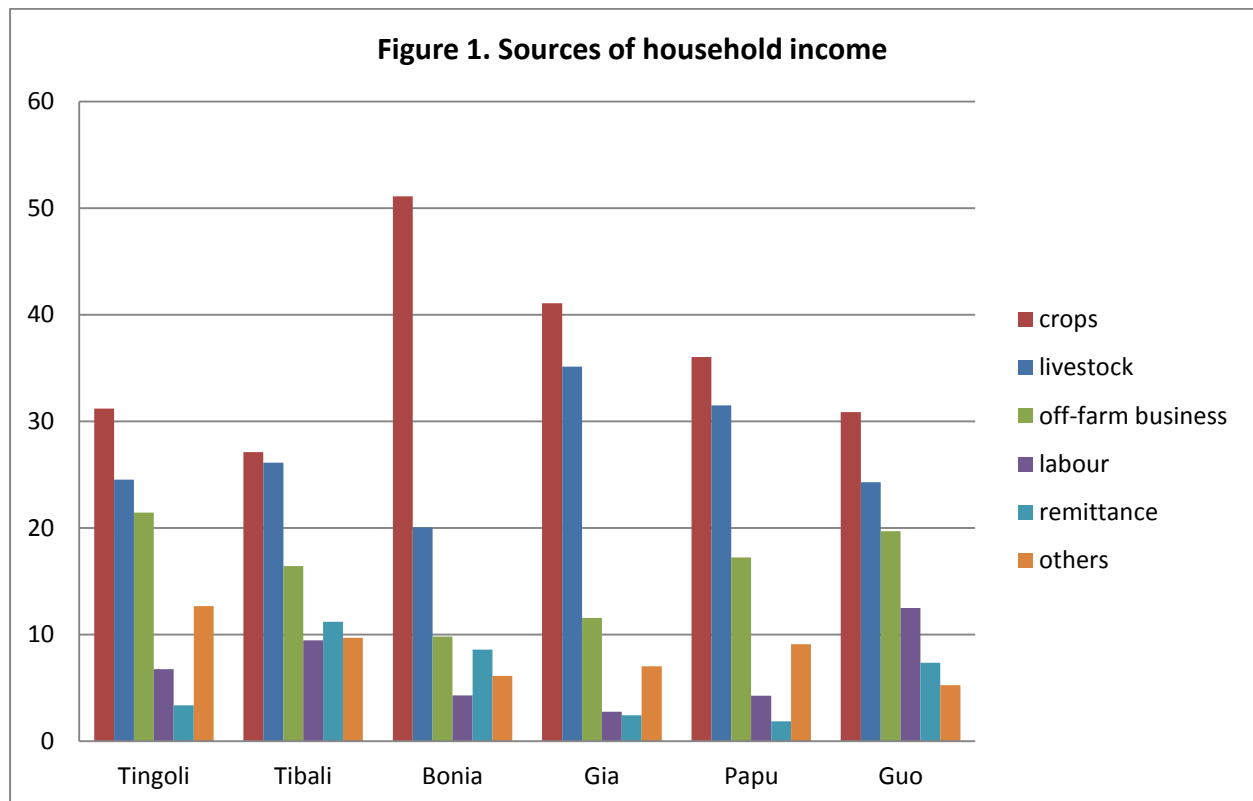
Households in each community of the study sites were grouped into four categories based on wealth ranking according to the respondents in each community. The households' land holding was the major criteria used for the categorization in most of the communities. Other factors used were number of livestock owned, family size and quantity of harvested grains per households.

In most of the communities, land could be sold, leased or given out on demand but in other communities such as Tingoli, sale of land was not allowed according to the community traditions. It could however be leased to interested farmers on request for cultivation. In the other study communities in Upper East and West Regions, land ownership was largely by inheritance and land was held in trust by family heads. For the categorization based on wealth (land and livestock holdings), table 1 shows the proportions of households in each community.

Table 1. Categories of households based on wealth

Category of farmers	Farmland size	Livestock Numbers (ruminant)	Quantity of food harvested (in bags)	Percentage of households in each category
Tingoli Community				
Landless	0	0	0	0
Smallholder farmer	Less than 2 acres	<6 animals	<5	30
Medium holder	3 to 10 acres	6-30 animals	5-10	50
Large farmer	More than 10 acres	>30 animals	50 or more	20
Tibali Community				
Landless	0	0	0	0
Smallholder farmer	Less than 3 acres	<6 animals	<5	30
Medium holder	3 to 10 acres	6-30 animals	5-10	60
Large farmer	More than 10 acres	>30 animals	50 or more	10
Gia Community				
Landless	0	-	-	0
Smallholder farmer	Less than 3 acres	-	-	50
Medium holder	3 to 10 acres	-	-	30
Large farmer	More than 10 acres	-	-	20
Bonia community				
Landless	0	-	-	2
Smallholder farmer	Less than 3 acres	-	-	28
Medium holder	3 to 10 acres	-	-	50
Large farmer	More than 10 acres	-	-	20
Guo Community				
Landless	0	0	0	0
Smallholder farmer	Less than 3 acres	<6 animals	<5	50
Medium holder	3 to 10 acres	6-30 animals	5-10	30
Large farmer	More than 10 acres	>30 animals	50 or more	20
Papu community				
Landless	0	-	-	0
Smallholder farmer	Less than 3 acres	-	-	25
Medium holder	3 to 10 acres	-	-	60
Large farmer	More than 10 acres	-	-	15

Common livelihood activities that contributed to household's sources of income in the study sites included: crop farming, livestock rearing, small scale off-farm businesses, labour, remittances and others. The levels of each activity's contribution to the household income generation are shown in figure 1. The results indicated that, crop farming was the first source of household income. Other sources of income were livestock rearing and off-farm activities such as petty trading. Remittance was found to be the lowest source of household income in the study sites.



Household sources of income generation identified in this study suggest that agriculture is the main source of income for the livelihood of the rural households and agree with the report of MoFA, (2006) on sources of households' income in the same study area. In the case of Guo where off-farm business was the highest income source among all, it is attributable to the proximity of Guo community to Wa township where trading activities are high (MoFA, 2007).

General description of farming systems

Mixed crop-livestock farming was the common practice among the smallholder farmers in all the selected communities of the three regions of northern Ghana. Similar finding was reported by Opong-Apanne, (2013) and depicts the livelihood activities of the farmers in the zone

Cultivation of crops in the homestead referred to as 'compound farming' was also very common and practiced annually except in Tingoli, where communal agreement had to be made annually as to whether they would do compound farming or not. Farming systems practiced were mixed cropping where cereals and legumes were planted in the same field while others did mono-cropping (Kombiok et al., 2006).

Table 2 shows mean values of farmland size per household estimated by farmers. The mean household farm sizes varied between 2.3 and 6.3 ha with an overall mean of 3.4 ha. At the regional level, it was observed that Northern Region had the highest mean value of farmland size per

household and Upper West Region recorded the lowest. This is similar to 4.69 ha mean farmland size per household reported by Ohene -Yenchera (2004) in the West Gonja District of Northern region but did not agree with the 2 ha per household reported by Karbo (2012) in the same zone and the difference might be attributed to differences in study communities as the current study sites were mainly rural and the one reported by Karbo (2012) included urban communities where there are competing land uses. Average farm size owned by the household were influenced by myriad of factors that farmers faced in deciding on the land area to cultivate such as land tenure system, labour, availability of mechanical or animal traction implement and animals for land preparation (Ohene-yenchera, 2004).

At the community level mean household size observed in the study sites was 11.5 people per household. Tingoli had the highest mean value of 18.0 people per household. The details are presented in Table 2 and include regional mean values.

Table 2. Farm land and household size

Communities	Farmland Size (ha)	Household size
Tingoli	2.3	18.0
Tibali	6.3	11.8
Bonia	3.6	8.4
Gia	2.5	8.6
Papu	3.2	11.8
Guo	2.7	10.4
Overall mean	3.4	11.5
Regions		
Northern	4.3	14.9
Upper East	3.1	8.5
Upper West	2.9	11.1

This present finding of mean household size is higher than the 6.6 mean household size reported by GSS (2012) in the same area. The difference may be due to the rural nature of this current study compare to the mean of both urban and rural households data used in GSS (2012) report.

The results of rainfall pattern as scored by the PRA participants on a scale of 0 (none) to 5 (abundant) are presented in Table 3 It showed similar rainfall distribution patterns throughout northern Ghana with little differences at the beginning and end of rainy season.

Table 3. Annual rainfall distribution pattern

Region	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Upper West	0	0	0	1	2	2	4	5	3	2	0	0
Upper East	0	0	0	2	3	2	4	5	5	2	0	0
Northern	0	0	0	1	2	4	5	4	5	3	0	0

Seven months of rainfall (April to October) with peak rains coming in June to September and 5 months of dry period (November to March) were discovered from the PRA sessions. The rainfall pattern influences the occurrence of two seasons in the area namely dry and wet seasons. Similar

finding of rainfall and dry season duration were reported in the study area and was described as having two distinct seasons (Opong – Anane, 2006).

It emerged from the PRA discussions that there were two sub-seasons with slight differences in both wet and dry seasons. The sub-seasons in dry season were windy dry (November to January) and warm - moist dry (February to April) and in the wet season, the sub-seasons were early wet with little rainfall from May to July and the main wet season with frequent and heavy rainfall from August to mid-October. This agrees with the popular assertion of rainfall start and end periods of the two seasons (rainy and dry seasons) in the ecological zone (Opong-Ananne, 2013; Kwaku Agymang, 2012; MoFA, 1998)

One cropping season was the consensus of all the PRA discussions in Northern Ghana with major farming operations starting from June and end in November. This starts mostly with yam, cassava and vegetables nursing after land preparation. The minor crops planted in August and harvested in October. Table 4 below gives the major farming activities and annually operation periods.

Table 4. Major farming activities and operation period

Major farming activity	Period of activity in months											
	J	F	M	A	M	J	J	A	S	O	N	D
Land preparation												
Planting												
Planting and weeding												
Weeding and late planting												
Fertilizer application												
Second weeding and planting late crops												
Harvesting begins												
Major harvesting												
Harvesting late crops												

The PRA results show that, over 90% of the farmer in many study communities had no access to irrigation facilities except Bonia in Kassena Nankana district of Upper East Region, where over 80% of the households had access to irrigation facility. As a result over 60% of the households cultivated rice and vegetables like tomatoes, pepper, and garden eggs under irrigation in the dry season. It was estimated in Bonia that, 15% of the farmers who utilized the irrigation facility came from different communities. The proximity of Gia to Bonia has given access to about 15% of Gia households to the irrigation facility for dry season farming. None availability of irrigation facilities to high percentage of farmers in Northern Ghana for dry season cultivation of crops and vegetables has been reported by many workers (FAO 1997; SEISI, 2003; Regassa et al., 2011) and actually limits the productive ability of farmers in the dry season (Oppong-Apane 2013).

The study showed that labour was available in all the communities in Northern Ghana in two forms, household labour and hired labour. The household or family labour was averagely 70% available per household per year while hired labour covered the remaining 30% of the year’s requirement. Labour was mostly required during planting, weeding and sometimes harvesting in all communities. The labour demand for weeding operation was the highest among the three operations mention above.

The cost of labour varied according to duration of work: the mean cost for six hours (7:00 am – 1:00 pm) duration of work was 2.5 US Dollars (GHC 5) per adult equivalent and for two hours (1:00pm – 3:00pm) the cost was 1.25 US Dollars (GHC 2.5) per adult equivalent in all the study locations. Weeding was sometimes done on contract basis in acres and the cost of weeding one acre varied according to area covered by weeds and the bargaining capacity of both parties. The average cost was 15 US Dollars per acre (GHC 30.00).

In Bonia and Gia, harvesting of crops like maize, millet, sorghum and rice was mostly done by women in the area and payment made in kind relative to the quantity harvested. Payment in kind entails giving some proportion of the food crops harvested as cost of labour for harvesting operation especially the cereal crops. For example in some communities, payment for harvesting one bag (82 kg) of rice is 12kg of the harvested rice. There was a communal labour system in many places where people form communal or family groups and take turns to work on group members' farms at no fee but food was provided. In most communities, some of these groups were available for non group members to hire at the prevailing cost per person per day.

The results show that an average of 15% of the communities' labour force drifted to cities and towns, for educational and engagement in formal and informal sector jobs but that of Bonia was 10% for education and formal sector employment. This was due to high labour requirement at the irrigation fields throughout the year in Bonia. The labour mean cost obtained in the study sites agrees well with the finding of MiDA (2013) that farmers typically pay in the range of 2.22-3.57 US Dollars (GH¢3-5) per day for agricultural labour. Also, the payment in kind for labour for some farming operations such as cereal harvesting confirm the findings of IFPRI (2011) on cropping practices and labour requirement survey. It is a common payment form for women rendering harvesting related labour in many rural communities.

The crops grown in the study area were cereals (maize, millet, sorghum and rice), legumes (groundnut, cowpea, soy bean, pigeon pea, bambara bean) and tubers (yam and cassava). Maize, rice, yam and groundnut were the major arable crops among which maize was the most common (MoFA, 2011) in all the communities except Bonia where rice dominated due to the presence of the irrigation facility. The mean areas (hectares) of dominant crops are presented in Table 5. Maize cultivation was significantly higher ($P < 0.05$) than groundnut and yam. The differences in areas of cultivation have been reported to emanate from the contribution of the crop to the diet of population (MoFA, 2011).

Table 5. Mean area of dominant crops

Crops	Mean area (hectares)	SEM
Maize	1.18 ^a	0.158
Rice	0.75 ^{ab}	0.173
Groundnut	0.55 ^b	0.158
Yam	0.22 ^b	0.194

Means with different superscripts in the same column are significantly different ($P < 0.05$).

These were mostly grown for food and the residues used fully or partially as feed depending on the type of crop. Most legume residues were collected and used as animal feed more than the cereal straws Awuma, (2012).

Average areas for the dominant crops in each site are presented in Figures 2 to 7.

Figure 2. Average area (ha) per household of dominant arable crops in Tibali

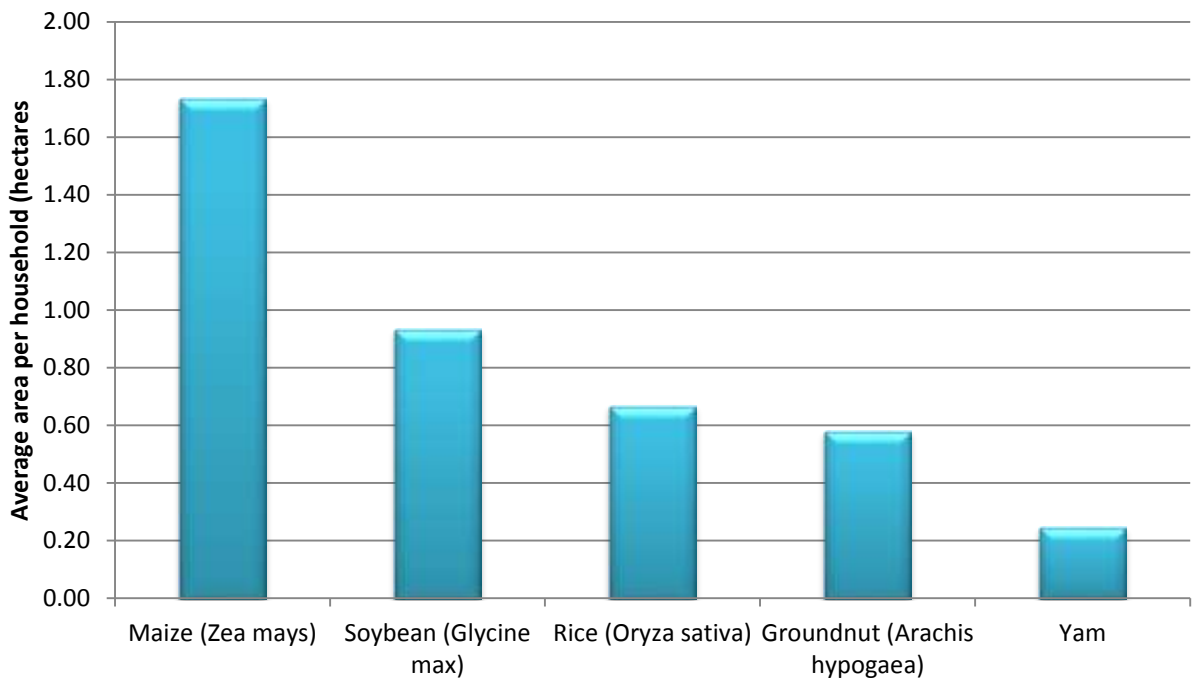


Figure 3. Average area (ha) per household of dominant arable crops in Tingoli

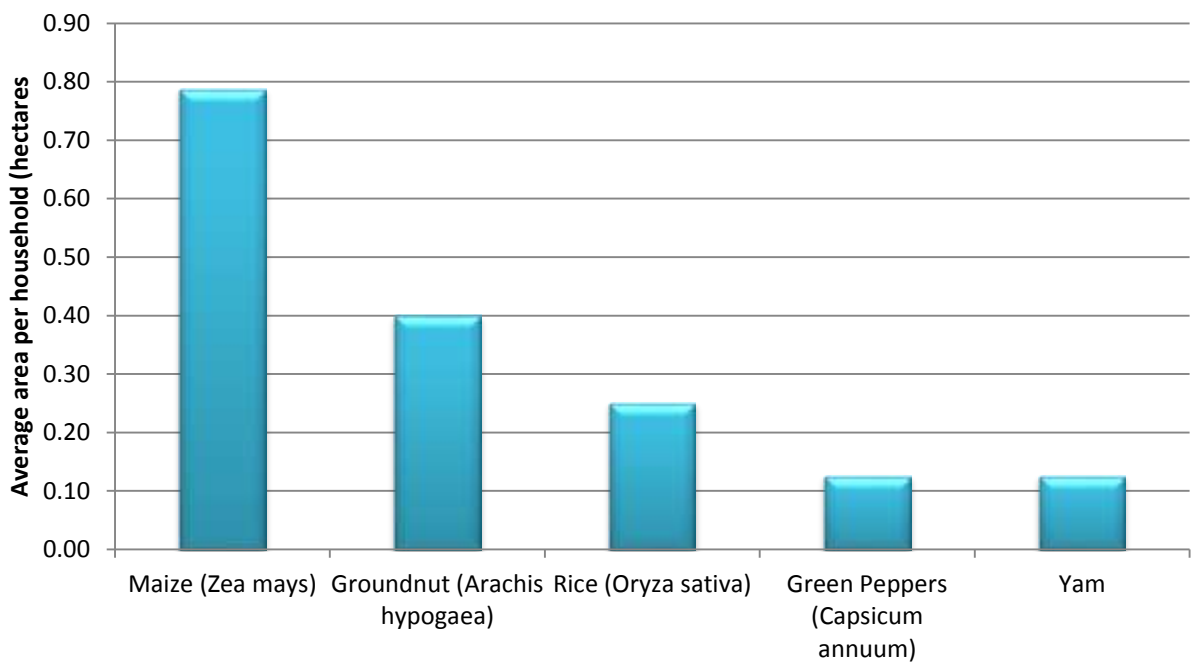


Figure 4. Average area (ha) per household of dominant arable crops in Gia

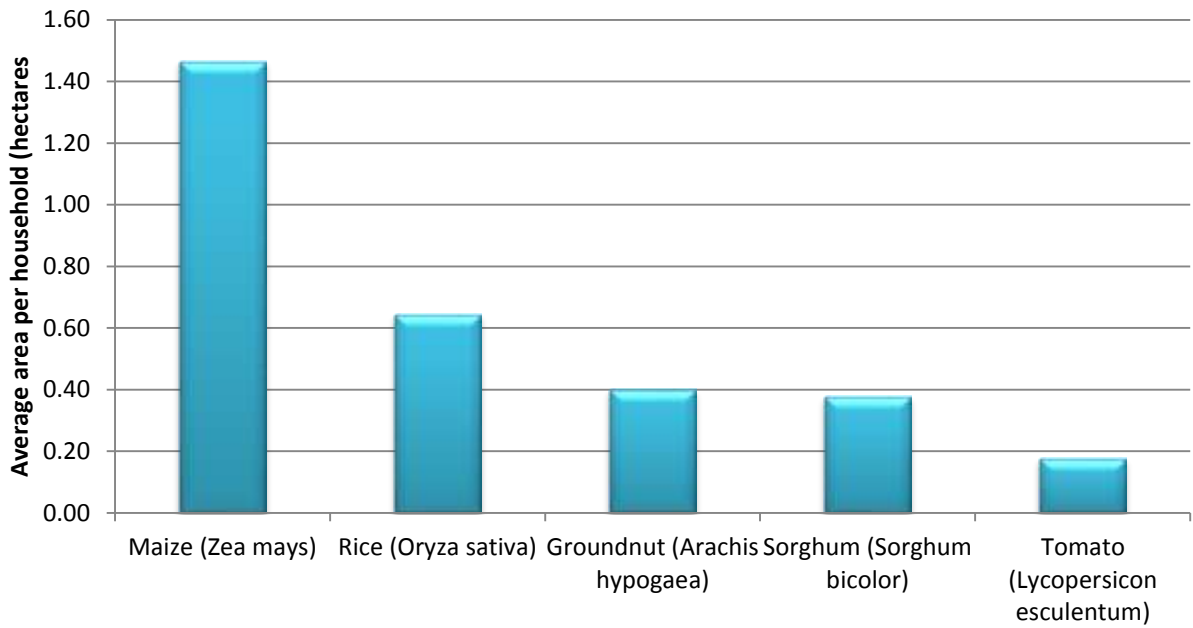


Figure 5. Average area (ha) per household of dominant arable crops in Bonia

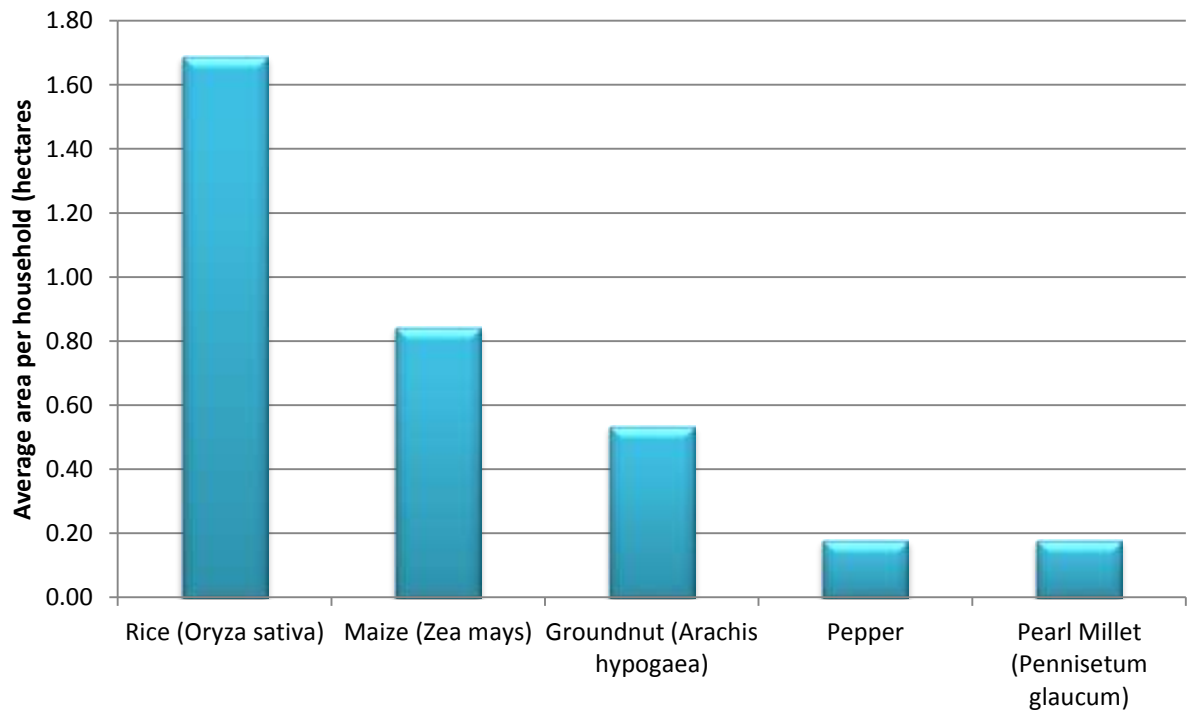


Figure 6. Average area (ha) per household of dominant arable crops in Papu

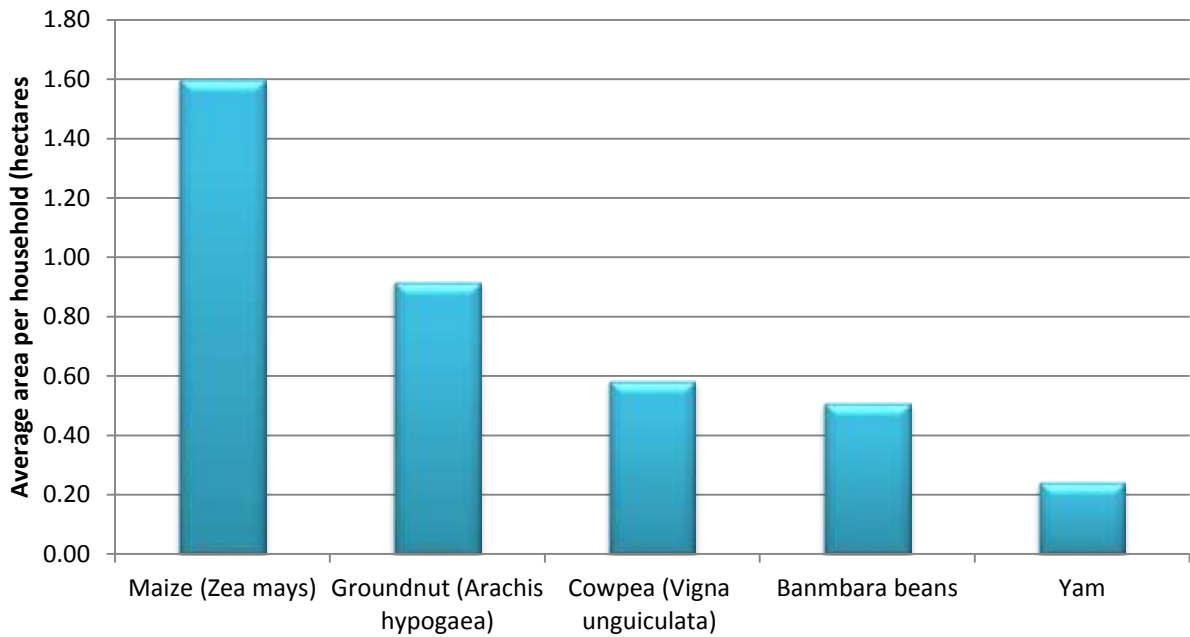
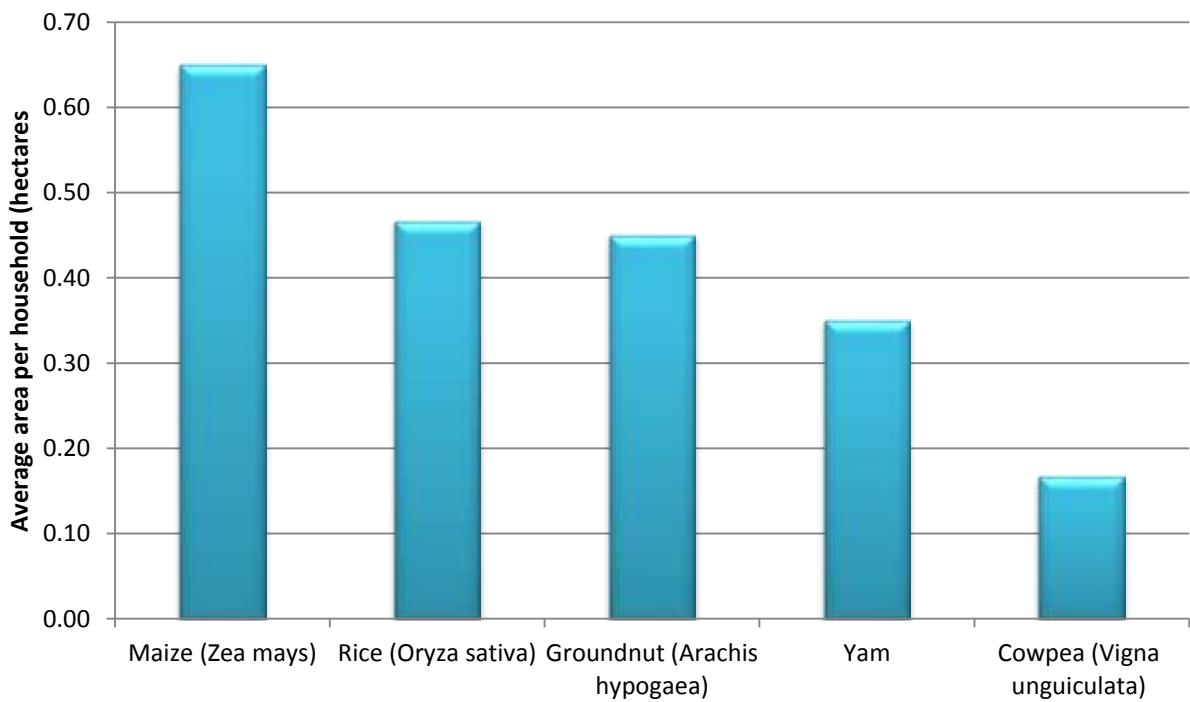


Figure 7. Average area (ha) per household of dominant arable crops in Guo



Livestock assets – roles and management

The proportion of households that owned various livestock species per community has been presented in Table 6. The dominant livestock species owned by many households were poultry, sheep and goats with fewer households owning cattle. Data analysis revealed that all households in the surveyed sites owned poultry and high proportion of the households owned sheep and goats. Similar findings were reported by other workers and asserted that poultry, sheep and goats were the common species owned by many households in the study sites (Oppong-Anane, 2013; Blench and Dendo, 2007). Unlike poultry, there were significant differences ($P < 0.05$) in the small ruminant ownership among the communities with Bonia and Gia in the Upper East Region having the highest households' ownership of 90%. Bullocks for traction activities were also owned by many households in Bonia and Gia and were found to be significantly higher ($P < 0.05$) than in other communities. This difference is attributable to presence of water livestock water at both Bonia and Gia throughout the year that enhanced dry matter intake during the dry season.

Table 6. Percent household ownership of livestock species

Communities	Livestock species						Donkeys
	Cattle	Bulls	Sheep	Goats	Pigs	Poultry	
Tingoli	29.0 ^a	10.0 ^b	86.5 ^a	94.5 ^a	3.00 ^a	100.0	-
Tibali	50.0 ^c	10.0 ^b	96.0 ^a	80.0 ^b	-	100.0	10.0 ^b
Bonia	70.0 ^b	70.0 ^a	90.0 ^a	95.0 ^a	20.0 ^b	100.0	2.0 ^c
Gia	80.0 ^a	60.0 ^a	90.0 ^a	98.5 ^a	40.0 ^c	100.0	70.0 ^a
Papu	10.0 ^d	18.0 ^{bc}	31.0 ^b	80.0 ^b	12.0 ^d	100.0	-
Guo	29.7 ^a	5.0 ^{bd}	70.0 ^c	80.0 ^b	15.0 ^d	100.0	-
Overall mean	44.8	28.8	77.3	88.0	18.0	100.0	27.0
SEM	1.06	1.45	1.35	1.17	0.92	-	0.96

Means with different superscripts in the same column are significantly different ($P < 0.05$).

The mean values of livestock ownership per household in TLU (Tropical Livestock Unit - “hypothetical” animal of 250 kg live weight per TLU (Jahnke, 1982)) recorded similar values both regional and community level although Gia recorded the highest livestock ownership mean value (Table 7), it was not significantly different from other communities.

Table 7. Average number of animals per household per community

Community	Mean number of animals (TLU)	SEM
Tingoli	12.23	3.13
Tibali	11.73	1.53
Bonia	11.35	1.05
Gia	15.17	2.96
Papu	10.95	1.60
Guo	10.80	2.26
Regions		
Northern	11.98	1.56
Upper East	13.26	1.64
Upper West	10.87	1.24

Table 8. Common livestock species reared and their uses

Livestock species	Uses
Cattle	Cash, manure and food
Draught cattle (bullocks)	Carting of manure, farm inputs and outputs, cash and food
Sheep (Djallonke and Sahelian)	Cash , manure, festivities, ceremonies and food
Goats (West African Dwarf)	Cash, manure, ceremonies ,festivities and consumption
Pigs (local and improved)	Cash, manure, festivities and food
Rabbits	income, manure and food
Village poultry (chickens, ducks and pigeons)	Cash, manure, festivities, ceremonies and food
Guinea fowls	Food, cash, manure, gifts
Donkeys	Carting of goods and water fetching, food, income

Results of our study show that uses of livestock in northern Ghana at the households' levels are mostly for family income, buying farm inputs, and household consumption (Table 8). Cows were not usually milked by most households but those under the Fulani care-takers were often milked for consumption and sale. Bulls and donkeys were used for ploughing crops fields and carting of farm inputs and produce. The main decision makers as to different uses of the household animals were household heads who are mostly men.

Households' livestock ownership was classified into three categories (above average, average and below average) based on wealth ranking by the PRA participants. The results revealed that the farmers above average keep higher numbers of poultry and cattle more than the average and below average households. Figures 8 to 13 show the results of three categories of livestock ownership in the communities. The households below average did not own cattle and donkeys. It was observed that most female headed households fall under the below average category.

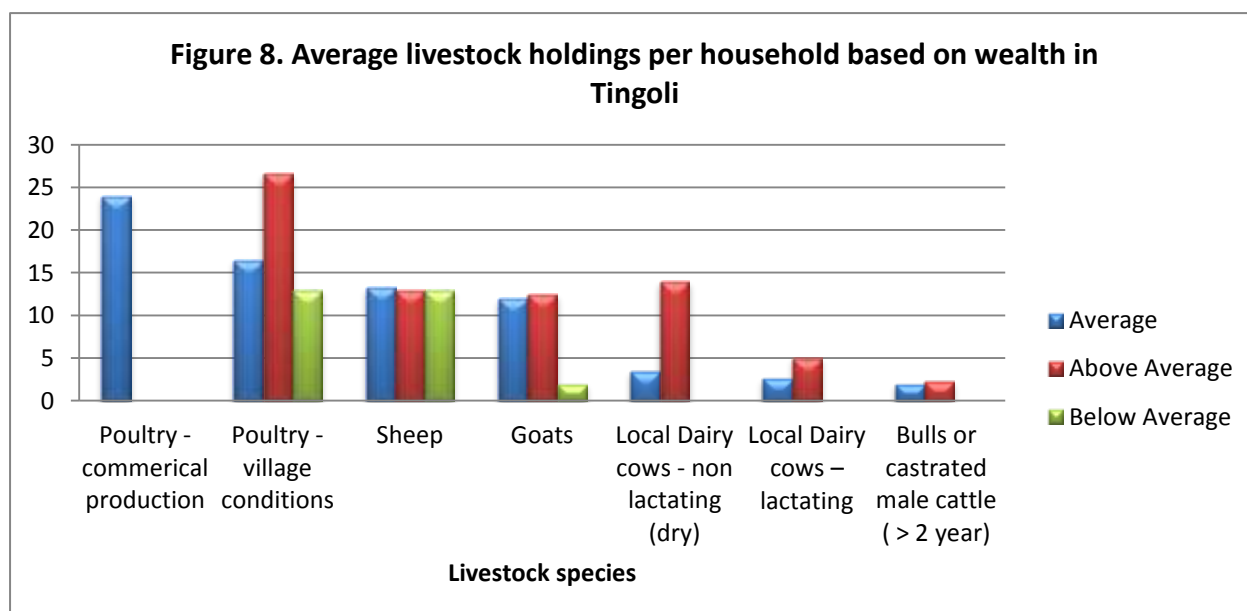


Figure 9. Average livestock holdings per household based on wealth in Tibali

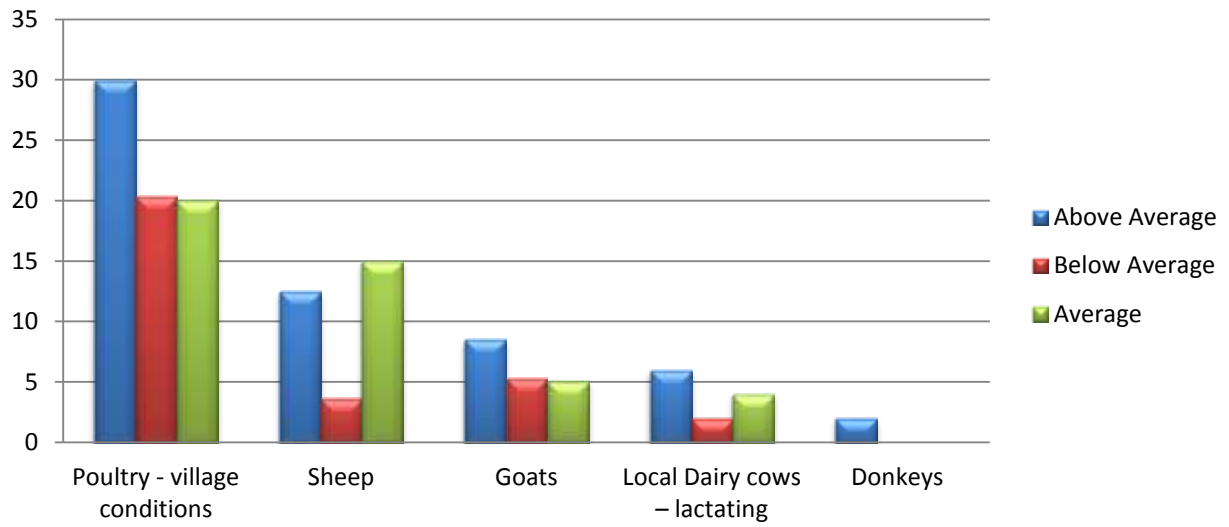


Figure 10. Average livestock holdings per household based on wealth in Gia

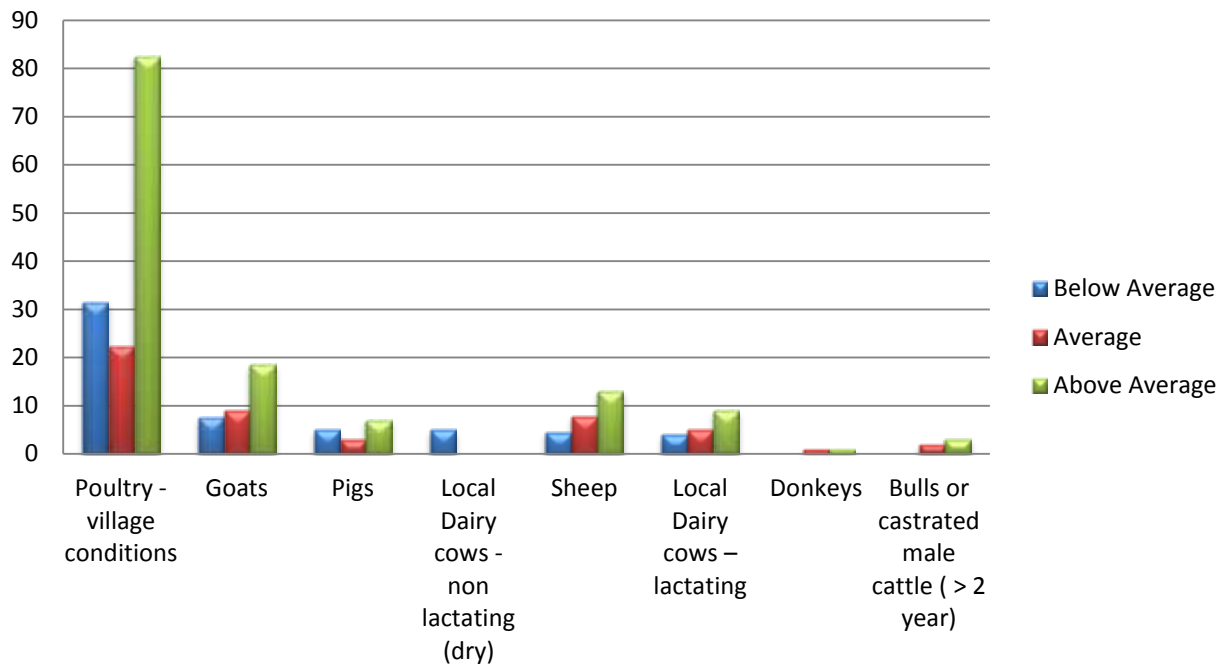


Figure 11. Average livestock holdings per household based on wealth in Bonia

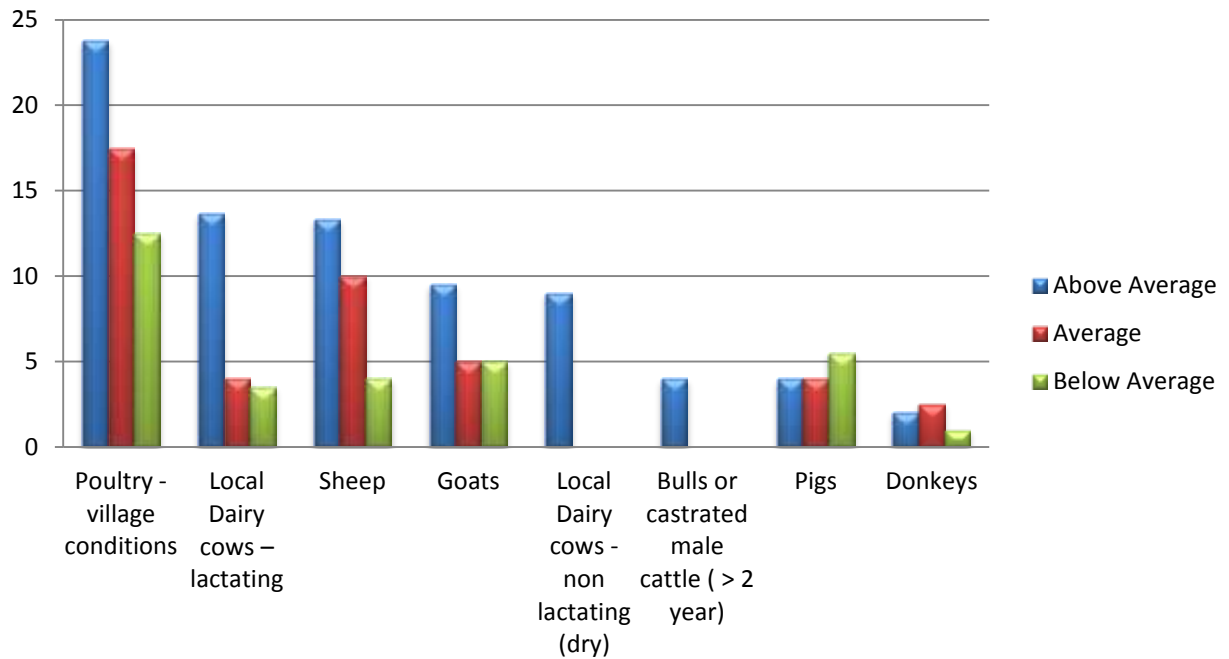
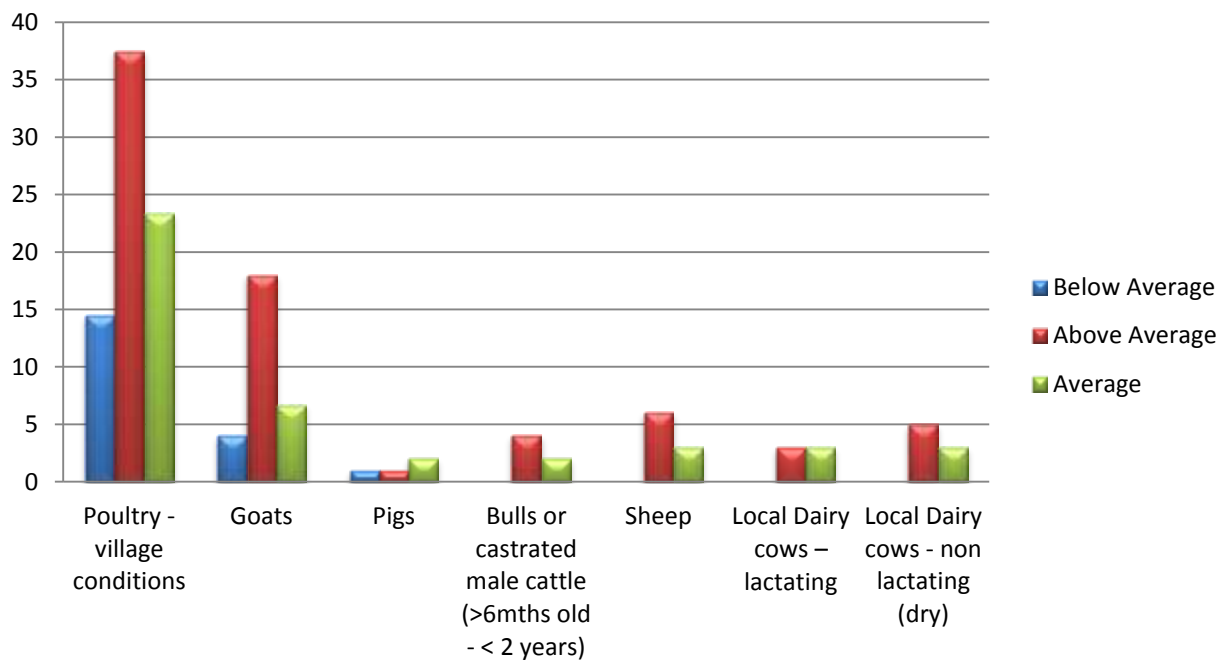
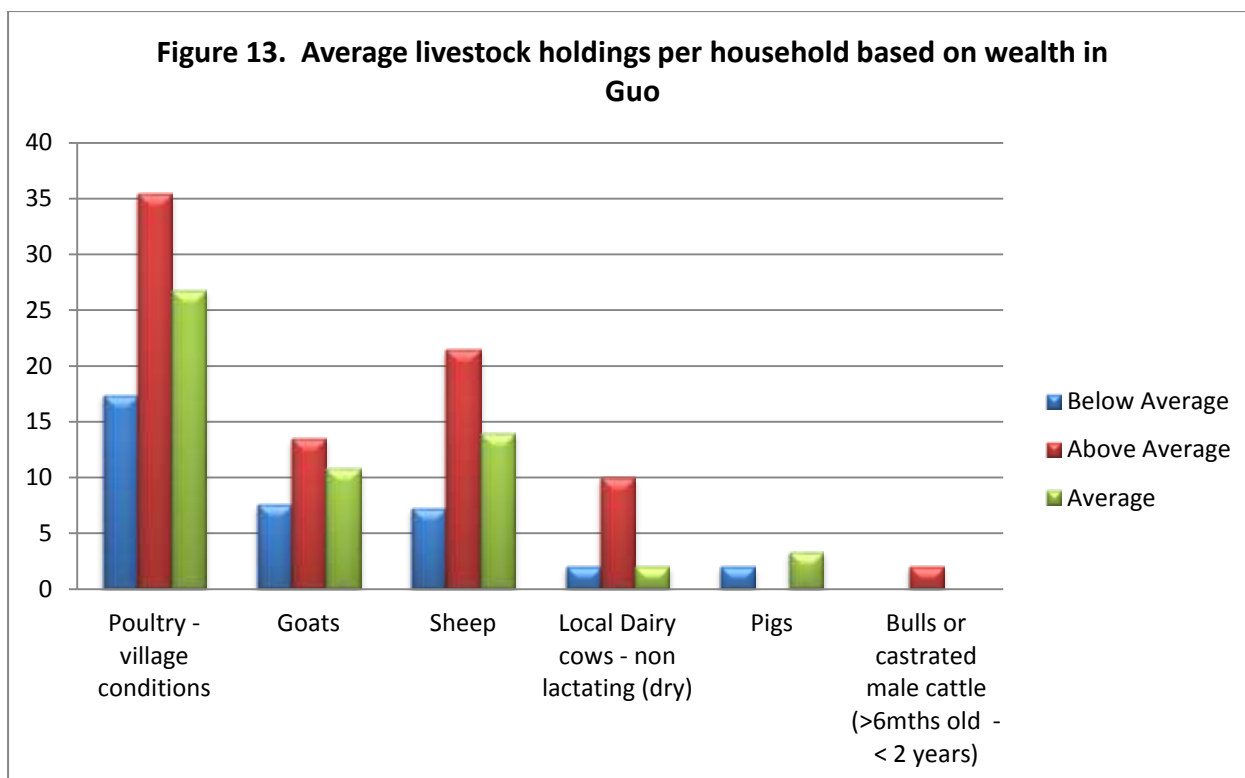


Figure 12. Average livestock holdings per household based on wealth in Papu





The results show that 30% of the farmers housed their animal at night and 70% do not housed their animals in the dry season while over 90% of them housed their animals in rainy season in poorly ventilated structures at night and confined the animals in the day for zero grazing, tethering (see plate 1) or shepherding due to crop cultivation during the farming season (Awuma 2012). Cattle were tethered at night in kraals around the houses of the owners or Fulani care-takers and herded for grazing in most part of the year. Over 90% of the households reared poultry under free range systems. The general poor housing is attributable to the subsistence nature of the production system and cost of constructing appropriate structures (Oppong-Anane, 2010).

Plate 1. Tethered sheep by the road side in Guo Community



The common feeding practice was open grazing in the dry season for small ruminants and cattle in the natural pasture and harvested crop residues feeding. The PRA participants estimated that 60% of the farmers were given supplementary feed to their animals in the dry season. Tethering of cattle for

grazing was found practiced in Upper East Region among households with smaller cattle herds due to lack of household's labour. Plate 2 shows how cattle are sometimes tethered at Bonia.

Plate 2. Tethered cattle at Bonia



In the dry season, most animals were under open grazing with supplementary feeding given by some farmers. Supplementary feeds offered to the animals included yam peels, cassava peels, maize bran, dawadawa (*Parkia biglobosa*) pulp and crops residue like groundnut haulms, beans (*Phaseolus vulgaris*) vines, rice (*Oryza sativa*) straw, cowpea (*Vigna unguiculata*) hay and pods, naturally occurring browses, fresh leaves of early harvested cereal crops like maize (*Zea mays*) and early millet (*Pennisetum spp.*), *Faidherbia albida* fruits and Pigeon pea (*Cajanus cajan*) residue were offered to ruminants in addition to the open grazing. All poultry such as chickens, ducks, guinea fowls and turkeys were given supplementary feed in the form of grains in addition to scavenging during the day and were housed at night.

The common feed processing methods used in all the communities included chopping, drying, saltation and bagging (cassava peels, yam peels, pigeon pea chaff, kitchen wastes, cowpea hay and groundnut hay). Salt solution is sometimes sprinkled on maize leaves and groundnut haulms to increase palatability.

An average of 2% of the farmers in the study sites practiced fodder cultivation as livestock feed the common crop planted was pigeon pea (*Cajanus cajan*) in small fields (0.02 hectares) or as a border crop between two farmers' field. about 15% of households also planted one or two leucaena (*leucaena leucocephala*) and other browse plants around their homestead which they occasionally cut for their animals especially during cropping season. These fodder crops were grown due to their palatability and fast growth rate. The present findings on feeding confirm the report that cattle and small ruminants production depended on grazing of natural pasture in rangeland and crop residue in the semi-arid Savannah zone of Northern Ghana (MoFA, 2011).

The results further revealed that some farmers purchase feed for ruminant supplementary feeding in the study area. The ranges of the popular purchased feed were brewer's spent grain 10% to 51%, Maize bran 4% to 76% and corn mill waste flour 27% to 72% (figures 14 to 19). The dominant purchased feeds varied among the communities due to differences in cultivation and consumption pattern of the crops from which these feed were derived after processing.

Figure 14. Quantity of feed purchased over 12 months in Bonia

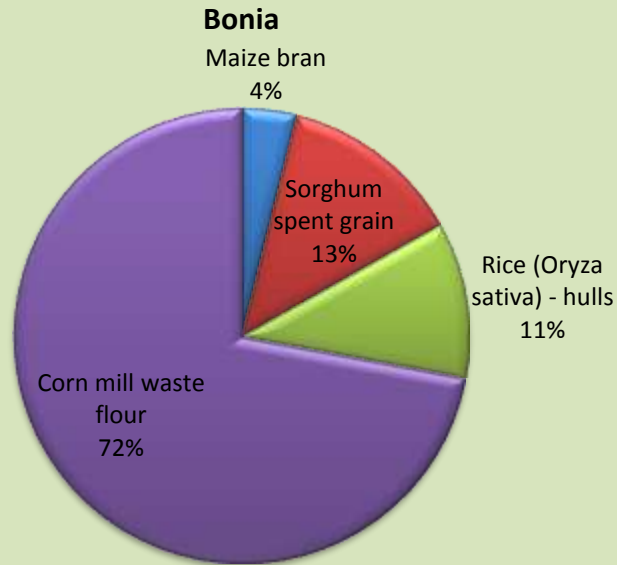


Figure 15. Quantity of feed purchased over 12 months in Gia

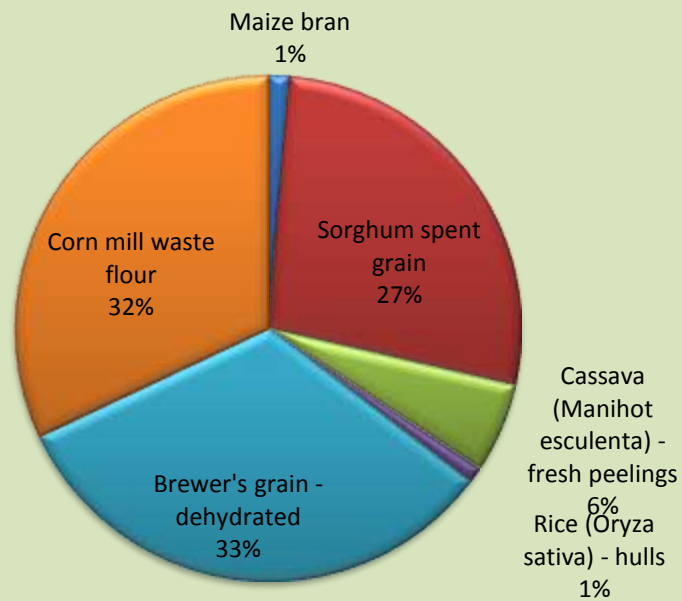


Figure 16. Quantity of feed purchased over 12 months in Papu

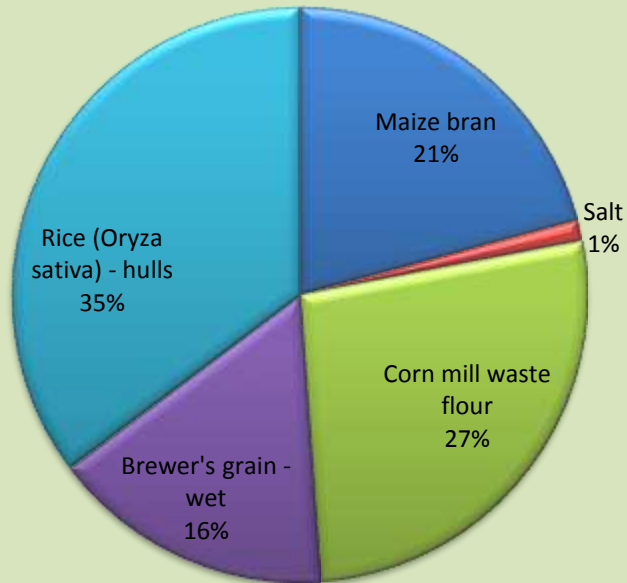


Figure 17. Quantity of feed purchased over 12 months in Guo

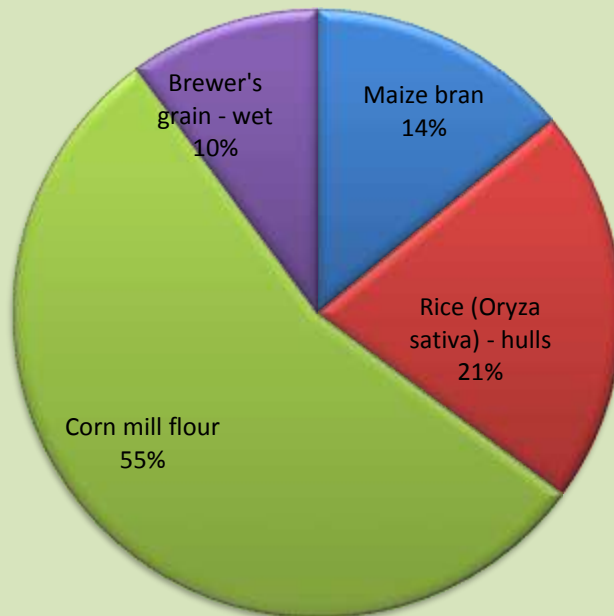


Figure 18. Quantity of feed purchased over 12 months in Tibali

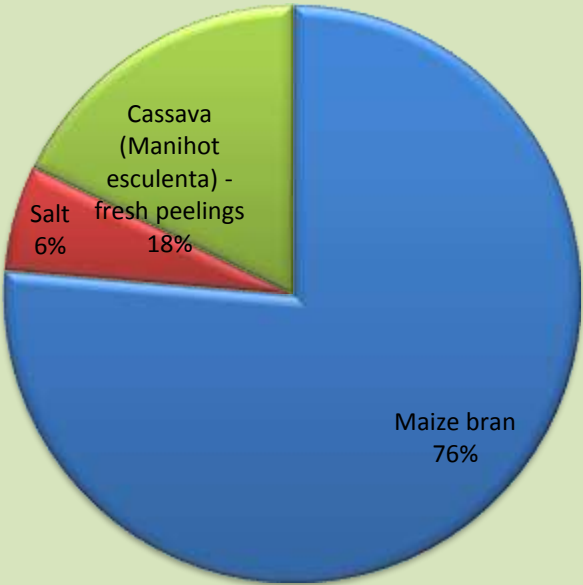
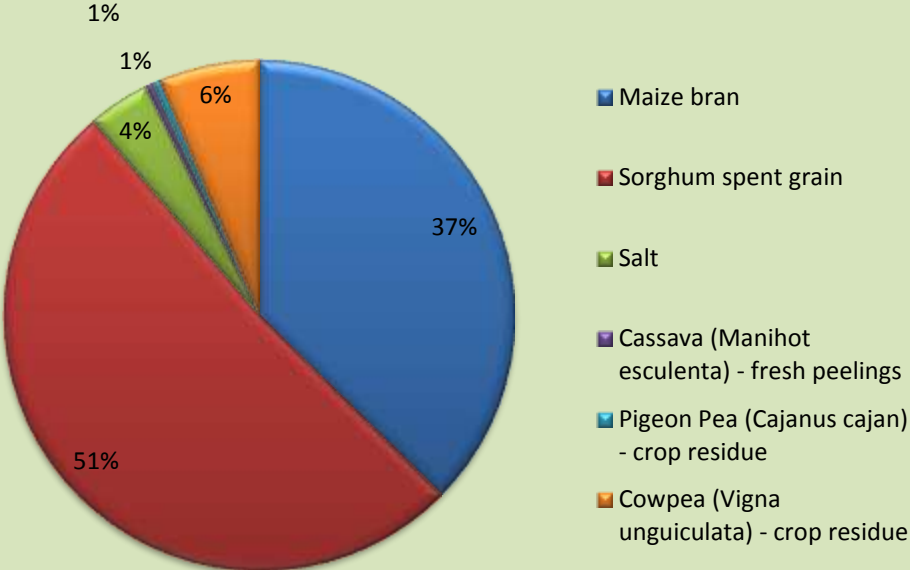


Figure 19. Quantity of feed purchased over 12 months in Tingoli



Constraints and opportunities to livestock production

The major constraints to livestock production in the study sites and farmers' identified opportunities are presented in Table 9. Generally, high incidence of diseases and its associated mortalities, and poor housing were the common constraints in most of the communities. Dry season water shortage was another key constraint mentioned by the respondents. Others were lack of improved breeds and dry season feed shortage. A unique constraint that came up in Bonia alone was pollution of livestock drinking water. This problem was attributed to application of agro-chemicals on the irrigated fields. Plate 3 shows some of the irrigated fields' water at Bonia.

Table 9. Pair wise ranking of communities' identified constraints and opportunities in livestock production

Region	District/community	First	Second	Third	Fourth
Northern	Tolon/ Tingoli	Poor housing	High incidence of disease and mortality	Inadequate feed in the dry season	High cost of veterinary drugs
	Savelugu/Tibali	Poor housing	High incidence of disease and mortality	Low market price of animals	high cost of medications
Upper East	Kasena Nankana /Bonia	High incidence of disease and mortality	Lack of improved breeds	Inadequate technical knowledge	Poor housing
	Kasena Nankana/ Gia	High incidence of disease and mortality	Dry season water shortages	Poor housing	Dry season feed shortages
Upper West	Wa West/ Guo	Dry season water shortages	Inadequate veterinary service	Lack of improved breeds	High rate of disease and mortality
	Nadowli/Papu	Dry season water shortages	Inadequate veterinary service	Lack of improved breeds	High incidence of disease and mortality
Existing opportunities identified in PRA sessions					
1.Availability of pasture / grazing land for ruminants					
2.Market availability for livestock and livestock products					
3.Availability of water or dam construction sites					
4. Existence of veterinary service providers					
5.Presence of different fodder species in the range land					
7. Less theft cases of animals					
8. Availability of labour for employment e.g. Fulani herdmen and household labour					

Plate 3. Polluted water by chemicals in some irrigated fields



The opportunities identified by the farmers in the study area are listed in Table 3.6. Most of the opportunities were in all the study sites and the veterinary service opportunity was most available in Tibali and less theft cases occurring in Tingoli and Tibali in Northern region and Bonia and Gia in Upper East region.

The constraints identified in this work confirm other findings in the growth of the industry (Amankwah et al., 2012; Opong-Anane, 2013) and the current ranking of disease and its associated mortality as being first among the constraints agrees with the report of Clotey et al., (2007). Poor feeding and inadequate health care contribute significantly to the diseases and mortalities (Opong-Anane, 2013). Notwithstanding this, results of current and previous work in the study area show the existence of potential to increase off-take of livestock and produce good quality meat and milk to satisfy a greater part of the nation's animal protein requirements as given in opportunities identified (Duku et al., 2010; Opong-Anane, 2013).

The common health problems in the area included mange, anthrax, heminthisis, Peste des petits ruminants (PPR) and trypanosomiasis. The study found out that animal health services provided were deworming wound dressing, complicated delivery assistance, treatment of bacterial diseases and vaccinations against common diseases like PPR and anthrax. There were some pockets of ethno-veterinary technologies that were being practiced in the area by some of the farmers. The PRA estimated that 50% of the required veterinary health service needs of farmers were met and was appreciated by farmers. The other 50% was not met due to inadequate veterinary service personnel to meet farmers' demand in all the communities in the study area except Tibali in the Savelugu district of Northern region where about 70% of their veterinary service needs were met. The high availability of veterinary service in Tibali was attributed to the presence of veterinary college at Pong-Tamale about 2 Km away from Tibali. The veterinary services were provided by Ghana Ministry of Food and Agriculture (MoFA) veterinary technical officers. The common livestock diseases and health care services found in this work were also reported by Opong-Anane (2013).

The presence of veterinary service demand gap needs to be addressed by increasing veterinary service providers to avert mortality (Clotey et al., 2007) and contribute to good returns in the production system.

Treatment cost of disease depended on animal species and ailment; for example deworming cost 0.5 US Dollars (GHC 1.00) per animal, wound dressing cost 1.5 dollars (GHC 3.00) per animal and vaccination was 0.50, 0.25 and 0.10 US Dollars per animal for cattle, small ruminants and poultry respectively. Other treatments cost ranged from 0.5 to 5 US Dollars (GHC 1.00 to GHC10.00) per animal depending on the types of drug needs. The major problem of the animal health service was

the cost of veterinary drugs for which farmers asked for subsidy from government and other bodies who can give them support.

Feed resources and seasonal availability

Feed resources found in the study sites for ruminant feeding were crop residues (groundnut haulms, cowpea hay, Pigeon pea residue (leaves and pods), rice straw and sorghum heads), peelings of yam and cassava, grazing fields made of naturally grown grasses and legume fodder and *in situ* crop residues like maize and millet stovers. Agro-industrial by-products included corn mill waste flour, brewers' spent grain of sorghum, maize bran and rice bran. The annual feed availability correlated positively with rainfall pattern and increased from June to October in the rainy season but declined with the end of rainfall. This agrees with the report that feed availability is a function of land use and rainfall pattern (Jayasuriya, 2002) and becomes more available and accessible to ruminant after crops are harvested and animals allowed to graze freely (Anor et al., 2007). In the rainy season, feedstuffs were found to be inaccessible to animals in some communities due to restricted mobility of livestock to prevent damage to crops. Similar findings have been reported in the study sites (MoFA, 2011; Awuma, 2012; Opong-Anane, 2013). The results further revealed that feedstuffs were about 80% available to ruminant after crop harvest while feed gaps were pronounced in the late dry season (February to April).

Figures 20 to 25 show the annual trend of different feedstuffs availability for ruminants in the study communities. Crop residues feeding occurred towards the end of the year and in the first two months of the year. Feeding of harvested green forage or browses was found practiced during cropping season when animals were mostly under confinement.

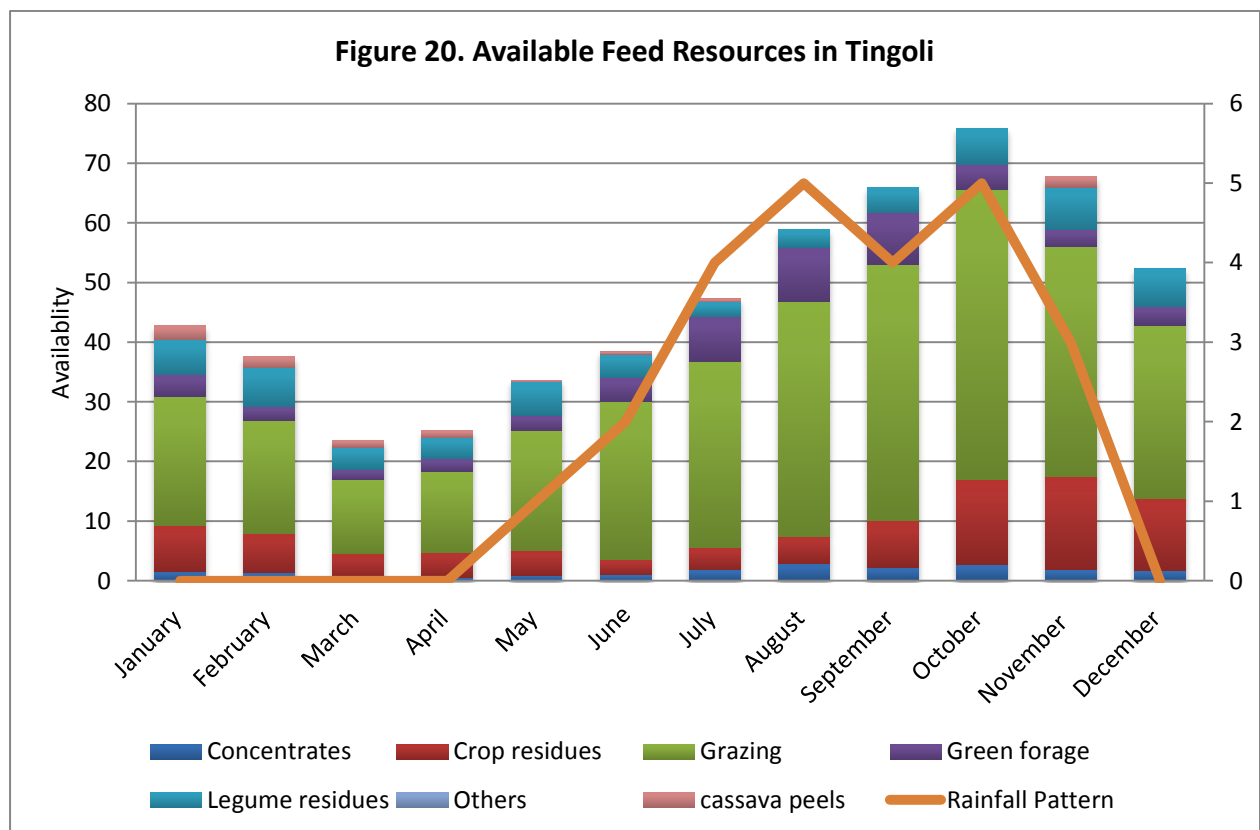


Figure 21. Available Feed Resources in Tibali

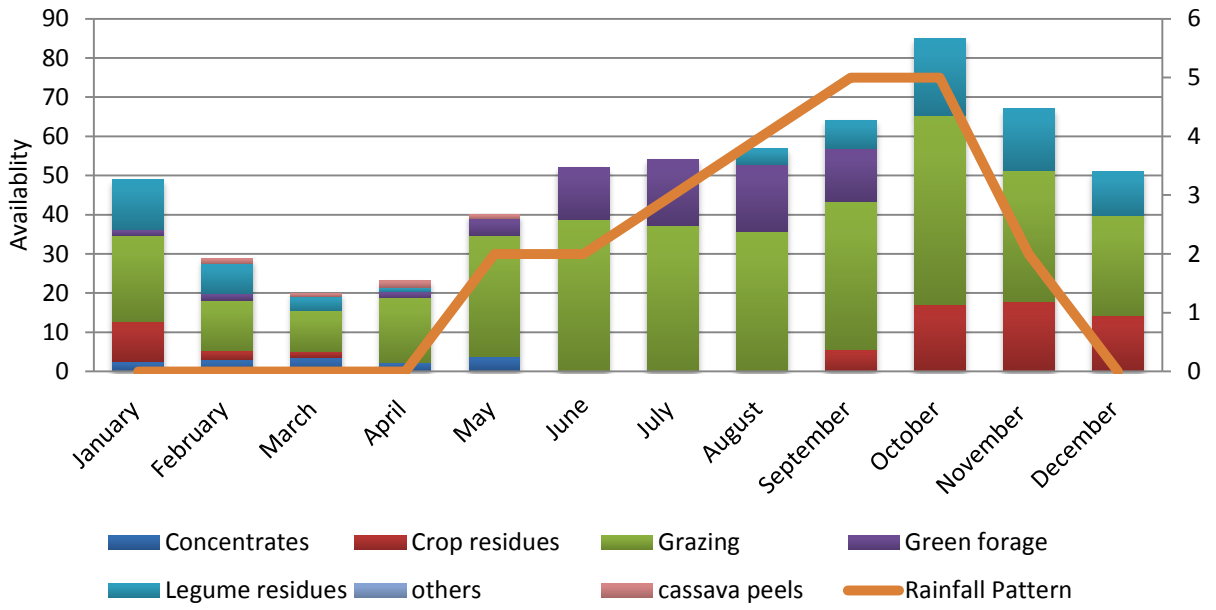


Figure 22. Available Feed Resources in Papu

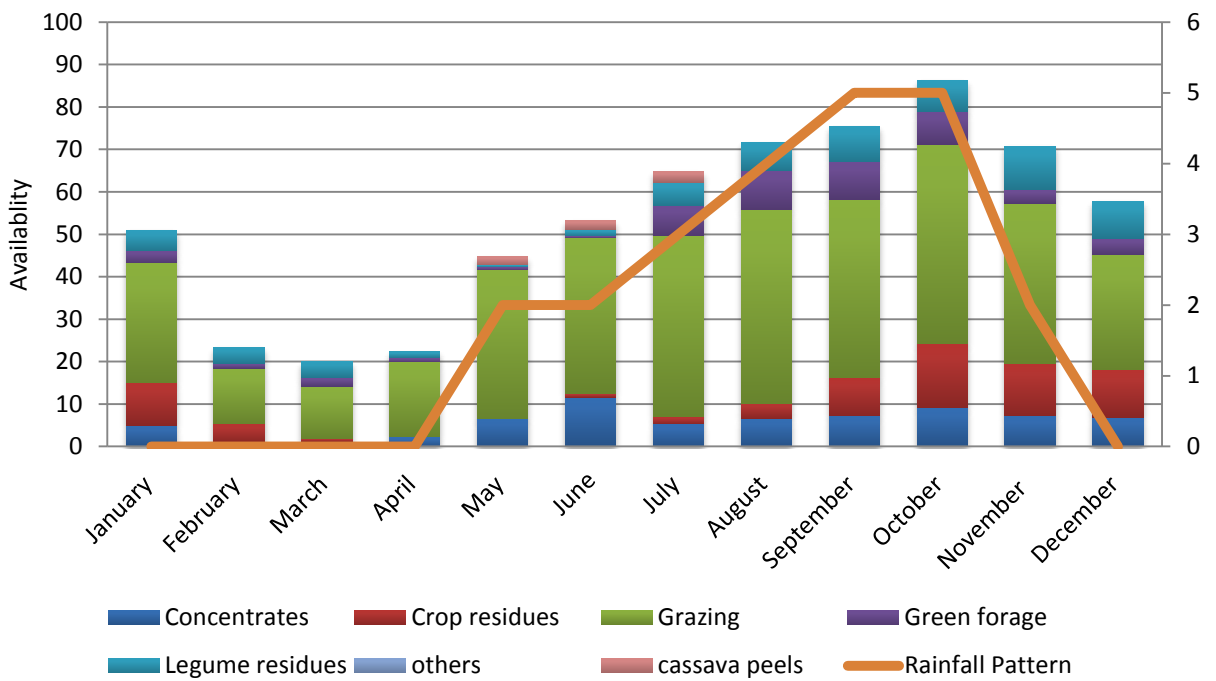


Figure 23. Available Feed Resources in Guo

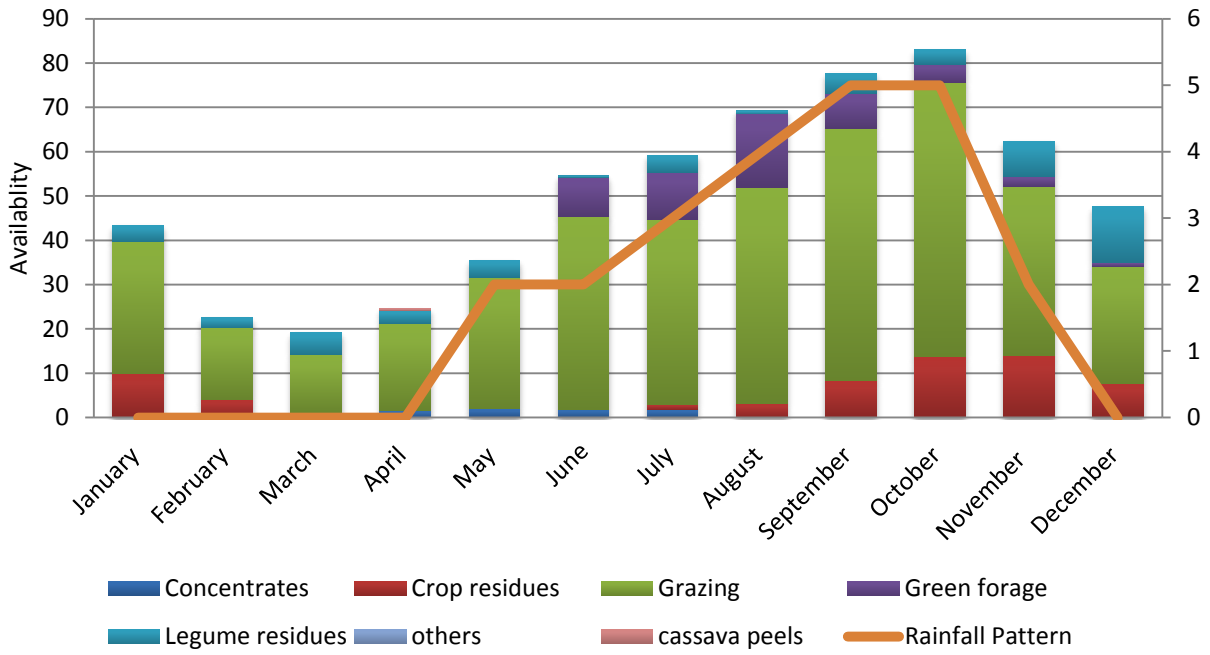


Figure 24. Available Feed Resources in Gia

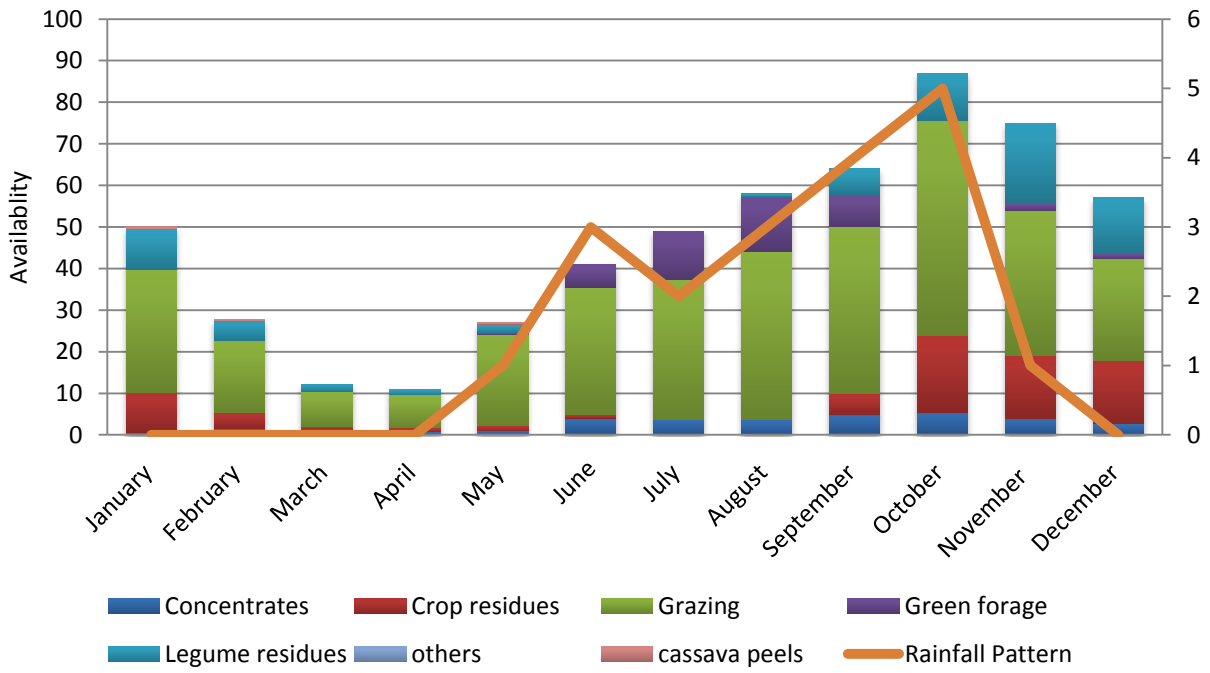
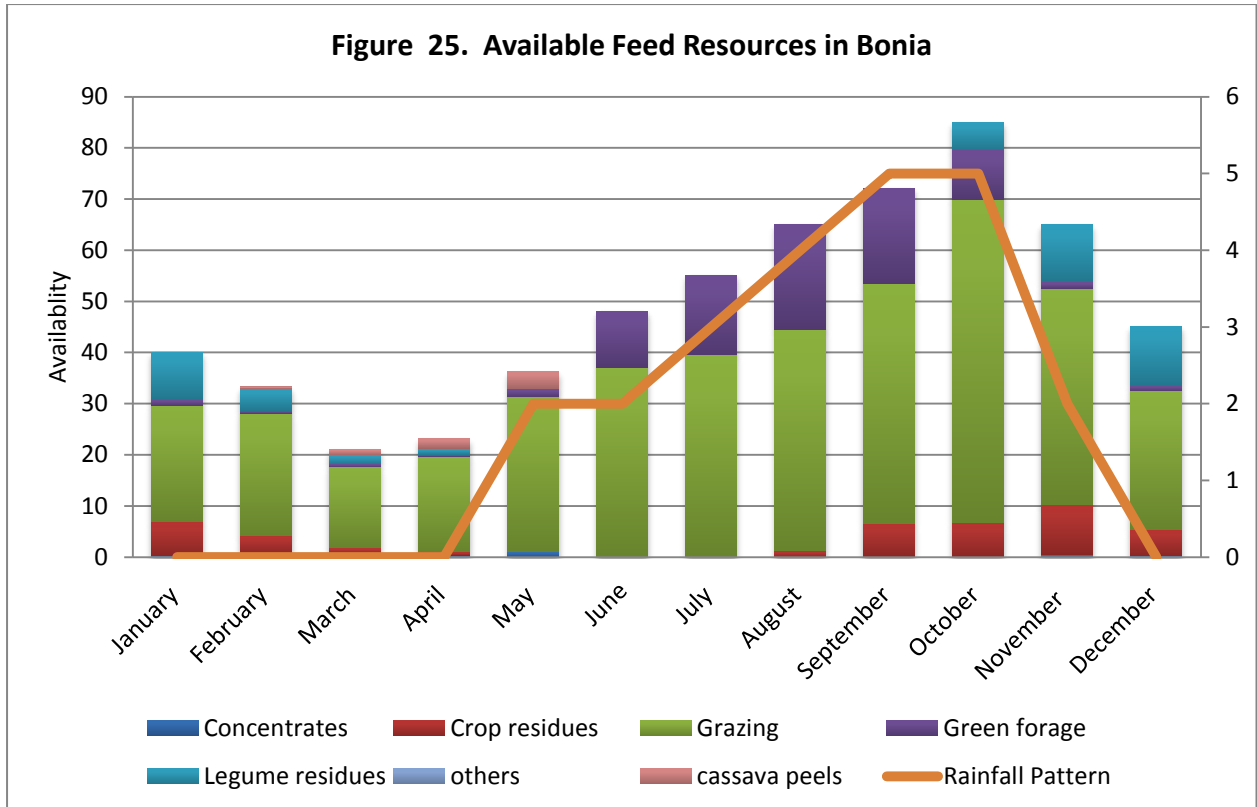


Figure 25. Available Feed Resources in Bonia



The feed resources available for ruminant during February to May – critical period of feed scarcity in the study area and other similar places in the tropics can be described as high fibre-low protein feeds and include residues arising from cereal crops, such as straws and stovers from rice, millet, sorghum and maize (Jayasuriya, 2002). These residues are characterised by high fibre content (>700 g of cell wall material/kg DM), low metabolizable energy (<7.5 MJ/kg DM), low levels of crude protein (20–60 g of crude protein/kg DM) and low to moderate digestibility (<30–45% organic matter digestibility). The small ruminant daily intake is often limited to less than 20 g dry matter/kg live weight. And most of the residues are also deficient in fermentable carbohydrates, reflected by the relatively low organic matter digestibility (Jayasuriya, 2002). Chemical treatment increases the potential feeding value of the crop residues (Anor et al., 2007). For instance alkali treatment of fibrous residues like urea as source of ammonia has been well researched and the benefit well established (Owen et al., 1989) but the adoption of this technology is insignificant in this area and does not allow farmers to exploit full potential of this cereal residue. Another category of available crop residue is less fibre-high protein feeds such as residues derived from legume crops (tops and haulms from groundnut, cowpea, and soya beans) and agro-industrial by-products (bran from cereal milling –rice and maize bran, brewer’s spent grain). They are generally less fibrous (below 700 g but above 400 g of cell wall material/kg DM) than those in the first category but have relatively high amounts of crude protein (> 60 g/kg DM) (Jayasuriya, 2002) but not available to many smallholder farmers in that period. The leaves from leguminous trees and browses plants such as *Glyricidia*, *Leucaena*, *ficus sp* and *Erythrina* have been reported to contain around 250–350 g of crude protein/kg DM, and can also be considered in this category (Jayasuriya, 2002) but the planting of this browses is yet to considered by few farmers in the study area.

Potential feed resources

The farmers in the study sites identified some potential feed resources that were presently under-utilized for ruminant production as given in Table 10 below.

Table 10. Potential feed resources

Region	Potential feed resources
Northern	1. Shea nut (<i>Vitellaria paradoxa</i>) tree leaves, flowers and fruits, corn husk, 2. Tree planting as browse such as ficus (<i>Ficus sychomorous</i>), <i>Leuceana leucocephela</i> , <i>Sesbania grandiflora</i> , <i>Acacia albida</i> and <i>Gliricidia sepium</i> and other local trees such as <i>Pterocarpus evinacelus</i> (niece) and <i>Afzelia sp</i> (kpalga)
Upper East	1. Shea nut tree leaves, flowers and fruits (the leaves are grazed by sahelian cattle breeds while the fruits are eaten by all ruminants in small quantities).
Upper West	1. Planting of browse trees and shrubs like ficus tree leaves (<i>Ficus spp</i>), <i>Acacia albida</i> , <i>Gliricidia sepium</i> , <i>Leuceana leucocephela</i> , <i>Albezia lobeck</i> as fodder banks

The main reason given by farmers for the under-utilization of the above feed resources was availability of comparatively good feed resources in the rangelands. In the case of shea nut tree fruits, farmers especially women use it for shea butter extraction to generate income.

Indigenous knowledge on feed quality assessment

Results on indigenous knowledge of feed quality assessment revealed that farmers used physical means to assess feed quality for ruminant, with colouration and appearance being the main factors. Table 3.5.2 presents the quality assessment of fodder/feed and its ratings given by the farmers (on a scale of 0 to 5; 0 being very poor with no intake and 5 being very good with high intake by the animals). The indigenous knowledge levels of the farmers on feed quality assessment differed across the regions (Table 11). This current finding differ with the report that farmers use predicted digestibility and effect on animal performance in determining fodder quality (Thorne et al., 1999) but agrees with palatability and voluntary intake based quality assessment used by farmers in Nepal (Thapa et al., 1997).

Table 11. Indigenous knowledge on feed quality assessment

Feed quality description	Score	Regional percentage of farmers			
		Northern	Upper East	Upper West	SEM
Fresh green with much leaves		93.33	56.67	90.00	7.50
Light brownish hay with much leaves not beaten by rain e. g. groundnut haulms		73.33	63.33	70.00	4.77
Dry brownish-green with much leaves/unmoldy an example is groundnut tops		83.33	76.67	76.67	6.30
Perforated yellow spotted fodder dry or fresh		63.33	53.33	66.67	4.36
Tan brownish (hay, crops residue) due to rains but not moldy		70.00	56.67	66.67	5.07
Moldy fodder (hay, crops residue) due to rains but not heavily moldy or rotten (smelly)		56.67	83.33	63.33	5.82
Flowered forage materials		70.00	63.33	66.67	3.44
Animal urine contaminated feed		70.00	80.00	76.67	3.30
Yellowish leafy forage		73.33	70.00	83.33	5.35
Heavily moldy or partially rotten hay (smelly) due to rains		70.00	60.00	66.67	3.62
Heavily perforated green leaves infested with caterpillar		73.33	56.67	70.00	5.44

The poor and very poor grade feed such as heavily moldy and animals' urine contaminated feed were dried and sometimes sprinkled with salt solution to improve intake according to the farmers. The treatment methods of poor grade feed need further assessment to determine the level of quality improvement. The drying might evaporate the uric acid in the feed and also, part of the fungi that forms molds may be blown off by wind in the drying process.

Conclusions and recommendations

The evaluation showed that dry season feed shortage exist (with critical the period occurring between February to May) with high incidence of disease and mortality as major livestock production setbacks in Northern Ghana.

Some farmers have recognized this and have identified fodder crops planting as potential feed sources for ruminant animals.

Joint feed and health care intervention packages will be appropriate for sustainable production in the study sites

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