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Estimating the Available Feed Resources and Production Constraints of Livestock Development in South Gondar, Amhara National Regional State

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Abstract

The study was carried out in four districts of South Gonder Zone of the Amhara National Regional State which represent highland and mid-altitude agro-ecology of the zone. The objective of the study was to estimate annual quantity of available feed resources produced in relation to livestock requirement and identify major constraints of livestock production. Two hundred ten rural households from both agro-ecologies were interviewed with semi-structured questionnaire. A single–visit-multiple-subject survey was carried out. The types of livestock feeds available are crop residues, natural pasture, hay, crop aftermath, indigenous fodder trees, agro-industrial by-products and improved forage crops and pasture which vary in season. The annual average maintenance DM requirement per household was higher ($p<0.05$) in mid-altitude (10.47 TDM) than in the highland agro-ecology (8.92 TDM) districts. An average of 9.69 TDM of maintenance DM was produced per household from the major available feed resources, of which 62.08%, 12.24% and 12.19% was obtained from crop residues, conserved hay and grazing land, respectively. The average livestock population per household was 5.92 TLU and the average annual utilizable DM feed per household was 9.69 TDM. However, the annual maintenance DM requirement was estimated to be 13.45 TDM. Hence, the study indicate that the existing feed supply can satisfies about 72% (263 days) of the maintenance DM requirement of livestock per household. However, the annual feed requirement greatly varied between the two agro-ecologies that accounted for about 68% and 76% of the maintenance DM requirement of livestock in high land and mid-altitude agro-ecologies, respectively. Insufficient feed, disease, poor genetic potential, lack of working capital, limited extension service and market problem were assessed to be the major livestock production constraints.

Keywords: Agro-ecology, feed resources, maintenance requirement, production constraints,

1. Introduction

Ethiopia is gifted with significant livestock resources and holds the largest livestock population in Africa. The domestic herd consisting of about 70 million cattle, 42.9 million sheep, 52.5 million goats, 8.1 million camels and close to 57 million poultry (CSA, 2021). The livestock production and management system in Ethiopia is mainly extensive, where indigenous breeds are kept under low input/low-output husbandry practices. In Ethiopia, livestock production is a vital source of income and means of livelihood for farmers (Dereje *et al.,* 2014), and generates >85% of the farm exchange income (Yeshitila *et al.,* 2008). Livestock are kept for creation of replacement stock, source of food, draught power, transport, income generation, soil compaction for planting cereal crops and manure production for soil fertility management (Bewket *et al.,* 2015). Currently, livestock production accounts for almost 12-16% of the GDP and virtually 16% of external earnings of Ethiopia (Bewket *et al.,* 2015).

The major livestock feed resources in the highland of Ethiopia are natural pasture and crop residues where all ruminants as well as equines depend on them. The availability of feed resources and the nutritional quality of the available feeds are the most essential factors that regulate the productivity of livestock. The role of natural pasture grazing as a main livestock feed resource is declining from time to time due to decreasing grazing land size (Yayneshet, 2010). The use of natural hay is limited in coverage and it is better in terms of its feeding value than crop residues if timely cut, proper handling and storage measures are applied. Even during years of good rainy season, forage is not sufficient to feed livestock in the highlands for causes associated with inadequate grazing land and poor management (Melese *et al.,* 2014).

In highlands of Ethiopia, the annual DM production could fulfill only two-third of the total DM requirements of the livestock due to this, during the dry season animals decline their body condition which is an indicator of feed inadequacy and suggests that livestock production and productivity are constrained by feed scarcity (Funte *et al.,* 2010). So to obtain improvement in animal production and productivity, an assessment should be done on the varieties and sources of livestock feed resources, total DM feed production of the area and livestock feed requirement whether the animal is in a free ranging system or under confinement.

In addition to the above factors, the other major limitations for livestock production comprise costs of feeds and its marketing systems (Sintayehu *et al.,* 2008). Improving market efficiency will increase demand and margins to producers and other market actors. Hence, feed market development can be considered as a significant factor in alleviating the feed scarcity problem (Berhanu *et al.,* 2009). Few literatures at hand mainly focuses on the existing feed resources without quantifying the amount obtained from each feed type without indicating their values on the bases of dry matter available which could satisfy the DM requirement of the livestock. So in order to obtain improvement in animal production and productivity, an assessment should be done on the types and sources of livestock feed resources; total DM feed production of the area.

Thus, on the assumption basis of this background the current study was proposed with the objectives to assess the quantity and quality of available feed resources in relation to livestock requirement, identify the major constraints in livestock production, and recommend possible intervention mechanisms in South Gondar zone.

2. Materials and Methods

2.1. Description of the Study Area

The study was conducted in South Gondar zone of the Amhara National Regional State. The South Gondar zone is situated 660 km Northwestern of Addis Ababa. The geographic

location of the zone lies between 11^0 02'- 12^0 33' North latitude and 37^0 25' –38^0 43' East longitude. The zone is defined agro-ecologically as highland (*Dega*) and mid altitude (*Woina Dega*) and the elevation ranges from 1500 to 3200 meters above sea level (m.a.s.l). The study area is commonly characterized by its rugged topography from the place called Gunna Mountain (4231mt) to the mid altitude of Dera district at the Lake Tana margin. The annual minimum and maximum temperature ranges from 17 to 27^0c, respectively. Rainfall distribution is largely mono-modal from June to mid-September. The heaviest rain usually occurs during July and August, and the mean annual rainfall differs widely from 500 mm up to 1600 mm (BoANRD, 2018).

2.2. Sampling Technique

For this study Lay Gayint, Farta, East Estie and Dera districts were selected purposely in order to represent all agro-climatic areas of the zone. Lay Gayint and Farta represented the highlands with elevation ranging from 2300-3200 m.a.s.l. and East Estie and Dera from mid-altitude districts with elevation ranging from 1500-2300 m.a.s.l., then from the total Rural Kebeles (RKs) 10% of potential RKs were purposively chosen; finally for this study 7 RKs from highland and 7 RKs from mid-altitude agro-ecological zone an overall of 14 RKs were selected. The criteria for selection was multifold vis livestock population, accessibility and experience of farmers keeping livestock were used as criteria to select RKs and farmers. From the selected RKs, households were chosen arbitrarily from comprehensive list of households available from RKs office and were 15 per RKs amounting to 210 households which currently own stock were included in the whole study.

2.3. Method of Data Collection

The data were collected from both primary and secondary sources. Primary data were composed by interviewing selected livestock producers /farmers with the support of semi-structured questionnaire, Focus Group Discussion (FGD), Key Informant Interview (KII) and field visit.

The semi-structured questionnaire were designed to attain information based on farmers perception on socio- economic characteristics, household herd size and composition, major feed resources, production of grain and crop residues, feed marketing structure and constraints of the production. The questionnaire was first pre-tested before the beginning of the study.

Field visits were made on randomly selected households and community owned resources i.e. appearance of animals, status of grazing lands, feeding methods, ways of conserving forages in the form of hay and other relevant husbandry activities. Focus group discussion was made at each RK to explicate issues not intimately addressed during survey and to authenticate some information collected by separable interview. Key informant interviews were conducted with zonal and district livestock and fishery resource promotion agency experts and development agents, which can help for validating the interview of selected groups. Secondary sources of data on agro-ecology, livestock population and crop production potential of the districts were collected by reviewing different official papers from appropriate district offices.

2.4. Estimation of Available feed resources and livestock feed requirement

The amount of feed dry matter (DM) obtained from crop residues per household were estimated by applying grain to straw ratio using conversion factor suggested by FAO (1987) for the varied crops grown produced in the study area. A factor of 2.0 for sorghum and maize Stover, 1.5 for wheat, barley and teff straw, 1.2 for pulse straws and oil crops specified as linseed straw were used to calculate yield of crop residues from grain yield. The quantity of crop residue on the basis of DM available and those actually obtainable for livestock consumption was estimated by deducting 10% of the same as wastage (Adugna Tolera and Said, 1994).

The amount of feed DM obtained yearly from diverse 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 livestock population per household was converted to tropical livestock unit (TLU) as recommended by Gryseels (1988) and Bekele Shiferaw (1991) for local and cross breed animals, respectively.

The DM requirement of an animal was calculated based on daily DM requirement of 250 kg dual purpose tropical cattle (an equivalent of one TLU) for maintenance according to Kearl (1982).

2.5. Statistical Analysis

Primary data from surveyed households were organized and analyzed usingstatistical package for social science (SPSS version 20). Mean, percentage values and standard deviations of various parameters were compared between the two locations.

3. Results and Discussion

3.1. Socio-economic Characteristics of the Respondents

3.1.1. Household Characteristics

The average family size of the respondents was 5.7 and 6.6 per household in the highland and mid-altitude agro-ecologies, respectively. The result was lesser than that of described by Sisay, 2006, in North Gondar which was 7. 23, while it was higher than the national average family size of rural areas (4.9) per household (CSA, 2011). The majority (90%) of the respondents were male household heads. The educational level of the respondents were 26.1% in the high land and 25.3 % in the mid- altitude areas were uneducated, while 48.9 and 49.9 %, 17. 5 and 21.1 % and 7.5 and 6.1 % had educational prospect for read and write, elementary school (1-8 grade) and secondary school and above in the high land and mid-altitude agro- ecology of the study areas, respectively.

3.1.2. Livestock Holding

Each household owned varied amount of cattle, sheep, goats and equines. The total livestock holdings per household were 5.65, 5.87, 6.16 and 5.92 TLU for Lay Gayint, Farta, East Estie and Dera districts, respectively (Table 1). Disagreeing to the current study, the overall average TLU of livestock per household in the study district is 7.97, 0.74, 0.46, 0.78, 1.44, 0.8 and 0.07 for cattle, sheep, goats, donkeys, horses and mules, respectively in Meta Roba district, Oromia Region were stated by Endale, 2015. The average holding of livestock per household were higher ($p<0.05$) in mid- altitude (6.04 TLU) than in the high land agro-ecology (5.76 TLU). This may ascribed due to more communal and private grazing land, occurrence of cattle for draught power and crop land availability from which higher proportion of livestock feed is obtained. Sheep holding per household in the high land area is significantly greater ($p< 0.05$) than in mid-altitude agro-ecologies. This may be due to the agro-climatic premise of the area, which is appropriate to rear sheep than others and NGOs working in these districts offer sheep to assure food security.

Goat holding per household in mid- altitude is significantly greater ($p<0.05$) than the high land agro-ecology which may be due to the suitableness of the area and availability of browse for the goats' feed. Out of the enumerate households cattle, oxen are paramount in all districts. This is because of the contribution of oxen to crop production as source of draught power and during threshing. Most of the cattle reared in the study area are indigenous. Crossbred cattle comprise 5.2% of the total cattle and were widespread both in the highland and mid altitude district.

3.2. Major Livestock Feed Resources

The major feed resources accessible to livestock in the study area were crop residues (62.03%), conserved hay (12.24%), native pasture (12.19%), crop aftermath (8.51%), indigenous fodder trees/shrubs, supplements of agro-industrial by-

products and to some extent cultivated forage and pasture crops (Table 2) that are related to the feed resources in most highlands of Ethiopia (Tolera *et al.*, 2012). Generally, crop residues, natural pasture, conserved hay and crop aftermath were the primary feed resources in the study district. Agro-industrial by products, indigenous fodder trees/shrubs, and cultivated forage and pasture crops were unusual and rarely used. The availability of these feed resources varied depending on season and agro-ecological zones with respect to quantity. The types of feed resources were not significantly different between highland and mid altitude agro-ecological zones. This may be due to in both agro-ecologies; integrated crop-livestock production system is much experienced by the farming community.

3.3. Estimation of Annual Feed Balance

The annual average utilizable DM feed supply per household was estimated at 8.92, and 10.47 TDM for high land and mid-altitude agro-ecology districts, respectively (Table.3). The annual utilizable DM feed provide per household different between the highland and mid altitude agro ecologies. The maintenance DM requirement of one TLU (an equivalent of a bovine of 250 Kg live weight) is estimated to be 2.5 % of the body weight or 6.25 Kg per day or 2.28 ton /year/ TLU (FAO, 1987).

In the study area, the annual maintenance DM requirement for 5.76 and 6.04 TLU per household was about 8.92 and 10.47 TDM for high land and mid-altitude agro-ecology districts, respectively. Based on the suggested estimation by FAO (1987) the annual feed dry matter requirement for maintenance for high land and mid-altitude agro-ecology was virtually 13.13 and 13.45 TDM, respectively (Table. 3).

The current study showed that, the existing feed supply on a year round basis satisfies for some 72 % (263 days) of the maintenance DM requirement (28% or 102 days inadequacy) of livestock per household over all in the study area. This insufficiency of feed supply could also match with low attribute of crop residue, over matured and improperly conserved natural pasture, crop aftermath and browse leaves. However, the annual feed supply varied between the two agro-ecologies and accounted for virtually 68% and 76 % of the maintenance DM requirement of livestock in highland and mid highland averages, respectively.

This might be that low crop land holding was registered in the highland than mid-altitude districts as the major feeds were derived from cropping system. Moreover, communal grazing land holding was very low due to the landscape of the districts which are influenced by mountains and hills that are defined by low forage production, rock out and steep slope and low yield of farm land as compared to the mid elevation districts.

3.4. Feed marketing

Roughages that are exist in the study area such as natural pasture hay, wheat, barley, Finger millet, rice and teff straw are sold by farmers and used as a source of cash income. The prices of roughages vary over the season, location and the size of the aggregation. Mostly, the price is lower at the gathering time of hay and crop which are available and gets costly as feed supply declined. Stover's from maize and sorghum are not sold and used as a source of cash income. In the study districts green pasture from protected grazing lands were also sold during the rainy season commonly from July to September months when it is available. Majority of the respondents (90%) in the high land and (86.5 %) in the mid- altitude areas replied that they did not buy agro-industrial by products for their animals from the market. The rest of the sampled households acquire commercial feeds in their proximate order towns. In agreement to this finding, Zewdie (2010) reported that 80 and 55% of the farmers at Jimma and Sebeta, respectively, indicated that agro-industrial by products are not available sufficiently in the market.The use of agro-industrial by products such as oil seed cakes, milling by products and molasses is currently modified to the emerging private dairy and fattening farms (Yayneshet, 2010). According to

this survey result, feed processers and retailers do not exist in the district so that livestock producers could not get agro-industrial by products from the market.

3.5. Major Constraints to Livestock Production

The livestock sub-sector in the study area does not make a great contribution to the national and /or regional income considering with its great potential. The major constraints that hampered the development of livestock activity in both agro-ecologies were mentioned as lack of grazing land and feed shortage, animal health problem, poor genetic potential, poor extension service, lack of working capital, shortage of labor and market problem, this is in agreement with other studies (Zewdie, 2010; Teshager *et al.,* 2013).

In the study area for livestock producers inability to feed their animal adequately throughout the year was the most wide spread constraint. Overall, 89 % of the respondents in all the study districts stated the importance of shortage of grazing land as a limiting factor for livestock production. This is due to the rapid increase of human population and high demand for food, pasture areas are steadily being converted to farm lands. Marginal lands unsuitable for cultivation such as water logged, flooded soils, swampy areas and steep lands are left for grazing and their productivity is very low.

Feed shortage and scarcity of grazing land was more sever in high land areas where more grazing lands are found on hillsides which are characterized by low forage production. In the study districts, there is ample amount of feed from communal grazing lands in the wet season, but the farmers face shortage of feed during the dry season due to lack of preservation of the feed resources properly. Crop residues which constitute over half of the harvestable biomass of the most widely grown cereals, their value is increasingly recognized in smallholder mixed and peri-urban farming systems. These roughages on their own are poor feed, low in nutrient content, low intake and digestibility. In addition there was also very few farmers who were involved on improved forage crop production in the rural and peri-urban areas. Insufficient land and labor, lack of inputs such as forage seeds and planting materials, and lack of awareness were among the reasons mentioned by the farmers for not widely cultivating improved forage crops in their lands.

During data collection through questionnaires and open discussion disease and parasite are the limiting factors for livestock production in all agro-ecologies of the study area.

The most economically important diseases are Anthrax, Blackleg, Pasterollosis, FMD, AHS, Sheep and Goat pox, Mastitis as well as Internal and External Parasites. The veterinary services also were not sufficient enough in all the study districts and the medicines supplied by the regional BoANRD were not satisfactory so the farmers were forced to buy from the private and illegal drug vendors with expensive prices.

During the study, out of 210 respondents only 11(5.2%) had the crossbred animals. The AI services were only giving services for per-urban and urban areas. Most of the cows inseminated by AI technicians were failed to conceive due to lack of proper heat detection and inefficient service. The other challenge assessed was limited extension services on improved forage development strategies, veterinary services, pasture management, dairying and fattening practices, lack of working capital for intensive dairy and fattening farming system, livestock marketing, particularly for fattened animals and dairy products in nearby was also a problem in all the study districts

However, high potential for livestock, availability of crop residues, irrigation practices and high market demand for livestock products are identified as good opportunities which could be used to enhance the performance of livestock activity in the study areas.

Table.1. Average livestock holding and composition per household in the study districts

Description	Districts								Overall	Contribution
	Lay Gayint N = 45		Farta N = 60		East Estie N = 60		Dera N = 45			
	TDM	%	TDM	%	TDM	%	TDM	%	TDM	%
Grazing land	0.91	10.9	1.18	12.4	1.43	13.19	1.24	12.28	1.19	12.19
Crop residue	5.68	68.1	5.87	61.72	6.33	58.4	6.05	59.9	5.98	62.03
Crop aftermath	0.73	8.8	0.78	8.2	0.87	8.02	0.91	9.0	0.82	8.51
Conserved hay	0.64	7.7	1.10	11.56	1.76	16.23	1.36	13.47	1.21	12.24
Fodder trees	-	-	0.026	0.27	0.014	0.12	0.11	1.09	0.04	0.37
Shrub land	0.26	3.1	0.24	2.52	0.17	1.56	0.10	0.99	0.19	2.04
Fallow land	0.014	0.2	0.003	0.03	0.006	0.05	0.02	0.20	0.01	0.12
Irrigation by–products	0.1	1.2	0.30	3.15	0.26	2.4	0.30	2.97	0.24	2.43
Agro-industrial by- products	-	-	0.014	0.15	0.004	0.03	0.01	0.10	0.01	0.07
Total supply	**8.33**	**100**	**9.51**	**100**	**10.84**	**100**	**10.09**	**100**	**9.69**	**100**

N = number of respondents; SE = standard error; TLU= tropical livestock unit

Table 2. Feed resources and animal feed dry matter supply per household in the study districts

Variable	Lay Gayint Mean±SE N = 45	Farta Mean±SE N = 60	East Estie Mean±SE N = 60	Dera Mean±SE N = 45	Overall Mean±SE N=210
Livestock (TLU)	5.65 ± 0.31	5.87 ± 0.34	6.16± 0.29	5.92± 0.33	5.9±0.31
Cattle (TLU)	3.57 ± 0.30	3.78 ± 0.29	4.06 ± 0.31	4.34±0.40	3.94±0.30
Sheep (TLU)	0.64 ± 0.30	0.62 ± 0.32	0.52 ± 0.33	0.44±0.29	0.55± 0.29
Goat (TLU)	0.29 ± 0.36	0.31 ± 0.19	0.41 ± 0.26	0.38±0.23	0.35±0.20
Donkey (TLU)	0.30 ± 0.10	0.25 ± 0.078	0.35 ± 0.076	0.30±0.08	0.3±0.29
Horse (TLU)	0.64 ± 0.10	0.56 ± 0.08	0.40 ± 0.066	0.32±0.07	0.48±0.09
Mule (TLU)	0.21 ± 0.06	0.35 ± 0.056	0.42 ± 0.07	0.14±0.05	0.28±0.06

N= number of respondent; TDM= ton dry matter

Table 3. Balancing of annual maintenance requirement of livestock with annual utilizable feed supply per household

Variables	Districts						Over all mean
	Lay Gayint	Farta	Average	East Estie	Dera	Average	
Annual utilizable feed supply (TDM)	8.33	9.51	8.92	10.84	10.09	10.47	9.69
Annual maintenance requirement (TDM)	12.88	13.38	13.13	14.04	13.47	13.77	13.45
Balance (supply-requirement) (TDM)	-4.55	-3.87	-4.21	-3.2	-3.4	-3.3	-3.76
Supply from the requirement (%)	64.67	71.08	67.94	77.21	74.8	76.03	72.04

TDM= ton dry matter

4. Conclusion and Recommendations

The major feed resources in the district were natural pasture grazing, crop residues and hay, local alcohol waste and crop aftermath. Agro-industrial by products, non-conventional feeds and improved forage utilization is uncommon and rarely used in the study areas.

The current study showed that, the existing feed supply on a year round basis satisfies for about 72 % (263 days) of the maintenance DM requirement of livestock per household over all in the study area. This deficit of feed supply could also couple with low quality of crop residue, over matured and improperly conserved natural pasture, crop aftermath and browse leaves, therefore alternative feed production technologies such as development of improved forages, efficient feed utilization technologies and natural pasture land improvement measures should be undertaken.

During dry season, most respondents use crop residues, hay and stubble grazing for their livestock feeding but the nutritive value of such feeds was low and its quality should be assessed in the future. In addition, crop residues accounted for 76.72% of the livestock feed share in the district therefore, efficient utilization of this feed should be designed.

Feed marketing along the value chain in the district was not practiced. Farmers mostly purchase feeds from local farmers and these feed types were mostly natural pasture and hay but commercial feeds were not available in the area. Feed processers and retailers were not present in the district so that livestock producers could not easily get agro-industrial by products from market. To alleviate feed marketing problems that were aggravated due to absence of feed processors and retailers, the local authority should organize interested farmers or landless youths to make an association that aims to supply feeds to local farmers. Credit service should also be facilitated in order to promote those individuals or groups involved in livestock feed marketing.

The major livestock production constraints shortage of grazing lands, absence of feed processors and retailers, absence of technologies in improved feed production and utilization, poor feeding system, poor land management and absence of awareness in feed production, storage and utilization.

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