academicJournals

Vol. 8(29), pp. 4067-4073, 1 August, 2013
DOI: 10.5897/AJAR2013.7096
ISSN 1991-637X ©2013 Academic Journals
http://www.academicjournals.org/AJAR

African Journal of Agricultural Research

Full Length Research Paper

Assessment of feed resource availability and livestock production constraints in selected Kebeles of Adami Tullu Jiddo Kombolcha District, Ethiopia

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Accepted 30 May, 2013

This study was conducted in Adami Tullu Jiddo Kombolcha district, Oromia Regional State to assess the major available feed resources in the area and to identify and rank feeding problems and possible improvement options for livestock feeding in the district. Multi-stage sampling techniques were used to select the study sites. Sixty respondents were selected from rural and peri-urban Kebeles. The total annual feed DM available was higher (P < 0.05) in rural (13.98 tons) than in the peri-urban (9.45 tons) kebeles. An average of 11.72 tons of feed dry matter (DM) was produced per household from the major available feed resources, in which 74.57% was obtained from crop residues. A total of 419.4 and 283.5 tones DM/year vs 423.6 and 394.3 tones DM/year was the requirements in rural and peri-urban areas, respectively. Hence, the study indicates that the available feed DM satisfies 99 and 71.9% of DM requirements of rural and peri-urban sites, respectively. The estimated annual DM requirements for maintenance were 13.63 tons with a deficit of 1.91 tons. Feed shortage, water scarcity, disease and low productivity of animals were assessed to be the major livestock production constraints.

Key words: Crop residues, feed availability, feed balance, feed requirement, urban-peri urban.

INTRODUCTION

Livestock industry is an important and integral part of the agricultural sector in Ethiopia. Livestock farming is vital for the supply of meat and milk; it also serves as a source of additional income both for smallholder farmers and livestock owners' (Ehui et al., 2002). Livestock production constraints can be grouped into socio-economic and technical limitations (Mengistu, 2003). Inadequate feed, widespread diseases, poor breeding stock, and inadequate livestock policies with respect to credit, extension, marketing and infrastructure are the major constraints affecting livestock performance in Ethiopia (Desta et al., 2000). Feed resources as reported by Tolera et al. (2012) can be classified as natural pasture, crop residue, improved pasture and forage and agro industrial by-products of which the first two contribute the largest share. The fibrous agricultural residues contributes a major parts of livestock feed especially in the populated countries where land is prioritized for crop cultivation. Tolera et al. (2012) reported that crop residues contribute to about 50% the total feed supply in Ethiopia.

Under smallholder livestock production system, animals are dependent on a variety of feed resources which vary both in quantity and quality. For optimum livestock

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productivity, the available feed resource should match with the number of animals in a given area. However, there is scanty of information regarding the assessment of feed resources in Adami Tullu area. Few literatures at hand mainly focuses on available feed resources without quantifying the amount obtained from each feed types without indicating their values on the bases of dry matter available which could satisfy the DM requirement of the livestock. For example, the study by Alemu et al. (2006) evaluated the utilization of crop residues in selected agro-ecological zones of Eastern Shoa which mainly focused on rural households. Moreover, the land which used to be allocated for grazing and crop production is being converted to other businesses which require regular assessment. Livestock production constraints could vary not only across agro-ecology but also among production systems. For example different classes of animals are kept by the urban and peri-urban farmers which are dictated by the demand for the products such as milk and availability of the supplemental feeds. The peri-urban and urban farmers usually purchase basal feeds (grasses and crop residues) from the rural area. However, the supply of feeds to the urban farmers depends on the availability of feed resources in the rural area. Shortage of feeds in the rural area affects the management and productivity of livestock in the urban and peri-urban areas. Therefore, it is necessary to study the feed production status and production constraints in the rural and urban/peri-urban livestock production systems. Such information is necessary for policy makers and farmers in order to alleviate the problems. There is very little information which asses the availability and utilization of feed resources in rural and peri-urban areas. Feed resource assessment is important to diagnose the problems and suggest intervention measures to be taken by farmers and policy makers. Therefore, it is important to assess the available feed resources in relation to the requirements of livestock on annual basis in a given area. Therefore, this study was initiated with the objective to assess the major available feed resources and investigate feed related problems in Adami Tullu Jiddo Kombolcha district.

MATERIALS AND METHODS

Description of the study area

The study was carried out in four Kebeles of Adami Tullu Jido Kombolcha (ATJK) district of East Showa Zone, Oromia, Ethiopia. The district was selected due to the severity of feed shortage and the rapid expansion of flower investment which limits feed production which necessitates the assessment of feed resources. The district is located between 38°20’ and 38.5°5’ E and 7°35’and 8°05’ N. It lies at altitudinal range from 1500 to 2000 masl. The district consists of 43 Kebeles and 4 urban towns. The livestock population of the district was estimated to be 211559 cattle, 116585 goats, 25114 sheep, 23720 donkeys, 1441 horses, 423 mules and 13059 Chicken (ATJK district Livestock Development and Health bureau, 2008). The agro-ecological zone of the district is semi-arid and sub-humid in which 90% of the area is lowland while the remaining 10% is intermediate. The average annual temperature ranges from 22 to 28ºC. The area receives average annual rainfall ranging from 760 to 1000 mm in which the distribution is uneven and erratic in nature (Kebede, 2010).

Adami Tullu Jido Kombolcha district is characterized by mixed crop-livestock farming system. Cattle, goat, sheep, donkey and poultry are important livestock species reared in the area. Cereals (maize, barley, and sorghum), haricot bean are the major crops produced under rain fed condition. The vegetation cover of the area is generally characterized by open woodland that consists of acacia and Balanite species. The major soil type of the district is sandy, loam and black (ATJK district livestock Development and Health, 2008).

Sampling technique

Information was obtained from Adami Tullu Jiddo Kombolcha District Office of Livestock Development and Health (LDH) on locally developed organizational structure of the Kebeles (lowest administrative unit), livestock population and distribution of cross breed animals in the district. First, rural and peri-urban potential Kebeles were purposively selected. The criteria for selection of kebeles and farmers were multifold vs livestock population, accessibility and experience of farmers keeping livestock for not less than two years. Accordingly, two Kebeles each from rural and peri-urban sites were selected for the study. Based on the aforementioned criteria, the selected rural kebeles were Elica Calamo and Arba while Edo-Gojola and Garbi-Gilgile kebeles were selected from the peri-urban areas. Sixty respondents (fifteen from each kebeles) were randomly selected for the study.

Types of data and methods of data collection

Data was collected both from primary and secondary sources. Secondary sources of data on climate, soil, topography, agro-ecology, human population, livestock population and livestock production constraints were collected by reviewing different documents and from Adami Tullu Jido Kombolcha LDH office. Primary data (household size, land utilization pattern, major feed resource, production of grain and crop residues, household herd size; seasonality of feed resources) were obtained from the questionnaire survey during the course of the study. The primary data was collected using semi-structured questionnaire between November and December 2010. The questionnaire was first pre tested before the commencement of the survey. Focused group discussions were made at each Kebele to clarify issues not well addressed thought survey and to validate some information collected by individual interview. A total of 28 individuals, 7 from each Kebele were involved in the group discussion. The discussion focused on identifying constraints related to livestock feed and identifying the major livestock production constraints.

Estimation of annual feed resources and livestock feed requirement

The quantity of feed dry matter (DM) obtained from crop residues per household farm were estimated from crop yield to crop residue ratio using conversion factors of FAO (1987). Accordingly, for a ton of maize stover conversion value of 2.0 was used, for a ton of wheat, barley and teff (*Eragrostis abyssinica*) straw, the conversion value of 1.5 was used, while conversion Figures of 1.2 and 2.5 were used for the haricot bean and sorghum, respectively. The quantity of crop residue on the basis of DM available and those

Table 1. Average land use patterns and holding size (ha) per house hold in rural (N=30) and peri-urban (N=30) Kebeles.

Land use type	Location of Kebeles	
	Rural	Peri-urban
Homestead	0.43 ± 0.04	0.27 ± 0.02
Cultivated land	2.44 ± 0.22	2.04 ± 0.13
Private grazing land	0.92 ± 0.24	0.18 ± 0.07
Plantation/wood land	0.15 ± 0.05	0.02 ± 0.02
Total land holding	3.81 ± 0.46	2.65 ± 0.17
Mean land holding of the area	3.23 ± 0.25	

N= Number of respondent.

actually available for livestock consumption was estimated by deducting 10% of the same as wastage (Tolera and Said, 1994).

The quantity of feed DM obtained annually from different land use type was determined by multiplying the hectare under each land use type (FAO, 1987). Conversion factor of 2.0, 0.5, 3.0, 1.8 and 0.7 tDM/ha/year were used for natural pasture, aftermath, private grazing land, fallow land and forest/wood land, respectively. The quantity of DM obtained from irrigation practices was estimated by multiplying the irrigated land size by 0.3 tDM/ha/seasons (FAO, 1987).

The livestock population per household was converted to tropical livestock unit (TLU) as recommended by Gryseels (1988) and Shiferaw (1991) for local and cross breed animals, respectively. The DM requirement was calculated based on daily DM requirement of 250 kg dual purpose tropical cattle (an equivalent of one TLU) for maintenances according to Kearl (1982).

Statistical analysis

Primary data from surveyed households was organized and analyzed using Statistical Package for Social Science (SPSS version 13). Leven's test was used to check homogeneity of variances in the data analysis. Mean and percentage values of various parameters were compared between the two study locations.

RESULTS AND DISCUSION

Analysis of *household survey*

General household characteristics of the sampled household

The average family size of the respondents was 9.92 ± 0.52 heads; however the range was quite broad and spanned between 3 to 20 heads per household. This result is similar to the average family size reported by Kebede (2010) and Wondatir (2010). This large family size may be attributed to lack of awareness towards family planning measures and having many family members is considered as an asset for extensive farm activity. The majority (85%) of the respondents were male household heads. The study further indicated that 21.7% of the respondents were illiterate, while the rest (23.3, 46.7, 5 and 3.3%) had educational background for basic education, primary education, junior secondary education and high school level, respectively.

Land holding and land use pattern

Land is one of the most important resources required for successful implementation of any agricultural farming activities. The results indicate that about 69% of the land was allocated for cultivation while the rest was allocated for private grazing land, homestead land and enclosed plantation/wood land, respectively (Table 1). Rural household farmers allocated more ($p<0.05$) land for homestead, private grazing land and closed plantations. As expected, the ownership pattern indicated that the land ownership was higher in the rural areas when compared with peri-urban areas. This may be ascribed to diversion of land for commercial purposes and/or for developmental activities in the area.

Livestock holding and population trend

The total numbers of livestock, cattle and cross bred cattle holding per household in the study area are presented in Table 2. The results indicate that the average total and cross bred cattle populations were 8.27 and 2.67 TLU, respectively. The average holdings of local breed type were higher ($p<0.05$) in rural areas than that urban Kebeles, while for the crossbred type the reverse was true. This may be attributed to the easy access opportunity for the necessary input such as veterinary services, agro-industrial by-products available in the peri urban areas thus ensuring the availability of nutrients in the lean periods and better access to market and thereby ensuring product off take.

Constraints of livestock production

The results from Table 3 indicate the constraints influencing the overall productivity of the livestock in the studied area.

Table 2. Total livestock and cattle, local and cross bred cattle holding per household in rural and peri-urban Kebeles.

Livestock type	Rural (N=30)	Peri urban (N=30)	Overall (N=60)
Total livestock (TLU)	9.76±1.31	9.10±0.66	9.43±0.73
Total cattle (TLU)	8.50±1.21	8.04±0.54	8.27±0.65
Local cattle (TLU)	6.77±1.06[a]	4.43±0.34[b]	5.60±0.57
Cross bred cattle (TLU)	1.73±0.25[b]	3.61±0.37[a]	2.67±0.25
Goat (TLU)	0.33±0.08	0.18±0.08	0.26±0.05
Sheep (TLU)	0.07 ±0.03	0.21± 0.07	0.14±0.04
Donkey (TLU)	0.6±0.12	0.62±0.13	0.61±0.09
Horses and mules	0.21±0.11	0.03±0.26	0.12±0.19

N = number of respondent; means with different superscript in a row are significantly different at P<0.05.

Table 3. Major Livestock production constraints in Adami Tullu Jiddo Kombolcha district.

Major constraints	Constraint level (N= 60)					Rank
	1	2	3	4	5	
Feed shortage	40 (67.7%)	13 (21.7%)	3 (5.0%)	3 (5.0%)	1 (1.7%)	1
Water scarcity	19 (31.7%)	34 (56.7%)	4 (6.7%)	3 (5.0%)	-	2
Disease	-	11 (18.3%)	35 (58.3%)	12 (20.0%)	2 (3.3%)	3
Low productivity of animals	1 (1.7%)	1 (1.7%)	11 (18.3%)	31 (51.7%)	16 (26.7%)	4
Others	-	-	7 (11.7%)	10 (16.7%)	43 (71.7%)	5

N = number of respondent; Others = change of crop farm to flower and winery farm, expansion of crop land at expenses of grazing land.

The results indicate that feed shortage is the major constraint identified by most of the respondents. Farmers indicated that increment in crop land at the expense of grazing land, shortage of land for forage production, renting and allocation of open grazing lands around Lake Zeway for investors has resulted in a decrease grazing land. The observations are in agreement with that of Keftasa (1996) who also indicated that shifting of grazing land into crop cultivation has dwindled the potential of the livestock in the area and also put immense pressure on the existing land. Recurrent drought, prolonged dry period and uneven distribution of rainfall which affects crop production and re-growth potential of grasses were also the factors which cause feed shortage in the study area. As most of the water bodies are recharged annually during the rains, erratic rainfall is hampering their proper recharge thereby affecting the livestock in the region as poor quality and inadequate quantity of water is affecting both livestock health and production. Farmers participated on group discussion pointed out that Lake Zeway and River Bulbula are the main sources of water for most of livestock in the district. They claimed that due to use of water from Lake Zeway, the volume of these water bodies is shrinking rapidly. Therefore, the maintenance of the existing water bodies and also identifying new water bodies to satisfy the water needs for both man and livestock alike need to be carried out on a priority basis in the area.

The result of the discussion also indicated that the prevalence of disease in the area is common. The most economically important disease are black leg, foot and mouth disease, anthrax, mastitis, pastreulosis and pox. The participated farmers ranked disease outbreak to be the third constraint. The disease generally occurs during the short rainy season spanning between March and May, which may be because the livestock are immune compromised due to lack of fodder in the preceding dry season. The observations in the present study are in accordance with the observations of Burmby and Scholtens (1986) who indicated that the animals health problem are closely linked to the kind of environment in which the herd is kept and the management methods used in production system.

The other challenge reported was the emerging investment growth in the area as the land available for grazing purpose are being taken away for industries adding to further woes to the already scarce feed resources prevailing in the area. Setting of land use policy for every type of activities and production system was the recommendation given by farmers during group discussion. The livestock production constraints as reported in the present study are in consonance with the observations of Desta et al. (2000) who indicated that the inadequate feed and nutrition, poor health , low productivity of local breeding stock are the main livestock production constraints in Ethiopia.

Table 4. Local name and scientific names of naturally grown grass and legume types identified by farmers.

Grass species		Legume species	
Local name	**Scientific name**	**Local name**	**Scientific name**
Korto	*Cynodon dactylon*	Ejisisa	*Crotalaria incana*
Marga hillo (grass)	*Chrysopogon plumulosus*	Calcabbi	*Indigofera spinosa*
Hufe	*Aristida adoensis*	Qore Hare	*Crotalaria spinosa*
O'aa	*Hyparrhenia cymbaria*	Galee	*Psydrax schimpefiana*
Sumaro	*Bothriochloa radicans*		
Egee sare	*Cenchrus ciliaris*		

Table 5. Estimated annual feed dry matter obtained per household farm from different crop residues, land use type and utilizable DM yield in rural and peri-urban kebeles.

Sources of feeds	Feed production (t DM)			%
	Rural	Peri urban	Average DM (t)	
Maize	8.7 ± 0.9	5.6 ± 0.5	7.2 ± 0.5	73.63
Teff	0.22 ± 0.1	0.34 ± 0.1	0.28 ± 0.04	2.86
Wheat	0.32 ± 0.18	0.31 ± 0.10	0.31 ± 1.0	3.23
Barley	0.6 ± 0.21	0.94 ± 0.20	0.77 ± 0.15	7.92
Sorghum	0.10 ± 0.08	0.07 ± 0.04	0.08 ± 0.05	0.84
Haricot bean	0.9 ± 0.23	1.3 ± 0.2	1.1 ± 0.2	11.21
Vegetables	0.04 ± 0.01	0.02 ± 0.01	0.03 ± 0.01	0.31
Total crop residues	10.9 ± 1.1	8.5 ± 0.5	9.7 ± 0.6	100
Utilizable crop residue	9.79	7.69	8.74	74.57
Aftermath	1.22 ± 0.11	1.02 ± 0.07	1.12 ± 0.06	9.56
Grazing land	2.76 ± 0.74	0.54 ± 0.20	1.65 ± 0.41	14.08
Fallow land	0.2 ± 0.06	0.07 ± 0.03	0.14 ± 0.03	1.19
Wheat bran	0.01 ± 0.01	0.11 ± 0.08	0.06 ± 0.04	0.51
Noug seed cake	-	0.02 ± 0.02	0.01 ± 0.01	0.09
Total DM available	13.98	9.45	11.72	100

Feed resource and feed availability

During group discussion farmers were asked to provide the types feed resources available in the area. Accordingly, natural pasture, aftermath grazing, crop residues, and maize thinning were the major feed resources during the wet season. However, crop residues, natural pasture and aftermath grazing were the major feed resources for dry season, in their descending order. In general crop residues and natural pasture are the major feed resources of the area which agree with the report of Tolera et al. (2012) who reported natural pasture and crop residue to be the major feed resources for highlands of Ethiopia. The major grasses species grown in the area is presented in Table 4. *Cynodon dactylon*, *Bothriochloa radicans*, *Aristida adoensis*, *Cenchrus ciliaris*, *Psydrax schimpefiana*, *Chrysopogon plumulosus* and *Hyparrhenia cymbaria* were the abundant grass species indentified by the local community while *Crotlaria Incana*, *Indigofera Spinosa*, *Crotaria Spinosa* and *Psydrax schimpefiaana* were legumes grown in which grass species were dominant in the natural pasture. The studies further indicated that *Psydrax schimpefiana* and *Chrysopogon plumulosus* are fast disappearing and are rarely seen now days. As reported by Chadhokar (1984) such incidences may be related to overgrazing, as is evident in the area and this has resulted in the domination of unpalatable species of grasses in the study area resulting the pasture to be dominated by unpalatable grass species. This may in turn affect the photosynthetic area of a plant as well as species composition in the area (Stoddart et al., 1975). The presence of many grass species in natural pasture as indicated by the farmers are in agreement with the findings of Abate (2007) who also observed high proportion of grass (78.6%) in the total biomass in arid zones of Bale.

Estimation of feed dry matter production

It is perceived from the results presented in Table 5 that the average utilizable feed DM yield per household

Table 6. Estimated annual utilizable feed DM supply, DM requirement and feed balance per household in rural and peri-urban kebeles**.**

Kebeles	Annual feed DM supply (t)	Estimated annual DM requirement for maintenance (t)	Balance of supply versus requirement (t)
Rural	13.98	14.12	-0.14 (99%)
Peri-urban	9.45	13.14	-3.69 (71.9%)
Total	11.72	13.63	-1.91 (86%)
Total/district	703.2	817.8	-114.6 (86%)

farm from crop residues was 9.79 and 7.69 tons per annum by using 10% loss for rural and peri-urban kebeles, respectively. McDonald et al. (2002) observed that in spite of the importance and availability of the crop residues, there are several constraints to their utilization which may be primarily attributed to the higher structural carbohydrates which limits its digestibility. The proportion of leaf to stem ratio is the major factor affecting the nutritional differences among crop varieties (McDowell, 1988). The higher production of DM in the rural areas may be related to the larger land holdings by individual household which is larger for rural households. The differences in varieties and types of the crop besides agronomic management viz. usage of quality and quantity of fertilizers; plant protection measures which may also lead to the difference in vegetative growth and thereby affecting the yield (Reddy et al., 1998). The relationship between grain yield and crop residues suggest that grain yield and vegetative growth is positively correlated (Keftasa, 1988). The present study indicates that 8.74 tons feed DM was annually produced per household farm from crop residues in the study district. The results are higher than the values (6.7 tons DM) reported by Bogale et al. (2008) in the Bale high land. From the annual dry matter obtained, a sizable amount of feed DM was obtained from crop residue in which maize stover contributes the highest proportion followed by the dry matter obtained from the residues of haricot bean (Table 5). From the overall crop residues on average, 73.63% of the total DM was obtained from maize stover alone. Following the harvesting of crops, aftermath grazing is used as potential source of feed for the livestock in the area which usually lasts for three to four months.

The mean annual utilizable dry matter production from different types of feed resources was estimated to be 13.98 and 9.45 tDM for rural and peri-urban Kebeles, respectively. The average value of feed dry matter produced per household farm in rural areas was higher ($p < 0.05$) than that of feed DM produced in peri-urban kebeles. In general a total of 11.72 tons of feed dry matter (DM) per household were obtained from the major available feed resources in which 74.57% was obtained from various crop residues and the rest (14.84, 9.56, 1.19, and 0.6%) were obtained from grazing land, aftermath, fallow land and industrial by-product. The value of crop residues dry matter contribution obtained in the present study was comparable to the findings of Admasu (2008) and Wondatir (2010) who found that crop residues contributed to 78.72 and 86.38% of total feed DM production in Alaba Wereda and Central Rift Valley of Ethiopia, respectively. The present study indicated that crop residues and aftermath grazing contributed to 84.67% of the total annual feed dry matter supply per household.

Estimated annual feed balance

The average annual utilizable feed DM supply was estimated to be 13.98 and 9.45 tDM per household farm for rural and peri-urban kebeles, respectively (Table 2). Based on the suggested estimation by Kearl (1982) the annual feed DM requirements for maintenances for rural and peri-urban areas was 14.12 and 13.14 tDM, respectively (Table 6).

According to the result obtained in this study, about 419.4 and 283.5 tDM/year feed was produced from all feed resources in rural and peri-urban kebeles, respectively, whereas about 423.6 and 394.2 tDM/year feed was the actual requirement for both locations, respectively. Hence the annual utilizable feed dry matter satisfied about 99 and 71.9% of the livestock maintenance requirement for rural and peri-urban kebeles, respectively. This result further indicates that the feed shortage was more aggravated in peri-urban than rural Kebeles. The negative feed balance observed in this study was comparable with the observations of Tolera and Said (1994), Admasu (2008) and Wondatir (2010) in Wolayita Sodo, Alaba Wereda and central Rift Valley of Ethiopia, respectively. However, Amare (2006) and Mulu (2009) reported a positive balance for DM matter requirements conducted at north Gonder and Bure wereda. These positive values reported may be related to the small livestock population in the area and also the fertility of the land favoring feed production. Another reason for the positive values may be related to the average moisture content in the area as these study cover different agro-ecology like the highland which have got surplus moisture compared with the current study area which is moisture deficit.

In general caution should be taken when analyzing feed

balance. For example, home made by-products and tree leaves are often utilized by smallholder farmers which is not easy to quantify. Also alternative use of crop residues is very common. For example, Alemu et al. (2006) indicated that farmers use crop residues as a source of cash, fire wood, construction material, mulching and mattress. Therefore, there could be overestimation or under estimation of the values obtained.

CONCLUSION AND RECOMMENDATION

From this study it can be concluded that, the availability of feed DM did not satisfy the maintenance requirements of total livestock reared in the study area. The study further highlights that the scarcity of feed was more serious in the peri-urban Kebeles. The feed deficit observed in the study area could be one of the contributing factors affecting livestock productivity. There should be land use policy regulation in the area which can secure area for livestock feed production to make the livestock sector contributes to poverty eradication and encourage smallholder farmer food secured household. Finally, with regards to feed resource assessment detailed study should be conducted on chemical composition especially crude protein and energy content and digestibility of available feed resources in the area to recommend concrete development strategies.

ACKNOWLEDGEMENTS

The authors would like to thank Oromia Agricultural Research Institute for granting financial support as well as Adami Tullu Agricultural Research Center for giving all necessary facilities. Also they particularly acknowledge Ato Abebe Mabirate and Ato Taha Mume for their support to facilitate material and financial needs, and Ato Aman Abdulkadir for his assistance in feed preparation and data collection of feeding trial. They appreciate farmers for their involvement during data collection.

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