

Review on Feed Resource Potential and Constraints in South Western of Ethiopia

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Abstract: The aim of this review shows the feed resource potential and constraints in south western of Ethiopia, identifying constraints limiting the feed resources. The south-western humid and sub-humid zone of Ethiopia are predominantly the perennial cash crops (coffee, chat, enset) producing areas. Currently, available land for grazing and browsing was shrinking due to expansion of arable land, the yield of natural pasture become low due to variation with altitude, rainfall, soil type and cropping intensity. At present, human population and arable land rapidly increases with grazing land decrease use of crop residues and stubble grazing is major source of feeds in dry season. Agro industrial by-product is special value of feeding livestock mainly in urban and peri urban livestock production system, their contribution is low and the use is to the emerging private dairy and fattening farms due to their high prices and low accessibility. The major constraints of feed resources are feed quality and quantity, climate variability/drought, ecological deterioration/expansion of cropping land, overgrazing, land tenure, border conflict, weed and bush encroachment, soil fertility, lack of seed and planting materials. Therefore, reviewing the feed resource potential and its constraints is a vital for effective and efficient utilization of the resources to boost the productivity of the livestock sector in the country.

Key words: Agro Industrial By-Product • Crop Residues • Feed Resource • Natural Pasture

INTRODUCTION

Ethiopia is known to be the center of origin and diversity for a number of domesticated crops, it is also known to be the center of diversity for pasture and forage species. In South western of Ethiopia, the large numbers of indigenous grass species and the very great variation within the species make the country a rich potential source of new and better tropical pasture grasses. Until now there are a total of 736 grass species from 181 genera that are documented in Ethiopia, of which 164 species from 68 genera are reported to be important (medium to high level) for pasture and forage purpose [1].

Forages are the cheapest source of livestock feed and ruminant animals have the ability to convert forages into milk, meat, hides and skins and draught power needed by man for food and drawing income. Skills fully using livestock to harvest forages leads to improved soil fertility, diverse, dense, useful pasture ecology and an extended grazing season. The role of natural pasture is diminishing from time to time due to shrinking grazing

land size and the use of native hay is limited in coverage [2]. Feed both in terms of quantity and quality is a major bottleneck for livestock production in Ethiopia. Livestock feed resources in Ethiopia are mainly natural pasture, crop residues, improved pastures, forage crops and agro-industrial by products [3]. The contribution of these feed resources, however, depends up on the agro ecology, the types of crop produced and accessibility production system. Feeds are either unavailable in sufficient quantities due to fluctuating weather conditions or are available but of such poor quality that they do not provide adequate nutrition [4]. Feed resources can be classified as natural pasture, crop residue, improved forage and agro-industrial byproducts of which the first two contribute the largest share. Currently, with the rapid increase of human population and increasing demand for food, grazing lands are steadily shrinking by being converted to arable lands and are restricted to areas that have little value. Productivity estimates also vary probably due to variation in time and ecological change, rainfall, soil type and cropping intensity.

Crop residues are providing a considerable quantity of dry season feed in most farming areas of the country. Agro-industrial byproducts have special value in feeding livestock mainly in urban and peri urban livestock production system, as well as in situations where the productive potential of the animals is relatively high and require high nutrient supply. Traditional livestock production system mainly depends upon poor pasture lands and crop residues which are usually inadequate to support reasonable livestock production [5]. During the latter part of the dry season, livestock feed is normally in short supply and is also of poor quality. Residues from cereals (wheat, teff, millet and sorghum for example) are the main source of forage but these are low in protein and have poor digestibility.

Generally, the feed resources availability and their contribution vary among agro-ecologies and production systems. The major constraints of livestock feed resources are feed quality and quantity, ecological deterioration, overgrazing, land tenure, drought, weed and soil fertility, lack of seed and planting materials. Therefore, assessing the, potential and constraints of the major feed resources is a paramount important for effective and efficient utilization of the resources to increase the production and productivity of livestock sector in the country.

Literature Review

Feed Resource Potential, Availability and Constraints: Feed is the most important input in livestock production and its adequate supply throughout the year is an essential prerequisite for any substantial and sustained expansion in livestock production [6]. Feed resource and availability, sufficient and quality feed resources availability are some of the major determinants of livestock productivity. Natural grazing land is a predominant feed source for livestock in south western of Ethiopia. Very little land is planted to introduced pasture or forage crops. Grazing areas are usually communally owned. Crop-residue and agro-industrial by-products represent a small proportion of feed resource in mixedcrop-livestock system. Seasonality in feed availability and lack of knowledge on feed conservation has created feed shortage both in the highland and lowland ecologies of Ethiopia [7].

There was severe shortage during the dry season from January to the beginning of the small rain [8]. Natural grazing and browsing on plots of permanent grazing land and stubble following crop harvest makes the

main sources of animal feed in south western Ethiopia. Farming systems and altitude are important variables affecting vegetation distribution [9].

Botanical composition of plant species and productivity of the pasture land are highly influenced by animal species, intensity of grazing and edaphic factors. Biomass production over time varies and therefore, causes seasonal variation in forage availability [10]. The feeding systems include communal or private natural grazing and browsing, provision of crop residues and cut-and-carry feeding.

Livestock Feed Resource Classification: Feeds can be classified according to some of their general properties. The classification used here is typical of that used in the feed industry. Feedstuffs can be classified as either concentrates or roughages. Animal feeds were classified as natural pasture, crop residue, improved pasture and forage and agro industrial by-products of which the first two contribute the largest share in livestock production.

Concentrates: Concentrates have low fiber content and a high content of either protein or energy or both. Cereal grains for example are considered as primary energy sources but also contribute a significant amount of protein. Energy source concentrates: are includes cereal grain (e.g. corn, sorghum and buck wheat), grain milling by-products (e.g. wheat bran and corn gluten meal), root and tubers (e.g. cassava and potatoes), food processing by-products (e.g. molasses, bakery waste, citrus pulp distiller and brewers' by-products), industrial by-products such as wood molasses. Protein source concentrates: Protein supplements generally are products with more than 20% crude protein. Some of these feeds are; oilseed meals (e.g. soybean, cottonseed, rapeseed, canola, linseed, peanut, safflower and sunflower meals), grain legumes (e.g. beans, peas and lupines) and animal protein (e.g. meat meal, tank ages, fishmeal's and whey feather meal [11].

Roughages: Roughages are bulky materials which have high fiber content and a low nutrient density. Hay, pasture, silage, straw and cottonseed hulls are examples of roughage. They are used primarily in feeds for ruminant or non-ruminant herbivores. The major roughage feed resources for dairy animals across all the different production systems included natural pasture/grasslands, crop residues, non-conventional feed resources (e.g. leaf and stem of *enset*, banana and sugarcane, crop thinning)

and crop aftermath (with the exception of urban dairy producers). The contribution of these feed resources, however, depends up on the agro-ecology, the types of crop produced, accessibility and production system [12].

Natural Pasture: Natural pastures supply the bulk of cattle feed. They are composed of indigenous forage species and are subject to severe overgrazing. Grazing occurs on permanent grazing areas, fallow land and on land following harvest. Average pasture yield for the highland areas is estimated to be 4 tons/ha. In many areas, natural pastures are invaded by species of low palatability [13]. Natural pasture comprises the largest feed resource and estimates of its contribution to overall feed resource vary greatly. In the highlands and semi-highlands, natural pastures account for 80% of animal feed. This is because the availability and quality of native pastures for livestock use vary with altitude, rainfall, soil type and cropping intensity. Pasture growth is a reflection of the annual rainfall distribution pattern [14]. However, quality and productivity of natural pastures is very poor to meet the nutrient requirement of animals [15] particularly in the dry season, due to poor management and their inherent low productivity and poor quality. In the highlands with the rapid increase of human population and high demand for food, pastures are steadily being converted to farmlands.

Crop Residues: The potential and abundance of crop residues that could be used for livestock feeding in south western of Ethiopia in most cases down from grain yield. Crop residues are fibrous materials, which are the by-products of cultivated crops. Crop residues are often left in the field or accumulated in places where the crop is threshed. Transportation of crop residues, even over short distances, can become difficult and costly because of their bulk. Crop residue is one of main feed in animal production in south western of Ethiopia, especially those area which practice livestock and crop production. The contributions of crop residues reach up to 80% during the dry seasons of the year [16].

Cereal crop residues are fed to livestock during the dry season when the quantity and quality of available fodder from natural pasture declines drastically [17]. Crop residues are abundantly available at the beginning of the dry season following the harvest and threshing of cereal and pulse crops. Residues from leguminous crops have better quality than the residues from cereals. Crop residues which constitute another major feed resource are produced in large amounts on farm, but only

a small fraction of the amount available is used strategically. A large quantity of cereal straws is left on the field for in situ grazing, instead of being harvested, treated and stored for long term feeding. When left on the field, the residues rapidly deteriorate and a large amount is usually trampled upon and wasted. In addition, the nutrient imbalance which characterizes these fibrous residues is not corrected by appropriate supplementation [18].

Agro Industrial By- Products: Agro-industrial by-products produced in Ethiopia include by-products from flour milling, sugar factory, oil processing factories, abattoir and breweries. Agro-industrial by-products have special value in feeding livestock mainly in urban and peri-urban livestock production system, as well as in situations where the productive potential of the animals is relatively high and require high nutrient supply [19]. These products are mainly used for dairy, fattening and commercial poultry production and the scope for their wider use by smallholder producers is low due to availability and price. The major agro-industrial by-products commonly used are obtained from flour milling industries, edible oil extracting plants, breweries and sugar factories. The current trends of increasing urban population has a significant effect on the establishment of agro-industries due to the corresponding increasing demand for the edible main products. Agro-industrial by-products are rich in energy and/or protein contents or both. They have low fiber content, high digestibility and energy values compared with the other class of feeds and more than 35% crude protein (CP) and 50 to 70% *in vitro* organic matter digestibility (IVOMD) for oil seed cakes and 18 to 20% CP and more than 80% IVOMD for flour milling by-products. Supplementing ruminants fed low quality feeds with agro-industrial by-products enables them to perform well due to higher nutrient density to correct the nutrient deficiencies in the basal diet.

Agro-industrial by-products cover flourmill by-products such as wheat bran and middling, oilseed cakes (Niger seed cake, linseeds, sesame seeds and rapeseeds), brewers' grain and sugarcane byproducts like molasses and bagasse. However, the contribution of these by-products is proportionally low, due to their escalating prices [20] and low accessibility. Even though, there are limited accessibility of agro-industrial by-products farmers supply agro-industrial by-products to their animals during the dry season to mitigate feed shortage.

Improved Pasture and Forage Crops Species: Over the past four decades several forages have been tested in different agro-ecological zones and considerable efforts have been made to test the adaptability of different species of pasture and forage crops under varying agro-ecological conditions. As a result, quite a number of useful forages have been selected for different zones. Improved forage crops have been grown and used in government ranches, state farms, farmers' demonstration plots and dairy and fattening areas. Forage crops are commonly grown for feeding dairy cattle with oats and vetch mixtures, fodder beet, elephant grass mixed with siratro and desmodium species, rhodes/ lucerne mixture, phalaris/trifolium mixture, hedgerows of sesbania, leucaena and tree-lucerne being common ones [21].

The most common cultivated forage crops include grasses like elephant grass (*Pennisetum purpureum*), Rhodes grass (*Chloris gayana*), guinea grass (*Panicum maximum*) and oats (*Avena sativa*) in the highlands. Among the herbaceous legumes, the most common ones include desmodiums (*Desmodium* spp.), vetch (*Vicia* spp.), Lucerne (*Medicago sativa*), lablab (*Lablab purpureus*), cowpeas (*Vigna unguiculata*) while the most common fodder tree legumes include Leucaenas (*Leucaena* spp.), Sesbania (*Sesbania* spp.), *Calliandra calthyrus*, *Gliricidia sepium*, pigeon pea (*Cajanus cajan*) and others. Tagasaste (*Chamaecytisus palmensis*) is important in the highlands. The leguminous forages are important as sources of nitrogen, fermentable organic matter and minerals in crop residues and poor quality natural based diets. Due to unprecedented population increase, land scarcity and crop dominated farming, there has been limited introduction of improved pasture and forages to smallholder farming communities and the adoption of this technology by smallholder mixed farmers has been generally slow.

Fodder Trees: Fodder trees and shrubs are important animal feeds especially in arid, semi-arid and mountain zones, where large number of the country's livestock is found. Most browse species have the advantage of maintaining their greenness and nutritive value throughout the dry season when grasses dry up and deteriorate in quality and quantity. Tree fodders are generally rich in protein, vitamins and mineral elements and can be used as dry season feed sources and supplements to poor quality grasses and crop residues. However, their utilization is reduced by the presence of tannins and other phenolic compounds in their leaves. Compared to grasses, fodder trees and shrubs have

relatively high concentrations of crude protein and minerals. These nutrients are subject to less variation than in grasses and this particularly enhances their value as dry season feeds for livestock. However, nutritive value of fodder trees decreases with aging, since they become woody as they mature.

Opportunities for Improvement of Fodder Resources: Biological resources are fundamental to human well-being in agriculture, livestock export and earning, economic output and for their ecological services and functions. Ethiopia has an immense ecological diversity and a huge wealth of biological resources. The complex topography environments for a wide range of life forms, like variety of pasture species of herbaceous legumes, browse trees/shrubs [22].

Biodiversity Conservation: Conservation and use of grass-germ plasm has made a significant contribution to the economic development of Ethiopia through the national pasture and forage research program. The International Livestock Research Institute (ILRI) has done much to fill the gap by collecting grasses from different parts of Ethiopia and by acquiring access to world collections of forage grass germ-plasm [23]. Currently over 371 accessions of grasses from 77 species and 37 genera, 2 076 accession of legumes from 140 species and 35 genera and 185 accession of browse from 41 species 18 genera are collected and conserved [24]. One of the best opportunities for highland farmers to use land efficiently will be through the introduction of pasture and forages in the farming system. In trials in the highlands on wheat and barley under-sown with Lucerne, annual clovers, tall fescue, perennial rye grass, Setaria and Phalaris, the sowing of both cereals and forages was at the same time. All under-sown forages established successfully except Lucerne and there was no significant reduction of cereal yield.

Pasture and Forage Seed Production: Many of the temperate and tropical pasture and forage crops that have been tested and grown in Ethiopia have no problem of flowering and setting seed. This provides a good opportunity for the country to establish local seed coupled with environmental heterogeneity offers suitable. Integration of Pasture and Forage into Farming Systems, forages could significantly relieve the feed problems of production in the existing farming system. Seed production systems adopted in the country are farmer contract seed production system, seed production

on ranches, seed production on specialized plots and opportunistic seed production. Under these systems over 200, 000 tons of forage seed were produced from 1988 to 2002. Of the seeds produced Vetch, Lablab, Cowpea, Axillaries, Siratro, Stylos, Desmodium, Oats, Rhodes, Panicum, Tree-Lucerne, Leucaena and Sesbania are dominant.

Irrigation: The irrigation potential of the country Ethiopia is high; the potential area for irrigation is estimated to be about 3, 000, 000 hectares and the south western Ethiopia shares more Small-scale traditional irrigation has been practiced for decades throughout the highlands; small streams are seasonally diverted for limited dry season cropping. This is a good opportunity to grow off-season pasture and forage crops. The potential for irrigated forage is untapped and still there is a great opportunity for producing seasonal and long term irrigated pasture and forages.

Better Grazing Land Resource Management: At every Agro point of resource management, community knowledge and participation, from the beginning to the end through evaluation and monitoring is vital. South western Ethiopia's farming people have traditional laws which govern the community, adopted for thousands of years. The presence of traditional community rules provides an opportunity in the management of the grazing and other land resources and the current government policies encourage peoples' participation and community participation from project conception through planning and implementation, monitoring and evaluation undertaken the program.

Improving Poor Quality Roughages for Livestock in tropical environments will have to eat feeds that contain a lot of fiber during most parts of the year. The bulky and fibrous nature of coarse feeds results in poor nutrient supply and reduced intake. Such feeds have to remain in the rumen/stomach for extended periods of time before they are sufficiently digested to move out of the rumen/stomach and allow more feed consumption. It is common for animals to lose weight and condition, produce less and even have difficulty breeding when fed on these low quality roughages. One approach to improving the feeding value of poor quality roughages is through treatment of roughages, either physically or chemically, is aimed at rendering the structural constituents more accessible to microbial digestive enzymes in the rumen [25].

Constraints of Livestock Feed Resources

Feed Quality and Quantity: Natural grazing is the main source of livestock feed and in the lowlands livestock production is almost totally dependent on it. However, grazing lands do not fulfill the nutritional requirements of animals particularly in the dry season, due to poor management and their inherent low productivity and poor quality. Marginal lands unsuitable for cultivation such as waterlogged, flooded soils and steep lands are left for grazing and their productivity is also very low. Another population associated problem is environmental degradation due to deforestation and overgrazing which have substantially reduced soil fertility and further reduced productivity. The south western of Ethiopia is recognized as a zone of highest risk of environmental degradation. Due to the highly undulating nature of the topography, especially in the northern and the eastern portion of the zone, together with overuse of the natural resource base, has rendered the region as the most fragile environment in the country.

Ecological Deterioration: The expansion of cropping land had put pressure on grazing land by facilitating the shrinkage in grazing and damaging water sources. Gradual encroachment of cultivation into grazing lands is common in both highlands and mid-altitude areas. So many meadows in the flood plains have been converted into croplands. Due to vegetation clearance many steep areas have become vulnerable to wind and water erosion. Important browse that was dry season forage has been wiped out to supply urban fuel and construction wood. Natural grazingland is deteriorating rapidly due to lack of attention and its carrying capacity declining due to high stocking rates especially in pastoral areas of the country.

Climate Variability/Drought: One of the most unfortunate characters of Ethiopia's climate is great variability and erratic rainfall from year to year and one of the non-technical livestock feed production constraints which has been affected livestock production through induce decline in pasture availability due to greater variability in rainfall patterns. Drought is particularly common in the pastoral area where rainfall is unpredictable and unreliable. Nomadic pastoralists have adapted to live with the situation but other factors (listed here) have made them vulnerable to famine [26]. The pasture availability from the grazing land is currently expected to decline due to climate change.

Border Conflict: Most extensive grazing lands are limited by ethnic boundaries and are often in border areas. There is conflict between tribes within the country and sometimes with neighboring countries. This has a profound effect on border grazing land.

Land Tenure/Change of Ownership: In Ethiopia grazing land ownership is thought to be communal, where ethnic groups used to manage grazing lands. However, the federal or regional state can allow private investment in pastoral areas. Besides the loss of grazing land, investment may prevent free movement of pastoralists that crates border conflicts and initiate urbanization. If the nomadic pastoralists' sustainable way of life changes to sedentary farming the tragedy of the commons will become real-unless some adjustment is made.

Soil Fertility: The annual food and livestock feed deficit of the country is attributed directly to soil erosion and nutrient export. About half of the highlands are vulnerable for water erosion and the remainder has been cultivated without conservation measures for thousands of years.

Weed and Bush Encroachment: In South western of Ethiopia weed control by herbicides, machine mowing and topping and hand weeding have been tried; hand weeding is the best and cost effective method. Since family and hired labor is plentiful and cheap there is an opportunity to use it for weed control, so there is a considerable opportunity to foster the development of improved pasture and forage crops on a large scale without a major problem of weed infestation. As a result of overgrazing many natural grazing lands are invaded by unpalatable weeds and woody plants. Weeds are major problems in both perennial and annual pasture and forage crops; unless they are controlled productivity will be low.

Lack of Seed and Planting Materials: The absence of quantity and quality seed and seedling production limits the vast expansion of improved pasture and forage development (especially around the dairy farming and fattening areas).

Overgrazing: Grazing and browsing animals overstock natural pastures; areas near water points are generally the most affected and grazing lands are dominated by unpalatable plants. In many pastoral areas, since the number of stocks has socio-cultural value, it has a

synergistic effect with the diminishing grazing lands. Soils are under risk of degradation with reduced infiltration, low permeability and a reduction in the water-holding capacity. The result is a decrease in the ability of the soil to support plant production.

CONCLUSIONS

This term paper reviewed feed resource Potential, availability and constraints in south western of Ethiopia. Livestock feed resources in Ethiopia are mainly natural pasture, crop residues, improved pastures, forage crops and agro-industrial by products. Communal or private natural grazing and browsing, cut-and-carry feeding, hay and crop residues are feeding systems in the country. Currently, natural pasture and crop residues major feed resources livestock are fed. Feed availability and quality are not favorable year round and hence gains made in the wet season are totally or partially lost in the dry season. The contribution of agro-industrial by-products is also minimal and restricted to some urban and peri-urban farms (dairying and fattening). In the past four decades, considerable efforts have been made to test the adaptability of pasture and forage crops to different agro ecological zones; several useful forages have been selected and recommended for different zones. At present, improved forage and pasture crops are mainly important as cut and carry sources of feed and as a supplement to low quality feeds. It have been grown and used in government ranches, state farms, farmers' demonstration plots and dairy and fattening farm areas and provided profit for smallholder farmers, medium and large scale private enterprises. Therefore, based on the conclusion, it is strongly recommended that detailed study in different agro ecologies of the country is imperative to investigate the feed resource potential, availability and constraints are commended to come up with recommendations to solve livestock feed resource constraints related problems and play a vital role in helping farmers and provision of strong extension services and training on improved forage cultivation and management practices in the different parts of the country.

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