Volume 15 Issue 46
Originally issued as D9

Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 15 Issue 9 Version 1.0 Year 2015
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Assessment of Livestock Production System and Feed Resources Availability at Melka Watershed of Nile Basin, Jeldu District, Western Ethiopia

By Zewdie Wondatir
Holeta Agricultural Research Center, Ethiopia

Abstract- A rapid assessment on the livestock feed resource availability and livestock production system was undertaken to identify main livestock production constraints and come up with possible intervention strategies in the Melka watershed area of the Nile basin. The watershed was chosen for its strategic representation and accessibility. Three villages (Abeyi, Bore'a and Dini) were selected for the study from Melka watershed area of Jeldu district. A total of 45 participants were selected from the three villages for the Participatory Rural Appraisal (PRA) and individual interviews. The FEAST excel macro program (www.ilri.org/feast) was used for data summary and analysis. Livestock production in the study area is mainly based on production of indigenous livestock breeds, with the exception of Bore'a village, where some farmers keep crossbred dairy cattle. Livestock serve as sources of draught power and manure for crop production, and sources of meat, milk and eggs and as sources of cash income. However, the productivity level of the livestock resources was indicated to be very low.

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GJSFR-D Classification : *FOR Code: 079901*

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Abstract- A rapid assessment on the livestock feed resource availability and livestock production system was undertaken to identify main livestock production constraints and come up with possible intervention strategies in the Melka watershed area of the Nile basin. The watershed was chosen for its strategic representation and accessibility. Three villages (Abeyi, Bore'a and Dini) were selected for the study from Melka watershed area of Jeldu district. A total of 45 participants were selected from the three villages for the Participatory Rural Appraisal (PRA) and individual interviews. The FEAST excel macro program (www.ilri.org/feast) was used for data summary and analysis. Livestock production in the study area is mainly based on production of indigenous livestock breeds, with the exception of Bore'a village, where some farmers keep crossbred dairy cattle. Livestock serve as sources of draught power and manure for crop production, and sources of meat, milk and eggs and as sources of cash income. However, the productivity level of the livestock resources was indicated to be very low. The respondents from the different villages identified different constraints that affect productivity of their animals, among which shortage of feed was ranked as the most important constraint in all the three villages. Natural pastures and crop residues are the main feed resources and their availability varies from season to season. The availability and use of improved forages and concentrate feeds is almost nil. Thus it would be necessary to alleviate the prevailing livestock production constraints in order to enhance the productivity and contribution of the livestock resources to the livelihood of the households in the study village as well as the district.

Keywords: *crop residues, grazing pasture, village, households*.

I. Introduction

Mixed crop livestock production system is the major component of agricultural practices in the highlands of Ethiopia. Cattle produce much more than food in smallholder production system as source of power for cultivation, milk, meat and direct cash income. In the mixed crop-livestock production system of the highlands, crop residues are the major feed resources for ruminant livestock. Thus, availability and quality of these feed resources shall govern the fate and sustainability of ruminant livestock production in the mixed crop-livestock production system. Studies in the central highlands of Ethiopia also indicated that the respective contribution of pasture area to total feed supply was in the range of 20-30% while the contribution of crop residues and aftermath grazing was 70-80% (Tadesse et al 2009). Moreover, progressive decline of average farm sizes in response to rising human populations, encroachment of cropping land onto erstwhile grazing areas and onto less fertile and more easily erodible lands, and expansion of degraded lands, which can no longer support either annual crops and pastures contributes to shortage of feed resources (Alemayehu 2005). However the production and productivity of livestock in different parts of the country is low due to multidimensional constraints. Among the numerous bottlenecks, shortage of feed supply and poor nutritional quality of available feed resources are the major constraints affecting livestock productivity (Adugna et al 2012). Moreover, livestock feed problem is more intense in the highlands of the country where more than 75% of both the human and livestock population are concentrated. However current baseline information is lacking with regard to livestock feed resource availability in the Melka watershed of the Nile basin. Thus, this study was carried out with the aim of rapidly assessing the prevailing farming and livestock production system, feed resources availability and livestock production constraints of the area in order to identify potential intervention strategies for the development of livestock feed resources and natural resource management.

II. Methodology

a) Main features of the study area

Jeldu district is located at 09 15' 54.9" N and 038 04' 54.4" E, approximately 115 km west of Addis Ababa in West Shewa Zone of Oromia Regional State. It has an elevation range of 2500 – 3200 meter above sea level (masl). The district has a total area of 139, 389 hectares with variable agro ecology of high lands (45%),

Author: *Holeta Agricultural Research Center, Holetta, Ethiopia.*
e-mail: zewbt2006@yahoo.com

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midlands (30%) and lowlands (25%). According to the key informants, average land holding in the district is 2 hectare per household.

Three villages were selected from Melka watershed area of Jeldu district. The watershed was chosen for its strategic representation and accessibility. Accordingly, Abeyi, Bore'a and Dini villages were selected for the study. These study sites are part of Melka watershed, which is one of the main spot for Nile Basin Development Challenge (NBDC) pilot project.

b) Sampling and data collection methods

The selection of villages was conducted by representatives of the technical group members at the District Office of Agriculture and Livestock. The three villages were selected purposively based on their representation of the landscape of the Melka watershed, where land degradation is the major problem. Development agents and village representatives of the selected villages selected the farmers based on land holding wealth category (land size: below average, average, above average) and gender. A total of 45 participants were selected from the three villages for the Participatory Rural Appraisal (PRA) and individual interviews. Accordingly, 15 farmers (9 men and 6 women) were selected from each village for the PRA survey. After the PRA discussion, 9 farmers (6 men and 3 women) representing the 3 wealth categories were selected from each village for individual interview to generate quantitative information.

c) Data analysis

The feed assessment tool (FEAST) excel macro program (www.ilri.org/feast) was used for data summary and analysis. Narrative responses collected during the group discussions were examined and reported in qualitative manner.

III. Results and Discussion

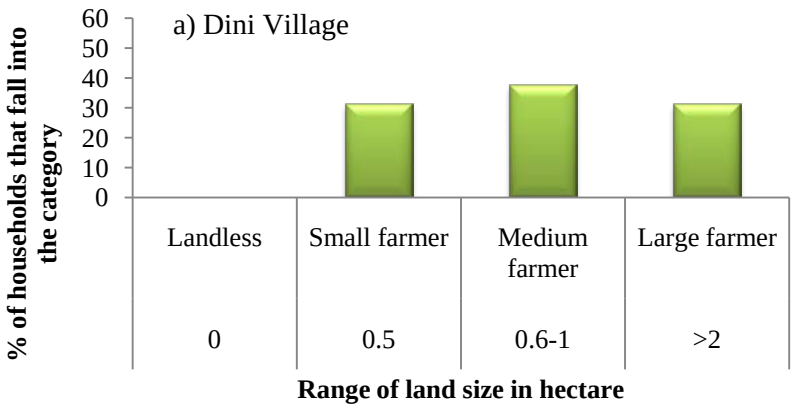
a) General observation of the study villages

Mixed crop-livestock production is the dominant production system in all the three villages. The number of households in Dini, Abeyi and Bore'a villages were reported to be 64, 30 and 90, respectively, and the average family size per household was reported to be 7 persons for Dini, 6 persons for Abeyi and 5 persons for Bore'a villages.

b) Land holding

The average land holding per household for various wealth groups is indicated in Figure 1. According to the definition of land holding size category developed by the respondents from each village, most households in Dini and Bore'a villages have medium size of land holding whereas small land holding was reported to be most prevalent in Abeyi village. However, it is to be noted that the definition of small, medium and large land holding sizes are different in the three villages.

The land holding size of the households in Dini village varies from 0.5 to 5 ha. Accordingly, <0.5 ha, 0.5-2 ha and greater than 2 ha were considered as small, medium and large holdings, respectively (Figure 1a). About 37.5 % of the households in Dini village are categorized under medium land holdings whereas small and large land holdings amount to 31.25% each. Almost 50% of the farmers in Abeyi village own less than 1 ha of land. The percentage of farmers having large land holding is lower in Abeyi than in Dini village. In Bore'a village, the majority of the households own between 1.5 and 3 ha of land, which was categorized as medium size in the village. The proportion of farmers who own greater than 3 ha (large land holding) in the village is smaller than those who own small and medium land holdings (Figure 1c). There was no report of landless farmers in any of the three villages.



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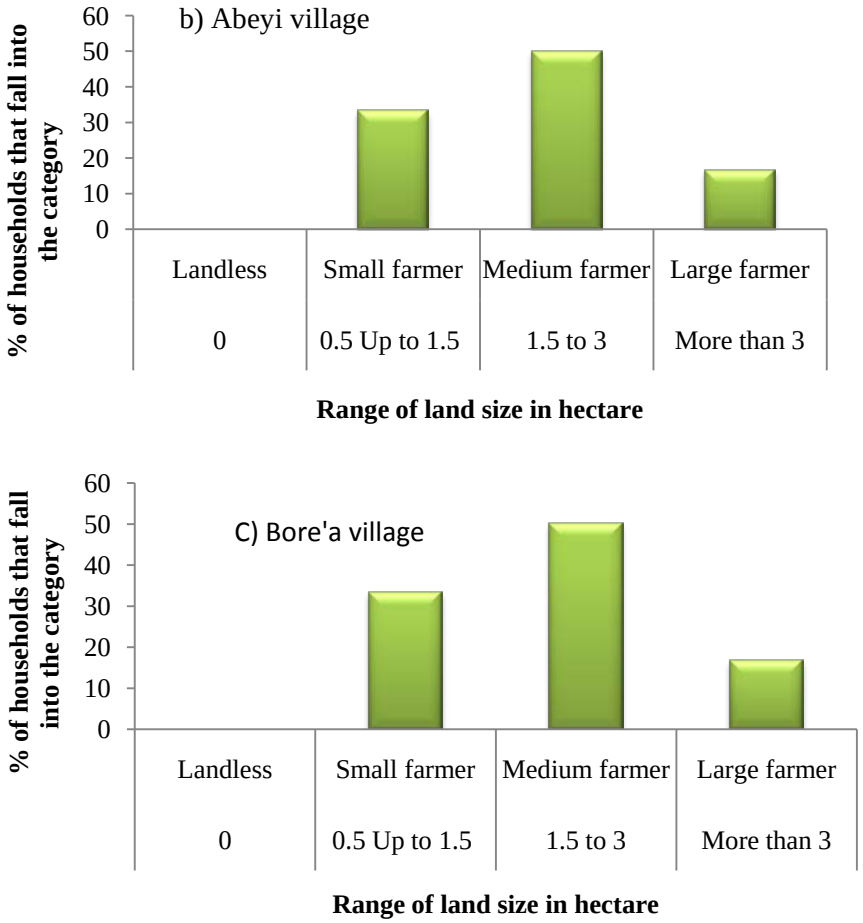

Figure 1 : Land holding size of the study villages

c) Crop production

The district is characterized as a mixed crop-livestock production system. Land preparation is mainly done by ox-drawn plough. The area has a bi-modal rainfall pattern with two distinct rainy and cropping seasons. The main rainy season (*meher*), which is also the main cropping season, extends from June to September. The short rainy season, known as "*belg* rain", usually covers the period from February to April. The respondents indicated that the small rainy season has become less dependable for cropping during recent years. As a result, most farmers depend on irrigation for their farming operations during this period. The villages are located near the Melka river, which serves as source of water for irrigation during the dry season. The type of irrigation practiced in the area is small scale traditional furrow irrigation that operates using natural gravity.

The main crops grown in the study areas include wheat (*Triticum aestivum*), tef (*Eragrostis tef*), broad bean (*Vicia faba*), barley (*Hordeum vulgare*) and potato (*Solanum tuberosum*) as shown in Figure 2. In addition, sorghum (*Sorghum bicolor*) is grown in Dini village whereas maize (*Zea mays*) is grown both in Abeyi and Bore'a villages. The crops grown by the farmers are used both for household consumption and as sources of cash income. Potato and maize are mostly grown for sale to generate cash income for the family whereas the other crops are grown largely to satisfy the food consumption needs of the families. Potato and maize are commonly grown in the dry season with the help of irrigation from Melka river. Most of the available crop land is allocated for production of wheat, which indicates that it is the most preferred crop in the area. This is followed by tef in Dini and Abeyi and by barley in Bore'a villages.

Crop residues are used as major sources of livestock feed during the dry season. However, small amounts of crop residues are sold as an income source and are also used for house construction, particularly for plastering of walls and thatching of roofs. Some farmers also use crop residues for mulching purposes to enhance fertility of the soil. Despite the importance of fodder crops as livestock feed, farmers in the area hardly grow improved forage crops. Moreover, the extension service to support forage development in the area appears to be weak and non-functional.

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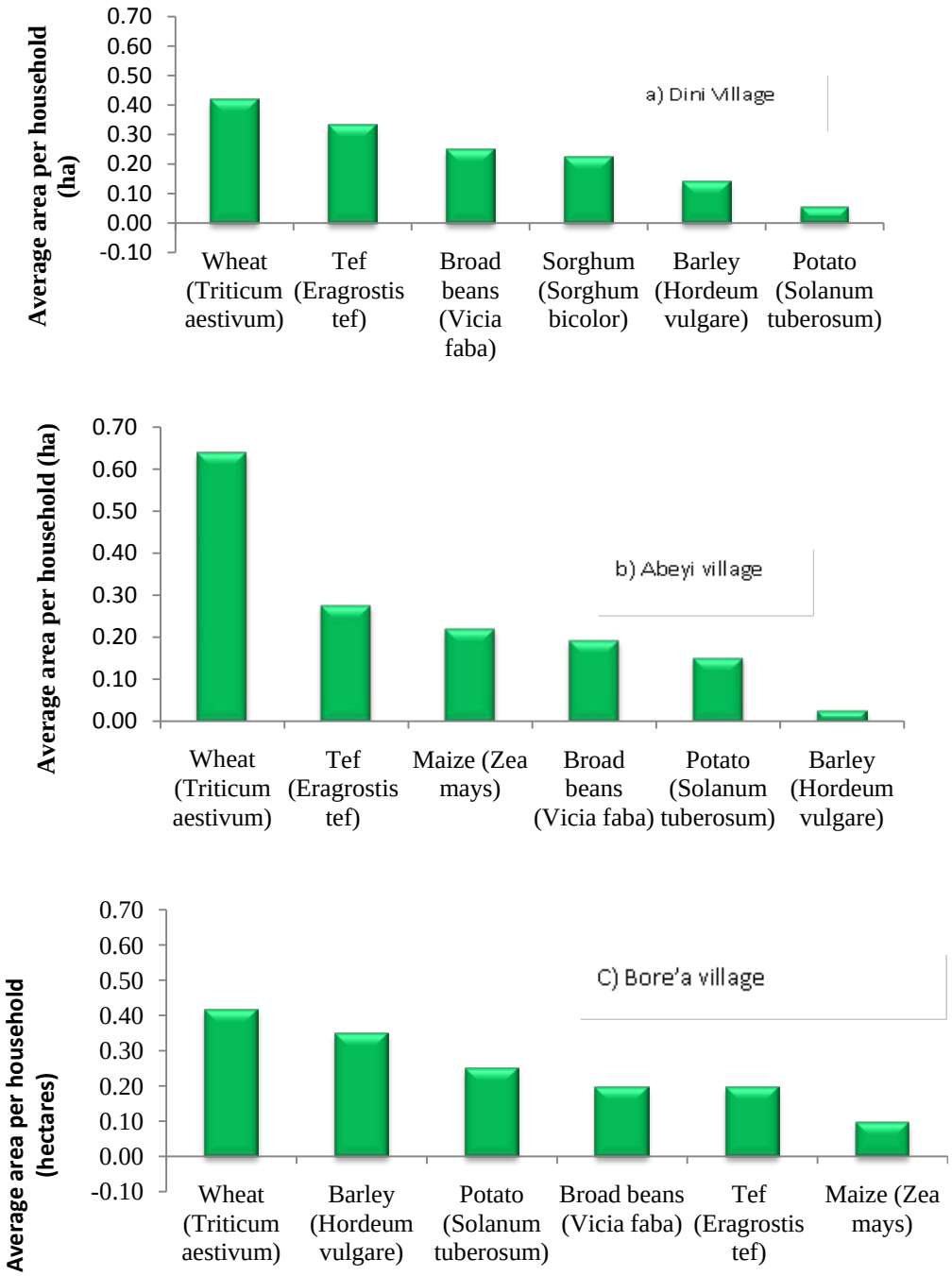

Figure 2 : Major crops grown in the study area

d) Livestock Production System

Livestock are an integral part of the farming system in the district as well as in the study villages. The main purpose of keeping livestock is for draught power. Livestock products such as milk and meat have secondary importance to the farmers. Small ruminants are mainly used as income sources as well as for household consumption.

The livestock production system commonly found in the villages is an extensive system where open grazing is the main style of feeding. The common breeds of cattle available in the area are mixed highland zebu types. Some crossbred or improved dairy cattle are also found in Bore'a village. However, the proportion of improved dairy cattle is very small compared to the local cattle. Local cattle, horses and sheep are the main livestock species kept by the households (Figure 3). In addition to horses, some farmers in Dini village keep donkeys that are vital for transport of goods from place to place. They are particularly important for transporting

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farm produce to the market and agricultural inputs to the farm. Limited numbers of scavenging village chickens are also raised by some farmers in all the three villages.

Local dairy cows are kept mainly for the purpose of milk production, breeding, manure, dung cake (cooking fuel), meat and as a source of income. The average milk production per cow is about half a liter per day. All milk produced by the household is consumed since the milk marketing culture is not common in the area. Oxen are mostly kept to fulfill draught power requirements whereas equines are a vital means of transporting goods and people. In addition to providing draught power, oxen are important for provision of manure, dung cake (cooking fuel), meat and to generate cash income.

Livestock housing is not common in the area. Except young calves and sheep, mature cattle and equines are kept in an open kraal at night all year round. However, about 30% of the farmers in Bore'a village house their cattle during the night. These are apparently those farmers who keep crossbred dairy cattle.

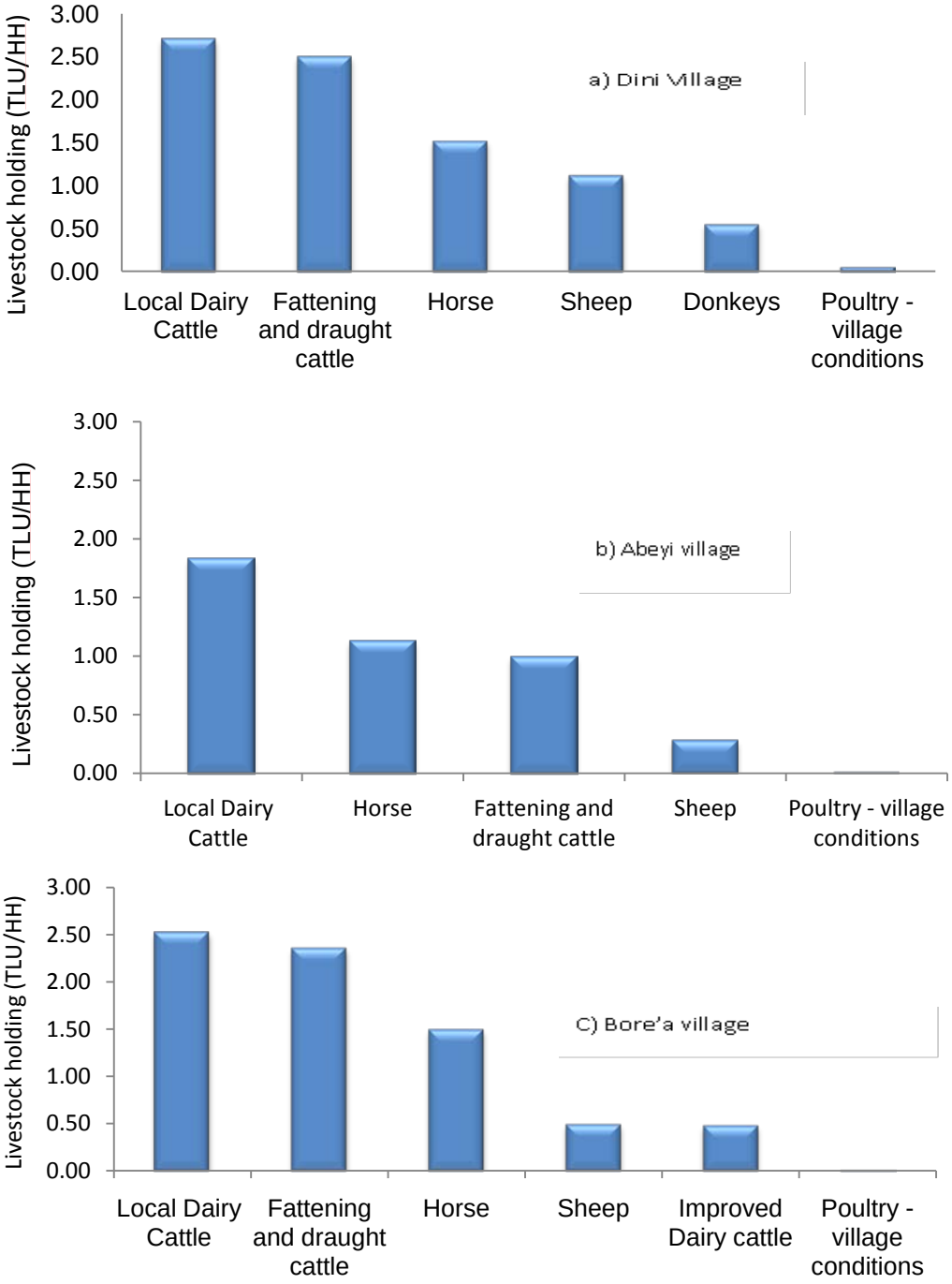

Figure 3 : Average livestock holdings per household in the three study villages (TLU)

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Natural pasture and crop residues are the main sources of livestock feed in the area. The animals are allowed out for grazing during the day. Stall feeding or the cut and carry system are not yet practiced by the households. Feed processing such as chopping, urea treatment and mixing of different feeds is not practiced in Dini village whereas farmers from Abeyi and Bore'a villages reported that they chop maize stover before feeding to the animals. In addition, farmers in Bore'a village practice mixing of crop residues with local brewery by-products and common salt to improve palatability and intake of the feed and performance of the animals.

The respondents from Dini village indicated that veterinary services are easily accessible whereas the respondents from Abeyi and Bore'a villages reported that although the service is available it is not easily accessible because of its location in Gojo town of Jeldu district, which is far away from the villages. It was also learned that artificial insemination (AI) service is not easily accessible to any of the three villages as the villages are far away from the service provision center. The respondents from Dini village indicated that they can access bull service at the cost of Ethiopian birr 50 per service whereas farmers in Abeyi village depend on uncontrolled natural mating due to lack of access either to AI or bull service in the area. On the other hand, both AI and crossbred bull service were reported to be available in Bore'a village although the access could be limited due to various reasons. The service charge for the crossbred bull service in Bore'a was reported to be Ethiopian birr 100.

e) Labour Availability

Labour is an important resource in agricultural activities in determining the production and productivity of a given household. The respondents from all the three villages indicated that labour is available throughout the year but varies from season to season. Family labour is the main source of farm labour except for potato production for which farmers commonly use hired labour. Labour is highly demanded during planting and harvesting seasons. The average daily wage payment per individual is around 30 Ethiopian birr. In addition, the farmers provide meal and local drink to the workers, which could cost around 25 Ethiopian Birr/day for each worker. Due to shortage of agricultural land in the area, some farmers may also leave their village looking for employment in other places during the months of September to December.

f) Agricultural inputs

To increase production and productivity of crop and livestock, input utilization is important. Inputs such as improved seed, fertilizer, pesticides, insecticides, irrigation facilities, livestock feed and improved cattle breeds were mentioned by the respondents. It was indicated that agricultural inputs like irrigation equipment, improved crop varieties and improved animal breeds are not readily available. According to the respondents, irrigation equipment is not available in the local market. However, it was indicated that fertilizer is readily available in the local market although most farmers are unable to purchase the required quantity because of its high price.

g) Credit services

Credit sources for purchase of livestock and crop production are not satisfactory. Although credit facilities are available from microfinance institutions such as Oromia Saving and Credit Share Company and *Busa Gonofa* microfinance, most farmers do not use the services because of fear of risks associated with crop and livestock performance failures that could lead to failure of repayment of the loan. Moreover, the credit services provided by the micro-finance institutions are group based; which makes individual farmers accountable for the group members who are unable to pay their loan. It was also indicated that the service provision is limited to only once per year so that it may not be available when it is needed most.

h) Household income sources

The various income sources for households in the study villages are indicated in Figure 4. In Dini village, about 36% of the household income comes from sale of crops such as wheat, potatoes and onions. On the other hand livestock and livestock products contribute about 28% of the total income of the households. The third income source for the households in this village comes from different businesses such as petty trading and casual work.

In Abeyi village, about 46% of the household income comes from the sale of fattened animals (sheep and cattle) and followed by horticultural crops (35%), such as potatoes and onions. In Bore'a village, 42% of the interviewed households generate their income from sale of food crops whereas 26% benefit from sale of poultry, eggs, small ruminants and dairy products. Furthermore, horticultural crops such as potato and cabbage contribute about 8% of the income share.

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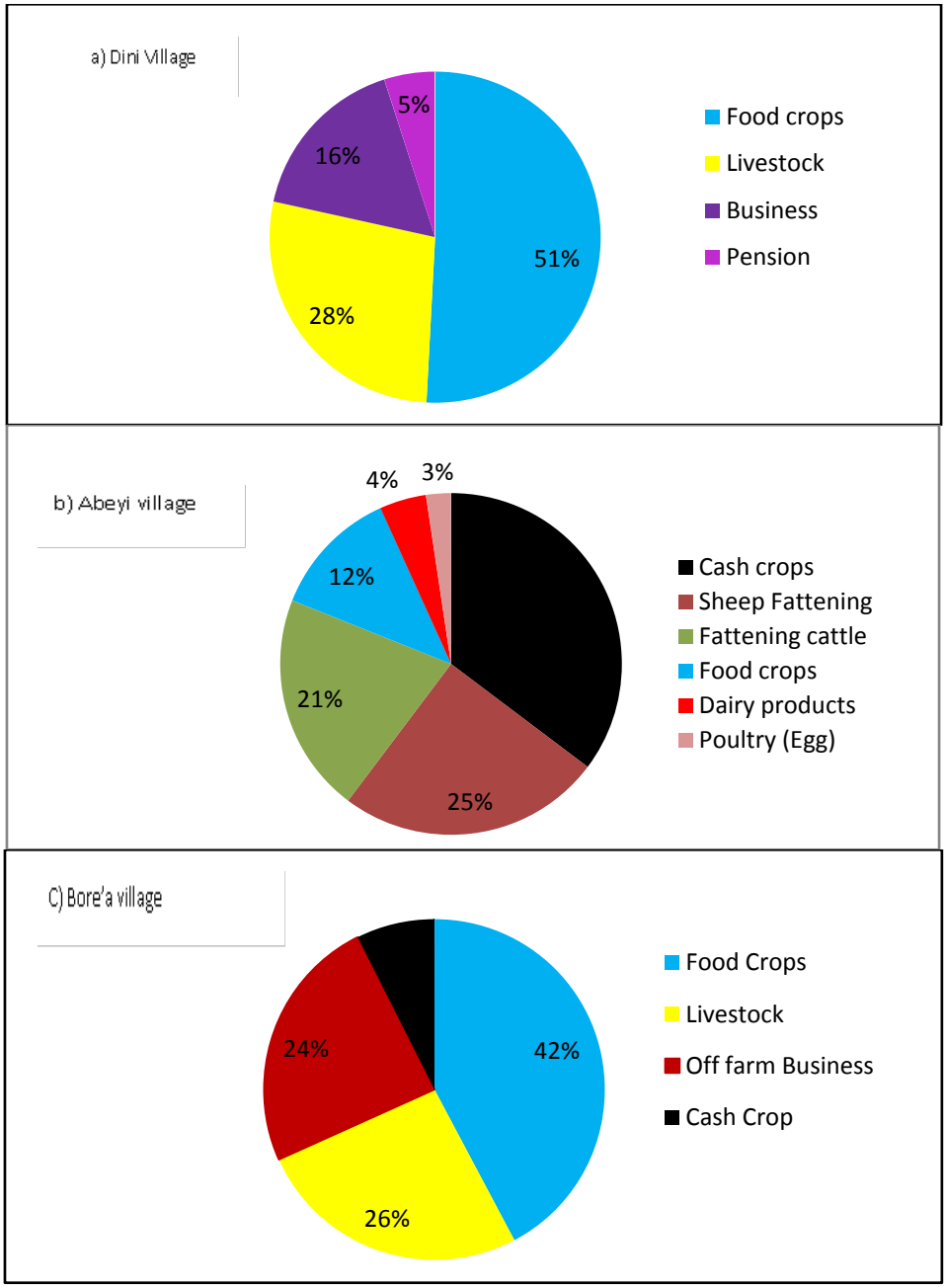

Figure 4 : Contribution of livelihoods activities to household income (as percentage)

i) Available feed resources

Livestock feed is one of the major inputs to improve livestock production and productivity. The major livestock feed resources include grazing, crop residues and naturally occurring and collected grasses. Availability of these feeds varies across different months of the year. During the rainy season, grazing pasture and naturally occurring and collected grasses are the two most important feed resources in the area. Availability of grazing pastures largely relies on rainfall and it is adequately available from the onset to the end of the main rainy season (June to October). However, crop residues are the main livestock feed sources in the dry season of the year. They are the main feed resources available to animals from January to May, a period of critical feed shortage (Figure 5). Surplus feed is obtained following the cessation of the heavy rainy season whereas moderate feed supply is available during the months of June, July, August and December. Despite the periodic availability of surplus pasture at the end of the main rainy season, fodder conservation to overcome the problem of feed deficit during lean period of the year is not a common practice in the area. Although, crop residues are the sole feed resource in

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the dry season, all farmers provide straw to their animals without any physical or chemical treatment such as chopping and application of urea.

The production of improved and cultivated forage crops is not a common practice in the study area except the recent intervention made by the Nile Basin Development Challenge (NDBC) pilot project on plots of a few households. As part of the NBDC pilot project, Dasho grass (*Pennisetum pedicellatum*) and Napier grass (*Pennisetum purpureum*) as well as Lucerne and Bana grass (*Pennisetum purpureum x P. glaucum*) have been established in the backyard by some of the respondents (Figure 6). However, the farmers have not yet started using the grasses to feed to their animals.

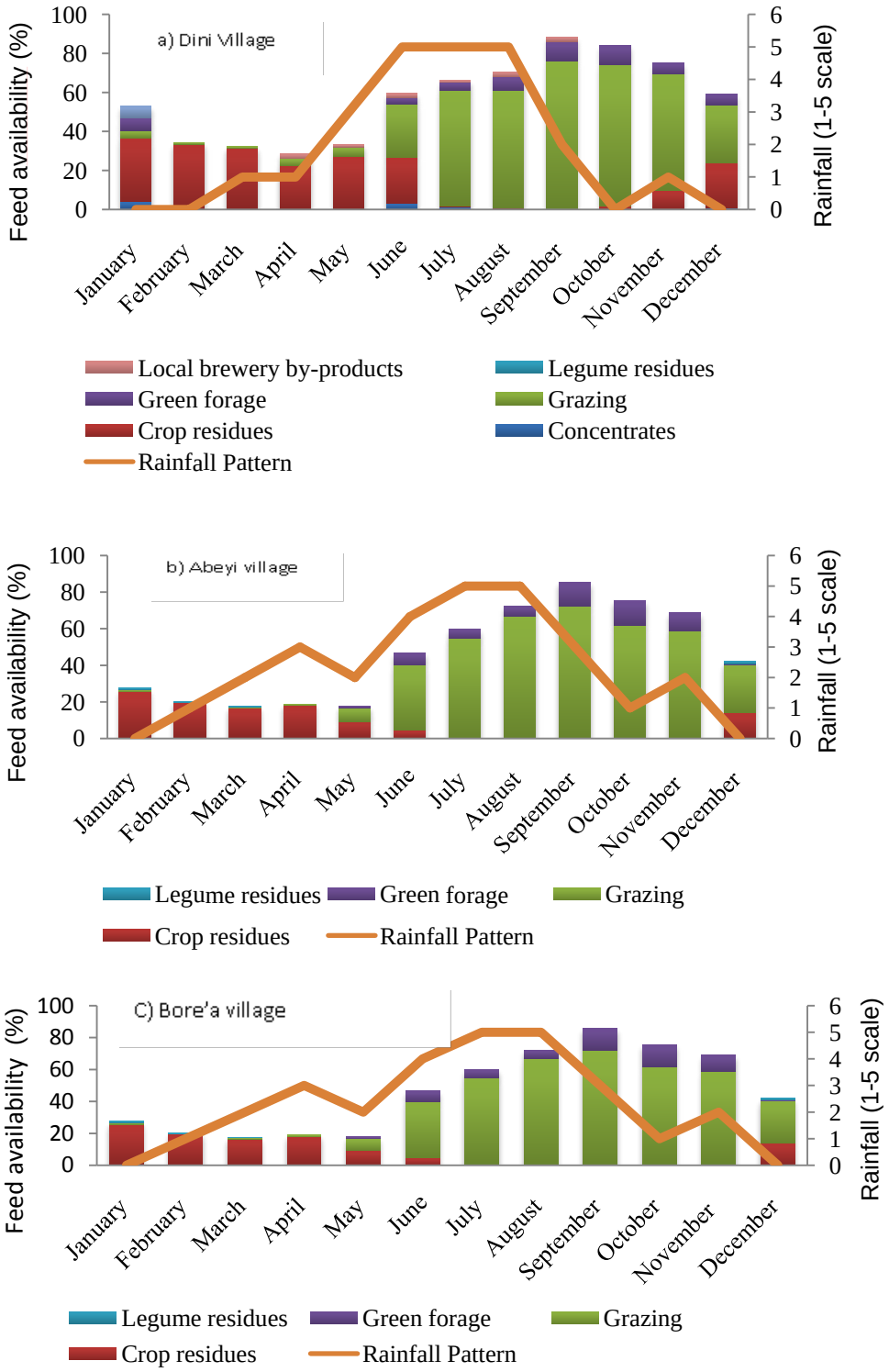

Figure 5 : The composition of the livestock feed throughout the year in relation to rainfall pattern

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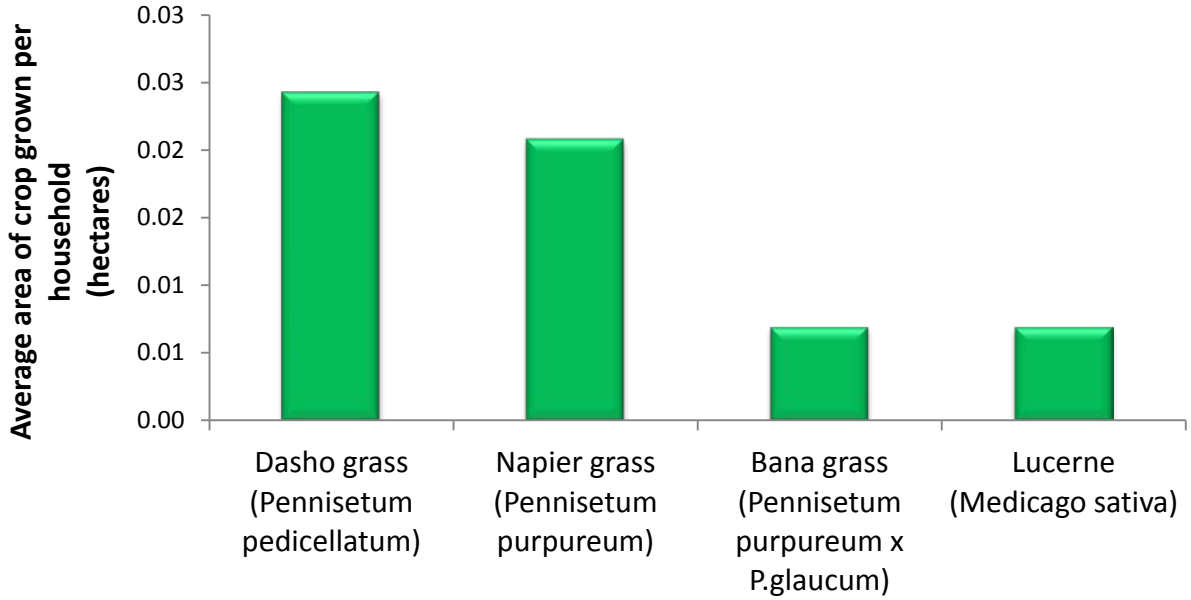

Figure 6 : Dominant fodder crops grown at Bore'a village

A few farmers purchase different feeds including crop residues. Wheat and tef straw are some of the purchased feed types by farmers. Some farmers who own more animals and who can afford it also purchase naturally growing pasture from nearby local farmers. Very few farmers also purchase noug seed cake, linseed cake and wheat bran from local vendors. Figure 6 shows that almost equal proportions of these agro-industrial by-products were purchased over a 12 month period in Bore'a village. In the dry season, concentrate feeds are mixed with crop residues and salt before providing to animals. Most of the farmers refrain from using concentrate feeds because of their rising price.

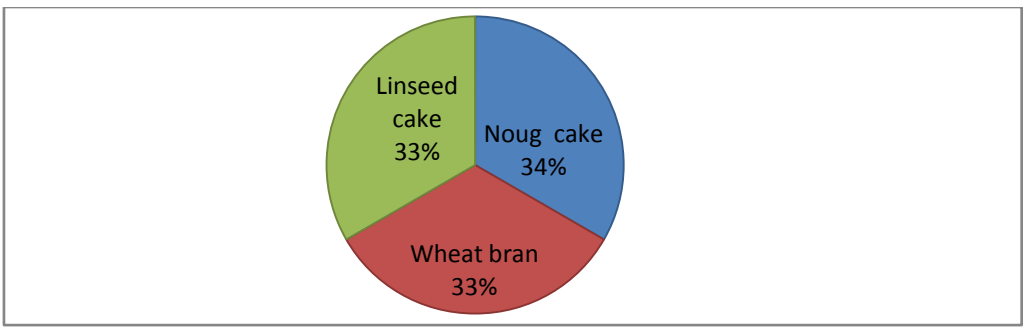

Figure 7 : Quantity of concentrate feeds purchased over a 12 month period at Bore'a village

The contribution of feed resources to the total dry matter (DM), metabolic energy (ME) and crude protein (CP) content of livestock diets in Dini, Abeyi and Bore'a villages is shown in Figures 8, 9 and 10, respectively. In Dini village, about 70% of the dry matter of livestock feed is obtained from grazing pasture while crop residues and naturally occurring and collected feeds accounted for the remainder (Figure 8, A). Large proportions of metabolizable energy and crude protein are also supplied by grazing pastures (Figure 8, B and C). In a similar way, in Abeyi, the largest share of livestock feed is obtained from grazing, which accounted for approximately 58% of the total dry matter, 60% of the metabolizable energy and 59% of the total crude protein of the diet, respectively (Figure 9: A, B and C). In a similar way, grazing and crop residues contribute to the largest proportion of DM, ME and CP content of the total diet in Bore'a village (Figure 10: A, B and C).

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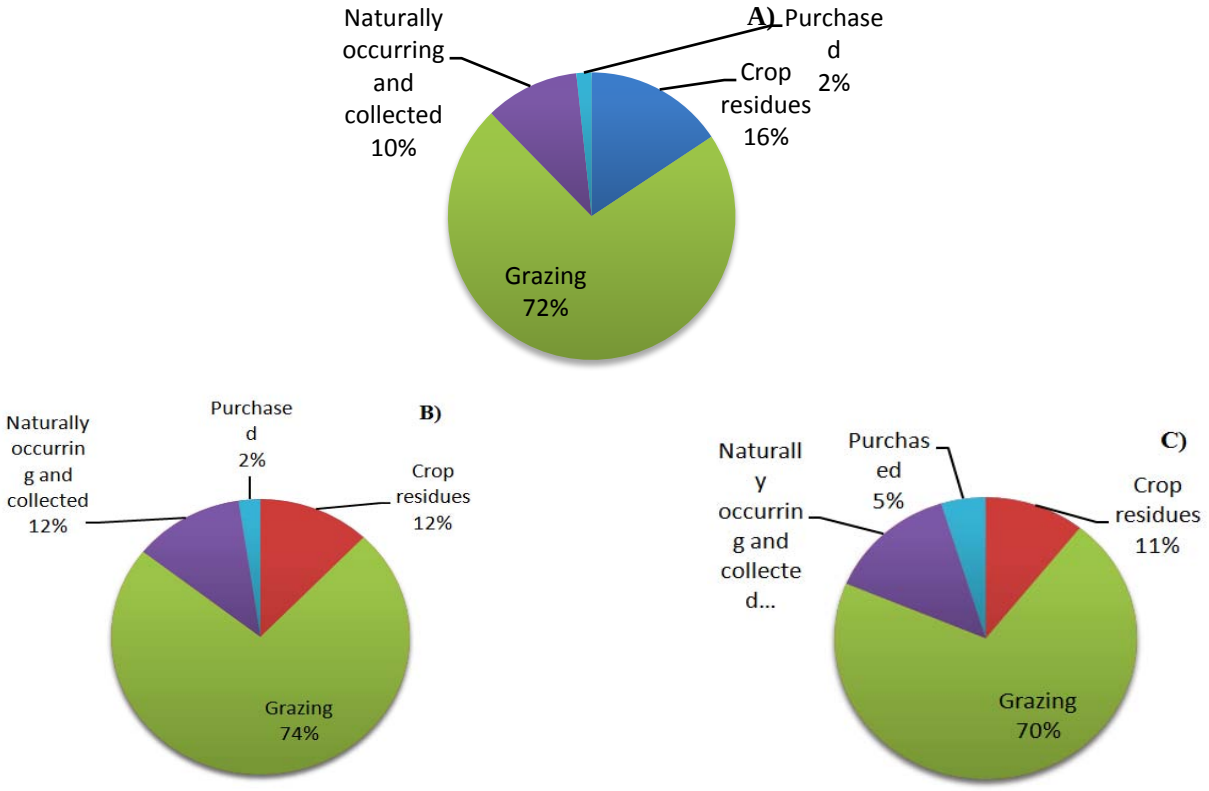
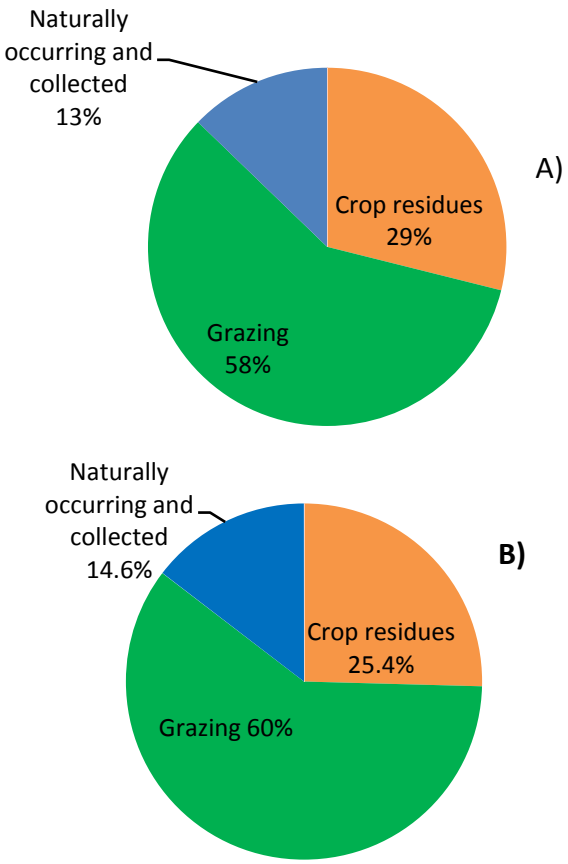


Figure 8 : Contribution of different feeds to the dry matter (A), metabolizable energy (B) and crude protein content (C) of the total diet of livestock at Dini village



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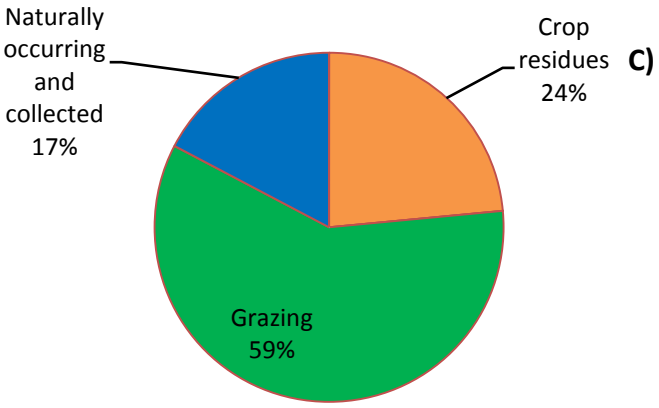
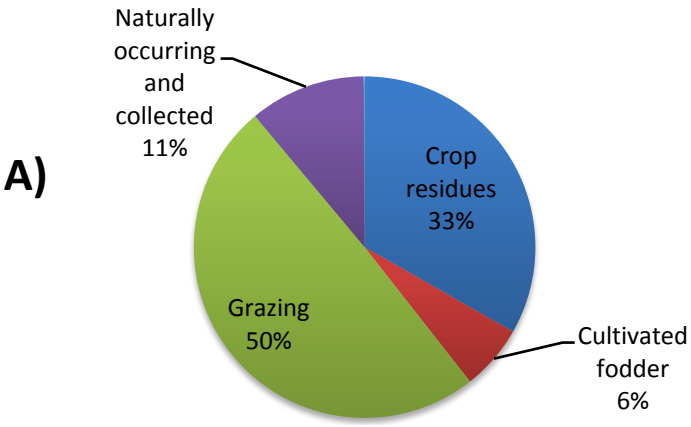
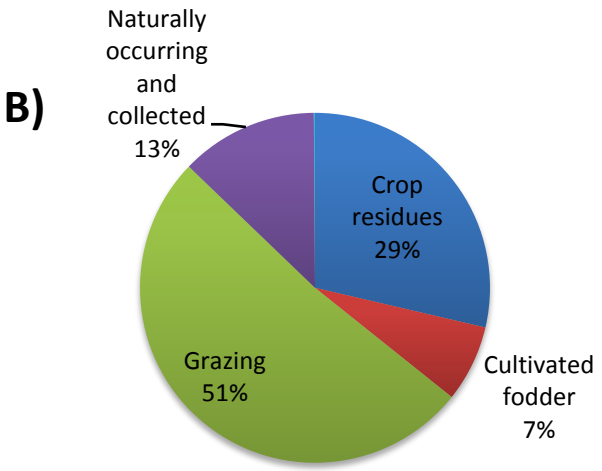


Figure 9 : Contribution different feeds to the dry matter (A), metabolizable energy (B) and crude protein content (C) of the total diet at Abeyi village





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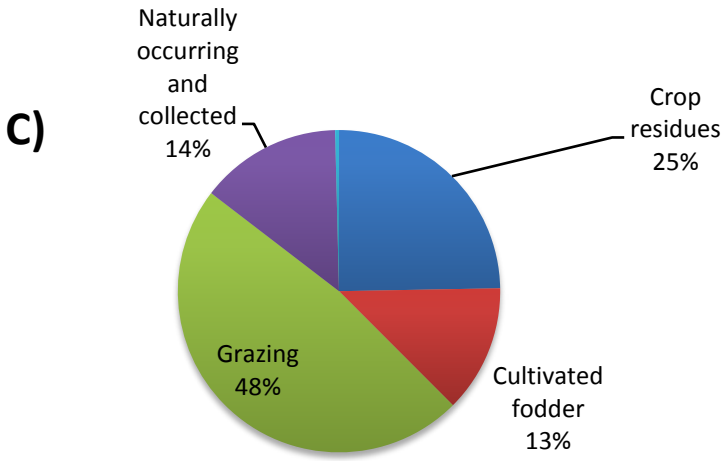

Figure 10 : Contribution different feeds to the dry matter (A), metabolizable energy (B) and crude protein content (C) of the total diet at Bore'a village

j) Main livestock production constraints

Based on pair wise ranking, a number of problems were ranked by the respondents in order of their importance. The farmers who took part in the PRA discussion also suggested some solutions to solve the problems in their respective villages. Shortage of livestock feed was identified as a major problem in all the three villages (Tables 1, 2 and 3). The other problems identified in Dini village were lack of improved cattle breeds, land shortage, land degradation and animal diseases (Table 1).

Limited knowledge/awareness, lack of animal health services and lack of improved animal breeds were other problems identified by the participants from Abeyi village (Table 2). The participants from Bore'a village identified lack of animal health services, poor genetic make of indigenous livestock breeds and lack of capital as additional constraints affecting livestock production in their village (Table 3).

Table 1 : Major livestock production problems identified and solutions suggested by PRA participants in Dini village

Problems	Problems listed	Suggested solutions
1	Livestock feed shortage	• Establish improved forages at backyards and multiply them • Reduce herd size • Training on how to establish and manage improved forages • Minimize free grazing
2	Lack of improved cattle breeds	• Artificial Insemination services provision • Improved bull services
3	Land shortage	• Reducing herd size • Intensification of cattle rearing • Production of improved fodder varieties
4	Land Degradation	• Vegetation of the area • Terracing • Proper plowing on steep slopes • Soil fertility management
5	Animal Diseases	• Establishment of animal health posts in nearby village • Assigning animal health workers

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Table 2 : Major livestock production problems identified and solutions suggested by PRA participants in Abeyi village

Problems	Problems listed	Suggested solutions
1	Livestock feed shortage	• Establish improved forages in backyards. Reduce herd size and focus on productive ones • Minimize free grazing
2	Limited knowledge/awareness	• Proper extension service and training on livestock husbandry, management and production
3	Lack of animal health services	• Make animal health clinic and services available at *kebele* level • Training on intensive livestock management system
4	Poor genetic makeup of indigenous breeds/lack of genetically improved animals	• Provide AI service coverage • Provide improved bull service

Table 3 : Major livestock production problems identified and solutions suggested by PRA participants in Bore'a village

Problems	Problems listed	Solutions suggested by farmers
1	Livestock feed shortage	• Improve utilization of crop residue • Reduce herd size • Improve grazing land management • Plant suitable improved forage varieties
2	Lack of animal health services	• Provide animal health clinics and services at the *kebele* level • Training on intensive livestock management system
3	Poor genetic makeup of indigenous breeds/lack of genetically improved animals	• Promote AI services and improve availability • Offer improved bull services and create awareness
4	Lack of capital	• Improve existing credit service mechanisms.

IV. Conclusion and Suggestions for Future Interventions

Livestock production is an integral component of the agricultural production system in the three study villages. Livestock production in the study area is mainly based on production of indigenous livestock breeds, with the exception of Bore'a village, where some farmers keep crossbred dairy cattle. Livestock serve as sources of draught power and manure for crop production, and sources of meat, milk and eggs and as sources of cash income. However, the productivity level of the livestock resources was indicated to be very low. The respondents from the different villages identified different constraints that affect productivity of their animals, among which shortage of feed was ranked as the most important constraint in all the three villages. Natural pastures and crop residues are the main feed resources and their availability varies from season to season. The availability and use of improved forages and concentrate feeds is almost nil. Thus it would be necessary to alleviate the prevailing livestock production constraints in order to enhance the productivity and contribution of the livestock resources to the livelihood of the households in the study village as well as the district. To this effect, it is suggested that future interventions take the following issues into account.

- Provide farmers with training on appropriate utilization of available feed resources and development and use of improved forages. Strengthen and reinforce the fodder development practices already started in the village by providing follow up training and linking to strategic feeding practices. Link the fodder intervention to the existing soil and water conservation activity of the community
- Improve utilization of available feed resources through application of appropriate processing and supplementation methods
- Introduce appropriate fodder conservation methods when green feed is in excess during some months
- Strengthening the existing livestock extension system particularly management, husbandry, feeding, and animal health in the village
- Improve the indigenous animal genetic potential through selection and crossbreeding
- Provide access to improved dairy cattle for the farmers who wish to enhance productivity of their animals. This needs to be linked with improved forage production and availability of good quality feed resources.

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V. Acknowledgements

The authors thank the International Livestock Research Institute particularly the Nile Basin Development Challenge (NBDC) pilot project for financial support to conduct the study. The authors would also thank farmers in the study area for their patience and willingness to conduct the interview.

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