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Feeds and Feed Resources Management of Small Holder Farmers with Opportunities for Utilization in the Farming Systems of Ethiopian

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Abstract: Ethiopia has diverse climate: arid, semi arid, highlands and sub-humid. The lowland area is dominated by arid and semi-arid climate where residents mainly are pastoralist. Livestock population is high resulting stocking rate far below the globally estimated carrying capacity and is reflected in low animal productivity and degraded natural resources. Seasonal rainfall distribution influence pasture production, which is in excess during the rain season and scarcity in the dry season. Requirements can be met by preserving wet-season herbage and residues of crops. It should be pointed out that there is a considerable opportunity for increasing pasture production and back-upping by available non-conventional feedstuffs. Farmers have some indigenous knowledge built through traditional experience: use non-conventional feed supplements which nothing was said about and are used differently in different localities. Regarding crop residues and agro-industrial by-products, appropriate technologies for improving their contribution to improve the nutritional values of available feed resources over seasons should be emphasized.

Key word: Grazing · Natural Pasture · Crop Residues · Feed Resources · Agr-Industrial Byproducts · Ethiopia

INTRODUCTION

Ethiopia has a total agricultural land area of about 18 million hectares operated by 17.1 million agricultural households [1] with diversified agro-ecological environment (in arid, Mid and high altitude areas). These diverse agro-ecology comprises the arid, semi-arid, sub-humid and the high lands area that cover about 48%, 8%, 6% and 38% of the total agricultural land area of the country respectively [2]. The highland area is characterized by higher annual rainfall, relative low mean temperature during growing periods, crop production particularly cereal cultivation and mixed crop livestock enterprises. In the other hand, the lowland area is dominated by arid and semi-arid climate where more than 90% of the residents are pastoralist. Households who base their living on agriculture 3% reside in urban areas whereas the 97% live in the rural (Table 1). With regard their holding 18% rely on crop only (where 98% dwell in rural area and 2% in urban), 8% on livestock only (where 83% dwell in rural area and 17% in urban) and the rest 74% on crop-livestock mixed production system (where 98% dwell in rural area and 2% in urban).

The ecological diversity rendered the country to possibly support both livestock production and animal agriculture which is an integral part of the farming system in almost all ecological zones. Livestock in the highland mixed crop-livestock production system plays great role as a source of income, encompasses about 75% of the agricultural households of the country at large and in the low land pastoral area as a sole source of livelihood accounting greater than 60% of the household revenue [2]. Table 2 is an indicative with regards to the importance of ruminant livestock to the rural subsistence farmers in the country where the majority of the herd is owned in the rural areas (98% of the cattle, sheep and goats population; similarly 99% of the horses and mules, 98% of the donkeys and camels).

Livestock production in Ethiopia by small farmers is based entirely on nothing but grazing the natural pasture throughout their life time, which account about 10% of the land holding of the farmers (Table 3),

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Table 1: Size of the population in agricultural households: type of holding and residence area

Residence area	Type of holding			Total holder	Household members other than holders	Total population in agricultural households
	Crop only	Livestock only	Crop & livestock			
Rural	1,982,943	785,189	8,370,757	11,138,991	41,521,931	52,660,922
Urban	49,041	163,382	156,029	368,451	1,518,706	1,887,157
Total	2,031,984	948,571	8,526,786	11,507,442	43,040,637	54,548,079

Source: [3]

Table 2: Estimated ruminant livestock population in Ethiopia

Livestock category	Population size	In rural area	In urban area
Cattle	59,500,000	58,200,000	1,300,000
Sheep	30,700,000	30,000,000	700,000
Goats	30,200,000	29,800,000	400,000
Horses	2,160,000	2,130,000	30,000
Donkeys	8,440,000	8,310,000	130,000
Mules	410,000	400,000	10,000
Camels	1,210,000	1,190,000	20,000

Source: [4]

Table 3: Land-use distribution in rural and urban areas for private holdings in Ethiopia

Land use category	Area in hectares		
	Rural area	Urban area	Total
Temporary crops	12,787,808	219,515	13,007,323
Permanent crops	1,461,506	52,172	1,513,678
Grazing land	1,886,030	---	1,886,030
Fallow land	590,271	---	590,271
Wood land	285,344	---	285,344
Other land use	821,378	---	821,378
Total	17,832,337	271,687	18,104,024

Source: [1]

where the management requires a complex process. The grazing management, however, is often difficult for the livestock herders, particularly because of a lack of knowledge about grass availability and quality. No question that grazing is the most economical feeding scheme for ruminant animal herders in the country. Productivity from grazing pasture depends highly on the trade-off between available soil moisture, fertility and land-escape. Inadequate moisture restricts pasture growth and grazing animals may not be able to harvest sufficient herbage to meet their needs, the major cause of poor livestock productivity.

The total livestock population presented in Table 2 is equivalent to 55,187,000 tropical livestock units (TLU) which gives a stocking rate of about 0.03 hectares of grazing land per tropical livestock unit. This value is clearly far below the globally estimated carrying capacity and is reflected in the existing low animal productivity and degraded range condition. The TLU is predicted according to [5] and [6] prediction value.

Another important feature of Ethiopia's natural pastures is the relatively low nutritive value for most of the year. In general, the basic feed resources of the tropics are characterized by poor nitrogen content and high structural carbohydrate content [7]. Hence, chronic deficit of energy may become the prime limiting nutritional factors for ruminant livestock production due to competition for forage within the population throughout the year, not just in dry season. However, livestock store protein and energy in wet period (relatively favourable period for the pasture growth). Many forage species grow very rapidly as soon as the rains commence in early wet season (starting June in Ethiopia). At this time leaf production is high and crude protein content and digestibility are satisfactory. By the end of the wet season, the plants develop tall flowering stems which are low in protein and high in fibre. These conditions place severe restrictions on livestock production and animal may lose both protein and energy reserves from their body in the dry season, which can be extended for about

seven months. This is due to the fact that, during dry season of a year, crude protein content and digestibility of the feed resources decline to level below maintenance [8] and [2]. That is, ruminants in this country feed mainly on poor-quality plant material, on natural rangelands or pastures as well as on bushes, trees and crop residues.

The present paper objective is to discuss some of the strategies that could be used to minimize the problem thereby improving overall livestock production throughout the year, with particular emphasis for dry season.

MATERIAL AND METHODS

This study is based on a series of tasks (collection of both secondary and primary sources of information) to gather information targeted on either mixed crop livestock, peri-urban, agro-pastoral or pastoral livestock production systems.

A diagnostic assessment of information (data) from the Central Statistics Office was done to collect recent secondary information of the country. The information collected were with regard to population density, average land holding, average livestock holding, farming system, importance of livestock in the farming system, feed resource condition, etc.

Similarly, selected district agricultural bureaus were visited and similar issue was interviewed and representative peasant associations were selected for informal survey. The informal survey, participatory rural appraisal (PRA), was employed for group and individual (key informants) interview. Purposive samples comprising: elders, educated, rich, poor, medium, female-headed household, livestock package users were interviewed in group.

Four districts were selected for natural pasture study. This selection was based on the importance & share of natural pasture from all other feed resources.

RESULTS AND DISCUSSION

Pasture Production Pattern in Ethiopia: Pasture production is usually related to seasonal rainfall distribution which in Ethiopia is restricted to only a few months of the year (forage is usually in good supply during the rainy season). Consequently livestock owners who rely exclusively on pastures experience periods of excess forage in the rain season followed (proceeded) with periods of scarcity in the dry season (an extreme shortage in the dry season). In order to sustain uninterrupted livestock production, the livestock owners should be able to adjust to this fluctuating feed supply. To some extent this could be achieved through seasonal disposal and purchase of livestock. While the dry season feed deficit could be improved by a number of measures: in the highlands, cereal straw and natural hay are the most important roughages. In the mixed farming (crop-livestock) system, haymaking is traditional. Off-season requirements can be met by preserving wet-season herbage and residues of crops. Inadequate nutrition is compounded by lack of proper technology for haymaking and storing residues.

Irrigation Practices: Pasture production can be practiced in the dry season through irrigation, which is currently none in the farming community. However, the country has appreciable potential to produce diverse grass and legume species through this system of production. Research results from the country, through irrigation, showed that the yield and the feed value of the grasses and the legumes considerably enhanced livestock production. Hence, it will be noble to facilitate farmers use irrigation for forage production as far as their situation allow. It is only 63,170 ha of land, 0.7% of the total cultivated area, being under irrigation in the country of which 66.2% for temporary crops (32.6% covered by maize which is followed by sorghum 17.3%) and the remaining 33.8% for permanent crops (33.2% covered by chat (*Catta edulis*) and followed by fruit trees 20.7%) [9].

Fertilizers Use: Of all imputes used for farm, fertilizer is the most important (fertilizer applied on 3.4, pesticide on 0.4, improved seed on 0.2 and irrigation on 0.06 million hectare of cultivated land). In the year 1998/99 cropping season, the fertilizer used for temporary crops accounts 92.3% and permanent crops 7.7% of the total fertilizer applied [9]. This indicates that fertilizer is being in use for food crop production of which the bulk is being used for annual crops. This could possibly be because of the cost in which pasture fertilization may appear unattractive. Hence, possibilities for strategic application of whatever quantities of fertilizer, as far as economically feasible, for better pasture production should be geared.

Use of Drought-Tolerant Species: Pasture species capable of growing out of season can be planted to prolong the period of good-quality forage, through understanding their agronomic characteristics and adaptability to the local environment. Drought-tolerant legumes can be particularly useful in this regard. They can

Table 4: Area and production of annual crops in farm holdings, Ethiopia

	Rural area		Urban area		Total	
Crop type	Area (ha)	Production (qts)	Area (ha)	Production (qts)	Area (ha)	Production (qts)
Cereals	7,074,875	90,696,238	112,514	903,478	7,187,389	91,599,716
Pulses	1,166,906	10,927,603	11,301	48,486	1,178,207	10,976,089
Oil seed	430,245	2,081,357	7,922	33,195	438,167	2,114,552
Vegetables	88,600	3,726,249	1,985	37,529	90,585	3,763,778
Root crops	262,557	18,681,218	3,197	89,893	265,754	18,771,111
Total	9,023,183	126,112,665	136,919	1,112,581	9,160,102	127,225,246

Source: [3]

Table 5: Area and production of permanent crops in farm holdings, Ethiopia

	Rural area		Urban area		Total	
Crop type	Area (ha)	Production (qts)	Area (ha)	Production (qts)	Area (ha)	Production (qts)
Fruit crop	34,582	1,907,352	2,198	134,165	36,780	2,041,517
Stimulants*	358,348	2,614,778	14,899	113,893	373,247	2,728,671
Other**	11,775	783,803	1,233	206,987	13,008	990,790
Total	404,705	5,305,933	18,330	455,045	423,035	5,760,978

* Chat (*Catta edulis*) (26.15%), coffee (68.73%) and hops (5.12%)

** Sugarcane

Source: [3]

benefit ruminants through their high productivity, high protein content and high mineral status. Besides being important as dry-season feeds, they can offer a variety of domestic uses. In this regard, shrub legumes and grass species that have been successfully established around homesteads needs to be investigated further.

Conservation of Excess Forage as Hay and Standing Hay: The production of hay from natural pasture (which accounts 64% of the feed resources) as well as improved pastures can be an easy and cheap method of conserving forage, cultural practice in Ethiopia farming. Its present lack of popularity emphasizes the need for more research on the quality of the various forage species available, appropriate techniques for cutting, drying and storing the hay and the socio-economic viability of such technologies.

Forage can also be stored as standing hay in a place where a decline in quality can be tolerated, mostly practiced in pastoral and agro-pastoral production system. This is generally the cheapest way of conserving forage. Standing hay may be conserved, usually on fenced grazing land, by leaving areas un-grazed during the preceding part of the growing season. It can then be utilized during the dry season when forage from other areas is no longer available in adequate quantities. Even on ranches, certain areas could be reserved during the growing season and grazed later.

Crop Residues: Across the country, in the dry season, natural pasture is dry and of little nutritive value for many months of the year. In the dry season proper, when the standing grass is mature and dormant, the grazing comprises mostly hard-to-digest fiber with low protein content. Even this material is in short supply in periods of drought. Following the harvesting of grain, two to three months into a dry season, livestock in mixed crop-livestock farming systems might also feed on cereal straws, stubble or other leftovers such as maize stover, which most have a nutritional value similar to that of mature natural grass. If available, smaller quantities of crop residues from leguminous crops, which have a greater nutritional value than cereal residues, may be used as protein supplements.

A wide variety of arable crops is grown on subsistence farm holdings. Many of these crops have residues which can form an important source of livestock feed, accounts about 14% of the feed resources. Yields of some of the common crops grown are presented in Tables 4 and 5 respectively. The contribution of such residues holds remarkable amount to total available feed resources where cereals cover the largest share of the cropped land, followed by pulses and others (Table 4).

Yields of cereal crop residue may be expected to vary depending on season, inputs and skill of the farmer. The potential and abundance of crop residues that could be used for livestock feeding in Ethiopia for the

year 2003, drown from Table 4, using multiplier [10-12] is 13,739,957.4 ton (13,604,435.7 ton in the rural area and 135,521.7 ton in urban areas) from cereals having CP value ranging from 3.1-6.7% with digestibility level about 40.7-54.1% and 1,317,130.7 ton (1,311,312.4 ton in the rural area and 5,818.3 ton in urban areas) from pulses having CP value ranging from 5.7-14% with digestibility level about 34.4-52.3%. They are suited for all classes of livestock in the country according to their nutritional characteristics.

Nutritional Characteristics of Some of the Feed Materials Which Can Be Used as Livestock Feed in Ethiopia. [13]

Cereals: This include, Teff straw (CP 5.2% and digestibility 53.2%), Barley straw (CP 6.0%, digestibility 48.03%), Wheat straw (CP 3.8% and digestibility 45.5%), Oats straw (CP 6.7% and digestibility 40.7), Maize stover (CP 3.9% and digestibility 52.6%), Sorghum stover (CP 3.1% and digestibility 54.1%).

Opportunities for improving the quality of dry cereal crop residues through treatment with chemicals such as urea, NaOH and NH_3 could be investigated in the country.

Whenever available, grain legumes such as groundnuts and beans should provide good-quality roughage after the crops have been harvested.

Pulses: Pulses are used as forage or fodder for livestock feeding. This include, Horse bean straw (CP 5.7% and digestibility 34.3%), filed peas (CP 7.3% and digestibility 44.4%), chick peas (CP 6.0% and digestibility 52.3%), lentils straw (CP 14.7 and digestibility 65.4%), vetch (hay CP 18.2%), haricot bean (CP value of haulm 6.3%; seed 25.5%),

Oil Seed: Oil seeds are palatable to all classes of livestock. This include, noug cake (CP ranging 34.1-36.9%), linseed cake (CP ranging 30.1-36.0%), rape seed (cake CP 32.1%; seed CP 19.3%), ground nut (cake CP ranging 33.5-55.7%; skin CP 12.1%; hull CP 4.9%; germ CP 3.0%), sun flower (cake CP ranging 26.7-42.7%; deseeded head CP 10.1%; hulls CP 20.0%), sesame cake (CP ranging 35.6-44.0%).

Vegetables: The most important vegetables grown in Ethiopia local farms include potatoes, cabbages, tomatoes and onions. The non-marketable parts of potatoes and cabbages can provide feed of high value compared to dry-crop residues. However they are difficult to store and would therefore be more suitable for daily feedings.

Vegetables use has no special limitation for ruminants, particularly leaves can be fed to all classes of livestock (CP value ranges 20.0-24.8%).

Root crops, particularly the surplus and culls, are suitable tubers which are highly digestible and are excellent source of energy with CP value ranging from 12.1-19.4 for the leaves and 10.3-12.7% for the tuber and digestibility 83-91.4%.

Fruit crops CP ranging from 5.4-11.1%, stimulant such as coffee pulp (CP 9.7% and digestibility 40.9%) and other such as sugar cane whole (CP 9.0%), stalk (CP 6.9%), cane tops (CP 6.3%), cane tops leaves (CP 5.9%) and digestibility on average 60%. The sugarcane tops could form an important feed source for animals raised around sugarcane growing areas. Similarly molasses is another feed which ought to be used very extensively.

The Chat (*Catta edulis*) browse CP is about 7.4% and Digestibility 33%: Citrus wastes may be regarded as high-energy feed for livestock. They are high in sugar, low in protein and fairly high in fibre. These types of waste products are at large quantity in factories, but they are largely thrown away due to the lack of appropriate technology and economic methods of utilization. Suitable methods of conservation could be devised. Otherwise should be used for immediate consumption.

Agro-industrial By-Products: Potential agro-industrial by products for livestock feeding includes molasses, bran and oil-seed cake, accounts about 9% of the total feed resources. These could be used to supply energy and protein in conjunction with poor-quality forage in the dry season. Oil-seed cakes are potential for making good-quality animal feed.

CONCLUSION

It should be pointed out that there is considerable opportunity for increasing pasture production and the availability of non-conventional feedstuffs in Ethiopia. Even though farmers were unable to up-root the long-lived poverty through their own ways of problem identification and amelioration techniques and their traditional production system, they have some indigenous knowledge built through traditional experience. For instance in some areas farmers use non-conventional feed supplements for oxen, lactating cows, calves, sick animals and for the whole stock during the season of feed shortage. The non-conventional feeds are essential with the main emphasis on the unknown

feeds for which nothing was said and are used differently in different localities.

Yield improvement can be effected through bold policies such as destalking in places where severe degradation noticed, fencing for efficient utilization of resource and bush clearing in places where bush encroachment is a major problem (particularly in the rangeland of the Southern part of the country). Planted pastures need considerable inputs such as fertilizers and, although the economics of such undertakings have often been questioned, the possibility of strategic application of small quantities could be explored. The inclusion of both herbaceous and shrub legumes in the cropping systems can significantly cut such production costs. All grains grown in the country are primarily for human consumption. However, their byproducts (bran, midlings, etc) have a high feed value, though are costly. They can contribute significantly to animal output. Considerable opportunities also exist for the use of crop residues and agro-industrial by-products. What is needed is a comprehensive inventory of the feed sources coupled with appropriate technologies for improving their nutritional values.

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