

Assessment of Available Feed Resources along an Agro-Ecological Gradient in Burkina Faso

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2019.

Acknowledgement

This study was conducted under EQUIP – Strengthening smallholder livestock systems for the future project funded by the Bill & Melinda Gates Foundation. The authors are solely responsible for the opinions expressed in this report.

Summary

Options for improving the efficient use of available feed resources in different agro-ecological zones of Burkina Faso was investigated using the Feed Assessment Tool (FEAST). The study was carried out in seven villages representing four agro-ecological zones in Burkina Faso namely: Bagre, Doubegue, Belempourou and Namoungou (*North Sudan*); Bagnani (*South Sudan*); Tougouri (*Southern Sahel*) and Goudebo (*Northern Sahel*). The result shows that the farming systems in Burkina Faso is a mixed crop-livestock farming system which is crop dominated in the south and north Sudan zones as well as in the southern Sahel. The north Sahel is livestock-dominated. Dominant crop and livestock species vary along the agro-ecological gradient as well as feed resources, seasonality and farmers' perception of the feeding system. There are major livestock challenges, from a shortage of water for livestock in North Sudan and the southern Sahel to shortage of feed in quantity and quality and South Sudan zone. According to the farmers, poor housing and management with inadequate technical knowledge were the major livestock problems in Northern Sahel. Opportunities to mitigate these constraints were discussed as well as potential interventions. Improvement of water sources and management is a crucial intervention in all sites. Training of farmers on effective feed resources utilization and formulation of feed ration could be a way to address these constraints.

Introduction

Livestock play an important economic role and is also important for the food security of many rural households in Sudano-Sahelian and the Sahelian regions of West Africa. For the average rural farmer, livestock provide a buffer stock and an effective hedge against income fluctuations (Fafchamps and Czukas 1995). Livestock nutrition in the Sahel depends essentially on the exploitation of naturally occurring herbaceous and ligneous plant species, and crop residues. Availability of these feed resources in terms of quality and quantity has been associated with the temporal and spatial distribution of the precipitation (FAO, 2014) as well as variation in the agro-ecological zone and crop type in the case of crop residue. The scarcity and seasonal fluctuations of feed resources in this region have been the major limitation to meeting the nutrient requirements of grazing livestock for most of the year (Kavana *et al.*, 2007), especially during the long dry season. During the dry season, the quantity and quality of natural pastures are low, and animals that feed on these pastures have slow growth rate, poor body condition score and are emaciated (Frylinck *et al.*, 2013). Migration of livestock and herders in search for feed has resulted in communal conflict between the rural settlers and herdsmen. There are opportunities to increase animal productivity through the application of appropriate feeding technologies in the production system, to improve nutrition and feeding of livestock (Wanapat *et al.*, 2013). Increasing the efficient use of available feed resources represents one of the most important strategies to improve the productivity of livestock in the Sahel. A crucial step in achieving this is through the assessment of locally available feed resources and understanding their seasonal variation along agro-ecological gradients to produce sustainable feed in the livestock production system in the Sahel. Arising from this is a need to understand the current available and potential feed resources and feeding strategies used by livestock farmers along the agro-ecological gradients of Burkina Faso.

Methodology

Site description

Burkina Faso, a Sahelian, warm tropical country, has four broad climatic zones. The dry Sahelian north, Sahelian south, the North Sudan zone in the centre, and the more humid South Sudan region in the south. The Sahelian north has a mean annual rainfall of 200-400 mm and a dry season of 7-9 months (October to June) while Sahelian south zone receives 400 to 800 mm rain in about 4-5 months. The North Sudan zone in central Burkina Faso has a mean annual rainfall of 800-1000 mm, with a 4-5 months rainy season (June to October). The South Sudan region in the south has a mean annual rainfall of 1000-1200 mm, and

a rainy season lasting up to 6-7 months (May to October) (Beal *et al.*, 2015). This study was conducted in the seven villages from different regions representing four agro-ecological zones (*South Sudan, North Sudan, Southern Sahel and Northern Sahel*) in Burkina as shown in Table 1.

Table 1. Study location, region and agroecological zones

Agro-ecological zones	Region	Village	Co-ordinates
South Sudan	Sud-Quest	Bagnani	10°57'30.3"N 3°14'38.0"W
North Sudan	Boucle de Mouhoun	Belempourou	13°10'08.5"N 3°53'29.5"W
	Centre-Est	Bagre	11°33'03.2"N 0°28'03.7"W
	Centre-Est	Doubegue	11°33'17.1"N 0°30'19.6"W
	Est	Namoungou	12°01'24.3"N 0°36'16.2"E
Southern Sahel	Center Nord	Tougouri	13°18'43.0"N 0°31'35.0"W
Northern Sahel	Sahel	Goudebo	14°08'57.7"N 0°04'02.4"W

From the focus group discussion in each study site

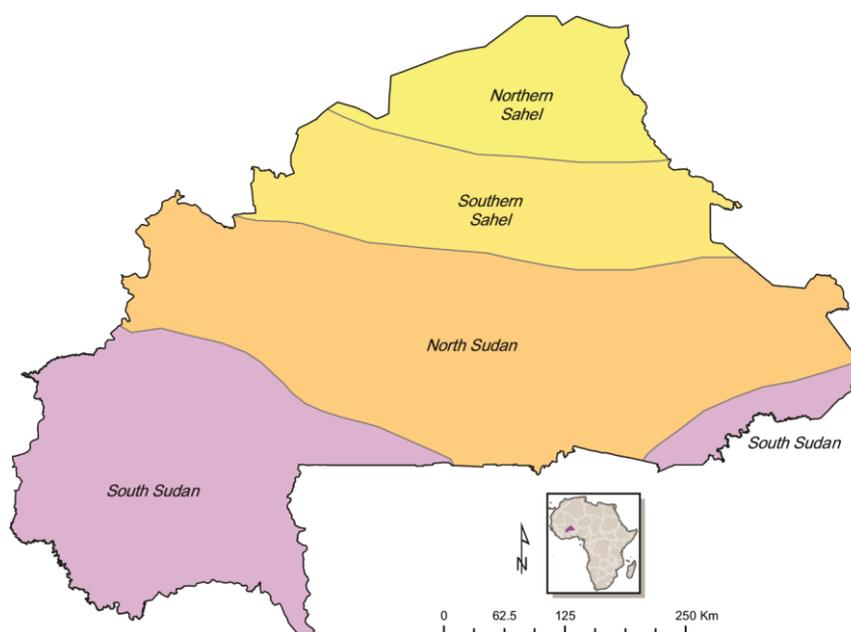


Figure 1: Different agro-ecological classification in Burkina Faso

[Source: www.fao.org/ag/AGP/AGPC/doc/Counprof/BurkinaFaso/burkinaFfrench.htm]

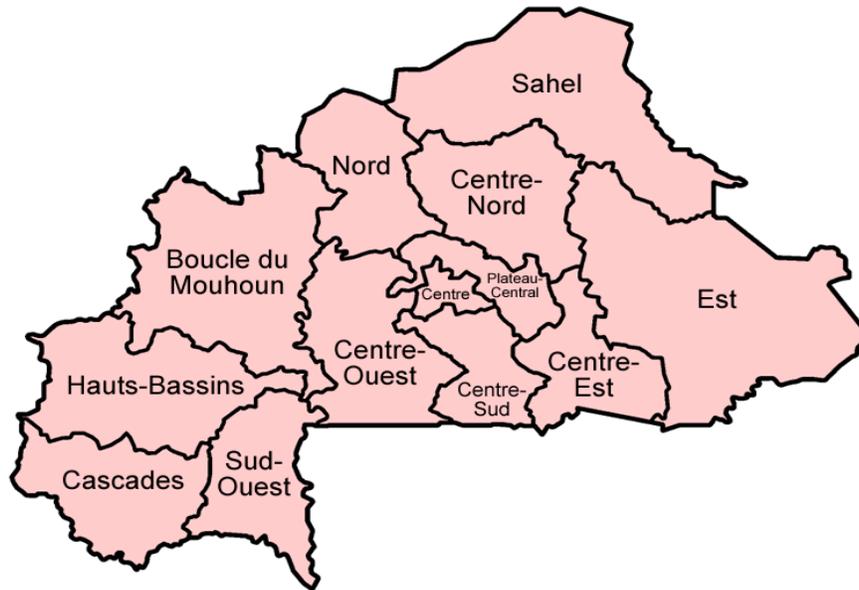


Figure 2: Different regions of Burkina Faso

Data analysis

The Feed Assessment Tool (FEAST) developed by the International Livestock Research Institute (ILRI) was used to evaluate the existing and potential feed resources in the study sites (Duncan *et al.* 2012). FEAST is a systematic method to assess local feed resource availability and use. It helps in the design of intervention strategies aiming to optimize feed utilization and animal production. FEAST consists of Focus Group Discussions (FGD) and individual household surveys. The quantitative data from the individual interviews of 84 farmers (12 from each village) representing small, medium and large-scale farmers were entered and analyzed using the FEAST excel template (www.ilri.org/feast). FEAST qualitative data collected through the FGD were examined and summarized for each major topic and linked with FEAST individual interview output. During the FGD, the information gathered includes average land and livestock holding per household, area cultivated and fallowed, crops grown on-farm, ruminant production per household system, livestock products, rainfall and seasonality of feed availability. A total of 174 farmers participated in the FGD from all the seven villages.

Results and discussions

Overview of the farm system in South Sudan zone (Bagnani)

The results from the focus group indicated that the majority of the farming households in Bagnani were smallholders with land sizes < 1 hectare. A few households were classified as medium and large farmers with relatively larger portions of land (< 2 ha) (Figure 3). The farming system in Bagnani can be classified as a mixed crop-livestock system with crop production being the dominant livelihood option. The most common crops that are grown in Bagnani included maize, assorted vegetables, sorghum, cowpea, millet and rice. From the results, the largest proportion of land per household was allotted to maize (Figure 4). Assorted vegetables were the next dominant crop in Bagnani and are grown for both household use and as a cash crop. According to the respondents, 70% of the farmland was cultivated for household food crops with 30% cultivated for cash crops.

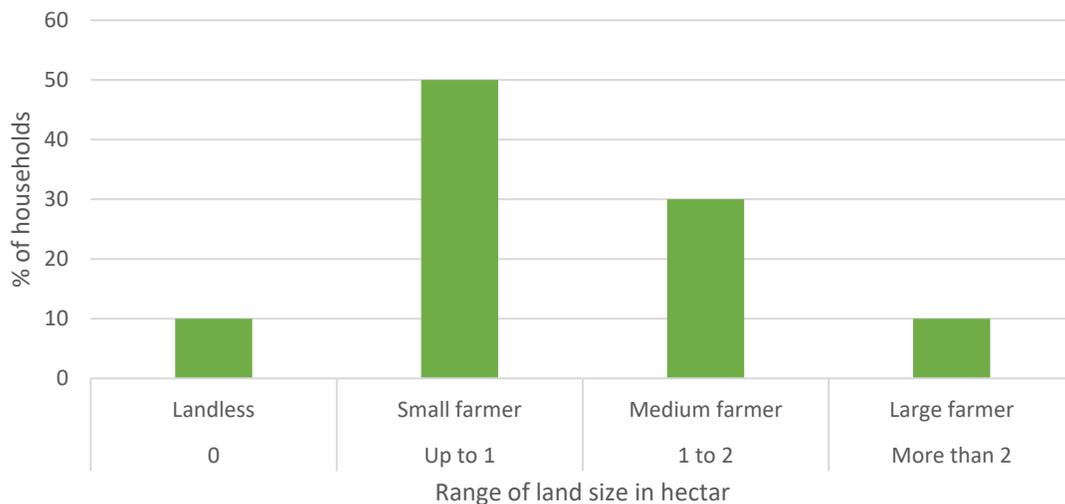


Figure 3: Average land area per household in Bagnani

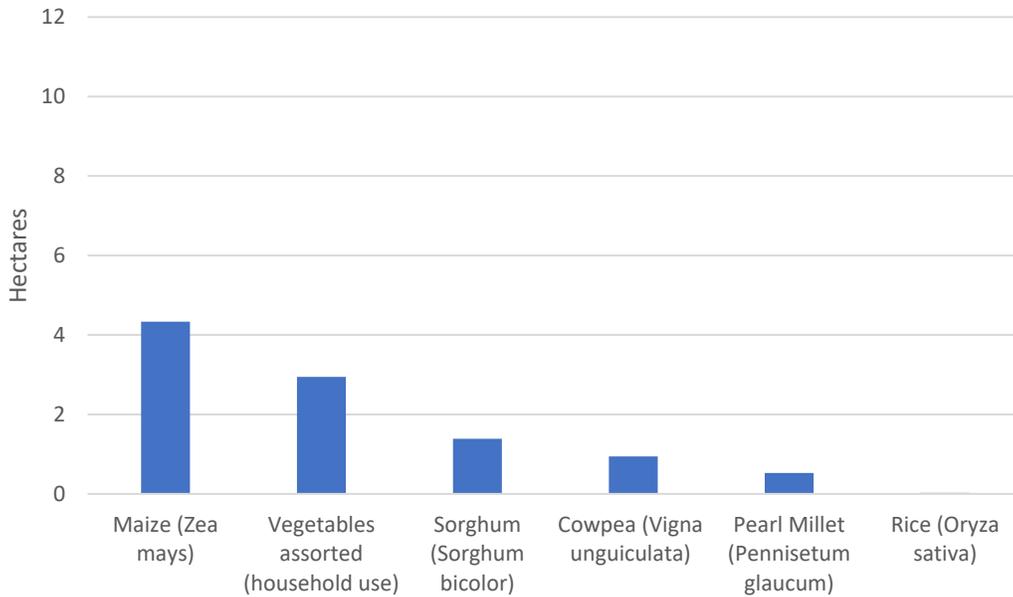


Figure 4: Average area (ha) per household of dominant arable crops in Bagnani

According to the farmers, land is one of the most limiting factors for agricultural activities in the areas. Approximately 10% did not have any land other than where they have constructed their homes. The land ownership is both by inheritance and through purchase. Consequently, fallowing is not commonly practised in the areas due to a shortage of land. No irrigation was reported in Bagnani due to the absence of perennial rivers suitable for irrigation.

The main factors that influence agricultural activities at the site are lack of land, labour, credit/finance and agricultural inputs. Labour is one of the major influencing factors for crop farming. Both family labour and hired labour are used to undertake different agricultural activities. Hired labour is mostly required during off-season cropping which coincides with the cold and hot dry season. The cost of labour depends on the type of farming activities. Labour cost for harvesting is 2000 FCFA per cropped area (3.4 USD) while for weeding could be as low as 1000 FCFA per cropped area (1.7 USD).

According to the respondents, around 30% of the household members left Bagnani in search of better livelihoods seasonally especially during off-season. Seasonal migration has been one traditional household strategies for escaping poverty, and remittances are often invested in land or livestock purchases (FAO 2001). From the focus group discussion, it was reported that there is a government microfinance bank for credit facility, but the farmers complained that the available credit system better suits crop production as compared to livestock production. The terms of credit require periodic repayment

that does not match the reproduction cycle of cows or ewes and consequently, farmers rely on informal credit among themselves. Agricultural inputs such as fertilizers, improved seeds, and other farm implements are available in local markets and are supplied by the government agricultural agency

Contribution of household income

Household incomes were reported to be derived mainly from crop production and livestock with more contribution from crop production (Figure 5). Household income from livestock is mainly from the sale of livestock while maize and assorted vegetables are the major contributors from crops.

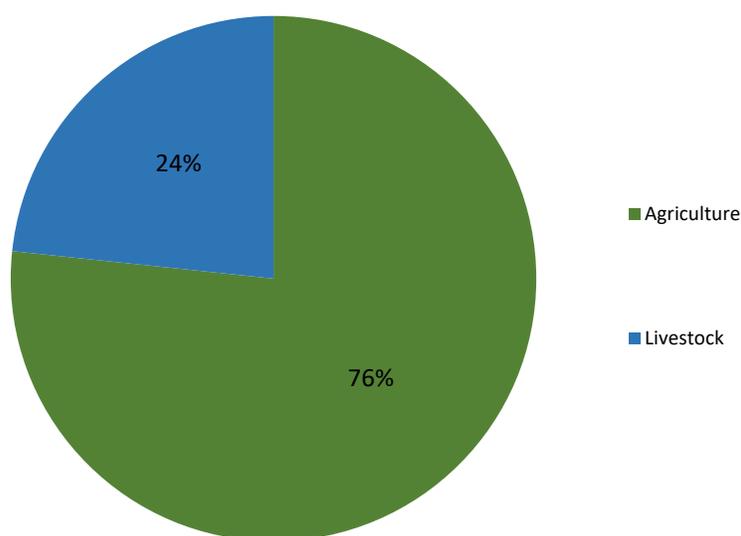


Figure 5: Contribution of livelihood activities to household income in Bagnani

Livestock production and management

Different livestock species which serve various purposes are raised in Bagnani. The number of livestock species per household is shown in Figure 6. Livestock species in the area included cattle (dairy and draught), sheep, goat, donkey and poultry. There were no improved breeds of livestock in the study sites. Apart from draught cattle, all species of livestock were reported to be used as a source of income enabling the farm household to meet unexpected expenditures. According to the farmers, sheep are sold at a higher price compared to goats and this could be the reason for its dominance over goat (Figure 6).

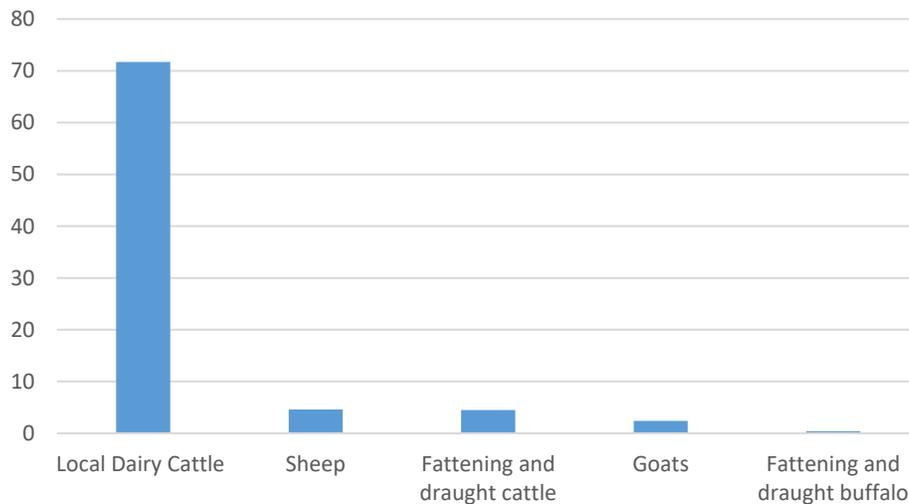


Figure 6: Average livestock holdings per household dominant species (TLU) in Bagnani

Different management practices (housing and feeding managements) are used in Bagnani as reported by the farmers. In most households, a wooden and wire-fencing enclosure are provided with a thatched roof to protect the animals against sun and rain. Farmers confirmed that all classes of animal are housed together. The primary style of feeding in the area was open grazing. Herding was common during the cropping season whereas animals are left free to roam during the remaining part of the year after the harvesting season. Feed processing was not widely practised in the area other than during the collection and conservation of residues of some crops. The farmers reported that no artificial insemination (AI) services are available and natural mating is the common method of animal reproduction in the area.

Major livestock feed resources and seasonal availability

The major feed resources in Bagnani were natural pasture, crop residues (both collected and grazed on the post-harvested field) and concentrate. Naturally occurring green fodder material from cropping areas, roadsides and naturally occurring grasses also served as sources of feeds (Figure 7). Seasonality of feeds indicated that natural pasture, the major feed resources in the area, was grazed almost year-round. However, its availability was lower in the late dry season from February to May. Crop residues become the available feed from November to February in Bagnani. Cereal residues were mainly left on the field for the animals to graze along with weeds.

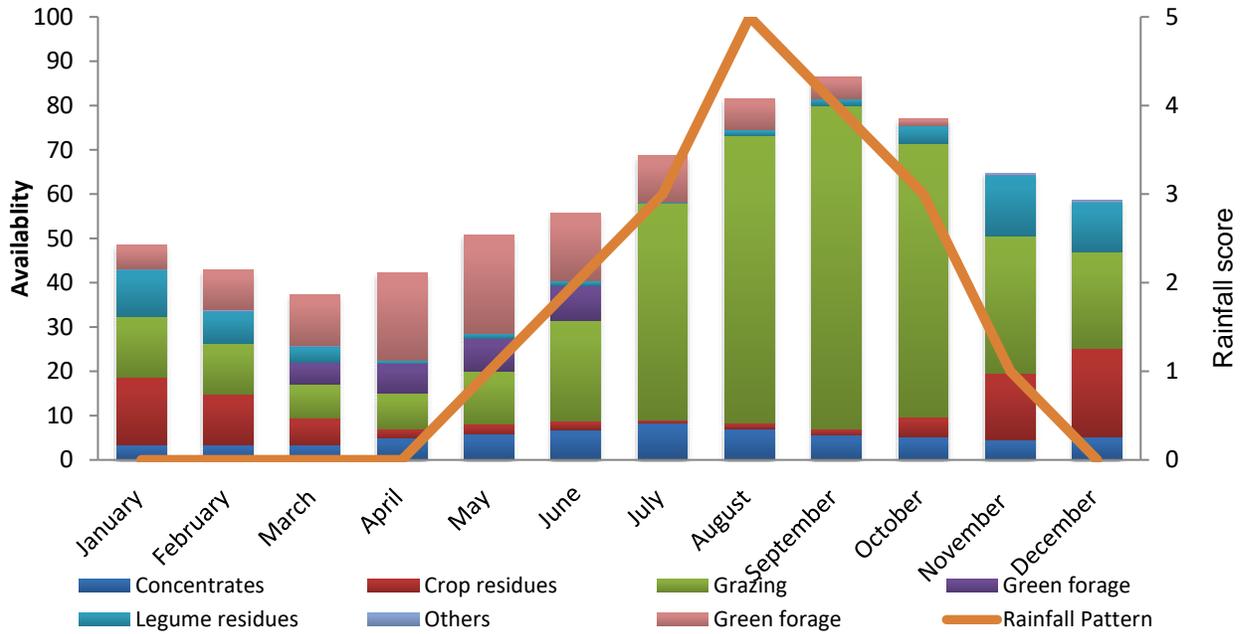


Figure 7: Seasonality of feed resources in Bagnani

Purchased feed

All the farmers interviewed in Bagnani purchased feed within the last 12 months of the study. Pearl millet bran was the highest quantity purchased by the farmers followed by cotton seed cake. Maize stover was the least purchased feed in the area (Figure 8).

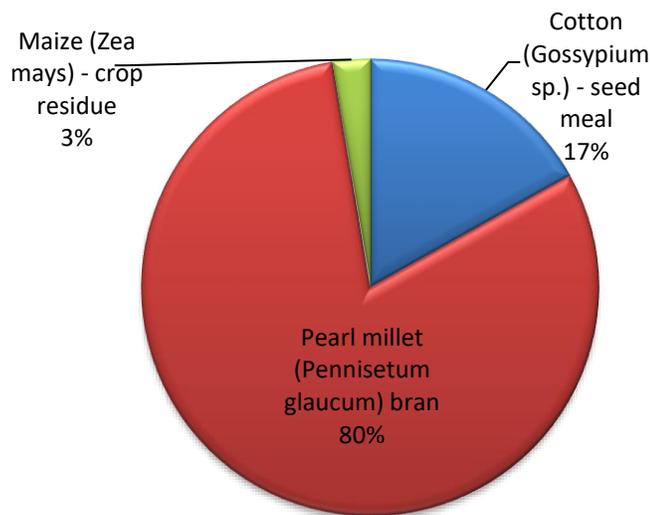


Figure 8: Type and quantity (%) of purchased feed resources in Bagnani

Dietary contributions

Grazing contributed the largest proportion of livestock diets in terms of dry matter (DM), metabolizable energy (ME) and crude protein (CP) in Bagnani followed by crop residues (Figure 9). The significant contribution of purchased feed to the proportion of CP at the site is an indication that farmers rely on concentrates as a source of protein for their livestock.

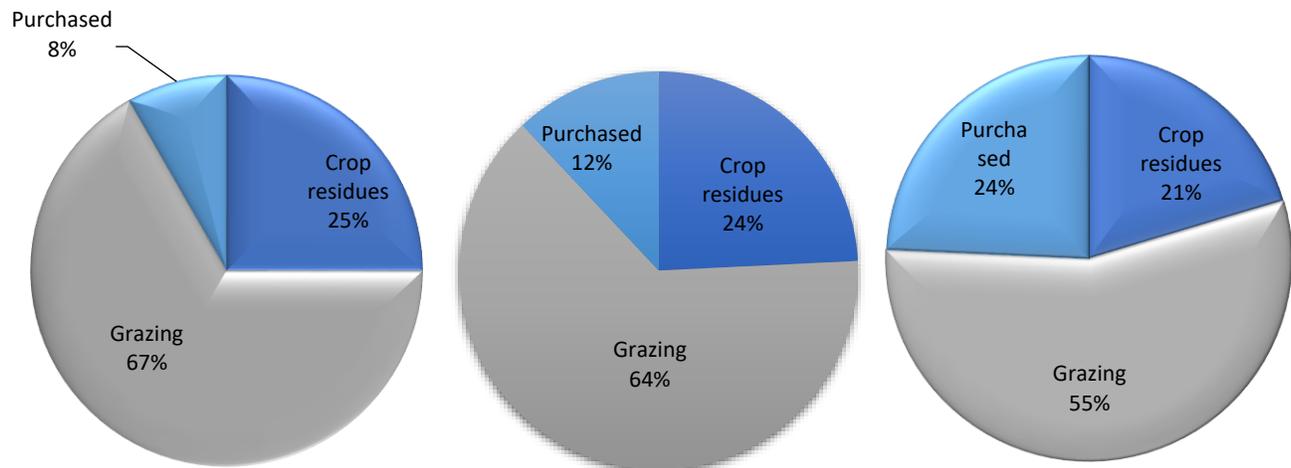


Figure 9: Contribution of various feed sources to the (a) Dry matter (DM) contents, (b) Metabolizable energy (ME) and (c) Crude protein (CP) contents of the total diet in Bagnani

Challenges and opportunities

The results of the FGD revealed the major challenges observed and identified by the farmers in Bagnani. Table 2 explains the challenges that were raised by the farmers regarding livestock production and their suggested interventions.

Table 2. Paired wise matrix ranking result of the challenges of livestock production Bagnani

Rank	Challenges identified	Proposed interventions by the farmers
1	Shortage of feed - both quantity and quality	Growing fodder crops in crop-fodder integration will both enhance biomass quantity and quality.
2	Disease and irregular veterinary services	Vaccination campaign and general flock treatment. Farmers also requested for government aids to subsidise veterinary service costs and provision of basic veterinary drugs.
3	Lack of dedicated land area for livestock grazing	Demarcating of grazing areas for livestock
4	Shortage of water	Construction of bore-holes with storage and training on water conservation. Small reservoir for the village.
5	Farmers and herders' clashes	Sensitization

Potential interventions based on farmers' suggestions

1. Better management of the existing water resources, collecting rainwater for dry periods, utilizing the existing limited water sources by making water reservoirs. Extracting the groundwater with the assistance of government and non-governmental organizations.
2. Interventions that facilitate efficient collection of crop residues, improve the conservation and utilization of crop residues will promote increase feeds and feeding efficiency.

Overview of the farm system in Northern Sudan (*Bagre, Doubegue, Belempourou and Namoungou*)

Based on landholding, the results indicated that the majority of the farming households in Bagre, Doubegue, Belempourou and Namoungou village were smallholders with land sizes less than 1 hectare. About 30% of the farmers fell into the medium landholder category with an average of 1 to 2 hectare while both landless and large landholding farmers accounted for 10% each in the village (Figure 10) shows the data for Bagre and other communities were similar. The results of the survey indicated that mixed crop-livestock farming was the dominant system in the study sites, which is dominated by crop production with over 80% of the households growing crops and rearing at least one species of livestock.

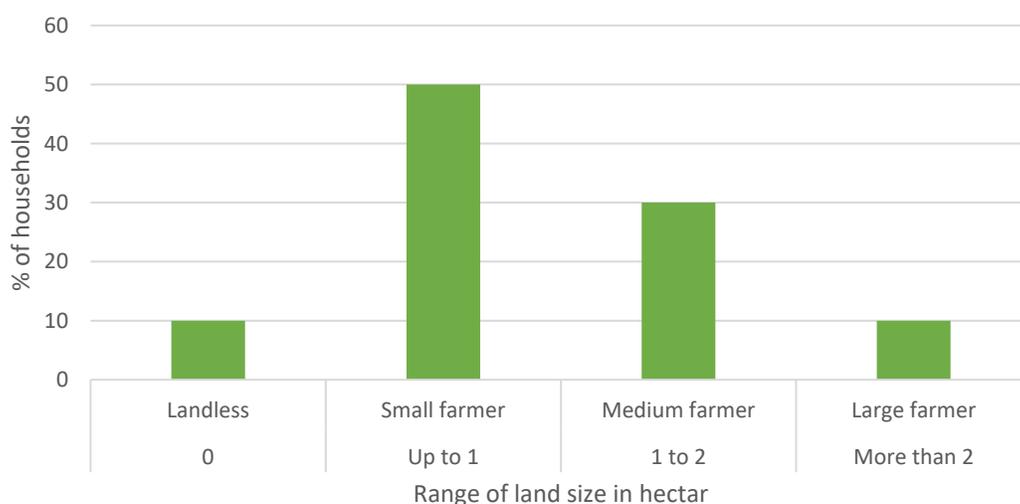


Figure 10: Average land area per household in Bagre, Doubegue, Belempourou and Namoungou by landholding categories by landholding categories

The most common cereal crops grown in the areas were maize, millet, sorghum and rice, while groundnut was the main legume grown according to the farmers. Maize was the dominant cereal crop in Bagre, Doubegue and Namoungou while millet was reported as the dominant crop species in Belempourou (Figure 11). The results indicated that cowpea was more prominent in all areas than groundnut. Farmers in Namoungou cultivated larger land areas than the other villages. Farmers in all the sites also cultivated assorted vegetables and sesame during the off-season which were intercropped on the same farmland in succession due to shortage of fertile land.

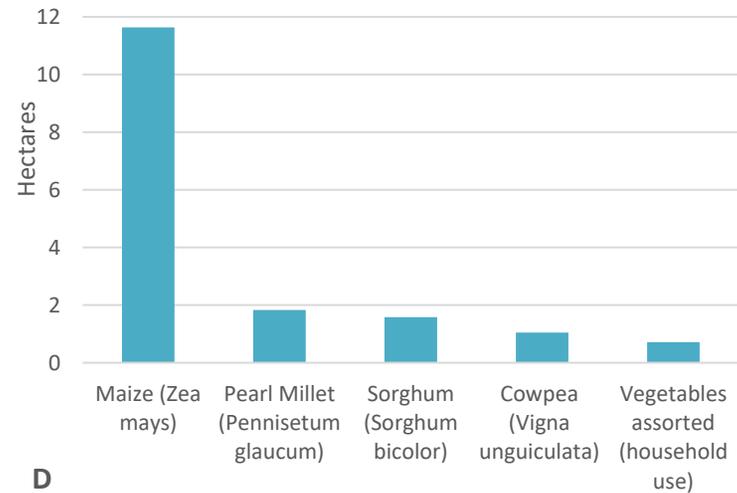
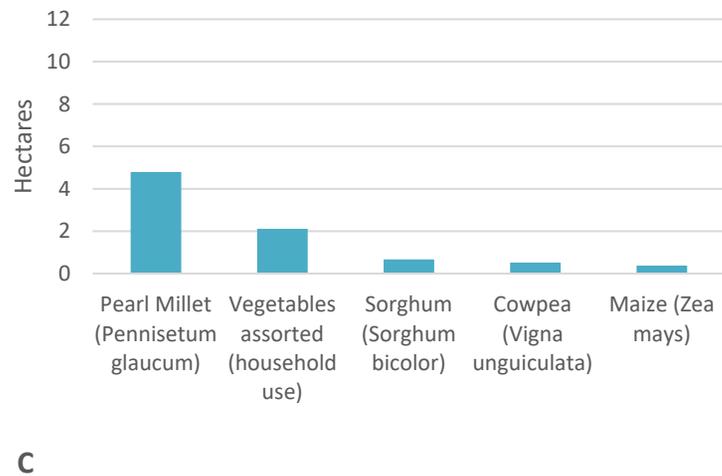
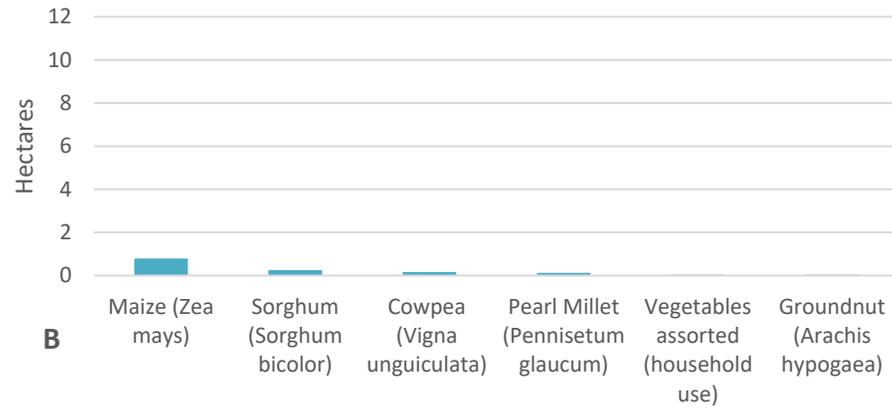
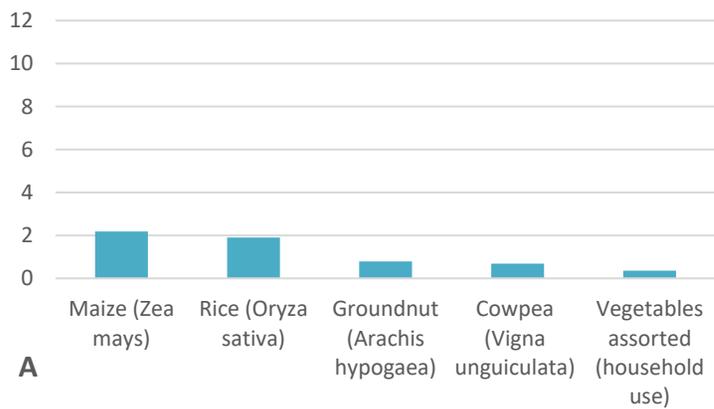


Figure 11: Dominant crops grown and average area (ha) per household in (a) Bagre, (b) Doubegue, (c) Belempourou and (d) Namoungou

The results from the focus group discussions indicated that land tenure and ownership is based on traditional common property rights. According to the farmers, such system accrues the ownership of the land to the village head who then distributes the land to all household heads according to their ages. This implies that older farmers have access to and own land while many youths can only access land through inheritance. Consequently, the increase in population resulted in short supply of land, leading to land fragmentation. It was noted that annual land rents per hectare in Bagre, Doubegue and Namoungou could be as high as 200,000 FCFA (USD 336), 100,000 FCFA (USD 169) and 150,000 (USD 254) FCFA respectively. This condition limits fallow land practice in the sites.

Farmers in Bagre agreed that irrigation is well practised in the study area but access to irrigation was minimal as only 40% of the households who can afford irrigation pumps used irrigation to grow rice and maize during off-season. Only 30% of the households in Doubegue had access to irrigation from the dam. The irrigation is done by manual water application as many farmers cannot afford irrigation pumps. There was no irrigation in either Belempourou and Namoungou.

In all the sites, family labour was used for most farming activities. However, hired labour is required especially during peak season for ploughing and planting. The average cost of labour was estimated at 3000 FCFA (USD 5) in Bagre for land preparation. Ploughing and planting cost 2000 FCFA (USD 3.4) per day each, while harvest could cost as much as 3000 FCFA (USD 5) per day in Doubegue. Labour cost could be as low as 750 FCFA (USD 1.3) per day in Belempourou and as high as 4000 FCFA (USD 6.7) per day in Namoungou.

Farmers in Bagre reported increase in number of emigrants in recent years. About 30% of the people (mostly youth) have migrated from Bagre to urban cities in search of better livelihoods. This is driven by a high poverty level and inadequate land for cropping in the villages. From the focus group discussion in Doubegue, 50% of the household members (mostly youth) migrated to the cities in search of better livelihoods, particularly during the dry season. According to the farmers, an average of 20% and 15% of the household members migrated to urban cities in both Belempourou and Namoungou respectively. Some of these migrants were reported to be seasonal in search for job and other off-farm activities. Credit services by government microfinance institute (*Cassie Populaire*) are available in Bagre and 20% of the farmers have accessed the service in the past few years. Farmers reported a delay in credit disbursement which limits its accessibility. In Doubegue, access to credit and loan is provided by both the government and the private sector. However, farmers are not utilizing the loan facility due to the high interest rate and difficulties in accessing the facility. The credit facilities are not well developed in Namoungou though farmers reported that it could only be used for buying improved seeds. Farmers have formed a co-operative

association, where they can obtain loans with low-interest rate. Inputs such as fertilizers, improved seeds and tractor services are readily available according to the respondents by both the government and private providers in Bagre, Doubegue, Belepourou and Namoungou. The costs of these services are generally high as reported by the farmers.

Contribution of household income

Figure 12 shows the two major livelihood activities that contribute to the household’s income in Bagre which were crop farming (74%) and livestock rearing (26%). Livestock contributed 55% of the household income in Doubegue. Major household income sources in Belepourou were agriculture (35%) and other business (24%) while agriculture (68%) and livestock (32%) formed the major household income in Namoungou.

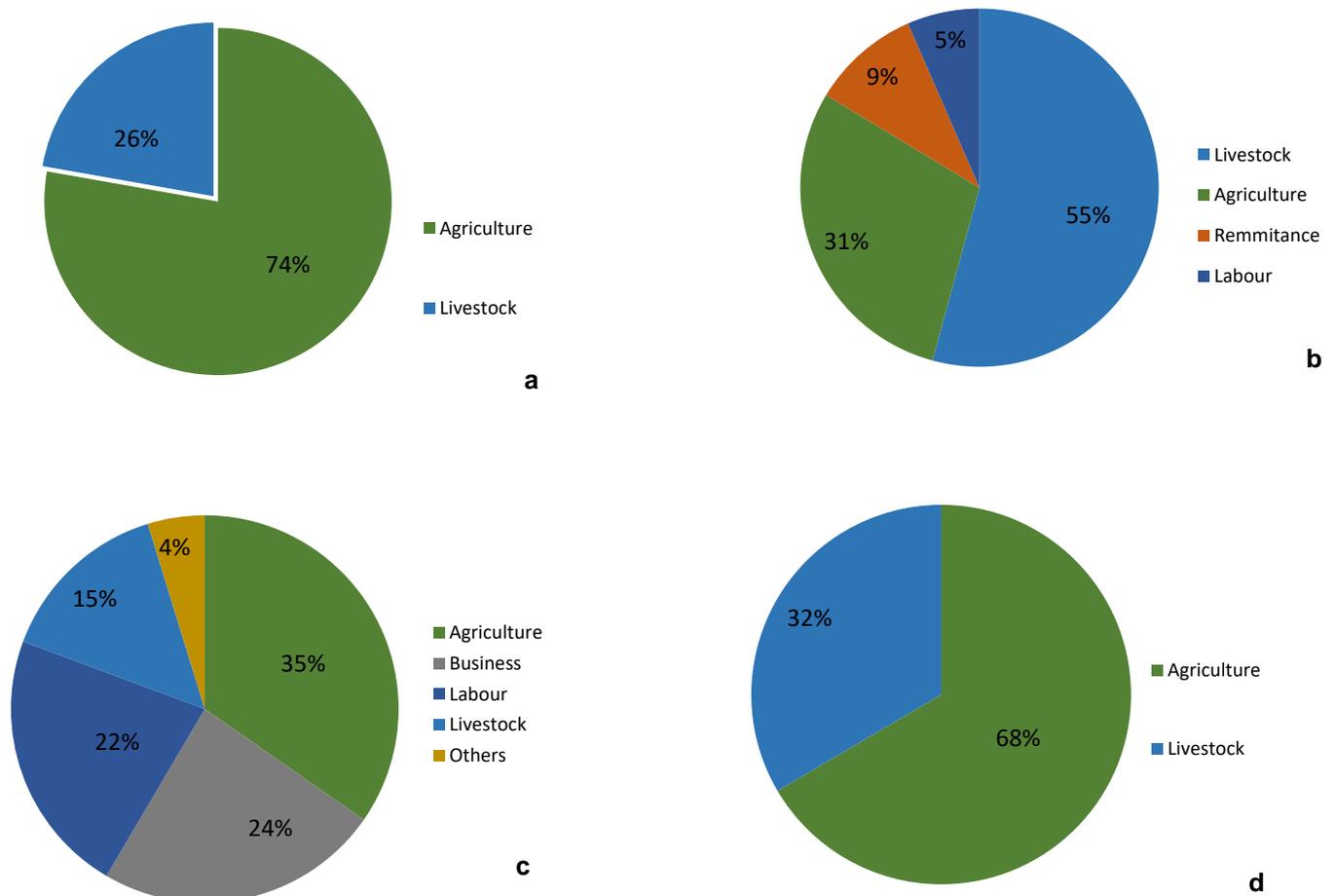


Figure 12: Contribution of livelihood activities to household income in (a) Bagre, (b) Doubegue, (c) Belepourou and (d) Namoungou

Livestock production and management

Livestock production is an integral component of the farming system in all the study areas with every household keeping a range of species including pigs, cattle, sheep, goats, donkeys and poultry. These are kept for various purposes; for example, cattle are kept to store cash, for draught power and for manure production. All the households keep sheep for home consumption and income generation while donkeys and horses are kept for transportation and draught purposes. Except in Bagre, local dairy cattle are the dominant livestock species in Doubegue, Belempourou and Namoungou (Figure 13). According to the results, pigs are the dominant livestock species kept mostly by households of below-average wealth in Bagre. In Namoungou, local dairy cattle were the dominant livestock species kept mostly by households of above-average wealth. Generally, households within the above-average wealth categories owned more livestock in all the sites than other wealth categories.

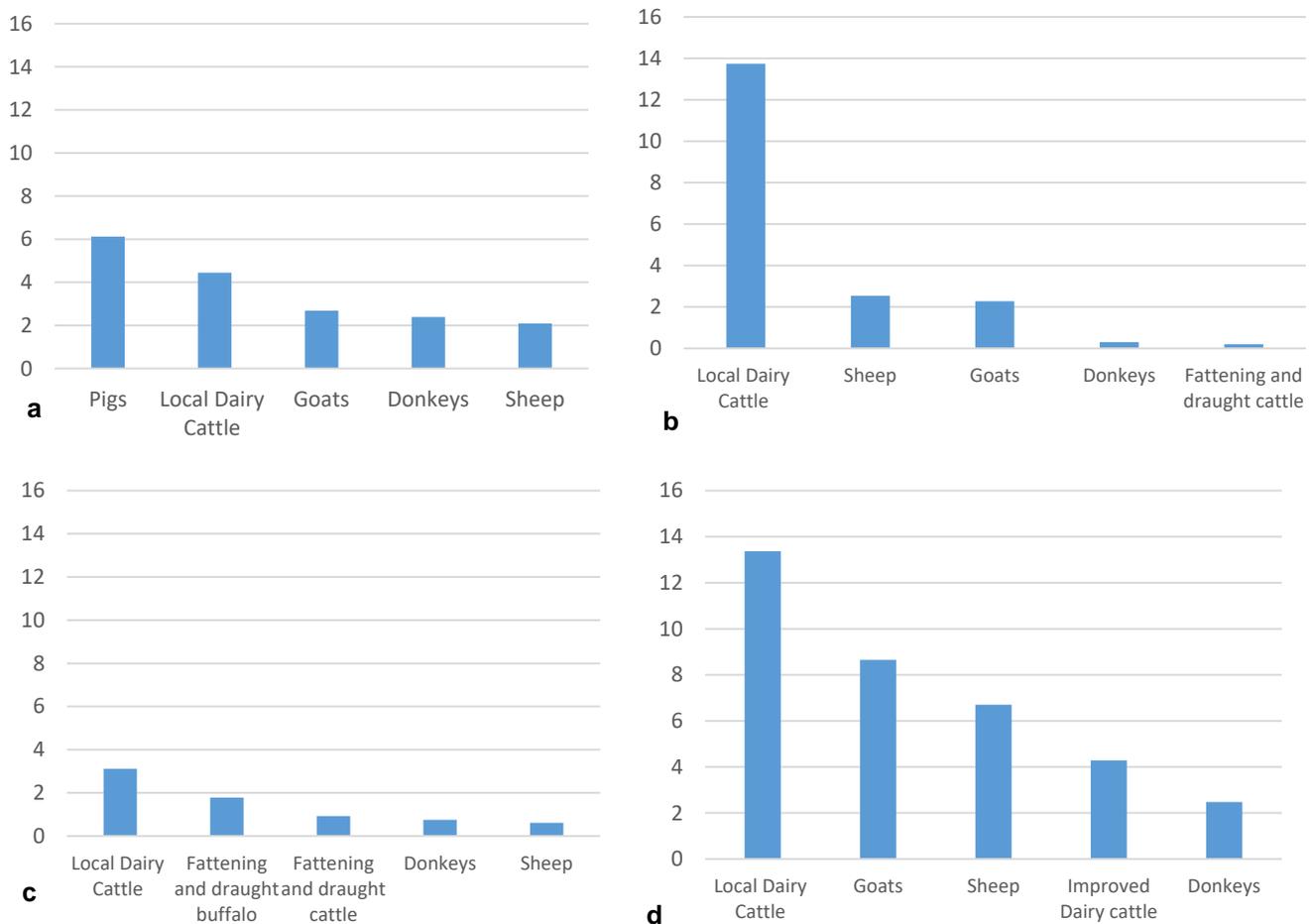


Figure 13: Average livestock holdings per household dominant species (TLU) in (a) Bagre, (b) Doubegue, (c) Belempourou and (d) Namoungou

From the respondents, livestock management in terms of housing and feeding differed in all study sites within the same agro-ecology zone. Farmers in Bagre provided housing for all classes of livestock only at night. Most households in Doubegue provided a wooden and wire-fencing enclosure with a thatched roof to protect the animals against the harsh weather. Farmers in Namoungou confirmed that all classes of animal are housed together. In all the sites, the primary method of feeding in the area was open grazing on the harvested field while concentrates were provided as a supplement for fattening animals. Feed processing was not widely practised in the area other than collection and conservation of residues of some crops by some households.

According to the farmers, veterinary services are available by both government and private organizations in Bagre and treatment costs depend on animal species and ailment. There are veterinary services both from the government and private individuals but not regularly in Doubegue. Farmers reported that treatment of most common disease (fever), is the most expensive costing about 1000 FCFA (USD 1.7) while vaccination costs 600 FCFA (USD 1) and castration cost 300 FCFA (USD 0.5) both per animal. Artificial Insemination (AI) services were not available according to the farmers and the use of local bull services was available at no cost in Doubegue, Namoungou and Belempourou. From the FGD, there are no artificial insemination (AI) services in all sites. Reproduction in all sites is by natural mating using bull service but costs around 10000 FCFA (17 USD) per service in Bagre.

Major livestock feed resources and seasonal availability

The feed resources in Bagre, Doubegue Belempourou and Namoungou were primarily composed of grazing, crop residue (cereals and legumes), and purchased feed and naturally occurring and collected fodder (Figure 14). These feed resources are seasonal in availability with severe shortage during the dry season from January to May until the rainy season starts. The most critical period is from February to May, when all feed resources are virtually depleted and all feed resources including the purchased feed are inadequate. Quantity of available feed resources throughout the year differed at each site.

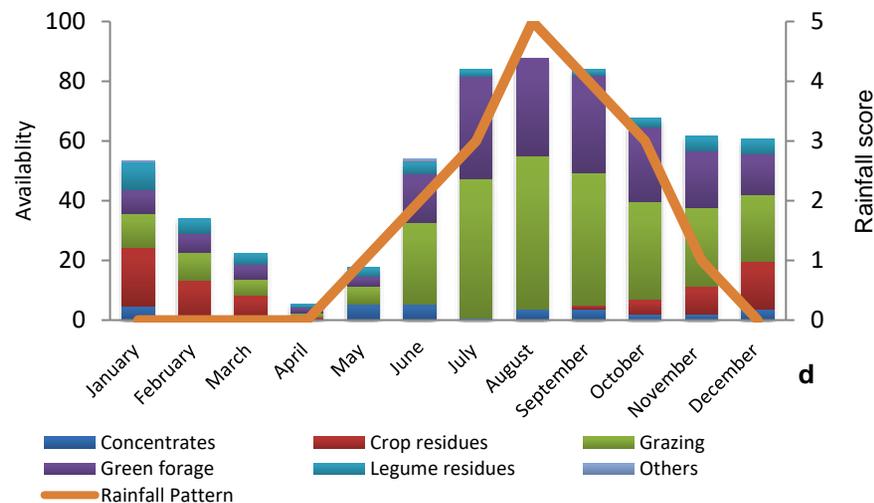
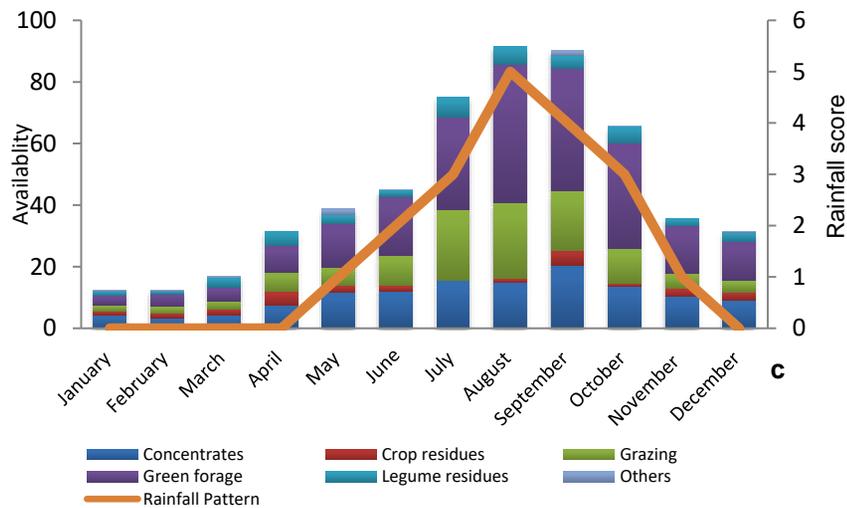
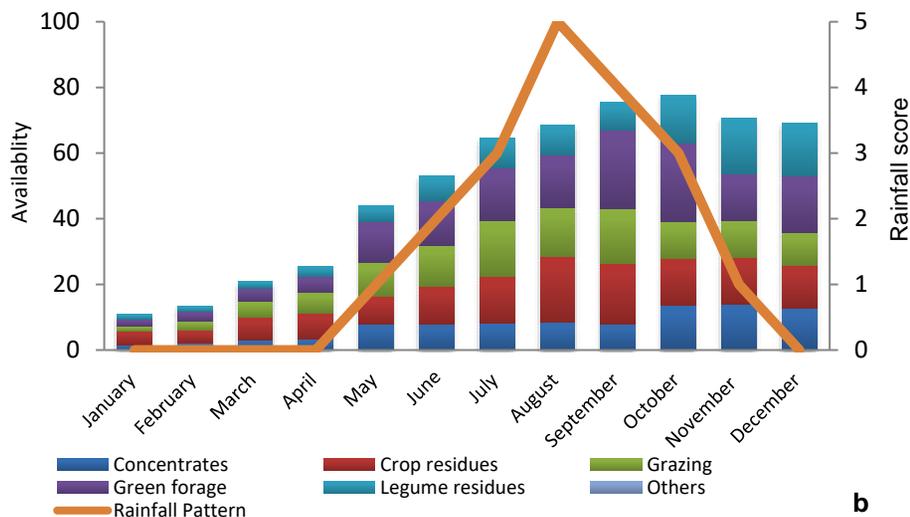
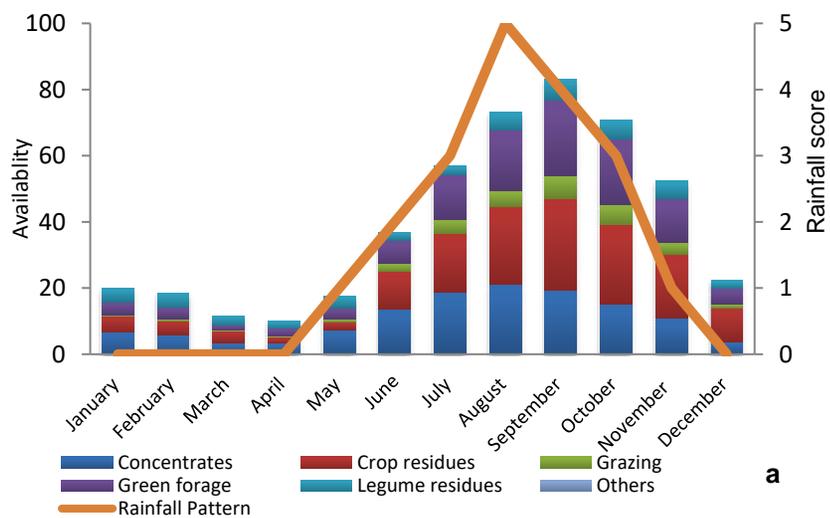


Figure 14: Seasonality of feed resources in (a) Bagre, (b) Doubegue, (c) Belepourou and (d) Namoungou

Purchased feed

The results indicated that 78% of the purchased feed in Bagre, within the last 12 months, was cotton seed cake while sorghum stover accounted for the remaining 22% (Figure 15). According to the farmers, maize bran from both household and the local mill was the major feed purchased in Doubegue in the last 12 months. Similarly, millet bran from household processing formed 7% of the purchased feed while cowpea residues and cotton seed cake were purchased in small amounts (1%). Furthermore, in Namoungou, the results indicated that 52% of the purchased feed in the site within the last 12 months was pearl millet crop residue (52%), cotton seed cake (34%) with other purchased feed accounting for the remaining 14%.

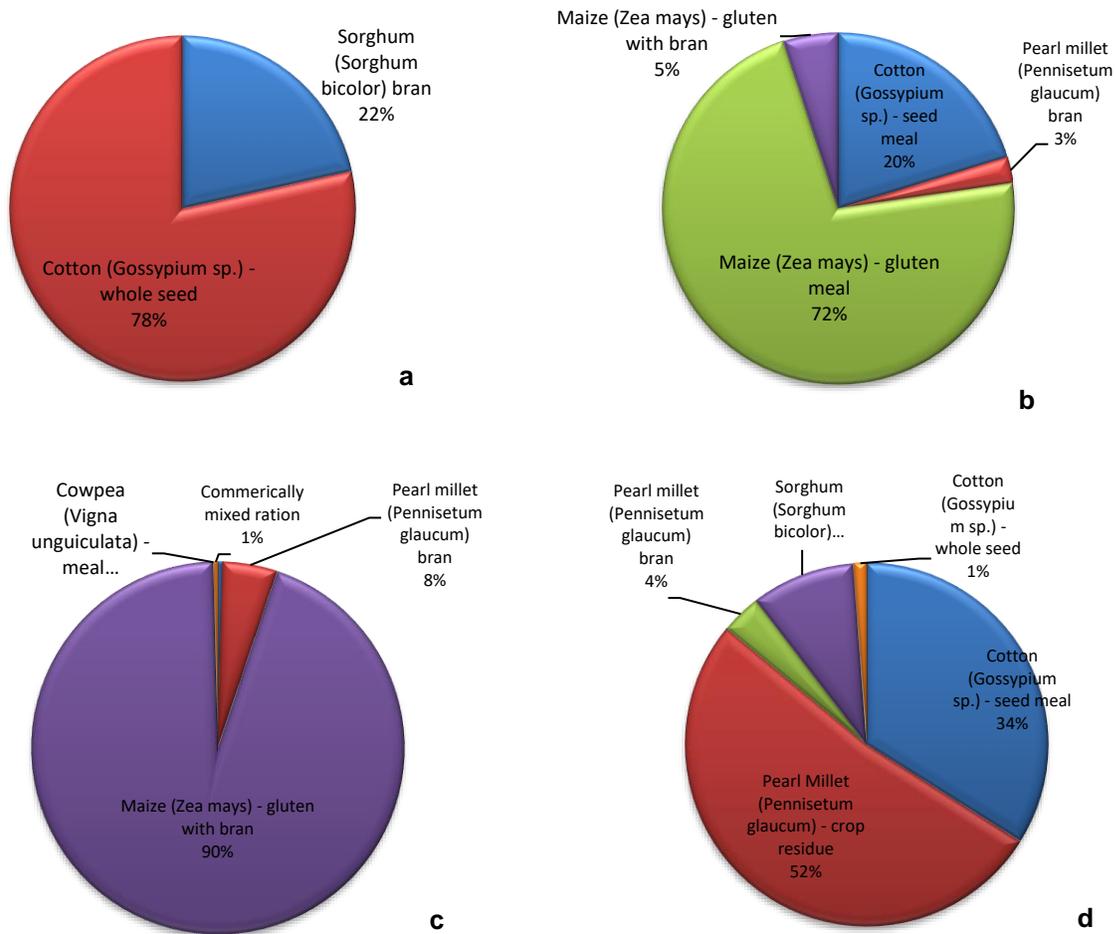


Figure 15: Type and quantity (%) of purchased feed resources in (a) Bagre, (b) Doubegue, (c) Belepourou and (d) Namoungou

Dietary contribution

Based on the information gathered from the individual interviews, crop residues contributed the most to the Dry Matter (DM) content (41%), the metabolizable energy (ME) (37%) and the crude protein (CP) (42%) of the total diet in Bagre (Figure 16). This indicates the level of dependence on crop residues in the area. In Doubegue, grazing contributed most to the DM and ME contents while purchased feed contributed mostly to the CP content of the livestock diet in Doubegue and Belempourou.

Challenges and opportunities

The results of the FGD revealed the major challenges observed and identified by the farmers in Bagre. Table 4 explains the challenges that were raised by the farmers regarding livestock production and their suggested interventions.

Potential intervention based on farmers' suggestions

- In Bagre and Belempourou, additional sources of water (community borehole) with government or non-governmental organizations will ease the shortage of water for livestock and household use.
- Establishment of village veterinary ambulatory to provide quick and low-cost veterinary services.
- Training on improving the feeding value of available crop residues, proper storage methods and establishment and management of browse trees will enhance the utilization of available feed resources in Bagre, Doubegue, Belempourou and Namoungou.

Delimitation grazing areas and enforcement of law against encroachment in Doubegue and Namoungou will eliminate farmers-herders clashes.

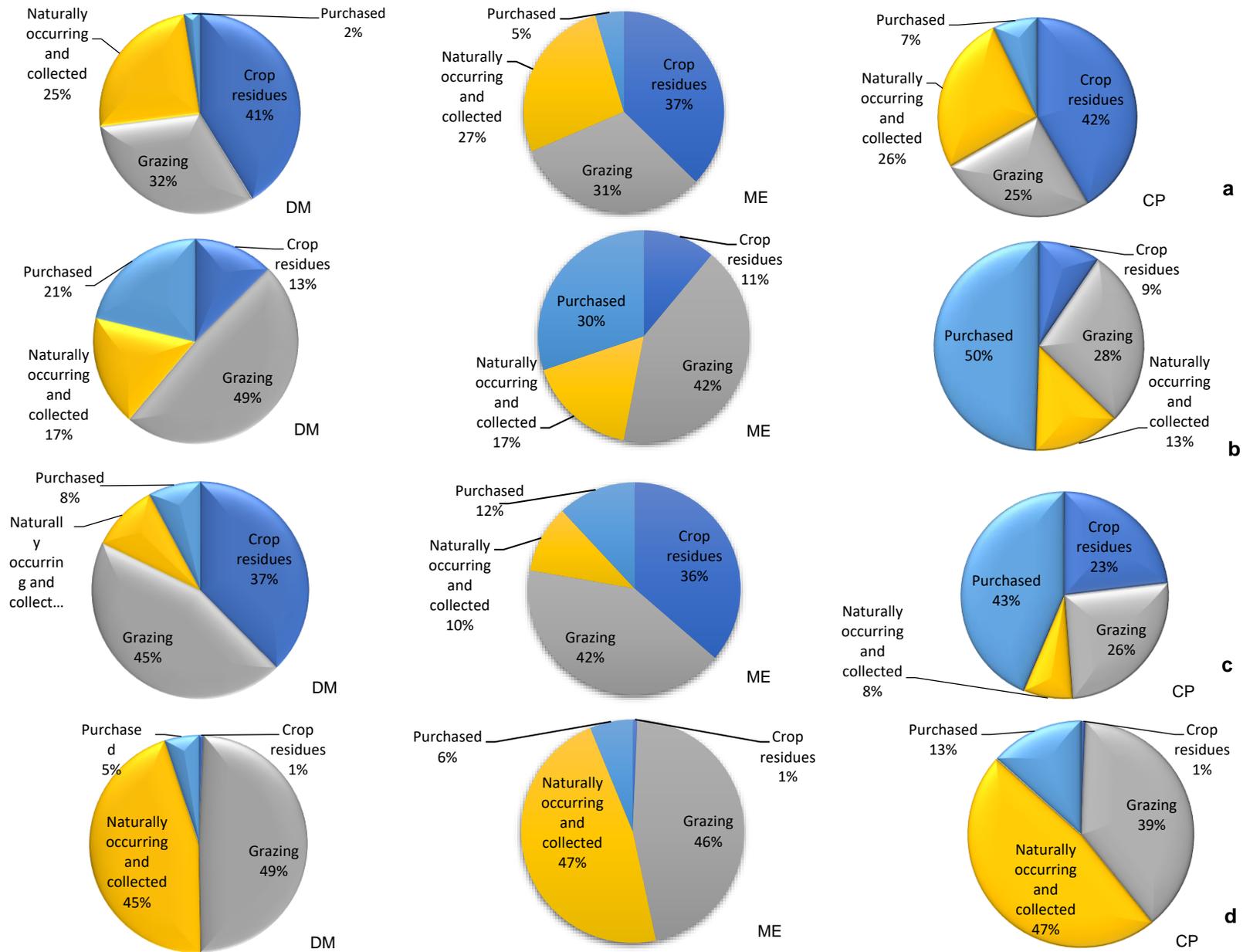


Table 3. Contribution (%) of various feedstuffs to Dry matter content (DM), metabolizable energy (ME) and crude protein content (CP) of the total diet of the livestock in (a) Bagre, (b) Doubegue, (c) Belepourou and (d) Namoungou.

Table 4. Paired wise matrix ranking result of the challenges of the livestock production in Bagre, Doubegue, Belempourou and Namoungou

Rank	Bagre	Doubegue	Belempourou	Namoungou
1	Shortage of water	Shortage of feed-in quantity and quality	Shortage of water	Farmers-herder clashes
2	Shortage of feed - both quantity and quality	Disease and irregular veterinary services	Shortage of feed-in quantity and quality	Lack of cattle route
3	Disease and irregular veterinary services	Lack of dedicated land area for livestock production	Disease and irregular veterinary services	Shortage of water
4	Poor market structure	Shortage of water	Insufficient grazing area	Shortage of feed-in quantity and quality
5	Poor access to credit	Farmers and herders' clashes	Poor access to credit	Disease infestation and high cost of veterinary services

Overview of the farm system in Southern Sahel (Tougouri)

Based on landholding, the results indicated that majority (50%) of the farming households in Tougouri were smallholders with land size less than 1 hectare. About 30% of the farmers fell into the medium landholding category with an average of 1 to 2 hectares while both landless and large landholding farmers accounted for 10% each of the villages (Figure 17). Tougouri is made up of several households with an average of 12 individuals per household. According to the respondents, land ownership is by family inheritance. However, land could be leased for certain periods. As the population has increased, the same inherited land areas were shared among the increasing number of family members which often resulted in the declining of available land.

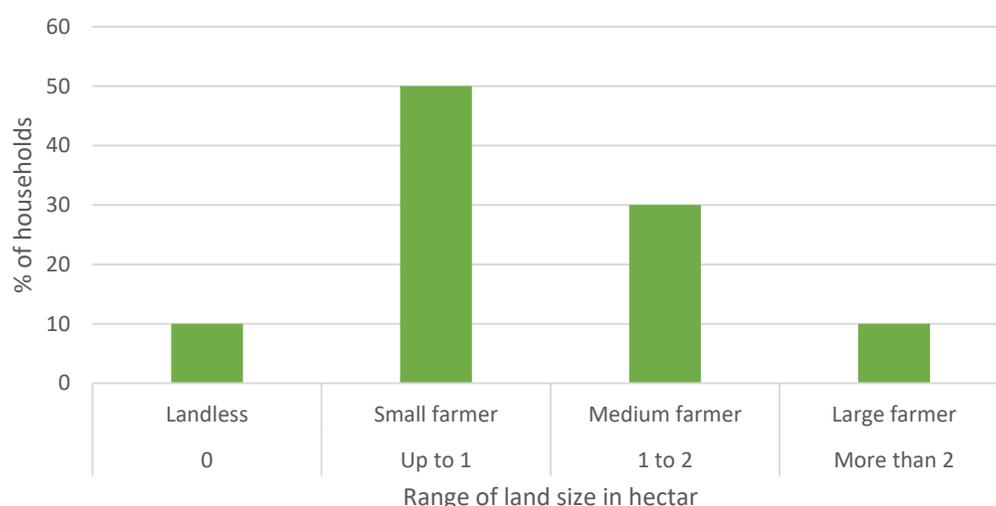


Figure 17: Average land area per household in Tougouri by landholding categories

The results of the survey indicated that farming system in Tougouri can be described as a mixed crop-livestock system with crop production as the dominant livelihood. The main crops grown in the study area were pearl millet, groundnut, sorghum, cowpea and vegetables (Figure 19). Pearl millet was the main grown crop by all wealth categories and respondents confirm that vegetables were mainly grown for house use. Groundnut and sorghum were grown at a minimal level with an average household land cultivation size less than 0.5 hectare while vegetables and cowpea were cultivated on farm size less than 0.4 hectare (Figure 18).

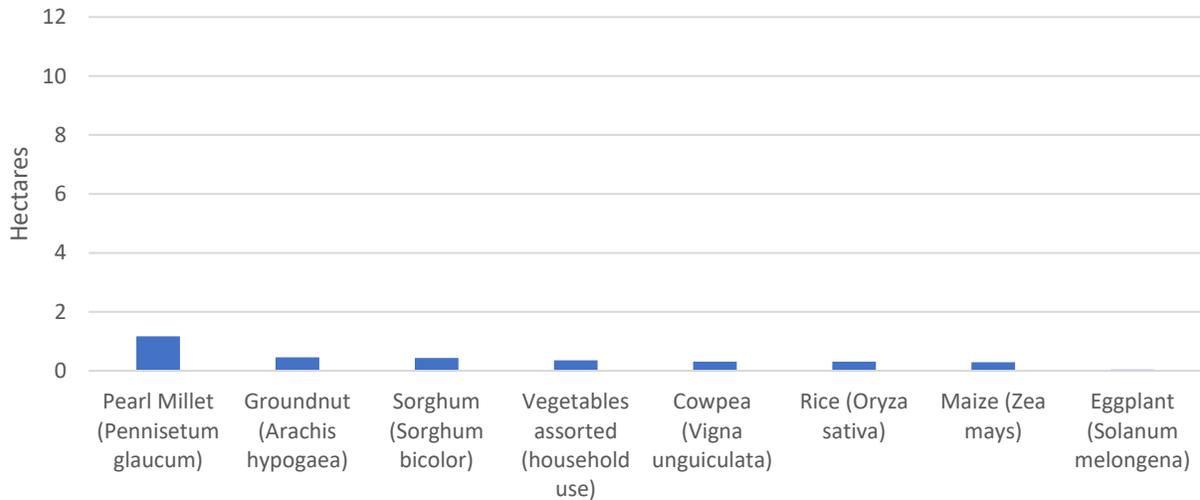


Figure 18: Average area (ha) per household of dominant arable crops

During the FGD, the farmers mentioned that the available water sources were wells, dams and bore-holes. According to the respondents, 40% of the village could access water for their livestock. About 12% of farmers in Tougouri practiced irrigation using motorised pumps and manual methods. Tomatoes, onion, carrots are commonly grown with irrigation. According to the farmers interviewed in Tougouri, labour was reported to be expensive especially for planting. Hired labour costs 15,000 FCFA (25 USD) per activity per hectare. In addition, an average of 30% of the people in every household had migrated to nearby cities to pursue education, occupational opportunity while few member of the transhumant households also practiced seasonal migration in search of pasture. Credit services by the government's microfinance institute (*Cassie Populaire*) are available in the study area. The respondents confirmed that due to several factors, only 20% of the farmers have accessed the service in the past few years. Farmers noted that the problem regarding credit service is in the procedures and the required collateral. From the results of the FGD, it was observed that inputs such as fertilizers and manure are sold at the market nearby, about 5 km away from Tougouri.

Contribution of household income

Figure 19 shows three major livelihood activities that contributed to household income in Tougouri, namely crop farming (62.5%), livestock rearing (20%) and remittance (17.5%).

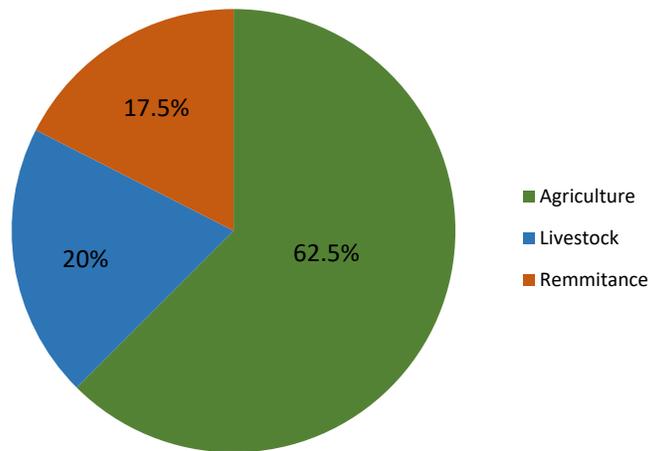


Figure 19: Contribution of livelihood activities to household income in Tougouri

Livestock production and management

Livestock production is a vital and main component of the farming systems in the study area with every household keeping dairying cattle, fattening and draught cattle, sheep, goats and donkeys. Generally, cattle were kept for the purpose of draught, milk and cash income. Donkeys were primarily kept for transportation of goods, crop harvests and people. Chickens are normally sold as the need arises and are also slaughtered for consumption during festivals or ceremonies but occasionally for food. Both sheep and goat are primarily kept for income and manure, while pigs are raised for income purpose. The dominant livestock species owned by household are local dairy cattle (Figures 20).

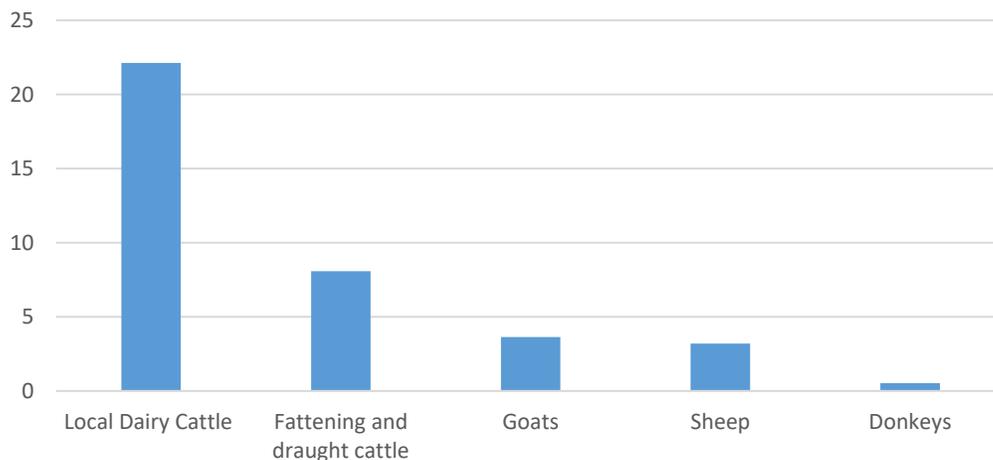


Figure 20: Average livestock holdings per household dominant species (TLU) in Tougouri

Common livestock diseases in the area according to the farmers are Pasteurellosis and fever in cattle, diarrhoea and food poisoning in sheep and goat and Newcastle disease in chicken. The farmers reported that veterinary services are available at about a distance of 6 km. The cost of vaccination and treatment of common ailment is 2000 FCFA (3.5 USD) per animal. Artificial insemination (AI) services were not available in the study site. The use of local bull services is available at no cost.

Major livestock feed resources and seasonal availability

The feed resources in the study area were primarily grazing, crop residues, green forages (collected fodder) and concentrates (purchased feed) with grazing and crop residues as the dominant feed resources. Feeds, particularly crop residues become available in November until February followed by a decline as the dry season advances (Figure 21). Farmers in Tougouri combine open grazing with supplementation in feeding their livestock. During the wet season which coincides with cropping season, animals are confined and fed with collected fodder until after the crop harvest. Farmers also confirmed the practice of mixing groundnut haulms with millet and sorghum stover.

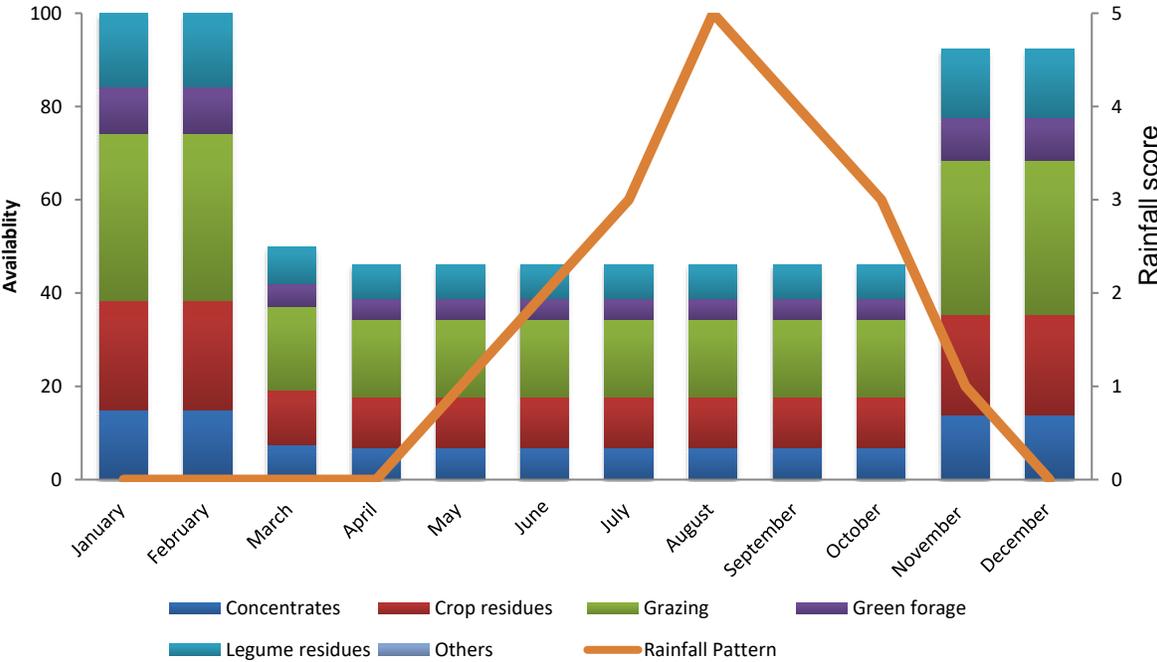


Figure 21: Seasonality of feed resources in Tougouri

Purchased feed

Farmers in Tougouri depend largely on residues from pearl millet, groundnut and cowpea during the dry season as animal feed resources. As the wet season approaches, crop residues decline and with a minimal grazing period the animals are confined and farmers depend on purchased feeds during this time. The results indicated that 56% of the purchased feed in the site within the last 12 months was pearl millet bran and 27% of pearl millet crop residue (Figure 22).

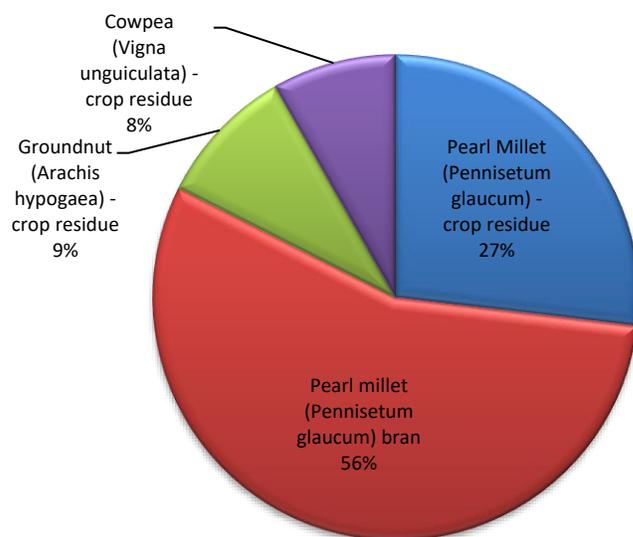


Figure 22: Type and quantity (%) of purchased feed resources in Tougouri

Feed quality

Based on the information gathered from the individual interviews, purchased feed contributed the most to dry matter (DM) content at 56%, metabolizable energy (ME) and crude protein (CP) at 73% of the total diet in Tougouri (Figure 23). This indicated the level of dependence on purchased feeds which are mostly crop residues in the area. Grazing contributed 33% to DM and 19% to CP of the total diet.

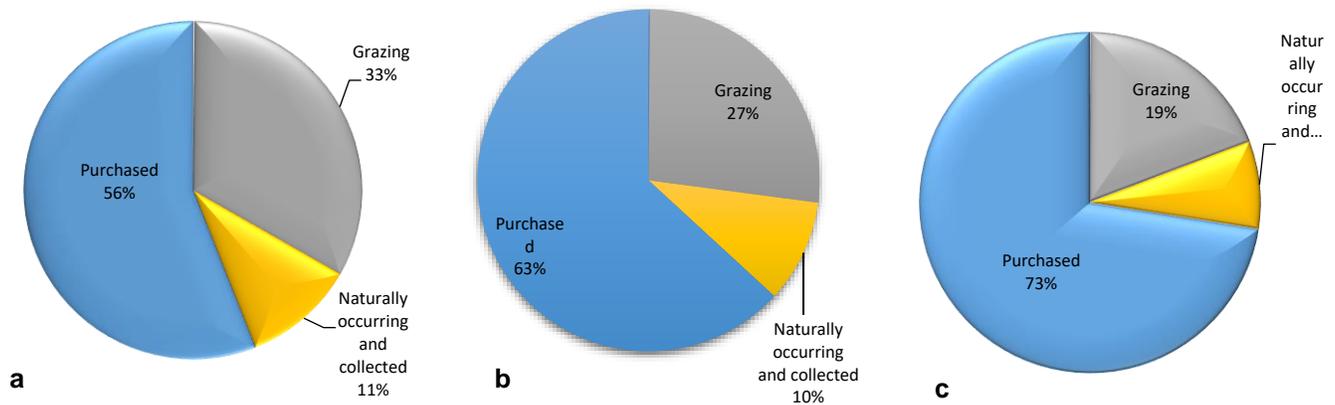


Figure 23: Contribution of various feed sources to the (a) Dry matter (DM) contents, (b) Metabolizable energy (ME) and (c) Crude protein (CP) contents of the total diet in Toungouri.

Challenges and opportunities

The results of the FGD revealed the major challenges observed and identified by the farmers in Toungouri. Table 5 shows the challenges that were raised by the farmers regarding livestock production and their suggested interventions.

Table 5. Paired wise matrix ranking result of the challenges of livestock production in Toungouri

Rank	Challenges identified	Proposed interventions by the farmers
1	Shortage of water	Construction of bore-holes with storage facilities in the village
2	Lack of cattle route	Creation of cattle route and with government support
3	Disease	Support for veterinary services to provide cheaper services
4	Encroachment of grazing areas.	Enforcement the law against the encroachment of grazing areas
5	Inadequate credit	Increase the soft loan available to the farmer

Overview of the farm system in Northern Sahel (Goudebo)

According to the respondents during the focus group discussion, 50% of the farming households were smallholders with land size less than 1 hectare (Figure 24). About 30% of the farmers fell into the medium landholding category with an average of 1 to 2 hectare while both landless and large landholding farmers accounted for 10% each in the village.

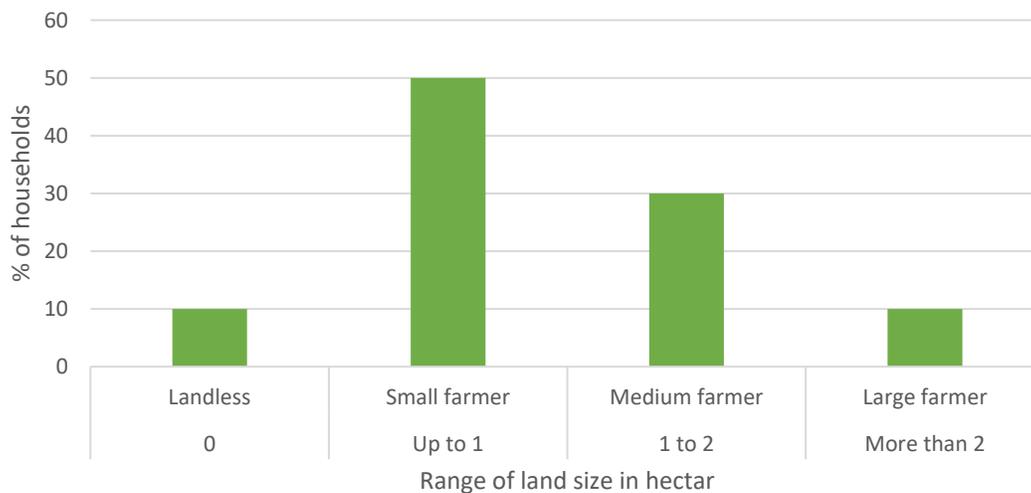


Figure 24: Average land area per household in Goudebo

Land tenure system in Goudebo is through the traditional ruler and head of the village who apportioned the land. The local council authority allocates land to individuals according to the land use acts. The results of the survey indicated that farming systems are a mixed crop-livestock system dominated by livestock rearing. The main crops grown in the study area were vegetables, maize, sorghum, cowpea and groundnut (Figures 25). Vegetables were the main grown crop by all wealth categories and respondents confirmed that vegetables were mainly grown for house use and for sale. Maize, sorghum, cowpea and groundnut were equally grown with an average household land cultivation size of almost 2.5 hectare.

During the FGD, farmers reported that irrigation is commonly practised for growing crops for sale (onions and cabbage). However, access to irrigation was minimal as only 20% of the households engaged in irrigated farming. Labour is required for all the farm activities. During the wet season, hired labour is very scarce and competitive due to many cropping activities (ploughing and planting) requiring more hired labours. The average cost of labour was estimated to 2,500 FCFA (4 USD) per day according to the farmers. Farmers reported that 30% (mostly youth) of the people had migrated from Goudebo to urban cities in pursuit of improved livelihoods as well as for educational reason.

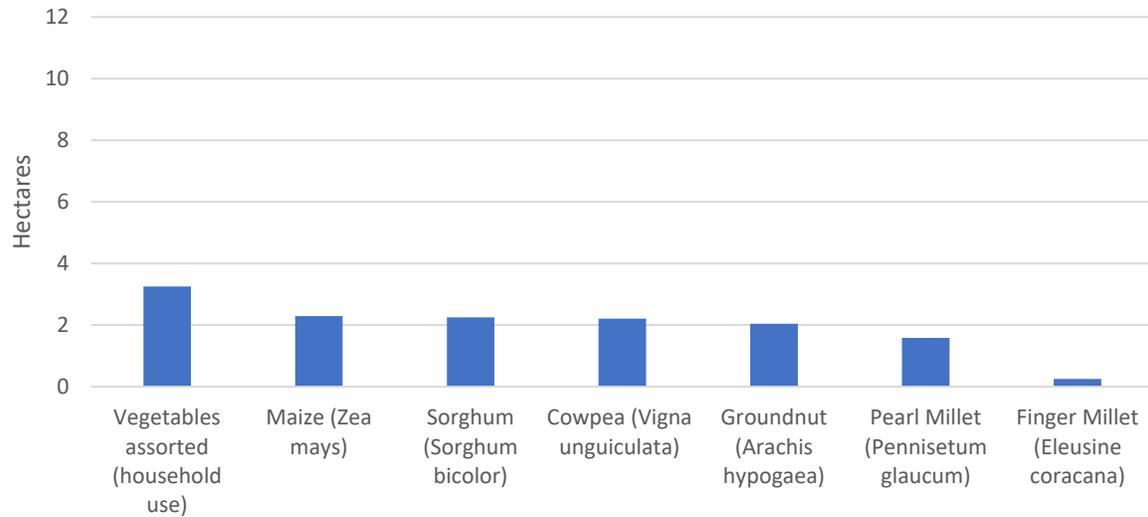


Figure 25: Average area (ha) per household of dominant arable crops in Goudebo

According to the respondents, an increase in population has led to land fragmentation. With arable land in short supply, consequently, land fallowing is not practised in the village. Credit services were not available in Goudebo according to the respondents. Farmers engaged in informal savings groups which provided loans for members of the group from the contributions. According to the farmers, agricultural inputs such as fertilizers and improved seeds are available but at a very high cost.

Contribution of household income

Figure 26 shows the two major livelihood activities that contributed to the household's income in Goudebo, which are livestock rearing (70.83%), and crop farming (21.66%). From the results, other sources such as remittance (9.16%) and labour (8.75%) also made a meaningful contribution to the household income in Goudebo.

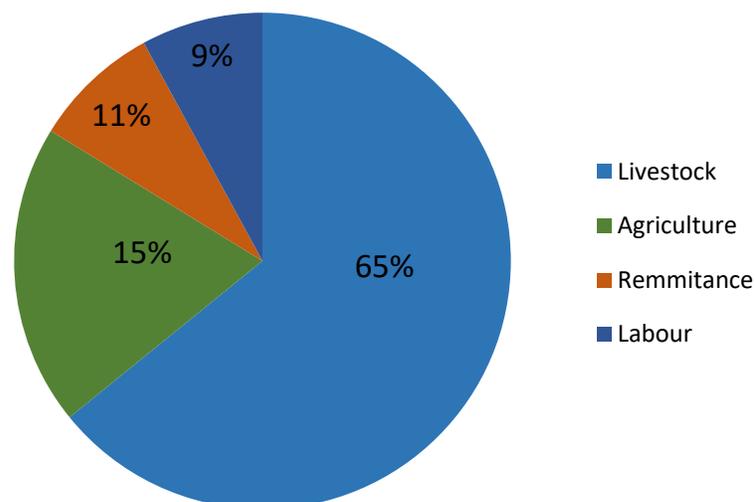


Figure 26: Contribution of livelihood activities to household income in Goudebo

Livestock production and management

Livestock are kept for various purposes: cattle are kept for milk, cash, draught power and manure production in Goudebo. In most cases, the household kept sheep for home consumption and income generation while donkeys are kept for transportation and draught purposes. The dominant livestock species owned by household were local dairy cattle. The results indicated that goat is more dominant than sheep

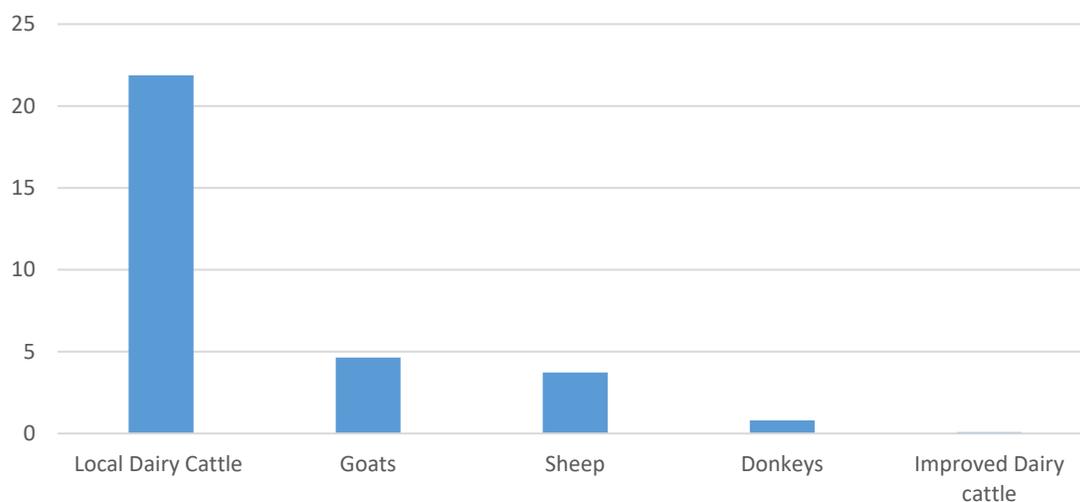


Figure 27: Average livestock holdings per household dominant species (TLU) in Goudebo

According to the farmers, 30% of the households provided housing for all classes of livestock at night in Goudebo. Stall feeding was mostly used for fattening bull while other classes of animals are kept on open

grazing in addition to mixing of groundnut haulms with cereal residue. Every household purchased cotton seed cake as a supplement for their livestock, especially for the fattening animals. The farmers reported that there were no AI services at the site, but natural mating using local bull at no cost is the usual practice. In addition, veterinary services are available by both the government and private organizations. Treatment costs depend on animal species and ailment, but 150 FCFA (USD 0.25) is the usual cost per vaccination. According to the farmers, agricultural inputs such as fertilizers and improved seeds are available but at a very high cost.

Major livestock feed resources and seasonal availability

The feed resources in the study area were primarily composed of grazing, crop residues (cereals and legumes), and purchased feed and naturally occurring and collected fodder. These feed resources are seasonal with a severe shortage from April to September in the study area. The most critical periods are from March to June when all feed resources are virtually depleted and feed resources including the purchased feed are inadequate. The annual feed availability correlates positively with rainfall with an increase in every available feed resource in the site from July to December (Figure 28). Feed availability continues till December and then declines as the dry season advances. This indicates that the rainfall is a major determinant of plant biomass production and the type of feed resource that will be available.

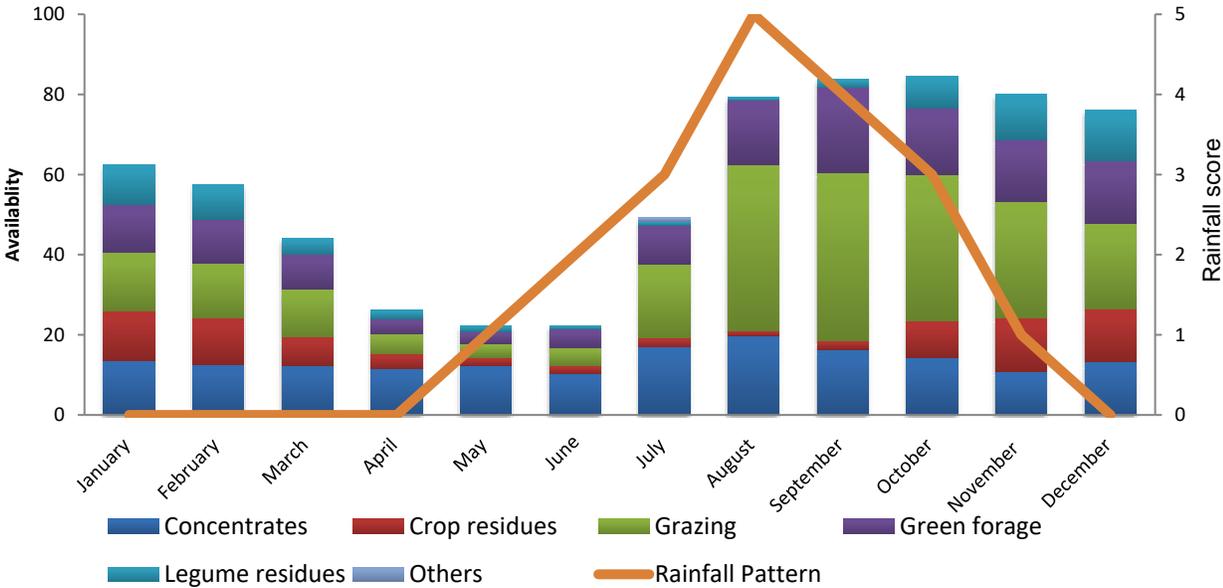


Figure 28: Seasonality of feed resources in Goudebo

Purchased feed

The results indicated that 41% of the purchased feed in the site within the last 12 months was fodder beet, while pearl millet residues and cotton seed cake accounted for 16% and 15% of the purchased feed, respectively (Figure 30). Other purchased feeds included maize (gluten with bran and stover), pearl millet bran, cowpea and sorghum residues while commercially mixed ration contributed just 1% of the total purchased feeds in Goudebo.

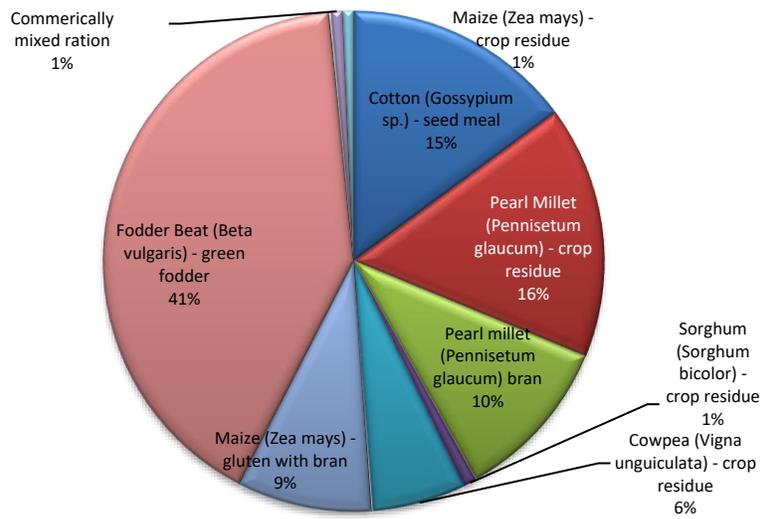


Figure 30: Type and quantity (%) of purchased feed resources in Goudebo

Feed quality

Based on the information gathered from the individual interview, grazing contributed the most to dry matter (DM) content (41%), while purchased feed contributed the most to metabolizable energy (44%) and the crude protein (53%) of the total diet in Goudebo. This indicated the level of dependence on purchased feed in the area (Figure 29). The contribution of crop residues was the least 13%, 10% and 11% to the DM, ME and CP of the total diet respectively.

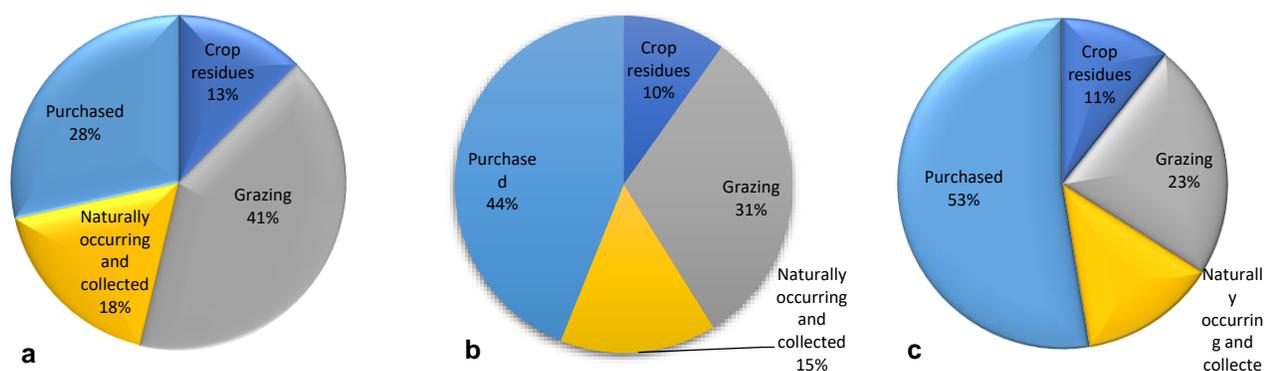


Figure 29: Contribution made by various feedstuffs to Dry matter content (a), metabolizable energy (b) and crude protein content (c) of the total diet of the livestock among farmers in Goudebo

Challenges and opportunities

The results of the FGD revealed the major challenges identified by the farmers in Goudebo. Table 6 explains the challenges that were raised by the farmers regarding livestock production and their suggested interventions.

Table 6. Paired wise matrix ranking result of the challenges of livestock production Goudebo

Rank	Challenges identified	Proposed interventions by the farmers
1	Poor housing and management knowledge	Technical training on cheap and safe housing material and good livestock management practices
2	Inadequate feed resources	The dual-purpose crop will increase the amount of crop residues and early harvesting and proper storage will reduce the loss of quality.
3	Shortage of water	Construction of bore-holes with storage and training on water conservation. Small reservoirs for the village
4	Disease and irregular veterinary services	Vaccination campaigns and general flock treatment. Government aids to subsidize the cost of veterinary service and provision of basic veterinary drugs.

Potential interventions suggested by farmers

1. Intervention package for Goudebo should include capacity building in the area on good general management practices.
2. Farmers depend largely on the crop residues generated from their personal farms which are limited in quantity to feed the number of animals. Dual-purpose varieties of pearl millet and sorghum could be introduced to the farmers to increase the quantity of crop residues without limiting the yield.
3. Provision of veterinary services and improvement of existing ones both government and private animal health service provider.

Highlights of major results

Synthesis of the results across the agro-ecological zones of Burkina Faso presented in Table 7 indicated that livestock is an integral part of the household livelihood in the study areas. Although the household livelihood in South Sudan, North Sudan and Southern Sahel are crop dominated, contributions from livestock as reported by the respondent were 24%, 32% and 20% in South Sudan, North Sudan and Southern Sahel respectively. This also reflects in the major income sources to household. Dominant livestock species were similar across the different agroecological zones, although household livestock holding varies. Major challenges facing livestock in the areas were similar but focused mainly on non-availability of water and feed (in quality) year-round.

Table 7. Synthesis of major results of feed assessment in four agro-ecological zones of Burkina Faso

	Farming system	Dominant crop	Migration	Major contributor to HH	Dominant livestock species	Major livestock feed	Major purchased feed	Major challenges
South Sudan	Mixed crop-livestock system with crop production being the dominant	Maize	30%	Agriculture	Local dairy cattle	Natural pasture.	Millet bran	Shortage of feed - quantity and quality
North Sudan	Mixed crop-livestock system with crop production being the dominant	Maize and Pearl millet	30 -50%	Agriculture and livestock in one of the sites	Local dairy cattle	Concentrate, crop residues and grazing	Cotton seed cake (CSC), Millet stover and maize bran	Shortage of water and feed - quantity and quality leading to Farmers-herder clashes
Southern Sahel	Mixed crop-livestock system with crop production being the dominant	Pearl millet	30%	Agriculture	Local dairy cattle	Crop residues and grazing	Millet bran	Shortage of water
Northern Sahel	crop-livestock system with livestock production as the dominant livelihood	Assorted vegetables	30%	Livestock	Local dairy cattle	Concentrate, crop residues and grazing	Green fodder	Poor housing and management knowledge

Conclusion and recommendations

The results of the study show that farming systems across all the agro-ecological zones in Burkina Faso are characterized by mixed crop-livestock production system with different dominant activities. The dominant activities changed from crop dominated mixed production system in South Sudan, North Sudan and the southern Sahel to livestock-dominated system in the northern Sahel. Similarly, dominant crops differed across all zones as well as the sources of water for both human and livestock. In all zones, available feed resources are similar but varied in quantity and seasonality. Prominent constraints to livestock productivity in these smallholder farming systems differed along agroecological gradients. The major constraints included diseases, shortage in water supply and seasonal fluctuation in feed quantity and quality, which often translate into poor livestock productivity. Farmer and herder conflict resulting from encroachment and over-exploitation of grazing land was a major constraint in few locations. In order to address the constraints to livestock production as described by the farmers, potential interventions includes capacity building on management and utilization of existing water sources and feed resources. Other potential interventions include the introduction of dual-purpose crop varieties to enhance increased crop residues and provision of adequate veterinary services by the government.

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