Potential Use of Crop Residues as Livestock Feed Resources in Ethiopia

Daniel Wana
Daniel Wana
Oromia Agricultural Research Institute, Adami Tulu Agricultural Research Center
Batu, Ziway, Ethiopia

Abstract: Inadequate quantity and quality of feed resources are major factors limiting productivity of livestock systems in Ethiopia. The possibilities of improving the livestock production systems by reviewing potential feed resources, their constraints and identifying points of intervention were lacking in Ethiopia. This review also identified some potential feed resources particularly crop residues that could be exploited for livestock nutrition at the time of feed scarcity. The main livestock feed resources in the country were natural pastures, crop residues, improved pasture and forage and agro-industrial by-products, of which the first two contribute the largest share. Among these resources Crop residues are roughages that become available as livestock feeds after crops have been harvested. The major crop residues produced in the Ethiopia could be broadly grouped into cereal, pulse, fruit, root crops, vegetables and sugar cane. The contribution of crop residues to the annual livestock feed requirement reaches 40 to 50%. About 14 million tons of crop residues are produced in the country annually, cereal straws accounts for 95 % of the total crop residues while legume residues account for the rest. The dry matter (DM) content of all crop residues was above 90%. All crop residues had lower CP contents than the minimum level of 7% CP required for optimum rumen microbial function. The yield and quality characteristics of residues are determined by the genetic makeup of the crop, growing conditions and harvesting, threshing and storage methods. As the level of dependence of livestock feeding on crop residues increases in the country, increasing the yield and quality of crop residues plays a pivotal role. Poor storage facility and effect of termites are the most serious problems related to crop residue utilization in the country. Improvement of crop residues (e.g. urea treatment and ensiling of crop residues) is rarely practiced except spraying salt solution to improve palatability by some farmers. Provision of technical knowledge on how to improve the quality of existing feed resources and its management facilities will enhance productivity.

Keywords: Crop Residues, Crude Protein, Livestock.

1. Introduction

Grazing is the predominant form of ruminant feeding system in most parts of the extensive and smallholder crop-livestock farming areas in Ethiopia. However, natural pasture as a source of feed is restricted to the wet season (Zinash et al., 1995). The major feed resources in the highlands are natural pasture, crop residues and stubble grazing (Alemayehu, 2004). Feed shortage has been understood as one
of the most critical problems limiting livestock Production and productivity. Substantial efforts have been made so far to resolve the feed shortage problem in the Ethiopian highlands, aiming at improving feed availability and thereby improve livestock productivity. However, the impact was so little to cope up with the problem that animals are still subjected to long periods of nutritional stress (EARO, 2001b). Studies have indicated that in Ethiopia, there is a feed deficit of about 12,300,000 tons of dry matter per year (Alemayehu, 2004). The adoption of feed technologies by farmers has been constrained by lack of follow up and technical backstopping (EEA/EERPRI, 2006).

Livestock farming is an important and integral part of the agricultural sector in Ethiopia. Livestock farming is vital for the supply of meat and milk; it also serves as a source of additional income both for smallholder farmers and livestock owners’ (Ehui et al., 2002). Livestock production constraints can be grouped into socio-economic and technical limitations (Mengistu, 2003). Inadequate feed, widespread diseases, poor breeding stock, and inadequate livestock policies with respect to credit, extension, marketing and infrastructure are the major constraints affecting livestock performance in Ethiopia (Desta et al., 2000). Feed resources as reported by Tolera et al. (2012) can be classified as natural pasture, crop residue, improved pasture and forage and agro industrial by-products of which the first two contribute the largest share. The fibrous agricultural residues contributes a major parts of livestock feed especially in the populated countries where land is prioritized for crop cultivation. Tolera et al. (2012) reported that crop residues contribute to about 50% the total feed supply in Ethiopia. Under smallholder livestock production system, animals are dependent on the variety of feed resources which vary both in quantity and quality. For optimum livestock productivity, the available feed resource should match with the number of animals in a given area. Livestock production constraints could vary not only across agro-ecology but also among production systems. For example different classes of animals are kept by the urban and peri-urban farmers which are dictated by the demand for the products such as milk and availability of the supplemental feeds. The peri-urban and urban farmers usually purchase basal feeds (grasses and crop residues) from the rural area. However, the supply of feeds to the urban farmers depends on the availability of feed resources in the rural area. Shortage of feeds in the rural area affects the management and productivity of livestock in the urban and peri-urban areas (Dawit et al, 2013). Therefore, the objectives of this review were to review potential use of crop residues as livestock feed resources and farmers’ perceptions on crop residues management practice in Ethiopia.

2. Literature Review

2.1. Crop residues as livestock feed resources in Ethiopia.

Livestock in the Sub-Saharan Africa are dependent primarily on native grasslands and crop residues (Ibrahim, 1999). According to Alemayehu (2003), Ethiopia’s Livestock feed resources are mainly natural grazing and browse, crop residues, improved pasture, and agro-industrial by-products. The feeding systems include communal or private natural grazing and browsing, cut and carry feeding, hay and crop residues. At present, in the country stock are fed almost entirely on natural pasture and crop residues. The availability and quality of forage are not favorable year round. As a result, the gains made in the wet season are totally or partially lost in the dry season (Alemayehu, 2003). Inadequate feed during the dry season is a major that causes decline in the productivity of ruminants. In the Sub-Saharan Africa, human population is increasing rapidly, forcing farmers to use grazing areas for arable farming. As a result, the smallholder farmers in this part of Africa have integrated their livestock into their cropping systems and used crop residues as a main livestock feed resources (Ibrahim, 1999).

2.1.1. Crop residues

Crop residues are important feed resources in the mixed crop/livestock production system. Reports (Daniel, 1988; Lemma, 2002) indicate that the contribution of crop residues to the annual livestock feed requirement reaches 40 to 50%. With the decline in the size of the grazing land and degradation through overgrazing and the expansion of arable cropping, crop residues have become increasingly important in the production system. According to EARO (2001b), about 14 million tons of crop residues are produced...
annually, cereal straws accounts for 95% of the total crop residues while legume residues account for the rest. Among crop residues, teff straw, maize Stover and sorghum Stover constitute the bulk with contributions of 27, 27 and 22% of the total residue yield respectively (EARO, 2001b). Apart from being a source of animal feed, residues are sources of building, roofing and fencing materials. They are used also as fuel and as fertilizers or as surface mulch in cropland (Van Raay and de Leeuw, 1970, 1974). Their value as feed depends on the demand from livestock owners, which varies with the overall supply and demand situation for feeds. This, in turn, depends on the density of livestock, usually expressed in tropical livestock units per square kilometer (TLU km-2) and the supply of other feed resources, in particular, forage and browse from natural vegetation (deLeeuw and Rey, 1995). The supply of crop residues is a function of the proportion of land used for cropping and the amount of edible feed yields per unit of land. Where consumable livestock feeds from crop residues exceeds from natural pastures (expressed in t DM ha-1)

In view of the existing scenario of the Ethiopian agriculture which is characterized by an ever declining per capita landholding (Byerlee et al., 2007) and dwindling/deteriorating grazing areas, cereal based intensification is the future (Diao and Prrat, 2007). This calls for greater integration of crop (cereal) and livestock systems ensuring better and sustainable resource flows between the two enterprises. However, the contribution of the livestock sub-sector to crop production has been severely constrained by shortage of feed both in quantity and quality. As the level of dependence of livestock feeding on crop residues increases in the process, increasing the yield and quality of crop residues plays a pivotal role. The yield and quality characteristics of residues are determined by the genetic makeup of the crop, growing conditions and harvesting, threshing and storage methods. The contribution of genetic as opposed to non-genetic factors to grain and fodder yields and to straw digestibility varies between crop species and among genotypes within a crop species.

Varietal differences for crop residue quality have been reported in wheat, rice, sorghum and maize (Reddy et al., 2003). A report by Adugna (2002) revealed the possibility of selecting/breeding for maize varieties that combine high grain yield with desirable Stover characteristics for livestock feeding in Ethiopia. If maize varieties that are with desirable fodder characteristics in addition to grain yield are generated and successfully adopted by farmers and become innovations, they will have an immense contribution towards achieving livelihood targets through enabling integrated and sustainable maize-livestock systems. A technology to become an innovation has to pass through a complex set of processes – the innovation system- in addition to the demand. As indicated in past research and extension efforts, the adoption of maize technologies has been poor. Therefore, analysis of the system using an innovation systems perspective is a crucial step to identify existing/potential problems and recommend possible remedies to enable maize-livestock innovation.

A wide variety of arable crops is grown on subsistence farm holdings and many of these crops have residues which can form an important source of livestock feed, following the harvesting of grain. Livestock in mixed crop-livestock farming systems two to three months into a dry season feed on cereal straws, stubble or other leftovers such as maize Stover. The potential and abundance of crop residues that could be used for livestock feeding in Ethiopia in most cases, drawn from grain yield, using multiplier is 13.7 million ton (13.6 million ton in the rural area and 136 thousands ton in urban areas) from cereals having CP value ranging from 3.1 - 6.7% with digestibility level about 40.7-54.1%. They are suited for all classes of livestock in the country according to their nutritional characteristics. Stover is the leaves and stalks of corn (maize), sorghum or soybean plants that are left in a field after harvest. It can be directly grazed by cattle or dried for use as fodder. Stover has attracted some attention as a potential fuel source and as biomass for fermentation or as a feedstock for cellulosic ethanol production (Yayneshet, 2010). Straw is an agricultural by-product, the dry stalks of cereal plants, after the grain and chaff have been removed. Straw makes up about half of the yield of cereal crops such as teff, barley, oats, rice, rye and wheat. It has many uses, including fuel, livestock bedding and fodder, thatching and basket-making. It is usually gathered and stored in a straw bale, which is a bundle of straw tightly bound with twine or and (Chairatanayuth, 2007).
2.1.2. Nutritional Values of Major Crop Residues in Ethiopia

Enset leaf is rich in crude protein (>16% CP), which makes it an important source of supplementation to low quality feeds (Nurfeta et al. 2008). The dry matter (DM) content of all crop residues was above 90%, which corresponds with Ahmed (2006), Sisay (2006) and Solomon et al. (2008b). The crude protein (CP) content of crop residues varied from 3.05% in oats straw to 6.74% in field pea straw. All crop residues had lower CP contents than the minimum level of 7% CP required for optimum rumen microbial function (Van Soest, 1982; Milford and Minson, 1966). The results of the current work agree with the report of Seyoum and Fekede (2008) that cereal crop residues are normally characterized by low digestibility and energy value, which are both inherent in their chemical composition. The mean in vitro digestible organic matter in the dry matter (IVDOMD) for cereal CRs was about 47%, which is lower than the minimum level required for quality roughages (Daniel, 1988; Seyoum and Fekede, 2008). Stubbles of barley, wheat, tef, faba bean, field pea, haricot bean and oats had lower CP content than that of their corresponding straw. This could be associated with lower leaf to stem ratio of stubble crops (Ramazin et al., 1986; Ørskov, 1988; Solomon et al., 2008b). The lower content of CP for both crop residues and stubbles grazing may be compensated with strategic supplementation of proteinaceous feeds to improve livestock performance.

2.1.3. Crop residue utilization and management

In Ethiopia survey indicates that not all CRs produced is used as animal feed. In some parts of the country households sell teff straw for wall plastering. Sorghum stover is mainly used for fencing and fire wood. Bean straws are not commonly used as animal feed. Maize stover is harvested and piled for feeding during periods of feed shortage, but most of it is left in the field for stubble grazing. Crop residues are kept outside with little protection and in many parts of the country improper stacking and extended storage for up to 3–5 months exposed crop residues to termite damage, wastage and nutrient leakage. Poor storage facility and effect of termites are the most serious problems related to crop residue utilization. Improvement of crop residues (e.g. urea treatment and ensiling of crop residues) is rarely practiced except spraying salt solution to improve palatability by some farmers. Generally, availability of green fodder during most part of the year reduces the importance and proper utilization of crop residues as livestock feed.

In many parts of the country, management and utilization of crop residues is much better than others; about 70% the households conserve crop residues properly, though the remaining 30% of the households keep crop residues stack outside exposing to spoilage by urine, manure and exposure to sunlight. Crop residues from cereals and pulses are fed mixed to improve their utilization. Irrigated maize Stover and thinned maize is a good source of green feed during the dry season. In rare case the crop residue management practice is manual chopping of enset, banana and sugar cane top, leaf and stem. In semi-arid areas, crop residues are conserved for the dry season, but these are collected late after removal of the cob/grains and piled outside for a long time (Solomon et al, 201
Table 1: Problems related to the utilization of crop residues.

<table>
<thead>
<tr>
<th>Collection and transportation</th>
<th>Storage problem</th>
<th>Feeding problem</th>
<th>Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor shortage, lack of</td>
<td>Stack outside, spoilage with urine, manure and rain</td>
<td>Treating feeds, use of proper feeding places and feeding troughs not widely used</td>
<td>Feeding with Atela and salt Concentrate and legume supplementation very limited</td>
</tr>
<tr>
<td>proper collection; transport and road problem</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of awareness, high cost, little practice of collection,</td>
<td>Lack of knowledge and capacity to properly store</td>
<td>Improving but wastage is there, resistance to the use of technologies by farmers</td>
<td>Chopping</td>
</tr>
<tr>
<td>Lack of timely collection due to shortage of labor</td>
<td>Lack of awareness, lack of storage facilities, termites, poor storage practice</td>
<td>No processing of feeds except traditional chopping of maize, no feeding troughs and proper feeding place</td>
<td>Occasionally feed by mixing with wheat bran for oxen</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No processing of feeds, access and input supply shortage, no treatment and conservation</td>
<td>Thinning and treating with salt dissolved water</td>
</tr>
</tbody>
</table>

Source: (Solomon et al, 2017)

2.2. Management and conservation of crop residues.

The fibrous agricultural residues represent a considerable potential forage resource in the smallholder mixed farming system of the tropics where land must be devoted to human food production as a priority (Nordbloom, 1988). Amongst the Word’s total crop residues maize yields the largest amount and wheat, rice and paddy and pulses each yield about half the amount of maize. The remainder consists of sorghum Stovers, barley straws, sugarcane tops and leaves, roots, and tubers, oil plants Stovers and foliage (Kossila, 1985). Their feeding value is limited by their poor voluntary intake, low digestibility and low nitrogen, mineral and vitamin content (Chenost and Sansoucy, 1989). In addition they are very slowly fermented in the rumen. Infact, they consist essentially of lignified structural carbohydrates, since they represent the dead aerial part of the mature plant after harvest. Their better digestive utilization can be achieved either through an appropriate supplementation (legumes, molasses, fruit pulps, poultry manure, urea, etc.) or chemical pre-treatments (urea/ammonia treatments) which both facilitate the microbial breakdown of the cell walls. Moreover, proper management and conservation practices could help to reduce further loss in feeding value of crop residues.

In Ethiopia, about 30% of the annual livestock feed supply is obtained from crop residues. Totally or partly in – door fed animals such as dairy cattle are given priority in feeding of the crop residues. However, as crop residues are produced only once in a year after crop harvest following the main rainy season, their quality and contribution for the annual feed supply depends on proper collection, conservation and utilization. The nutritive value of crop residues is variable depending up on the species and variety of the crops, time of harvest, and handling and storage conditions. Different studies (Tesfaye and Chairatanayuth, 2007; Funte et al., 2010 and Zewdie, 2010) have shown that collection and storage of crop residues for feed is a common practice in different parts of Ethiopia. Storage of crop residues is one of the important coping strategies to tackle dry season feed shortage. The studies also indicate that majority of farmers in the Ethiopia store crop residues under open air conditions for varying periods of time. It is anticipated that such a practice could lead to further loss in quality of the inherently low quality crop residues Quantification of the loss in quality of crop residues under the prevailing management and
storage conditions is necessary to design proper supplementation strategies for better productivity of dairy cattle.

3. Conclusion

Previously natural pasture grazing land was the main forage feed source for livestock. At this time the natural grazing land become reduced due to fast growth of the country’s population with increasing land demand for crop cultivation. The remaining uncultivated pasture land also reduced in forage production because of over grazing and reduction of soil fertility. Now the main feed resource for livestock in traditional production system is crop residue which is low quality high fiber content, low digestibility of roughages as a result the livestock productivity will decreased due to malnutrition with reduction of disease resistance.

Ethiopia’s Livestock feed resources are mainly natural grazing and browse, crop residues, improved pasture, and agro-industrial by-products. At present, in the country stock are fed almost entirely on natural pasture and crop residues. The availability and quality of forage are not favorable year round feed. With the decline in the size of the grazing land and degradation through overgrazing and the expansion of arable cropping, crop residues have become increasingly important in the production system. The major crop residues produced in the Ethiopia could be broadly grouped into cereal, pulse, fruit, root crops, vegetables and sugar cane. All crop residues had lower CP contents than the minimum level of 7% CP required for optimum rumen microbial function.

Not all CRs produced is used as animal feed. Crop residues are kept outside with little protection and in many parts of the country improper stacking and extended storage for up to 3–5 months exposed crop residues to termite damage, wastage and nutrient leakage. Improvement of crop residues (e.g. urea treatment and ensiling of crop residues) is rarely practiced except spraying salt solution to improve palatability by some farmers. As the level of dependence of livestock feeding on crop residues increases in the process, increasing the yield and quality of crop residues plays a pivotal role and Provision of technical knowledge on how to improve the quality of existing feed resources and its management facilities will enhance productivity. The yield and quality characteristics of residues are determined by the genetic makeup of the crop, growing conditions and harvesting, threshing and storage methods.

4. Recommendation

a. Provision of integrated extension services regarding feed resources management and training on basic principles of feed collection, storage, proper feeding systems and amounts of supplementation of the feed resources should be made.

b. A due attention should be given to chemical treatment of crop residues and balancing legume and grass mixtures in the district through introducing legume species that are appropriate to the area and through putting in place effective grazing management.

c. Crop residue management and improvement: The post-harvest period is the most critical period to consider in relation to crop residues and harvested hay management and utilization. There is a need to identify cost effective storage designs and for regular application of best crop residue improving options. In some districts the use of urea is recommended and in others supplementation with AIBPs in the form of mixed total ration is justified. The knowledge and capacity of smallholder farmers should be strengthened by skill training and continual coaching and mentoring sessions. Demonstrating the importance of on-farm testing of known crop residue improving technologies through research for development is essential.

d. Research on feed utilization: A priority research area in the face of unavailability and high cost of commercial formulated rations from the big feed processors could be development of rations based on locally available resources. Strategic research incorporating crop residue quality in to crop variety research could also be considered.
5. Reference


Ibrahim H.1999. Feed Resources for Ruminant Livestock. ILRI Slide Series 1. ILRI (International Livestock Research Institute), Nairobi Kenya 44 pp


World Bank (1989) Sub-Saharan Africa: From Crisis to Sustainable Growth. Washington DC, USA


© Copyright 2018 International Journal of Zambrut | Scientific Researcher Group