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Assessment of livestock production system and feed balance in watersheds of North Achefer District, Ethiopia

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Abstract: A survey was conducted in North Achefer District of Amhara National Regional State in six selected watersheds with the objectives of characterizing the livestock production system and to assess the major feed resources and its management. The watersheds were selected purposively based on agro-ecology conditions (mid and low altitude). Moreover, focus group discussions and field observations were done to enrich survey data. The major feed resources biomass estimation in terms of dry matter (DM) was conducted using conversion factors. Diseases such as FMD, internal and external parasite, bloat and Newcastle (poultry diseases) are dominant in the area. Most of the respondents reported that the major water source for livestock during dry season was from well (49.6%) followed by spring water (37.5%) the remaining is from river water (12.9%). The major livestock feed resources available in the study areas were crop residues, natural pasture, hay and improved fodder harvested from backyard and soil and water conservation areas. In the study area, about 32.51% of feed dry matter deficit has been recorded. Mixed crop livestock production system was characterized as the major farming system in the study area. The major livestock production constraints of the study watersheds were shortage of grazing land, low productivity, disease, shortage of water, shortage of labor and predators in the order of importance. Watershed development is now being an important intervention for natural resource conservation in the study area and at the same time it is becoming very important to be a livestock feed source if cut and carry system is regularly applied.

Keywords: *Agro-ecology, feed resources, livestock, watershed*

Introduction

Though Ethiopia has huge livestock population (Hunduma, 2012), the productivity is comparatively low. There are many factors contributing for the lower productivity such as seasonal availability of feed, prevalence of diseases, low genetic potential of the livestock, and poor management. Feed is the most important input in livestock production, and its adequate supply throughout the year and an essential prerequisite for any substantial and sustained expansion in livestock production (Legesse *et al.*, 2010). The free grazing system has contributed significantly to the extensive grazing land degradation. Realizing the degradation of natural resources, the government of Ethiopia has given due attention as top priority agenda on natural resource conservation for maintaining agricultural productivity using watershed development. Wani *et al.* (2008) reported that people and livestock are integral components of watershed and their activities affect the productive status of watersheds and vice versa. Therefore, watershed development represents a promising strategy for sustainable and productive livestock farming in terms of availability of quality and quantity of feeds, and water. Belay *et al.* (2013) reported the constraints of livestock production in Ginchi watershed area, but information regarding to livestock production system and management of available feed resources is lacking for North Achefer District watershed. This study was done to characterize the livestock production systems and assess major feed resources and their management in selected watersheds areas of North Achefer District.

Materials and Methods

Description of the study area

North Achefer District is located at 545 km northwest of Addis Ababa, the capital of Ethiopia and 102 km to the west of Bahir Dar, the capital city of Amhara Region. It is 11.24° to 11.89° N latitude and 36.51° to 37.2° E longitudes with an altitude ranging from 1500 to 1800 m.a.s.l with area coverage of 82,386.74 ha and the total cultivated area is 43,521ha. The area receives an average annual rain fall ranging from 1000 to 1500 mm and the minimum and maximum daily temperature was 25 °C and 30°C (NADoA, 2013).

Methods of data collection

In the study District six kebeles (name of lower level local administration in Ethiopia), which are in the watershed development were selected purposively based on agro-ecology (midland and lowland) differences. A total of six watersheds were selected; of which three of them are found in lowland (500-1500) and the other three watersheds were found in midland (1500-2500) agro ecology conditions. A total of 240 households, 40 from each kebeles were selected purposively based on their participation in livestock production and used for primary data collection. Both primary and secondary data sources were used in the study. Primary data was collected from selected households by interviewing using semi-structured questionnaire. Field observation and focus group discussion were also employed to enhance the survey data. The DM yield from natural pasture was estimated using the conversion factors of 2 t/ha and from stubble grazing 0.5 t/ha (FAO, 1987). Estimation of biomass dry matter from different major crops grown in the area was estimated based on already established methodology (FAO, 1987).

Estimated forage dry matter yield from improved pasture

In the selected watershed areas Sesbania sesban and pigeon pea are well adapted improved forage species and its biomass yield in terms of dry matter in the intervention area was estimated based on the following methods. The amount of total land was collected by questioner in the working watershed. Then, from the assumptions of from one hectare bund there is 0.03 hectare plantation area (Lakew et al., 2005); then by calculating the total area of the watershed by 0.03, the total area of improved forage plantation was estimated. And the DM from improved forage was estimated by multiplying the area of plantation by 9.75 (Firew and Getnet, 2010).

Feed gap analysis

In order to understand the feed gap of the study area, the livestock population data collected through questionnaire was converted to total tropical livestock unit (TLU) using FAO (1987) methodology. For the standard TLU of 250 kg dual-purpose tropical cattle, a DM requirement of 2.5% of body weight is equivalent to 6.25 kg DM per day or 2281 kg DM per year (Jahnke, 1982).

Methods of data analysis

The collected data was managed and organized with MS-Excel and was analyzed using Statistical package for social sciences (SPSS) (version 20, 2011) and Statistical analysis system (SAS, 2002). Descriptive statistics was employed to present the quantitative variables obtained from the household survey. A simplified model for statistical procedure of SPSS (version 20) with dependent variables of forage DM yield over the independents of agro-ecology and watershed location was presented with the following model.

$$Y_{ijk} = \mu + A_i + L_j + e_{ijk}$$

Where, Y_{ijk}= Total feed DM yield from watershed areas

μ = overall mean

A_i = the effect of i^{th} watershed agro-ecology (mid and lowland watersheds)

L_j = the effect of j^{th} locations (1-6)

e_{ijk} = random error

The purpose of livestock keeping and major livestock constraints were analyzed and summarized by index method. Index was computed with the principle of weighted average according to the following formula as employed by (Musa *et al.*, 2006):

Index = $R_n*C_1+R_n-1*C_2+....+R_1*C_n/\sum R_n*C_1+ R_n-_1*C_2....R_{1*}C_n$

Where;

R_n = Value given for the least ranked level (example if the least rank is 5^{th} rank, then $R_n=_5$, R_n-_1=4 and … R_1= 1).

C_n = Counts of the least ranked level (in the above example, the count of the 5^{th} rank = C_n, and the counts of the 1^{st} rank = C_1).

Results and Discussion

Household characteristics

Family size and age structure per respondent household in the study area is shown in Table 1. The average family size of the study area is 6.6 persons per household and male and female structure per respondent of household was almost proportional. The average family size in the study area was comparable but relatively higher to 6.22 (Adebabay, 2009) reported for Bure District of Amhara National Regional State, and it is also higher than the two lowland Districts (Mandura and Pawe) of Metekel zone of Benshangul Gumz region ranging 6.04 to 6.94 (Yeshambel *et al.,* 2011).

The educational level of the respondents is indicated that the majority of the respondent (43.7%) in the six watersheds areas were illiterate, whereas the rest (56.3%) were literate. Among the literate 38%, 10.3% and 8% of the respondents were able to read and write, attended primary school, and completed secondary school, respectively. The higher the population the literate class at the working District, the better in the acceptance of technologies like trainings, improved agricultural technologies and adopting them for better live improvement. Better results were reported by Sisay (2006) average, 31% of the respondents in the three District are illiterate, whereas 28% are able to read and write, 2.5% have religious education, 21.3% have attended primary school, and 17.2 % completed secondary school in North Gondar Zone, Ethiopia; Adebabay (2009) percentage of illiterate family members (31.5%) reported in Bure District, Ethiopia; Bedasa (2012) which was on average above 50% of the respondents were literate in the highlands of the Blue Nile Basin, Ethiopia; whereas Wondatir and Mekasha (2010) above 89% of the respondents were literate in highlands and central rift valley of Ethiopia.

Table 1 - Household characteristics of respondents in study area.

Variables	Agro ecology					
	Mid Altitude		Low altitude			
	Ariba N=40	Azula N=40	Marwenz N=40	Kolama N=40	Guntala N=40	Dokmit N=40
	Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE
Age of the respondents	41.57±1.71	44.85±1.38	41.95±1.26	41.50±1.41	38.15±1.04	43.10±1.71
Household size	6.3±0.27	6.97±0.30	6.4±0.22	6.37±0.23	7.1±0.32	6.5±0.33
Male	3.10 ±0.14	3.35 ±0.19	3.43 ±0.23	3.55±0.217	3.5±0.186	3.7±0.23
Female	3.2±0.13	3.57±0.19	2.97±0.194	2.9±0.188	3.57±0.22	2.85±0.18

N= number of respondent; SE=standard error

Landholding and land use pattern

The overall land holding of the study area was reported to be 2.18ha. The average landholding of the selected watersheds, (Ariba, Azula, Marwenz, Kolama, Guntala and Dokmit), was 2.17, 2.17, 2.44, 1.97, 2.19 and 2.12ha, respectively. The average land holding per household is higher than the findings of Shenkute *et al.* (2010) the overall land holding 0.93 in Goma District and lower than the report of 2.55ha per household (Yeshitila, 2008) for Alaba District and also Sisay (2006) 3.28 ha per household in the North Gondar of Ethiopia. This result is less than the national average land holding size of 2.5 ha. The mean grazing land owned per house hold in this study is smaller than that report of 0.33 ha Bogale *et al.* (2008) in Bale high land, and which was 0.51ha (Asaminew and Eyassu, 2009) in Bahir Dar Zuria. This discrepancy would be due to the shifting of grazing lands for crop production.

The overall cultivated land of the current study was 2.01ha. Additionally mid altitude agro-ecology had higher (2.08ha) crop land than low land agro-ecology (1.95) which is due to the fact that mid altitude agro-ecologies are known to be favorable for growing of many crops than low altitude agro-ecologies. The cultivated land per household obtained in this study was higher than the finding of Teshome (2009) with the average land holding size of the respondents was 1.14 ha in Fogeraworeda in south Gondar zone and lower than the report of 2.55ha per household (Yeshitila, 2008) for Alaba District, Southern Ethiopia.

Livestock holding and their use

The average Tropical Livestock Unit (TLU) holding per household is presented in Table 2. Livestock is an important component of the farming system in the study areas. Species of livestock owned by the respondent farmers is the same across the watersheds. The overall cattle, sheep, goat, equine and poultry holding per household were 5.54±0.39, 0.27±0.051, 0.36±0.031, 0.49±0.072 and 0.15±0.06TLU, respectively. Cattle holding per household of this study was smaller than that reported by Yeshitila (2008) total TLU in the Alaba District was found to be 9.87 per household as per the survey result of which cattle, sheep, goats and equine take a proportions of 7.38, 0.27, 0.42 and 1.8 TLU respectively and this study was larger than that reported by Belay et al.(2013)in Dandi District, Oromia regional state, central Ethiopia. The overall mean population, except cattle, show a significant ($p<0.001$) effect by agro ecology. In lowland agro-ecology cattle, goat and poultry had a greater mean population, which may be due to the favorable agro-ecological for goats and the cattle keepers hold many cattle's for sharing of natural disasters, over keepes of livestock in the watershed was poultry followed by cattle; which might be less purchasing cost for poultry which used as an immediate cash income source for the smallholder farmers and the cattle was due to its source of traction power.

Table 2 - Livestock holding (TLU) in the selected watershed area.

Variables	Agro ecology						Significance
	Mid altitude		Low altitude				
	Ariba=40	Azula N=40	Marwenz N=40	Kolama N=40	Guntala N=40	Dokmit N=40	
	Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE	
Cattle	5.49±0.25	5.81±0.31	5.17±0.41	5.39±0.38	6.20±0.36	5.19±0.60	NS
Goat	0.28±0.05	0.25±0.047	0.32±0.03	0.42±0.061	0.50±0.071	0.41±0.047	**
Sheep	0.66±0.05	0.56±0.04	0.313±0.06	0.008±0.0075	0.055±0.02	0.03±0.01	***
Equine	0.52±0.04	0.65±0.08	0.48±0.088	0.28±0.059	0.64± 0.094	0.38± 0.07	**
Poultry	0.13±0.01	0.15± 0.015	0.14±0.018	0.19± 0.018	0.18± 0.18	0.11±0.13	***
Total	7.0808^{ab}	7.4120^{ab}	6.4313^{ab}	6.2980^{ab}	7.5339^{a}	6.1323^{b}	

N= number of respondent; SE= standard error; NS=non significant, **=significant at ($p<0.01$), ***=significant at ($p<0.001$)

Purpose of livestock keeping

The agricultural farming system in the study area was characterized dominantly by crop livestock production. The purposes of livestock keeping at the selected watersheds areas are presented in Table 3 and 4. Cattle were the most important component of the mixed crop-livestock production system in both agro-ecology of watershed areas. Smallholder farmers employed oxen as traction power for crop production while cows were for milk production. In addition, cattle in the study areas served as threshing, asset holding and direct cash income from direct selling and/or product selling. Poultry, sheep and goats are kept mainly as a source of direct cash income as soon as the need had arose. Equines (mainly donkey and mule) are used for transportation agricultural inputs from market to home and vice versa, water transportation (mainly at low altitude watersheds), and animal cart to bear additional incomes and for human transportations. Similar results on the purpose of keeping livestock were reported by Bedasa (2012), Wondatir and Mekasha (2010) and Asaminew and Eyasu (2009) in different parts of Ethiopia. During festivals and religious celebrations, farmers in the study area slaughter sheep/goats for home consumption and additionally they slaughter oxen in group (local named as "Kircha") and this is also supported by Teshager *et al.* (2013) in Ilu Aba Bora.

Table 3 - Purpose of livestock keeping in mid altitude ranked according to importance

Purposes	Cattle			Small ruminants			Equines			Poultry		
	Score	Index	Rank	Score	Index	Rank	Score	Index	Rank	Score	Index	Rank
Traction	840	0.35	1	0	0	0	0	0	0	0	0	0
Threshing	714	0.3	2	0	0	0	0	0	0	0	0	0
Milking	390	0.16	3	0	0	0	0	0	0	0	0	0
Income	330	0.14	4	840	0.74	1	532	0.38	2	813	0.49	2
Meat	60	0.03	5	296	0.26	2	0	0	0	840	0.51	1
Manure	66	0.03	5	0	0	0	19	0.01	3	0	0	0
Transport	0	0	0	0	0	0	840	0.6	1	0	0	0

Index for the purpose of livestock keeping in mid altitude = sum of purpose of livestock keeping i.e 7*1st ranked purpose of livestock keeping + 6*2nd ranked purpose of livestock keeping +5*3rd ranked purpose of livestock keeping 4+1*4th ranked purpose of livestock keeping +3*5th ranked purpose of livestock keeping +2*6th ranked purpose of livestock keeping +1*7th/ ranked purpose of livestock keeping of all sum ranked purpose described.

Table 4 - Purpose of livestock keeping in low altitude ranked according to importance

Purposes	Cattle			Small ruminants			Equines			Poultry		
	Score	Index	Rank	Score	Index	Rank	Score	Index	Rank	Score	Index	Rank
Traction	840	0.52	1	0	0	0	0	0	0	0	0	0
Threshing	537	0.33	2	0	0	0	0	0	0	0	0	0
Milking	68	0.04	4	0	0	0	0	0	0	0	0	0
Income	124	0.08	3	833	0.68	1	209	0.47	2	840	0.51	1
Meat	0	0	0	391	0.32	2	0	0	0	823	0.49	2
Manure	41	0.03	5	0	0	0	0	0	0	0	0	0
Transport	0	0	0	0	0	0	238	0.53	1	0	0	0

Index for the purpose of livestock keeping in low altitude = sum of purpose of livestock keeping i.e 7*1st ranked purpose of livestock keeping + 6*2nd ranked purpose of livestock keeping +5*3rd ranked purpose of livestock keeping 4+1*4th ranked purpose of livestock keeping +3*5th ranked purpose of livestock keeping +2*6th ranked purpose of livestock keeping +1*7th/ ranked purpose of livestock keeping of all sum ranked purpose described.

In both agro-ecologies of the watershed cattle were dominant among other livestock species and given similar rank and this might be because of its significant contribution for cropping activities. The result is in agreement with Funte et al. (2010) inWhaco watershed in Southern Ethiopia.

Livestock husbandry practices

Livestock housing

There were four types of housing was identified; simple shed (constructed adjacent to the main house by simple woods as control from predators), separated housing (a house constructed separately only for the livestock), in family house (living together with the family member within the same house) and perch for hens. In all watersheds, adult cattle, equines and small ruminants were housed in a simple shade with respective percentages of 88.75, 65 and 58, respectively. Additionally, calves were reared in family house (65%), this might be due to special care given for calves and avoiding of the death of calves with adults, to let them suckle the dam at night. The results in this study were in agreement with the reports of Solomon (2004) in Sinana and Dinsho Districts of Bale highlands, southeast Oromia; Wondatir and Mekasha (2010) in the highland and central rift valley of Ethiopia; Belete (2006) in Fogera District; Asaminew and Eyasu (2009) found in Bahir Dar and Mecha Districts.

As the result revealed that, Ariba (92.5%), Azulla (72.5%), Dokmit (50%), kollama (62.5%), Guntala (65%) and Marwenz(57%) had both feed and watering trough at the livestock barn. This indicated that watersheds of mid altitude had better management practice for their livestock. Additionally the majority of the respondents reported that they practice cleaning of the livestock barn once a day.

Livestock watering

The major water source for livestock during dry season was well (49.6%) followed by spring water (37.5%) the remaining is river water (12.9%). Whereas in wet season the major water source were river water (58.8%) followed by spring water (29.6%).As the respondents indicated, during dry season they use some household river water (12.9%) and the others they do not use due to the presence of leech (aleket). The respondents indicated that during dry season watering of their livestock was done two times a day (66.11%), while during the wet season watering frequency is once a day (83.4%). This variation may be due to that during wet season there is enough water source around their grazing land and animal feed is moister than the dry season. Comparably, reported by (Belete, 2006) in Fogera District 48.75% use water for their cattle from ground wells, 47.2% from rivers, 3% near Lake Tana, 2.29% from ponds and 0.2 % from tap water. Cattle and equines were watered two times a day during dry season where as sheep and goat had watered once a day in dry season. Most livestock species had watered once a day during wet season. This find is in agreement with reports by Bedasa (2012) in the highlands of the Blue Nile basin, Ethiopia; Wondatir and Mekasha (2010) in highlands and central rift valley of Ethiopia.

Livestock feeds and feeding system

The major livestock feeding system in the selected watershed area of North Achefer were presented in Table 5. The feeding system in the study watersheds is dominantly homestead (34.17%) followed by all grazing system (home feeding, homestead and in grazing land) (27.5%). In Kolama and Dokmit watershed, grazing contributes the highest percentage; that might be due to wide area coverage and land pattern (as they are low watersheds) that might be due usage of weed as a feed source and grazing lands left around their homestead.

Table 5 - Livestock feeding system in the selected watershed area of North Achefer

Feeding system	Agro ecology												Total N=240	
	Mid altitude						Low altitude							
	Ariba N=40		Azula N=40		Marwenz N=40		Kolama N=40		Guntala N=40		Dokmit N=40			
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Home feeding	7	17.5	10	25	8	20	2	5	4	10	2	5	33	13.75
Homestead	18	45	14	35	12	30	12	35	15	37.5	11	27.5	82	34.17
Grazing	5	12.5	4	10	11	27.5	14	35	10	25	15	37.5	59	24.58
All system	10	20	12	30	9	22.5	12	35	11	35	12	30	66	27.5

N=number of respondents

The maximum grazing time (5.21±.50hr) was recorded at Dokmit watershed; whereas the shortest grazing time is reported by Azula (3.31±0.13hrs). In low altitude agro-ecology there is two hours additional grazing time over the mid altitude agro-ecology. This might be due to lack of additional feed and absence of awareness on feeding of cattle at the homestead in the lowland agro-ecologies. Whereas in mid altitude agro-ecology there is additional feed sources from crop residue and conserved hay. The grazing time spent by livestock in the current study lies within the range of two to twelve hours reported by Chen *et al.* (2013) for sheep in China.

Livestock disease

The major livestock disease occurred in the watersheds were bloat and Newcastle disease in poultry. Bloat, which is due to grazing of fresh clover, Newcastle disease (commonly called as fengil) also in poultry are major diseases across all watersheds. As per the focus group discussions held in each of the study watershed, though there was livestock health problem associated with feed scarcity, due to the establishment of animal health center in the nearby, animal health problem showed a decreasing trend. The diseases and parasites observed in this study are in agreement with Belete (2006).

Major feed resources and their management in the study areas

Estimated DM/tone for major feed resources in the study area is shown in Table 6. The type of available feed resources in the study area includes natural pasture, crop residue, and hay from natural pasture, improved fodder trees and supplements like local brewery by product in all watersheds.

Table 6 - Estimated DM/tone for major feed resources in the selected watershed area of North Achefer.

Major feed	Agro-ecology					
	Mid altitude			Low altitude		
	Ariba	Azula	Marwenz	Kolama	Guntala	Dokmit
	Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE
Crop residue	1.34±0.08	1.4±0.11	1.7±0.12	1.17±0.1	1.3±0.1	1.2±0.17
Natural pasture	0.3±0.03	0.25±0.03	0.38±0.04	0.36±0.038	0.27±0.035	0.48±0.039
Improved forages	0.29±0.032	0.25±0.033	0.38±0.041	0.24±0.018	0.25±0.03	0.21±0.021
Local brewery by product	0.20±0.03	0.21±0.032	0.28±0.037	0.212±0.028	0.26±0.012	0.14±0.018
Total	0.53±0.11	0.52±0.051	0.68±0.06	0.49±0.046	0.51±0.44	0.5±0.062

N = number of respondents SE = Standard Error

The dominant feed type in mid altitude watershed was from crop residue, followed by natural pasture. The contribution of communal grazing land was lower because of the delineation of watershed to integrate with area rehabilitation and the grazing lands had been given to the organized landless youths living around the watershed. Low altitude agro-ecologies had still used natural pasture as a major feed source of livestock. The average size of land holdings per household for natural pasture was 0.17ha. In this study recorded pasture land was smaller when compared with estimated national average of 0.26 ha per household (CSA, 2013) and in regional level 0.3ha (BoA, 2014). The result indicated that, agro ecology had shown a non significant ($p>0.05$) effect on natural pasture (private). Watershed show a significantly ($P<0.005$) effect on grazing land; and a higher area of grazing land was reported at Marweniz and Dokmit watershed and a less grazing was allocated at Azula watershed. This variation might be due to the total area of the watershed and the livestock population difference. The respondents, mainly of the low altitude agro-ecology had the average of (0.18ha) natural pasture land for hay preparation. This difference might be because the production of other optional feed sources like crop residue had small contribution in low altitude agro-ecologies.

According to Firew and Getnet (2010) though hay utilization in West Gojam is among the lowest there is growing trend of hay making from natural pasture, especially from school compounds, church yards and other public places. Hay is made during October to December and commonly very late, therefore of poor quality. Part of the pasture could be protected and left for standing hay. Native hay is also used during the dry season. Hay production is widely practiced in all watersheds, where feed shortage is severe and most land is allocated for crop production. In Ariba, Azula, Marwenz, Dokmit, Kolama and Guntal watershed, out of the total respective respondent farmers, 72.5%, 62.5%, 82.5%, 85%, 70% and 75% made from natural land for hay production. The observed trend of good grazing land management resulted in the production of good quality and quantity of hay had a better opportunity for improved livestock productivity in the study area. This opportunity further goes to improvement in the household income of the smallholder farmers in the watershed areas. Similar results reported by Sisay(2006) in North Gondar.

Crop residue is known as dominant feed resource in all livestock production systems in Ethiopia (Alemayehu and Sisay, 2003). The nature of crop residues produced depends on the amount and type of crops grown in the area (Sisay, 2006). As the presence of different agro-ecologies in the study area, farmers practice mixed crop production and usually produce a mixture of crop residues, which can be used as feed for their livestock. The major crop residues used as livestock feed in the study area are maize, teff, barley, finger millet, sorghum and pulses. The mean DM yields of crop residues per household was 1.34±0.08,1.4±0.11,1.7±0.12, 1.17±0.1, 1.3±0.1and1.2±0.17tons of DM/annum for Ariba, Azula, Marwenz, Kolama, Guntala and Dokmit, respectively. The higher DM production of crop residues produced in Marweniz (1.7±0.128tones) was probably due to the potential of the watershed for crop production; while the lower DM of crop residue is reported for Kolama (1.17±0.1tones) was due to the lower productivity of crops in the area due to low soil fertility and degradation. The other reason may be the land possessed by individual households is larger which was reflected on the size of cultivated land. The feeding system followed for the crop residue was alone feeding, chopping (mainly for maize), treating with salt and the product of local made brewery (attela) and mixing with green feeds.

Cultivation of pigeon pea and sesbania as a feed source is practiced in all watersheds. The main reason for this is plantation of different species like pigeon pea and sesbania on watershed structures like bunds. As the result reveals, almost all of the respondents practice improved forage plantation on their soil and water conservation bunds. Whereas small proportion of backyard forage development, 5% (Ariba), 7.5% (Azulla) and 10% (Marwenz) involved in some fodder species like Sesbania and elephant grass. As the respondents indicate they use the forage as a fence around their homestead. The lower percentage of backyard forage development practice is mainly due to shortage of land (73%), lack of interest (3%) and absence of improved forage seeds and cuttings (24%). The rare practice on improved forage was in line with Sisay (2006). During focus group discussion, discussants raised the issue of collection and transportation of fodder from the soil and water conservation areas to the backyard for livestock feeding.

Figure 1 - Improved forages in soil and water conservation structure at the study area.

Feed balance

The watershed has 1600.6 Tropical Livestock Unit (TLU) (1330.2 cattle, 64.8 sheep, 87.2 goat, and 118.4 equines). Assuming that DM requirement for maintenance of one TLU is 6.25 kg/day (2.28 ton/year/TLU); total annual requirement is about 3649.4 ton DM. As the watershed produces 2462.74 ton DM, result a deficit of 1186.7ton/year (32.51%). As the result indicates, the watershed development had not supported by optional animal feed development strategy like backyard, on bund terrace feed development and others, to fill the observed feed gap. Firew and Getnet (2010) reported about 36% dry matter deficit in different parts of Amhara National Regional Sate. About 42% feed DM deficit reported at national level (CSA, 2013) here, Yeshitila (2008) reported that 56% of dry matter deficit in Alaba District of southern Ethiopia. This indicates that a forage development intervention in the watershed areas of this study has substantial dry matter contribution for livestock production.

Livestock production constraints and opportunities

The major livestock problems of the study watersheds were grazing land, low productivity, diseases, water, labor and predators. As the respondents indicated, grazing land had reported to be the major problem for cattle production followed by sheep and goat production. This shortage of grazing land might occur due to expansion of crop lands due to increased population. Diseases, mainly FMD, bloat, pasteurallosis and internal and external parasites were reported as the major problems in cattle, sheep and goat production; whereas Newcastle disease is reported to be the main disease of poultry production. Predators were the main problem for poultry production; additionally, in a less extent sheep, goats and equine were also reported to be affected by predators. All of the respondents of the watershed reported that there was no feed shortage problem for small ruminant production; this might be due to low feed requirement nature.

According to the respondents of Ariba (33%), Azula (35.5%), Dokmit (38.5%), Kolama (38%), Guntala (37%) and Marwenz (31%), reported as they had no enough feed resources for their livestock throughout the year. As the respondents indicated during these times, they minimize their livestock population, conserving and purchasing optional feeds as a coping mechanism. The main months of feed shortage in the study area were different in the study watershed areas. In the Azula watershed feed shortage occurred during June to August might be the presence of rain and traction of grazing lands and muddy nature of the available grazing lands; while in the Guntala the shortage during December to February is attributed to dry period of the season. This monthly feed shortage variation among watersheds might be attributed by differences in agro-ecology, feed resource management and landholding size (Assefa *et al.*, 2014; Tegene *et al.*, 2015).

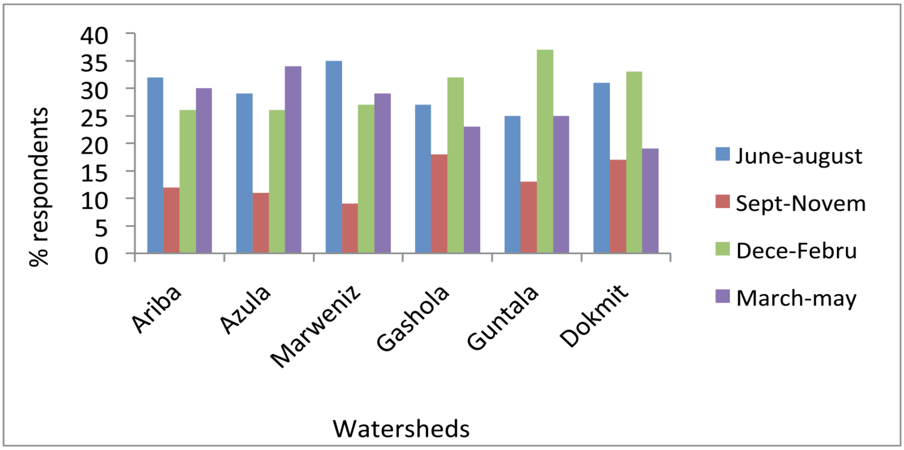

Figure 2 - The major feed shortage months in the selected watersheds.

Conclusion

In the study watershed areas, the current natural resource conservation activities conducted by smallholder farmers are enhancing the integrity of crop livestock production system. This practice allows farmers to harvest fodder for livestock which has a positive impact on livestock production system changing from extensive grazing to semi-intensive system although still feed shortage gap is existing in the study area. The number of livestock and the available feed resources were not proportional to be beneficial from the livestock rearing beyond the existing situation. Generally, watershed development is now being an important intervention for the improvement of livestock productivity through controlled grazing, improvement of optional feed staffs and control of sporadic disease. Moreover, backyard livestock production system should be accompanied with regular cut and carry feeding system and different feed development strategies should be practiced by smallholder farmers to fill the observed feed gap.

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