

Middle-East Journal of Scientific Research 21 (4): 616-622, 2014

ISSN 1990-9233

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DOI: 10.5829/idosi.mejsr.2014.21.04.82406

Livestock Feed Resources Assessment, Constraints and Improvement Strategies in Ethiopia

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Abstract: The objectives of this review was to know the existing animal feed resources availability and associated risks and to set livestock feed resources improvement strategies in the country. Ethiopia is one of Sub-Sahara African country. Its topography consists of a high central plateau and extensive lowland plain area to the south and south- east with varying altitude. Agriculture is the base of the country's economy in which livestock contributes 20% to Gross Domestic Product (GDP) and 40% to the gross value of annual agriculture output. The agro-ecological conditions of the different parts of the country determine the type of crop and animal production. In the country animal can be produce in three systems which are extensive (pastorals and ranching), semi-intensive (mixed crop-livestock) and intensive production. Feed stuff for those production systems can be grouped in to two which are concentrate and roughage. In Ethiopia the source of animal feed are natural pasture, crop residues and agro-industrial by products. There are many constraints (problems) of livestock feed resources in the country like poor quality and quantity, drought, ecological deterioration, over grazing, land tenure/change of ownership, border conflict, weed and bush encroachment, soil infertility and lack of seed and planting material. The quantity and the quality of the available feed resources can be improve in different strategies like biodiversity conservation, pasture rehabilitation, integration of pasture and forage in to farming system, irrigation and batter grazing land management. Physical treatment such as soaking and chopping and chemical treatment like ammuniton and urea treatment are also used to improve poor quality roughage. In conclusion, the main feed resource 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.

Key words: Constraint • Feed resource • Improvement • Livestock

INTRODUCTION

Ethiopia is a landlocked country in the horn of Africa, bounded to the north by Eritrea, to the west by Sudan, to the south by Kenya and to the east by Somalia and Djibouti. It lies within the tropics between 3°24' and 14°53' North; and 32°42' and 48°12' East. It covers 1 billion, 120, million km² total land area. Smallholder peasants farm occupies 8% (about 10, million ha) of the national land area and about 3.1 million ha are fallow. The total area of grazing and browse is estimated to be 61–65, million ha, of which 12% is in mixed farming and the rest in pastoral areas [1]. The topography consists of a high central plateau ranging in altitude from 1,800 to

3,000 m and the extensive lowland plain areas to the south and south-east with varying altitudes but often less than 1,000 m. These are the areas occupied by nomadic people [2].

Agriculture is the backbone of the country's economy with the raising of crops being the major activity. Coffee is the major exportable agricultural commodity and it earns the largest proportion of foreign exchange. Livestock also play an important role in Ethiopia's economy being the second largest earner of foreign exchange after coffee [3]. With an overall contribution of about 20% to the gross domestic product (GDP) and 40% to the gross value of annual agricultural output [4].

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Ethiopia's livestock population is the largest in Africa, with cattle 40.6 million; sheep 14.3 million; goats 9.6 million; equines 5.7 million; camels 0.48 million; poultry 40.9 million. About 70% of the cattle and sheep and 30% of the goats are in the highlands above 1,500 m. All camels are in the lowlands. The suitability of an area for either animal or crop production and the type of animal or crop to be produced in the area depends on the agro-ecological conditions of the area. The feasibility of cropping and the type of crops to be produced depend on climatic, edaphic and biotic factors. On the other hand, the feed resource base and disease challenge determine the animal production system of the area [3].

Objectives of the Paper:

- To spot out the existing animal feed resources availability and associated risks found in Ethiopia.
- To describe the basic livestock feed resources improvement and feeding strategies in the country.

Livestock Production System in Ethiopia: Many suggestions have been made for the classification of livestock production system. But none of these classifications provide completely suitable framework for the evaluation of tropical livestock production systems on worldwide basis. Either the criteria used are regional in concept or scope or the classification is too complex for the worldwide evaluation purposes. A classification must be simple and be based on universally recognized criteria according to Payne and Wilson [5].

Pastoral Production and Extensive System: Traditional pastoralist and Ranching are systems that have been adopted to exploit the extensive arid and semi-arid regions of the tropical world [5]. This is characterized by little or no crop production. In general pastoral system is associated with agro ecological zones that are too dry to sustain crop, no crop agriculture and high mobility in search of grazing and water. Under Ethiopian conditions pastoral system of production are found at altitude below 1500 m.a.s.l and where the annual precipitation is less than 500mm. In this production system livestock are maintained as a primary activity. Fifty percent of household revenue comes from livestock or more than 20% of household food energy is derived directly from livestock or livestock related activities. Range land is the main land resource [6].

Ranching: Ranching is an alternative system to various forms of pastoral practices in the different regions of the country. However there have two fundamental differences. In ranching livestock are raised to provide

cash income whilst in pastoralist their primary role is to provide food for the family. The other difference is that in ranching the stocking rate has to be adjusted to the carrying capacity of limited pastor area whilst in pastoralist adjustments to carrying capacity are made by moving the livestock to new pastures on the communal grazing [7].

Management of livestock in ranching system of production is characterized by grazing with in defined borders and individual tenure system with possibilities of intensified feeding and watering of animals. Ranchers can be differentiated by targeted livestock species and products, although the most common ranching is cattle ranching system, sheep and goat ranching for production of skin, wool and meat also exist and intensity and level of development [7].

Semi-Intensive Production: In this rain-fed system crop agriculture is integrated to a greater or lesser extent with livestock production. The holding are small, the economy is the mixture of semi-subsistence and cash. As it is semi-subsistence/semi-commercial it includes mixed farming system in the highland and lowland and agro pastoral system in semi-arid areas [5].

Mixed Crop-Livestock System: This system is generally found in areas where the altitude ranges between 1500 and 3000 m.a.s.l. The area has adequate rain fall and moderate temperature and is thus suitable for grain production. The integration of crop and livestock is high in most areas. The integration is low in perennial crop-livestock system (Coffee growing areas) in the south Ethiopia where animals are of minor importance. Livestock in general play an important role in food security and food self-sufficiency in this production system. In the cereal based mixed production system livestock are the main cash source for the purchase of agricultural input. Livestock are used as saving and insurance mechanism. Cattle are the dominant livestock species and kept [8].

Agro-Pastoral System: This system is characterized by less integration with crop production as compared to crop-livestock production system. Producers under this system have a permanent residence and their movement is limited in terms both distance and duration. The system is characterized by a high degree of dependence on milk and meat production some crop agriculture is practiced around the permanent homestead. This is also low input/low output system. The system is usually practiced below 1500 m.a.s.l but with higher rain fall to support short season crops compared to the pastoral system [7].

Highland Livestock-Crop Production: Here animals are part of a mixed subsistence farming complex. Animals provide inputs (Draught power, transport, manure) to other parts of the farm system and generate consumable or saleable outputs (Milk, manure, meat, hides and skins, wool, hair and eggs [3].

This system is found in a highland about 3000 m.a.s.l where crop grown are barley and pulses such as *faba* beans lentils etc. Temperature is the main factor determining productivity of highland crop and livestock production system. At a time, night temperature fall below zero degree centigrade and frosty nights are common particularly between October and January. Cropping intensity in this area is generally low. Sheep are the dominant livestock species. The main feed resource base includes waste land grazing, stubble and sometimes straw [8].

Intensive Production System: The intensive system is one in which the livestock are fed in confinement with a limited access to land. In most cases they fed high quality feeds and have much more labour, technology and overall attention directed to them [9]. Not all intensive system are fully commercial operations; there are landless families both within and outside urban area who husband livestock under very intensive conditions and sell some part of what is produced [5].

Livestock Feed Resources Classification in Ethiopia: 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 [10].

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, peens and lupines) and animal protein (E.g. meat meal, tank ages, fishmeal's and why feather meal [10].

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 [10].

Available Feed Resources in Ethiopia: Natural grazing land is a predominant feed source for livestock in Ethiopia. Very little land is planted to introduced pasture or forage crops. This is especially true for the pastoral and agro-pastoral areas. Grazing areas are usually communally owned. Crop-residue and agro-industrial by-products represent a large proportion of feed resource in mixed crop-livestock system. Reliance on a crop residue for animal feed is ever-increasing or more land is cropped to feed the fast-growing human population [6].

Natural Pasture and Browse: Natural pasture supply the bulk of livestock feed which is composed of indigenous forage species and is subjected to overgrazing. Grazing occurs on permanent area, fallow land and a land following harvest. Both fallow land and crop stubble provide poor grazing for a very short period just after

Table 1: Availability of different feed resources in different production system.

Coffee-Enset system	Coffee-crop system	Crop production system	Pastoral and agro-pastoral system
-Natural grazing	-Natural grazing	-Natural grazing	-Natural grazing
-Hay	-Hay	-Hay	-Standing hay
-Enset by-product	-Cereal crop residue	-Cereal & Pulse crop residue	-Browse shrubs & trees
-Sugar cane tops or leaves	-Oilseed cakes	-Oilseed cakes	
-Root crop leaves	-Enset by-product &	-Sugar tops /leaves	
-Local brewery by-products	Sugar cane tops/leaves	-Local brewery by-products	
	-Root crop leaves	-Molasses	
	-Local brewery by-products	-Milling by-products	
	-Molasses		
	-Milling by-products		

Sources: [6].

harvest of crops. The availability and quality of native pasture varies with altitude, rainfall, soil type and cropping intensity. The higher rainfall area of the pastoral zone is characterized by dense thorn bush of low carrying capacity. The basic types of grazing system are continuous grazing and rotational grazing [11].

Conserved Pasture Forage: Preserving of forage is a means of distributing forage throughout the year and is usually in excess during spring and early summer and in deficient for the rest of the year. So forage conservation is desirable to provide feed during the dry season. Conserved pasture forage can be categorized in to standing hay, harvested hay and silage. Oat, barley and wheat plant materials are occasionally cut green and made into hay for animal fodder; however they are more usually used in the form of straw, a harvest by-product where the stems and dead leaves are baled after the grain has been harvested and threshed. Straw is used mainly for animal bedding. Although straw is used as fodder, particularly as a source of dietary fiber, it has lower nutritional value than hay [12].

Crop Residues: 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, down 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 [11].

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 wire. Bales may be square, rectangular, or round, depending on the type of baler used Tesfaye and Chairatanayuth [13].

Agro Industrial by Products: By-products from sugar: The sugar industries in Ethiopia have factories at three sites (Wonji, Shoa and Methara). The present area of cane is 13,000 ha and the estimated yield of cane tops is 6 tones dry matter per hectare or 78,000 tones dry matter per year. Production of molasses in 1981/82 was 51,100 tons of which 29,000 tones were exported.

At present the use of a molasses/urea mixture as a drought-relief feed has been started in a pilot scheme run jointly by the Ministry of Agriculture, the Ministry of State Farms and ILCA [14].

Oil-cake: Oil cakes are an excellent concentrate feed for ruminant livestock in Ethiopia which grows most of the temperate and sub-tropical oilseed plants such as linseed, groundnuts, rape, sesame, sunflower, cotton and Nug. Nug is a native annual composite, which produces Niger seed for oil, is also grown. The processing factories of oilseeds is widely practiced on a family basis or in small village mills [11].

Milling by-Products: The various milling by-products obtained through processing wheat, corn and barley are of great interest as livestock feed for state farms, city dairy holders and to a lesser extent for some dairy co-operatives. Wheat grain is processed in big mills, whereas in the case of teff, barley, maize and sorghum the whole grains are processed and used for food [11].

Slaughter Product: Large numbers of livestock, mainly cattle, sheep and goats are slaughtered every year of these, only a small proportion of the cattle are slaughtered in abattoirs with processing facilities. Addis Ababa Municipality, which is responsible for the abattoirs, produces meat, bone meal and blood [14].

Brewery by-Products: Brewer's grains are traditionally valued for lactating cows because of their palatability and milk-producing property. In addition to commercial beer production at the more than nine breweries are practiced in the country [11].

Constraints of Livestock Feed Resource

Feed Quality and Quantity: Natural grazing is the major 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. In the highlands with the rapid increase of human population and high demand for food, pastures are steadily being converted to farmlands. 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 [15].

Ecological Deterioration: 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 grazing land 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 [16].

Pastoralism is becoming less and less possible and a riskier business. Since the ecosystem is very fragile, the abuse and mismanagement of resources has created severe problems for people in grazing lands; indigenous people who are adapted to live in the dry lands are facing an ecological crisis [2].

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 [17].

Drought: One of the most unfortunate characters of Ethiopia's climate is great variability and erratic rainfall from year to year. 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 [18].

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 [3].

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 coupled with environmental heterogeneity offers suitable environments for a wide range of life forms, like variety of pasture species of herbaceous legumes, browse trees/shrubs [3].

Biodiversity Conservation: Conservation and use of grass germplasm 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 (ILCA) 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 [19]. 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 [20].

Integration of Pasture and Forage into Farming Systems: 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. Since fallowing cropland is common in the highlands, under-sowing cereals with forages could significantly relieve the feed problems of the area [3].

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

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 [2]. 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. Large local seed production is under way using farmers' contracts [21].

Irrigation: The irrigation potential of the country is high; the potential area for irrigation is estimated to be about 3,000,000 hectares. 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 [3].

Better Grazing Land Resource Management: At every point of resource management, community knowledge and participation, from the beginning to the end through evaluation and monitoring is vital. 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 to monitoring and evaluation undertaken the program [3].

Improving Poor Quality Roughages: 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 [6].

CONCLUSION AND RECOMMENDATIONS

Above 85% of the Ethiopian population live in the rural area and their economy depends on crop-livestock production system. 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.

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