



PARADOXICAL ROLE OF CROP RESIDUE IN THE AGRICULTURE OF ETHIOPIAN HIGHLANDS: A REVIEW

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Abstract

The highlands of Ethiopia hold about 95% of the cropped area and two-thirds of the livestock population. Livestock-crop mixed farming practice is the characteristic feature of agriculture in the area. The manure produced and draft animal power supports crop production in a complementary manner to support the livelihood of the producers. Native pasture, crop residue and aftermath grazing are the major feed resources. Because of the pressure of the increasing human population on the natural grazing pasture, livestock production is being challenged by feed scarcity and under nutrition. The role of crop residue has a paramount importance in livestock production as well as conservation agriculture. From the total crop residue produced, 60% is used for livestock feeding the rest is used for other purposes including mulching. Contrary to this it has shown that removing even 30-40% from the field has a negative effect on the soil fertility. The aim of this review is therefore to highlight the competing use of crop residues in agriculture.

INTRODUCTION

The highlands of Ethiopia hold about 95 per cent of the cropped area and two-thirds of the livestock population, 75-80 per cent each of the national cattle and sheep flock and about 30 per cent of the national goat flock (Kebede and Lambourne, 1987). The agricultural practice in this area is crop-livestock mixed farming system which is continuously challenged by feed scarcity and under nutrition. Native pasture, crop residue and aftermath grazing are the major feed resources. Because of the pressure of the increasing human population on the natural grazing pasture, the role of crop residue has become of great importance in livestock production. The contribution of different crop residues varies with the intensification level of each crop in the area (Bediye et al., 2001). However another role of crop residue in agriculture, preventing soil degradation if the crop residue is not utilized as animal feed shows contradictory role of the crop residue. The concept of conservation agriculture being well practiced in north and south America, Australia, Europe and newly introduced in some parts of African region needs to reduce tillage and leaving crop residues on farm/field. The aim of this review is therefore to show up the paradoxes of role of crop residue in agriculture (conservation agriculture vs livestock production) in the highlands of Ethiopia.

Livestock- Crop Mixed Farming Practice In the Highlands of Ethiopia

Livestock in small holder farming system is produced on pasture grass, browse and crop residue. The undigested and unabsorbed part of the ingested feed is returned as a manure to the soil, replacing part of the nutrients taken up by the plant. The manure produced and draft animal power will support crop production in a complementary manner to support the livelihood of the producers (Herrero et al., 2010). But, the mixed farming practice is challenged by the increasing human population which drives the demand for arable land for food crop cultivation. This reduces area of land devoted for grazing. This forces the livestock producers to be more dependent on crop residues for animal feeding than natural pasture. However the nutritional value of crop residues are usually lower than grass hay obtained from pastures.

Feed Resources of Ethiopia

Keeping livestock is an important risk reduction strategy for vulnerable communities, and livestock are important providers of nutrients and traction for growing crops in smallholder

farming systems. In Ethiopia livestock obtain feed from: (1) Grazing and browsing on natural pastures; (2) Crop residues and agro-industrial by-products; and (3) Cultivated pasture and forage-crop species (Mengistu, 1985). Grazing and browsing on natural pastures is becoming hard to meet the dry matter requirement of livestock and improved forage development is still in its infant stage. Even in the lowlands of the country the range lands are being deteriorated and need rehabilitation and regulatory managements(Gemedo-Dalle et al., 2006, Desalew, 2008). This brought high dependency on the use of crop residue for animal feeding particularly in the highlands of Ethiopia is not alternative rather compulsory. Other sources of feed sources are not the interest of this review and hence the role of crop residue will be discussed below.

Crop Residues for Animal Feeding

Ethiopian smallholder farmers grow diversified crops and usually produce a mixture of crop residues including the cereal straws like tef, wheat, barley, millet, maize, and sorghum; and different grain legume haulms which includes faba beans, lentils field pea and grass pea. These feeds are high in their fiber content which downgrades the nutritional value in common with their low energy, protein and minerals contents. However, Crop residues are still major feed sources particularly in the long dry season of highlands of Ethiopia. There is no exact figure on the quantity of crop residues produced in the country(Feyissa et al., 2015). But, there are estimations of crop residues from crop yield with conversion factors by different authors (Keftasa,1988; Schiere et al., 2004). The estimation can be affected by the level of inputs used and agronomic practices employed to produce the crop. What so ever the amount of crop residue, Zinash and Seyoum (1991) indicated that 63% of cereal straws is utilized as animal feed, 20% is used for fuel, 10% for house construction and 7 % used for bedding indicating that the major use of crop residues by smallholders in Ethiopia is as feed for livestock. Though the amount of crop residue produced varies place to place and time to time, the estimated amount of crop residue produced in 2015 is presented below in table1.

Table 1. Estimated crop residue production from major cereal crop

Major crops	Annual production (quintal)	Sources	Conversion factor	Sources	Estimated CR production (quintal)
Teff	44,713,786.91	CSA, 2015/6	3	(Keftasa,1988)	134,141,360.7
Wheat	42,192,572.23	CSA 2015/6	1.5	(Bogale et al., 2008b)	63,288,858.3
Barley	18,567,042.76	CSA 2015/6	1.5	(Bogale et al., 2008b)	27,850,564.1
Sorghum	43,232,997.52	CSA 2015/6	1.73	(McIntire et al., 1988)	74,793,085.7
Maize	71,508,354.11	CSA 2015/6	2	(de Leeuw et al., 1990)	143,016,708.2
Millet	9,402,463.39	CSA 2015/6	3	(Schiere et al., 2004)	28,207,390.2

Currently technical efforts being practiced in Ethiopia is not to promote the principles of conservation agriculture rather to improve the feeding value of crop residues either by supplementation or treatment(Males, 1987) so that mobilization of crop residue for animal feeding is being maximized.

Role of crop residue in soil conservation

Soil degradation in sub Saharan Africa is a problem primarily caused by expansion and intensification of agriculture in efforts to feed its fast growing population(Nkonya et al., 2016, Kato et al., 2011). Because of the changes in fertility, structure and moisture content of the soil, the productivity of land in the highlands of Ethiopia is getting worse. The land degradation is mainly attributed by the crop and livestock production systems being practice in the country. Using the steeply sloppy lands for crop cultivation and grazing by large animals; lack of vegetation cover on the stone terraces constructed for soil conservation and deforestation pressure by the increasing huge human population are some of the causes for land degradation (Taddese, 2001). To minimize the effects of such land degradation on the livelihood of small holder farmers in the country, practicing conservation agriculture (CA) may offer potential benefits (Giller et al., 2011). CA has given increasing attention in sub-Saharan Africa, as a means to improve food security and minimize environmental degradation (Baudron et al., 2012). Conservation agriculture consists of a range of cropping systems based on a combination of three main principles: (1) soil tillage reduction, (2) soil protection by organic residues and (3) diversification in crop rotation that need to be adapted to local conditions (Scopel et al., 2013). The distinguishing and novel feature of conservation tillage systems is the retention of a crop

residue mulch just after crop establishment to ensure an adequate soil cover (Erenstein, 2002). It is believed that even a partial removal (30–40%) of crop residue from land can aggravate soil erosion hazard, accentuate emission of CO₂ and other green house gases from soil to the atmosphere, and exacerbate the risks of global climate change(Lal, 2005). On the other hand; research plots where straw had been incorporated, and high cover crop residue with reduced tillage result in greater soil organic C and N, which may improve soil productivity (Powlson et al., 1987, Havlin et al., 1990).

However; the role of crop residues as animal feed especially in the long dry season is increasing in the highlands of Ethiopia where crop-livestock mixed farming is being practiced (Keftasa, 1988, Bogale et al., 2008a). Moreover it has been indicated that the inherent nature of crop-livestock mixed farming systems often implies competing uses of crop residues since they are used as feed, as mulch/soil amendment, fuel and construction material, both within the mixed farm and/or by others (Erenstein, 2002). But, in the highland of Ethiopia crop residue is not currently used for mulching purpose. This is because of the severe feed shortage problem faced due to decreasing grazing land in favor of crop cultivation to feed the increasing human population.

It may be important to devise innovative cropping systems to produce the desired amount of crop residue for alternative uses and returning surplus to the soil. In this regard, cover crops and conservation tillage systems can play an important role in designing appropriate cropping/farming systems(Lal, 1995). But still the demand for crop residue for animal feeding is high so that it is difficult to use crop residues for soil cover. And even the management for mulching is difficult as the free grazing system being practiced can allow the animals to feed on mulched residues.

Conclusion and Recommendation

Crop residue is the main source of animal feed and at the same time important to maintain soil fertility. The current utilization of crop residue is mainly for animal feeding only and policy makers and/or experts shall pay attention to the concept of conservation agriculture. This is important to the hilly lands of Ethiopia if other alternative forage sources replace the role of crop residues for animal feeding so that crop residues can be used for maintenance and improvement of soil fertility.

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