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Review paper

Characterization of Beef Cattle production Systems in tropics, the case of Ethiopia.

***Getachew BF[1, 2*] and Keredin M[1]**

[1*]Department of Animal Production and Technology, College of Agriculture and Natural Resource, Gambella University, PO Box 126, Gambella, Ethiopia,
[2*]Addis Ababa University, College of Veterinary Medicine and Agriculture, Department of Animal Production, P O Box 34, Bishoftu, Ethiopia.

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The diversity of Ethiopia's topography, climate and cultural conditions make it difficult to generalize about livestock production systems in the country. Therefore, this review was conducted to show characterization of beef cattle production systems. Livestock have diverse functions in the livelihood of farmers in the mixed crop–livestock systems in the highlands and pastoralists and agro-pastoralists in the lowlands of Ethiopia. They are a source of income, which can be used by rural populations to purchase basic household needs and agricultural inputs. In the rural areas of many developing countries, financial services such as credit, banking and insurance are virtually non-existent. Cattle fattening, is dependent up on the development of forage resources. Fattening techniques relies on a minimum time of three months up to a maximum of about 18 months to 2 years. The length of the period depends up on the characteristics of the animals used and the food resources available. So that based on feeding regimes and the nature of the main products used, fattening operation could be classified in to three systems.

Key words: beef, fattening, feed, livestock, production system.

INTRODUCTION

The diversity of Ethiopia's topography, climate and cultural conditions make it difficult to generalize about livestock production systems in the country. Numerous authors used different criteria to classify livestock production systems in Ethiopia (Mohammed *et al.*, 2004). However, about five production systems have been identified based on integration of livestock with crop production, level of input and intensity of production, agro-ecology and market orientation. The following systems have been defined viz. pastoral, agro-pastoral, mixed crop-livestock farming, urban and peri-urban dairy farming and specialized intensive dairy farming systems (Mohammed *et al.*, 2004).

The potentials for increased livestock production and the productivity is proportionally lowered by various livestock management problems, prevalence of major endemic diseases, poor feeding and high stocking rate on grazing lands, lack of support services such as extension services, veterinary services, insufficient data to plan improved services and inadequate information on how to improve animal breeding, marketing, and processing (Kedija *et al.*, 2008).

Accordingly, existing range-livestock management practices and the perception of the farmer and pastoral communities towards rangeland degradation and deterioration were important, as this will provide the way for designing different rangeland interventions to be undertaken in the area to enhance the livestock productivity. Identification of overall management activities with their constraints and opportunities associated to cattle production and marketing are preconditions for designing suitable cattle production development strategies (Heffernan, 2004). In general cattle husbandry and marketing practices has not been studied in the study area. Thus it is not possible to improve the benefit gained from live animal, meat, milk, skin and other products from indigenous cattle. Therefore the objective of this paper was to review on characterization of beef cattle production systems and

*Corresponding Author: E-mail: gechobek@gmail.com

constraints in tropics the case of Ethiopia and generating data to develop crucial information.

Beef production system in Ethiopia.

Livestock have diverse functions in the livelihood of farmers in the mixed crop–livestock systems in the highlands and pastoralists and agro-pastoralists in the lowlands of Ethiopia. They are a source of income, which can be used by rural populations to purchase basic household needs and agricultural inputs. In the rural areas of many developing countries, financial services such as credit, banking and insurance are virtually non-existent. In these areas, livestock play an important role as a means of saving and capital investment, and they often provide a substantially higher return than alternative investments. The cattle population is Ethiopia was estimated to be 59.5 million among which 99 % were local cattle and 1 % were cross breeds (CSA, 2017). Cattle are a very common asset in Ethiopian households and 70 % of the total population depend on cattle for their livelihoods and the country produces about 1million tons of beef per year valued at USD 5.1 billion (ASL, 2018). The annual contribution of ruminants to meat production in Ethiopia was estimated to be over 3.2 million tones representing over 72 % of the total meat production (Issack et al., 2017), from which beef accounted for over 70 % of the total red meat production and over 50 % of the total meat output in Sub-Saharan Africa (Wabalo and Anja, 2018). According to Bachewe et al. (2017) in Ethiopia the consumption expenditure on Animal Source Foods (ASF) increased by 13.4 % in 2011 from which beef accounted for 42 %. Bachewe *et al.* (2017) noted that the value of exported of meat products increased from 18 million USD in2005 to 107 million USD in 2015 due to the increase in international livestock trade.

Cattle in Ethiopia are almost entirely of the zebu type and are sources of milk and meat. However, these cattle do relatively well under the traditional production system. About 70 % of the cattle are in the highlands, and the remaining 30 are kept by pastoralists in the lowland areas (Solomon *et al.*, 2003).

Cattle production details including husbandry practices, feed resources, purposes of keeping cattle, production systems and environments interacting under smallholder settings required for improving productivity and profitability of the cattle were not properly studied in different parts of the country (Alemayehu *et al.,* 2000). Similarly, cattle and cattle product markets and marketing situations crucial for enhancing incomes and livelihood of the smallholder livestock keepers were also not described in various parts of the country (Solomon *et al.*, 2003).

Cattle production systems differ markedly due to differences in resource endowments, climate, human population, disease incidences, level of economic development, research support and government economic policies (Devendra and Thomas, 2002).

Beef cattle fattening in the tropics.

Beef cattle fattening is a common practice in Ethiopia and special attention was given bythe government to boost red meat supply through cattle fattening (Agmas and Adnan, 2018). Accordingly, cattle fattening is an increasing business at different scales in Ethiopia. Various research activities in cattle fattening have been conducted over the years to fill the production gaps, identify the challenges and opportunities of cattle fattening and support needs of the sector.

Grass fattening.

This system is still the most widely practiced. It consists of reserving the best pastures for the animals destined for slaughter and giving them the most attentive care during the space of time necessary to reach the live-weight required. Feeding is basically forage with, sometimes, a small supplement of mineral or concentrate. There is no specialized beef cattle breeds and production systems in Ethiopia like that of commercial/intensive cow-calf, stocker and finisher beef production systems found in USA, Australia, Canada and other European countries (Agus and Widi, 2018). In Ethiopia cattle breeds are multipurpose type with majority found in the mixed crop-livestock production system (Gebremariam et al., 2013). The commercial feedlot system, peri-urban small-scale fattening, backyard fattening in the mixed crop-livestock system, the pastoral/agro-pastoral livestock production system were the existing production systems identified based on the level of input, source of animal, feed resources and marketing conditions (Gebremariam et al., 2013; CSA, 2017).

Intensive fattening.

In this system, the animals are confined in feedlots or pens and receive in the trough a completely balanced ration of forage, concentrate feed or diverse agro-industrial by- products. The duration and cycle of cattle fattening vary depending on the quality and availability of feed, management system, breed type, body condition as well as seasonal fluctuations of market demand due to religious and other holidays in the year. According to the study conducted by Beyene and Fufi (2017) in Guduru and Hababo Guduru districts of Oromia region, the majorityof the duration of fattening were3 – 4 months (September – December) while, 5 – 6 months (December – May) wereless in percentage. Wabalo and Anja (2018) in Dermot Pullassa district, Southern region showed that the length of fattening period <3 month accounted for 30 %, 3 – 6 months accounted for 50 % and >6 month accounted for 20 %. Guyon (2016) indicated

that body condition of the animals was the most common criteria used to decide the length of fattening period and it took 3, 5 and6 months in the mid altitude, lowland and highland agro-ecologies, respectively. Cycle of fattening animals was once peryear (highland), twice per year (lowland) and thrice per year (mid-altitude).

Fattening practices in Ethiopia.

Beef fattening in traditional systems.

Cattle are kept mainly for draft power, milk, and manure production and are usually only sold when they are too old for these purposes, or drought or cash shortages force people to sell. Oxen are usually sold after the plowing season when they are in poor condition.

Meat yield are low, the beef is poor quality and farmer returns are often inadequate to buy a replacement ox. There is obvious scope to improve this traditional and inefficient system through strategic feeding of good quality forage to fatten animals before they are sold, or to buy and fatten animals sold by others.

In the lowland, where pastoralists do not use cattle for draft and sometimes fattened on natural pasture in good seasons, however much body weight is lost during long distance trekking to Addis Ababa and the animals may reach market in little better condition than culled highland stock. In average or poor seasons, lowland cattle are rarely fattened and often have to be sold in poor condition at low prices.

These traditional systems are very inefficient because they do not use the proven opportunity to add weight and condition to cull animals before slaughter. Several improved systems are in use, but none of them are widespread yet.

Beef Fattening on Product-Based.

The high demand of animal products and the establishment of various agro-processing plants and huge industrial parks for processing and sale of processed livestock products, the expansion of urbanization, peaceful political relationship among east African countries and middle eastern countries will open an excellent market opportunity (NEPAD, 2013; Wolde et al., 2014; Weldesilassie et al., 2017). Especially with the two-decade-long cold war between Ethiopia and Eritrea ending and signing of a peace agreement in July 2018 and the reopening of tradeties (IFPRI, 2019) will have a positive economic impact.

The development of certain crops, such as sugarcane, cotton, and oil palm, leads to the establishment of industrial processing activities (sugar refineries, cattle cake factories, oil mills) which generate byproducts, which can be used for livestock feeding (Pagot, 1992).

The Hararghe fattening system.

Intensive feeding of the available feed supply to young oxen they are using for draught power could best describe the Hararghe fattening practice. The feed types used for the fattening are entirely obtained from crop production especially from maize and sorghum. Pagot (1992) substantiated that in Ethiopia the farmers fatten young bullocks at the edge of the fields with lower leaves taken from the stems of sorghum. Among the most common feed types used for fattening, thinning, leaf strip and part of maize and sorghum plants are major feeds offered to fattening animal during the main and early dry seasons.

This tradition is seasonal undertaking to utilize seasonally available feed. During abundant feed supply, the animals are offered in ad libitum. Farmers extend animal's day time feeding up to nighttime and supplement the animal with common salt or locally available mineral licks twice a week.

Meat consumption in Ethiopia

According to Abbey (2004), many Ethiopians, like other developing countries, do not consume adequate amount of meat. The few that do, however, maintain a meat diet of beef, sheep, goat, and poultry. In 1987, 51% beef, 19% sheep, 14% goat and 15% poultry contributed to a meat diet composition. Most Ethiopians do not consume pork, in addition to many types of fish, due to religious factor. Consumption of sufficient meat is a rare extremity in most developing countries. Developed countries consumed a consistent level of 77 kg of meat per capita annually, while developing countries struggled to maintain a diet with only 25 kg of meat per capita annually. Ethiopians remained slightly below the meat intake of all low-income countries and consuming 9 kg per capita annually (Abbey, 2004). According to the development roadmap (2015/16–2019/20) regarding red meat /milk and cattle feedlot systems in Ethiopia include various challenges. The challenges related to feed include poor quality of grazing lands, lack of knowledge of better use of crop residues and poor availability of concentrates and other feed supplements.

Challenges related to genetic potential like use of inferior bulls for breeding, low genetic improvement extension coverage, poor recording scheme, inadequate local semen collection and processing and AI delivery (Shapiro et al., 2015). Concerns related to animal health services at production level include poor animal health extension advice, inefficient animal health services, inadequate supplies and qualities of vaccines and drugs andpoor-quality control of drugs and supplies. The other concern is absence of policy. This include absence of breeding policy, the enforcement of land use policy, loss of land to alternative investments outside livestock and a need for protective trade policy (Shapiro et al., 2015).

Purpose of cattle rearing.

The potential of livestock to reduce poverty is enormous. Livestock contribute to the livelihoods of more than two-thirds of the world's rural poor and to a significant minority of the peri-urban poor. The poorest of the poor often do not have livestock, but if they can acquire animals, their livestock can help start them along a pathway out of poverty. Livestock also play many other important roles in people's lives. They contribute to food and nutritional security; they generate income and are an important, mobile means of storing wealth; they provide transport and on-farm power; their manure helps maintain soil fertility; and they fulfill a wide range of socio-cultural roles (ILRI, 2002). Livestock in Ethiopia provide draught power, income to farming communities, means of investment and important source of foreign exchange earning to the nation. Of the total household cash income from crop and livestock, livestock account for 37 to 87% indifferent parts of the country (Ayele *et al.,* 2003), and the higher the cash income, the higher is the share of livestock, indicating that increased cash income comes primarily from livestock, particularly in the pastoral areas.

Cattle provide traction power that is the single most important source of power in the overall farm power requirements. Cattle are kept for multiple purposes and the emphasis on use varies with the production system. In both crop-livestock and agro-pastoral systems, animal traction ranked first, followed by milk and reproduction. Manure production is also considered as a secondary important by-product by most crop-livestock and agro-pastoralist farmers. In contrast, in pastoralist systems, reproduction/breeding requirements received higher ranks and for female animals breeding outranked the importance of milk production (Workneh and Rowlands, 2004).

Cattle breed type.

Major indigenous cattle breeds of Ethiopia thus far identified are Sheko, Begayit, Boran (Borena), Abigar, Afar, Horro, Fogera, Arado, Jidu, Arsi and Red Bororo. In addition, very heterogeneous mixtures of Zebu sub-types (Black Zebu or Jem-Jem, short horn zebu and small zebu) have been described under the name Abyssinian Zebu (IBC, 2004). Furthermore, report by FAO (1999) indicates that the presence of zebu-sub-classes (Adwa, Ambo, Bale, Goffa, Gurage, Harar, Smada, Mursi and Hammer) cattle types in different parts of the country. About 99% of the cattle population in Ethiopia are indigenous that are adapted to feed and water shortages, disease challenges and harsh climates. The productivity of indigenous livestock is, however, believed to be poor even if no practical recording scheme at national level has been used to judge their merit. Crossbreeding has been practiced with encouraging results, however, a strictly controlled breeding program has not been practiced and there has been no dairy herd recording scheme at national level. Less than 1% of the 49.3 million cattle populations of Ethiopia are exotic or crossbred dairy cows (CSA, 2009).

In Ethiopia, genetic improvement of the indigenous cattle for dairy production, focusing on crossbreeding, has been practiced for the last five decades, albeit with little success. Selection as an improvement tool has been given less emphasis and as such there have been no systematic and organized selection schemes for cattle genetic improvement in Ethiopia. In addition, little or no genetic improvement work targeted at improving beef production has been undertaken so far. Therefore, there is a need to develop effective and sustainable genetic improvement schemes for indigenous cattle breeds of Ethiopia (Aynalem *et al.*, 2011).

Cattle feed resources and feeding management.

Livestock feed resources in Ethiopia are mainly natural grazing lands and browses, crop residues, forage crop and agro-industrial by products. Feeding systems include grazing or browsing on communal or private natural pasture and rangelands cut and carry feeding, hay and crop residues. At present, livestock are fed almost entirely on natural pasture and crop-residues. Using of improved forages and agro-industrial by-products is minimal and most of agro-industrial byproducts are concentrated in urban and peri-urban areas (Alemayehu, 2005). In the mixed cereal livestock farming systems of the Ethiopian highlands, crop residues provide on average about 50% of the total feed source for ruminant livestock. The contributions of crop residues reach up to 80% during the dry seasons of the year (Adugna, 2007). The availability of feed resources in the highlands depends on the intensity of crop production, population pressure, the amount of rainfall, and distribution pattern of rainfall and seasons of the year. Pasture growth is a reflection of the annual rainfall distribution pattern (Seyoum *et al.*, 2001). However, with the decline in the size of the grazing land and degradation through overgrazing and the expansion of arable cropping, agricultural by-products have become increasingly important (Alemayehu, 2004).

Seasonality in feed availability and lack of knowledge on feed conservation has created feed shortage both in the highland and lowland ecologies of Ethiopia. The population pressure and expansion of crop land calls for alternative ways of feed production, conservation and utilization. The seasonally surplus total dry matter biomass could be effectively utilized to support market-oriented ruminant production (Tesfaye *et al.*, 2010). The quantity of feed is inadequate in the dry season for the existing livestock, while there is surplus in the wet season. Cereal crop residues (straws and stovers) are mostly stacked and fed to livestock during the dry season when the quantity and quality of available fodder from natural pasture declines drastically (Getachew, 2002).The arid and semi-arid lowlands are characterized

by high spatial and temporal variability in rainfall distribution and pattern. Although there are general rainy and dry seasons, the rains may start at different times in different years, increasing irregularity and distorting the normal pattern.

Chances for prolonged dry spells at the end of the dry season and the beginning of the rainy season are very high. In such conditions meaningful crop production cannot be attained in rain-fed agriculture and extensive livestock production appears to be a better means of exploiting the grazing and browse resources in the arid and semi-arid lowlands. The semi-arid southern rangelands of Ethiopia support the livestock that are highly valuable to the nation as direct sources of consumption for the pastoral and agro-pastoral population, as sources of cash income and foreign currency for the nation and for provision of draught power for small-holders in the highlands (McCarthy *et al*, 2002). At present, the production of improved pasture and forages is insignificant and the contribution of agro-industrial by-products is also minimal and restricted to some urban and peri-urban farms (Alemayeu, 2005). The same author also indicated that in the past two decades, considerable efforts have been made to test the adaptability of pasture and forage crops to different agro ecological zones and several useful forages have been selected for different zones. Hay making is commonly used means of feed preservation technique in Ethiopia, which is expected to mitigate problems of livestock feeding during the dry period and therefore such experience is a good indicator that there are certain practices of efficient feed utilization. High quality hay can be defined as forage that is dried without deterioration and retaining most of its nutrients.

Animal housing.

Housing is very important for animals and the rearing system determines the kind of provision to be made. The housing systems of different livestock species in Ethiopia is predominantly open fenced barn that do not have roofing to shelter larger livestock; like cattle (except calves), camel and donkey during night time (Tesfaye, 2007).Animals were housed in open and closed type of houses (in house hold hut) depending on age and types of animal. Those young cattle and young and mature goats are housed separately in the family hut. It is constructed inside the family hut with wood and walled by a mud. However, mature cattle, young and mature camels were housed in the open field around their encampment by fencing it with available piece of thorn wood and different bush plants. This type of house is locally called as „*Mora'*. *Mora* and mud house are constructed with the main objectives of protecting the animals from predators during night time.

However, if the animals were sick, the enclosure was used to prevent movement of animals during day time. The herders believes that the major reason that the goats of all ages groups kept in the family house during night time is due to the fact that goats are not able to defend themselves from predators while other animals, cattle and camels, are able to defend themselves first by giving sign for their herders when predators come. Housing of animals is practiced only during night time and *Mora* cleaning performed by married women.

Cattle calves were housed in well-protected enclosures until they reach one month old. However, after one month of age, they are tethered in *Mora* on the day time and occasionally taken out to graze. During the dry season women sometimes cut grass and carry it home for calves. The more severely of the dry season, the more important this becomes. In case of camel calves, they are always kept in the *Mora* from the time of birth up to the time they go out for grazing after one month (Kedija, 2008) On the other hand, most of the farmers keep their calves and small ruminants in closed barns that had roof cover. Provision of closed barns for calves and small ruminants varies from place to place. Overall calves are most favored in getting roofed night time shelter followed by goats and sheep (Tesfaye, 2007).

Watering management.

Temporary surface water, ponds, rivers, streams traditional well *"Ellas",* hand dug wells like hand and solar pumps and bore holes are the main source of water for cattle in Ethiopia. In highland areas water sources of cattle is rivers, streams and temporary surface water both in dry and wet seasons. In all pastoral areas, temporary surface water and ponds are used in the wet seasons. Livestock watering frequency varies from season to season, species to species and accessibility of water sources. During the wet seasons most of the livestock are watered every 1-2 days. But during dry seasons cattle are watered every 2-3 days and camels every 3-5 days based on availability and accessibility of watering points. During dry seasons the pastoralist with their livestock travel more than 6-8 hours per day for looking of water source (CARE-Ethiopia, 2009).

Animal healthcare.

Animal health care and improved health management is one of the major constraints of livestock development in Ethiopia, which caused poor performance across the production system. Many of the problems result from the interaction among the technical and non-technical constraints. For instance, poorly fed animals have low disease resistance, fertility problems, partly because the animal health care system relays heavily on veterinary measures. Moreover, poor grazing management systems continue to cause high mortality and morbidity (e.g. internal parasites), many of the diseases constraints which effect supply are also a consequence of the non-

technical constraints, for example, insufficient money to purchase drugs or vaccines (Ibrahim and Olaloku, 2002).

Contact of livestock brought from various localities through the use of communal pastures and watering as well as marketing places play an important role in the transmission of economically significant infectious and parasite diseases. Such livestock movements could be the cause of direct or indirect transmission of various economically important livestock diseases (Zinash, 2004).

CONCLUSION

The potentials for increased livestock production and the productivity is proportionally lowered by various livestock management problems, prevalence of major endemic diseases, poor feeding and high stocking rate on grazing lands, lack of support services such as extension services, veterinary services, insufficient data to plan improved services and inadequate information on how to improve animal breeding, marketing, and processing. Cattle production details including husbandry practices, feed resources, purposes of keeping cattle, production systems and environments interacting under smallholder settings required for improving productivity and profitability of the cattle were not properly studied in different parts of the country. Cattle are kept mainly for draft power, milk, and manure production and are usually only sold when they are too old for these purposes, or drought or cash shortages force people to sell. Oxen are usually sold after the plowing season when they are in poor condition.

Meat yield are low, the beef is poor quality and farmer returns are often inadequate to buy a replacement ox. There is obvious scope to improve this traditional and inefficient system through strategic feeding of good quality forage to fatten animals before they are sold, or to buy and fatten animals sold by others. Feeding is basically forage with, sometimes, a small supplement of mineral or concentrate. Intensive fattening system, the animals are confined in feedlots or pens and receive in the trough a completely balanced ration of forage, concentrate feed or diverse agro-industrial by- products. Therefore, the following recommendations are forwarded for future action. Training about dairy cattle production system and constraints must be given for the livestock owners, choice of representative feed availability and climate stations for livestock enterprises, particularly in the arid and semi-arid regions must be considered, recordation of additional inputs to milk product marketing, especially in highly potential zed zones must be applied.

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