Tropical and Subtropical Agroecosystems

FEED RESOURCES AND THEIR MANAGEMENT SYSTEMS IN ETHIOPIAN HIGHLANDS: THE CASE OF UMBULO WACHO WATERSHED IN SOUTHERN ETHIOPIA

[RECURSOS ALIMENTICIOS Y SUS SISTEMAS DE MANEJO EN LAS TIERRAS ALTAS DE ETIOPÍA: El CASO DE LA CUENCA DE UMBULO WACHO EN EL SUR DE ETIOPÍA]

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SUMMARY

A study was conducted to assess the prevailing feed resources and feeding management systems in Umbulo Wacho watershed, southern Ethiopia. The data used were obtained through individual interviews conducted on 85 randomly selected livestock owners, group discussions with key informants and from secondary sources. In the study area, livestock provide draught power, milk, meat and manure. Cattle were the dominant livestock species and cows comprised 36% of the total number of cattle. The average landholding per household was 0.7 ha, of which 0.1 ha was reported as grazing land. Communal and private grazing lands were gradually shrinking due to the expansion of crop production. This led to the growing practice of tethering and stall-feeding. The annual feed DM yield was only two-third of the DM requirement for livestock kept in the area. Natural pasture, crop residues, crop stubbles, enset by-products and sugarcane top were among the main feed resources. Crop residues were found to be major feed resources for the livestock in the study area, particularly during the dry season in which the biomass of the natural grazing lands is very minimal. To be able to bring about a positive impact on livestock production, increasing the quantity of crop residues through crop breeding and their nutritive value by physical and chemical treatments are recommended.

Keywords: Crop residues; dry matter requirement; feed; feed DM yield; livestock; natural pasture.

RESUMEN

Se llevó a cabo un estudio para evaluar los recursos forrajeros y los sistemas de manejo de la alimentación en la cuenca de Umbulo Wacho, en el sur de Etiopía. Los datos utilizados en el presente estudio se obtuvieron a través de entrevistas individuales con 85 ganaderos seleccionados al azar, discusiones en grupo con informantes clave y consulta de fuentes de información secundarias. En el área de estudio, el ganado proporciona: fuerza para el tiro, leche, carne y estiércol. El ganado vacuno era la especie dominante de ganado y las vacas comprendían el 36% del número total de cabezas de vacuno. Cada hogar contaba en promedio con 0.7 hectáreas de tierras, de las cuales 0.1 hectáreas eran de pastoreo. Las tierras comunales y tierras de pastoreo privadas se han ido reduciendo debido a la expansión de la producción agrícola. Como resultado hay incremento en la costumbre de atar a los animales y de estabular. La producción anual de materia seca (MS) fue de sólo dos tercios del requerimiento de MS para el ganado en el área. Las principales fuentes de alimento para el ganado fueron: pastos naturales, residuos de cultivos, rastrojos, subproductos *enset* y punta de caña de azucar. Los residuos de cosecha fueron los principales recursos alimenticios para el ganado en el área de estudio, especialmente durante la época de sequía en la que la biomasa de las tierras de pastoreo natural era muy baja. Por lo que el aumentar la calidad y cantidad de los residuos de cosecha tendría un impacto positivo en la producción ganadera.

Palabras clave: Residuos de cosecha; requerimentos de materia seca; alimentos; producción de alimentos; ganado; pastos naturales.

INTRODUCTION

The highlands in Ethiopia comprise nearly half of the land area of the country and hold more than 85% of the total human population, and about two thirds of the livestock population (Jahnke, 1982; Dejene, 2003). These highland areas (those above 1500 m.a.s.l.), which are dominantly crop-livestock systems, are recognized to be under stress because of shrinking cultivated areas per household, land degradation and reduced feed availability (Aune *et al.*, 2001).

Inadequate feed supply, both in terms of quantity and quality, is the major constraint affecting livestock production in Ethiopia. Feed scarcity is indicated as a factor responsible for the lower reproductive and growth performance of animals especially during the dry season (Legesse, 2008). The season is characterized by inadequacy of grazing resources as a result of which animals are not able to meet even their maintenance requirements and lose substantial amount of their weight. In the last two decades, the use of communal grazing lands, private pastures and forest areas as feed resources has declined while the use of crop residues and purchased feed has generally increased (Benin *et al.*, 2003). Though increased utilization of agro-industrial by-products has been reported (Benin *et al.*, 2004), they are not available, affordable or feasible for most of the farmers in the highlands of Ethiopia.

Natural pasture is one of the feed sources for livestock in the Umbulo Wacho watershed of southern Ethiopia where this study was conducted. But its productivity is gradually decreasing because of overstocking and resultant overgrazing, and other interrelated factors. Livestock exclusion was found crucial in stabilizing such areas and has been practiced in the watershed.

Identification of feed resources and assessment of opportunities and constraints associated to livestock feeding are preconditions for designing suitable livestock development strategies. Such studies have not been previously carried out in the watershed. The current study was, therefore, undertaken to assess the prevailing feed resources and feeding management systems in Umbulo Wacho watershed in southern Ethiopia.

MATERIAL AND METHODS

Study area

Umbulo Wacho watershed (38°17'E, 7°01'N) is located in Borecha and Hawassa Zuria districts of Sidama Zone in the Southern Nations, Nationalities and Peoples' Regional State (SNNPRS), Ethiopia. It is located approximately 15 km west of Hawassa town, the capital of SNNPRS. The watershed is in the Ethiopian highlands within the African Rift Valley. Based on 13 years of cumulative rainfall data from the nearest meteorology station, the average annual rainfall for the area is 1067 mm. The rainfall in the area has bimodal pattern with two rainy seasons: the short rains between March and May (peak in May) and the long rains between June and October (peak in September). The typical dry season normally occurs between November and February.

The area was selected for the study since it suffers from food and feed insecurity and has large closed areas due to soil degradation. In addition, a Participatory Rural Appraisal (PRA) conducted earlier indicated that shortage of livestock feed was among the top priority constraints (Diagnostic survey report, 2003).

Cattle, sheep, goats, donkeys, horses and chickens are the livestock species kept in the watershed. Maize (*Zea mays*), enset (*Ensete ventricosum*) and haricot bean (*Phaseolus vulgaris*) are the major crops grown in the area. Minor crops produced include chat (*Catha edulis*), teff (*Eragrostis tef*), barley (*Hordeum vulgare*), hot pepper (*Capsicum annuum*), Irish potato (*Solanum tuberosum*) and sweet potato (*Ipomoea batatas*).

Quantifying available feed resources

The quantity of feed resources available in the area was estimated using the information on crop production and land use. Secondary data on annual and perennial crops and the amount of grains produced in the watershed were collected, from which the amount of crop residues and by-products that were used as a source of animal feed were estimated using established conversion factors developed by different researchers. For maize residues, the multipliers of 2.0 as proposed by De Leeuw et al. (1990) and for haricot bean a multiplier of 1.2 and for teff straw 1.5 were used. But the feed DM obtained from enset and banana (*Musa accuminata*) was estimated by multiplying the area under the crop with the estimated annual DM yield/ha (FAO, 1987), which is 8,000 kg. According to Tolera (1990), about 10% of crop residues would be wasted during utilization; the total quantity of crop residues estimated was thus multiplied by 0.9 to arrive at more realistic value that remains for actual utilization by animals. 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). The total available feed DM was estimated by summation of DM from the different feed sources.

The total DM production from available feeds was, then, compared with the annual DM requirement of the

livestock population (converted to total tropical livestock unit, TLU) in order to estimate the discrepancy. 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). Whether this is sufficient for maintenance and production depends on levels of energy, protein and essential elements, digestibility of nutrients and availability of water (Jahnke, 1982).

Assessment of feeding management systems

Feeding management system was assessed through interviewing 85 households (HHs) (7% of 1171 HHs of the watershed) were randomly selected from two peasant associations (PAs), 35 HHs from one PA and 50 HHs from the other. A semi-structured questionnaire was used for the interview. The sampled population was 10% of HHs of the watershed who owned at least one animal and were willing to participate in the survey. The survey was conducted between February and November 2005.

Group discussion was undertaken with key informants (elders, leaders and model farmers) on issues related to livestock production and feeding. The points raised included livestock population, herd composition, trend of livestock population and productivity, livestock management system, available feed resources, feeding system, effects of season on feed and water availability, feeding calendar, coping mechanisms of feed shortage, attitude and awareness about the use of improved forages and area closures and its impacts on community. The discussion was also used as a means of cross-checking the individual farmer responses.

Statistical analyses

The statistical analysis was carried out using a statistical software called SPSS, tenth edition (SPSS, 2001).

RESULTS AND DISCUSSION

Livestock population and its role

As shown in Table 1, cattle comprised 92 % of total TLU. About 37 % of the cattle herd was cows followed by calves (20%), oxen (19%), steers (18%) and heifers (7%). Most of the HHs kept milking cows with calves. Large number of goats, among small ruminants, is owned per HH which might indicate that these animals could fit into production systems with shortage of livestock feed and may attract the attention of extension activities. For such labor intensive cereal-based production system, the number of oxen per HH is definitely smaller than expected, possibly due to the prevailing feed shortage.

According to the respondents there is a declining trend in HH's number of livestock, herd composition and size due to decline in size of arable and grazing land per HH, quality and quantity of the forage which are caused by frequent occurrences of drought and overwhelming human population pressure.

Farmers keep local breeds of animals with the exception of very few crossbred chickens. The cow is the most important animals because it is a source of milk and milk products, replacement stock (calves) and cash. Donkey is the second in the order of importance and is used for transportation of seed, fertilizer; crop residues, grain and drinking water. According to the respondents those farmers who have one or more donkeys in addition to other species of animals are considered wealthy in the community.

Livestock are used as sources of draught power, milk, meat and manure, which is analogous to the assessment results of Alemayehu *et al.* (2000). Enset (*E. ventricosum*) is the major food crop and one of the important feed sources for livestock. On the other hand, manure from livestock is normally distributed on the enset (*E. ventricosum*) land in the area. Number of cattle owned per HH are significantly correlated ($P < 0.05$, $r = 0.22$) with area of enset cultivated (Table 2), which means farmers with large number of livestock have large source of manure for their enset (*E. ventricosum*) plantation which in turn provides leaves and pseudostem for livestock feeding and thus has a complementary effect and encourages farmers to keep more livestock. Brandt *et al.* (1997) indicated that manure is generally applied to important crops (enset: *E. ventricosum* and coffee: *Coffea arabica*) grown nearby homesteads. According to these authors, unproductive enset (*E. ventricosum*) plantations were from farmers with small numbers of livestock because such farmers could not apply adequate farm manure which is essential to proper enset growth.

Livestock feeding calendar in the watershed

There are different feeding calendars for different feed sources. Of the total HHs interviewed, 14.1 % reported to provide crop residues to their animals any time based on the availability of other feed resources; 44.3 % of them offer crop residues to their animals between November and February; 16.9 % and 24.7% of them provide the feeds between December and February, and January and February, respectively. When the three feeding calendars are put together it can be seen that over 86% of the crop residues are fed between November and February which is the peak of the dry season, which comes before the small rain.

Table 1. Livestock population of Umbulo Wacho watershed and the number of livestock owned per household.

Animals	Population	TLU equivalent*	Total TLU	Mean TLU/HH**
Cattle	5874		4076.7	3.48
Cow	2093	0.7	1465.1	1.25
Oxen	1111	1	1111	0.95
Heifer	430	0.5	215	0.18
Steer	1047	1	1047	0.89
Calf	1193	0.2	238.6	0.20
Sheep	881	0.1	88.1	0.075
Goat	715	0.1	71.5	0.061
Donkey	271	0.5	135.5	0.12
Horse	74	0.7	51.8	0.044
Total TLU			4423.8	3.78

*__Source:__ Jahnke, 1982

**HH = household; the total number of households during the study period was 1171.

Table 2. Correlation amongst land use (area of land allotted for enset, cereal crops and natural pasture) and livestock ownership (numbers of cattle and oxen per household) of Umbulo Wacho watershed (n = 85).

		1	2	3	4	5	6
1	Arable land (ha)	1.0					
2	Enset (*E. ventricosum*) (ha)	0.56**	1.0				
3	Cereal crops (ha)	0.74**	0.23*	1.0			
4	Natural pasture (ha)	0.06	0.08	0.06	1.0		
5	Cattle (No/HH)	0.23*	0.22*	0.14	0.04	1.0	
6	Oxen (No/HH)	0.23*	0.25*	0.1	-0.12	0.71**	1.0

* Significant at $p<0.05$, ** Significant at $p<0.01$, n = number of household

More than two-third of the respondents allow their animals to graze on the standing hay any time depending on feed availability; but 13 % of them used it between December and February, 7 % of them between November and February and 12 % of them between January and February. The time of abundant crop residues (November – February) is the time when the amount of natural pasture, crop thinning and weed used is minimum, which indicates that it is the period when there is some kind of substitution effect of these feeds with crop residues.

Most respondents agreed that by-products of enset are fed for about 6 months but the duration of feeding can be small or big based on the availability of other feeds and water. Brandt *et al* (1997) also indicated that in all areas where enset is grown it might be used for seven to eight months, or only for a couple of months at the height of the dry season. The time of feeding enset by-products correspond with that of crop residues, standing hay and sugarcane tops when other feed alternatives such as natural pasture, crop thinning and weed are meager.

Livestock feed resources

The common feed resources of the watershed available to livestock included natural pasture, crop residues, enset by-products (leaf and pseudostem of enset), green feed (weeds and crop thinning) and sugarcane top (Table 3). The by-products from maize, haricot bean and enset were among the major feed sources. On the other hand, industrial by-products were rarely used. There was positive correlation between number of oxen and amount of enset produced by a HH. All parts of enset including corm was used as feed for plowing oxen as plowing period and season of feed shortage commonly overlap.

The annual distribution of livestock feed lacked consistency for several years because of variations in rainfall, time of harvesting and production levels of crops and the amount of rainfall influenced growth of forages and amounts of crop residue produced (Diagnostic survey report, 2003).

Although the shortage begins from the end of November onwards, January, February and March are the driest months when the productivity of the natural pasture dwindles and are thus months of critical feed shortage. The quantity and quality of fodder obtained from natural pasture gradually decline during the dry season, and farmers feed residues of maize, haricot bean and enset to their animals. Some farmers use enset as a year-round source of feed and water (as it

contains greater than 85% moisture, Nurfeta *et al.*, 2008a).

The majority of the farmers (83 %) graze their animals on crop stubbles; 74% and 5% on maize and haricot bean stubbles, respectively. However, because of the intercropping of haricot bean with maize, frequent weeding and uprooting of the beans at harvest, feed resources left on the field after the harvest is minimal.
To cope up with critical feed shortage nearly half of the respondents set aside/store crop residues, about a quarter of them depend on migration plus grazing animals on standing hays, but very small proportion of them solely depend on migration or standing hay (Figure 1).

Conserving crop residues and sending animals to the areas with better feed availability are the main coping mechanisms used against critical feed shortage. Some farmers do have additional homesteads in other places (districts) which facilitate the movement of animals based on the availability of feedstuffs.

Table 3. Allocation of feed resources by season (% of respondents, n = 85).

Season	Green fodder	Enset parts	Crop residues	Natural pasture	Sugarcane top
Did not use the feed	70.6	3.5	2.4	0.0	78.8
Dry season	8.2	42.4	43.2	0.0	15.3
Wet season	20.0	4.6	5.9	73.0	3.5
Both dry and wet seasons	0.0	3.5	1.5	23.5	1.2
Conditional*	1.2	46.0	47.0	3.5	1.2

* Conditional includes such conditions like feed and water availability, drought occurrence, etc.

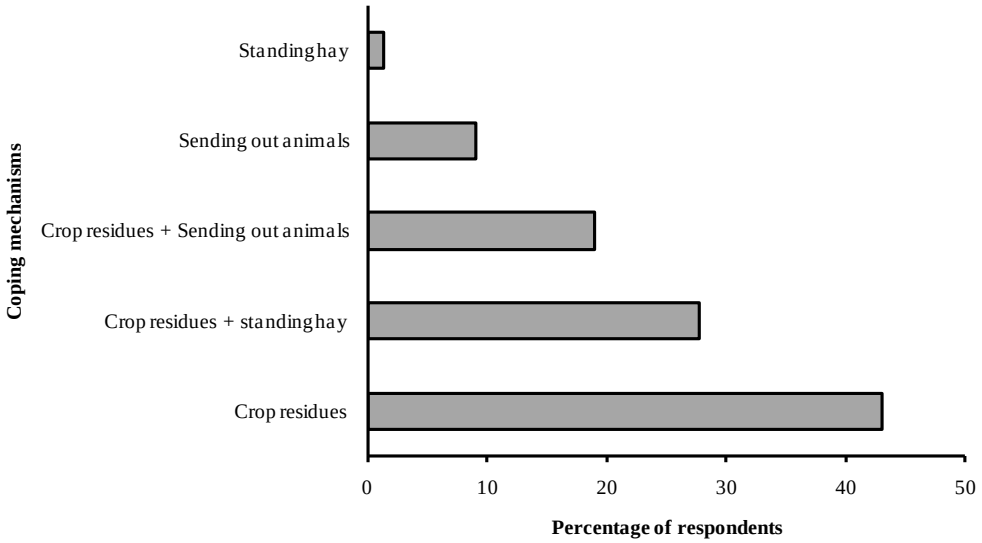

Figure 1. Coping mechanisms reported by farmers in Umbulo Wacho watershed to tackle feed shortage (n = 85).

Recent reports in central and southern highlands of Ethiopia also indicated that there is increasing importance of crop residues as a livestock feed (Bogale *et al.*, 2008; Tsegaye *et al.*, 2008). According to Tsegaye *et al.* (2008), shortage of grazing lands and the absence of alternative feed resources accentuate the increased dependence on crop residues in the central highlands of Ethiopia. Similarly, the practice of feeding livestock with crop residues in the mornings and evenings around homesteads has been reported to increase in the recent years in the Bale highlands of Ethiopia due to the reduction of the herbage obtained from natural pasture because communal grazing areas are overgrazed (Bogale *et al.*, 2008).

Some households purchase green maize leaf, maize stover, sugarcane top, natural pasture and standing hay and enset by-products but only very few households

purchase wheat bran. Three-fourth of the respondents indicated that they were not using purchased feeds because they are less available on the local market and are expensive to smallholder farmers.

In order of their importance maize stover, sugar cane top and natural pasture were the commonly purchased feeds from local markets in the watershed. Sugarcane is generally purchased during the dry season for milking cows, plowing oxen and/or fattening cattle, because these groups of animals need more nutrients over their maintenance requirement for production and work than other classes of livestock to go through the harsh dry season.

Most of the households who live far from Lake Hawassa used to buy the mineral supplement (Bole) from local markets but those in the proximity of the Lake believed that their animals get sufficient mineral from the shores of the lake and thus purchased no mineral supplement of any kind.

In current study site, 80% of respondents indicated that the grazing areas are dramatically shrinking. The importance of feed sources other than pasture such as enset (*E. ventricosum*) is coming into picture and thus should be well recognized. The analysis of aerial photography of Umbulo catchment revealed that the land cover of cultivated land increased between 1965 and 1972 by 140% (Moges, 2008). This change was at the expense of wood land, shrub land and grassland+shrubs which decreased by 65, 44 and 79%, respectively. In 1965, vegetation dominated land cover was 72% but in 2000 it was 10%. From the satellite image of the catchment for the period between 1986 and 2000 revealed that the vegetation cover (potential grazing area) was only 8% of the total land cover and decreased by 29%, but cultivation has expanded from 28% in 1965 to 90% in 2000 (Moges, 2008) and the recent increase in cultivation was explained by an increase in enset plantation as a food security measure. Mengistu (2004) has also reported that grazing lands are steadily shrinking being converted in to arable land in the mixed farming and mid altitudes of Ethiopia. Similar trends of expansion of cultivated area have also been reported by Woldeamlak (2002) and Belay (2002) of Gojam and Wello, northern Ethiopia. Changing grazing land into arable land could be considered as an opportunity, as it permits production of more DM biomass from crop residues, if they are effectively and efficiently utilized as livestock feed through ensiling and treating with urea and alkalies. Besides the considerable contribution of different crop residues, enset (*E. ventricosum*) was found as an important feed source in the area. Enset is one of the major food crops in the densely populated south and south-western parts of Ethiopia. Studies indicated that enset can be an extremely important crop for livestock feeding particularly during the dry season (Tsegaye, 2002; Desta and Oba, 2004; Nurfeta *et al.*, 2008a; Nurfeta *et al.*, 2008b).

Regarding the nutritive value of different parts of the crop, Nurfeta *et al.* (2008a) reported a high crude protein content of leaf lamina and a high dry matter degradability of pseudostem and corm. Another study also showed that feeding different parts of this crop in a mixture or alone and supplementing with legume to sheep on a basal diet of wheat straw could help to maintain body weight and allow modest level of body weight during the dry season (Nurfeta *et al.*, 2008b). The magnitude of the utilization of crop residues and enset in the study area underscores the significance of including overall biomass yield of grain and by-products of food crops and also feeding traits of their by-products in future breeding programs for crops.

Feeding and watering systems

Animals are allowed to graze natural pasture or crop stubbles. Previously, grazing natural pasture was the major feeding practice but it is now shifting to zero grazing because of continuing shrinkage of grazing land. Animals are grazing around homestead and are supplemented with weed, by-products of enset and crop residues. Herding depends on size of land per HH and season. Those HHs with large number of livestock allow their animals to graze around the homestead or nearby communal grazing land. Similarly Brandt *et al.* (1997) stated that there was variation in livestock management according to wealth category; wealthier HHs possess more livestock and require greater access to additional labor and grazing land. Reduction of communal grazing lands was caused by using the grazing lands for crop production; enclosures of vast areas as a result of severe overgrazing, land degradation and deforestation.

Tethering is also the common way of managing animals in the area. Poor correlation (Table 2) between size of natural pasture and number of cattle per HH implies that farmers were forced to tether animals around homestead. Tolera (1990) earlier reported the increasing practice of cut-and-carry system (feeding of grasses and weed from crop field and roadsides) in southern Ethiopia. Tethering or herding depends on size of herd and land per HH and season. Those HH with small herd size tether their animals in front of their houses. Stall-feeding is practical during the rainy season in the watershed when enset leaf attains its maximum rate of growth and also to protect the crop land from damage due to livestock. Contrary to this finding, Brandt *et al.* (1997) reported that stall-feeding is practiced during the dry season in most enset growing areas of Ethiopia.

During the wet season, livestock are entirely herded by children and women by roadsides or on available grazing land (for larger herd size, accounting for 52% of HHs) or tethered around homestead (for smaller herd size, accounting for 48% of HHs). In this season, almost half of the respondents reported to herd their stock on natural pasture around homesteads and the other half reported practicing stall-feeding (generally using locally produced feedstuffs). During the dry season, on the other hand, 71% of respondents allow their animals to graze on crop stubbles and natural pasture; but, only 18 % use stall-feeding. Feeding livestock with maize stover and haricot bean straw in the morning and evening, providing chopped leaf and pseudo-stem of enset around homestead in the evenings of the dry period are also common practices. In general 86% of HHs allowed free grazing of the natural pasture, 96% of them practiced stall-feeding of crop residues and 92% fed enset by-products to their animals.

Farmers prioritize livestock for feeding crop residues. The first in the order of priority are milking cows followed by plowing oxen; other animals are fed without a defined order of priority. Similar trend of priority in feeding livestock has also been reported in the Bale highlands of southern Ethiopia (Bogale, 2004).

Shortage of water is a critical problem in the area. The main sources of water for animals are ponds, Lake Hawassa and pseudo-stem of enset particularly during the dry season. During the rainy season farmers water their animals from ponds and flood nearby homesteads. During the dry season most of the ponds dry up and the main water sources are Lake Hawassa and enset. Animals have to travel about 10 km to reach at the Lake. Animals are watered at an interval of 3 to 5 days; the interval depends on the proximity to watering point and availability of pseudo-stem of enset, which is influenced by the size of enset plantation/HH. The watering frequency was positively correlated ($P < 0.01$, $r = 0.48$) with number of cattle owned. The interval was larger for large herd size because farmers could not water their animals by fetching water from the ponds as it requires large amount of labour; the farmers could not also satisfy water requirement of the animals by feeding enset as large quantity of pseudo-stem is required. But, households with smaller herd size (mainly a milking cow plus a calf) use both options (pond plus enset) and decrease the watering frequency.

Annual feed DM availability and DM requirement of livestock

The quantity of available feed resource (kg DM/year) was estimated based on the secondary data on grain yield of the watershed for 2004/05 production year (Table 4)

Annual feed DM produced (kg) from enset was calculated by multiplying the area (ha) covered with enset by 8000**.** Total area of land covered by enset in 2004/05 production year was 187 ha which gave a total DM yield of 1,496,000 kg. As indicated by Tolera (1990), approximately 10% of this yield may not be used properly. Thus, only 1,346,400 kg DM was available.

The other source of feed is natural pasture. Because of absence of secondary data on the exact size of natural pasture, it was estimated by multiplying size of land allocated for natural pasture per household, which is 0.1ha, by the number of households. The total estimated area of natural pasture in the watershed was thus 117.1 ha. The natural pasture provides 2 t DM/ha/year (FAO, 1987). Therefore the natural pasture provides 234,200 kg of DM/year. The stubble grazing covers an area of 879 ha and thus provides 439,500 kg DM/year (879*0.5 t/ha). The actual yield of the stubble might be less than the above figure, because as indicated earlier there is a practice of intercropping haricot bean with maize and the feed material available on such fields is less since the haricot bean is usually uprooted.

There is a total of 4423.8 TLU in the watershed. According to Jahnke (1982), 4423.8 TLU requires 27648.75 Kg DM daily. The year-round estimated feed DM requirement of the watershed is 10,091,793.75 kg. According to this result, the annual DM production of the watershed could satisfy only two-third of the total DM requirements of the livestock kept in the site. But some of the DM requirements might be compensated via the supplementation of weeds, sugarcane tops (which were not included in the estimation because of lack of conversion factors and small quantity of production per annum) and by moving their animals away from the watershed to other sites where feed is available. During the dry season animals lose their condition which is an indicator of feed shortage and suggests that livestock production and productivity by and large are constrained by feed scarcity.

Table 4. The annual feed DM (kg) produced from crop residues, enset, natural pasture and crop aftermath in Umbulo Wacho watershed.

Crop	Grain yield (kg)	Correction factor	Total DM (kg)	DM available* (kg)
Maize	2,637,000	2	5,274,000	4,746,600
Haricot bean	175,000	1.2	210,000	189,000
Teff	1,500	1.5	2,250	2,025
	Crop residues			4,937,625
	Enset			1,346,400
	Natural pasture			234,200
	Crop stubbles			439,500
Total				6,957,725

*10%less than total DM

CONCLUSIONS

The current study was carried out to assess the prevailing feed resources and feeding management systems in Umbulo Wacho watershed, southern Ethiopia. Livestock are used for draught power, milk and meat production, and as a source of manure to fertilize cropping lands. The annual feed DM production in the watershed was 31.4 % below the DM requirement for livestock kept in the area. Natural pasture, crop residues, crop stubbles, leaf and pseudostem of enset, weed and sugarcane top were among the main feed resources. Crop residues, however, are the major feed resources for livestock, particularly during the dry season when the biomass of the natural grazing lands is very low. Since crop residues are low in crude protein and some desirable nutrients, treating the residues and partial supplementation may be required for optimum performance of the animals. Enset was found to serve as a staple crop and a notable source of feed and water. Any attempt to increase the yield and the quality of this crop is, therefore, believed to positively affect the overall farming community in general and livestock production in particular. The management of large degraded areas of the natural pasture of the watershed that has been enclosed to bring about rehabilitation has been entrusted to the PAs of the farming community. Awareness creation on the value of this common resource should be promoted because some farmers are tempted to cut trees and let their animals into the enclosure when there are no controllers. Although the farmers are in severe livestock feed shortage, 89% of them did not plant improved forages due to lack of forage seed, shortage of land, lack of interest and combinations other related factors. The introduction of feed conservation methods and multi-purpose forages/fodder trees can also be potential alternatives in order to tackle the serious feed shortage in the area.

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