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Review paper

Review on Characterization of Dairy Cattle Production Systems and Constraints in tropics, in Case of Ethiopia.

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Livestock perform multiple functions in the Ethiopian economy by providing food, input for crop production and soil fertility management. Therefore, this review was conducted to show characterization of dairy cattle production system and constraints. Although total annual milk production in the country tends to increase, per capita milk consumption tended to decrease, and demand is not yet satisfied. For instance, per capita milk consumption decreased from 19 kg/year in 1980 to 17kg in 1993 and below 15kg in 2000 despite the estimated increase in annual growth rate in milk production from 1.7% during the period 1980-1993 to about 2.2% during the period 1994-2000. Inability to feed animals adequately throughout the year is the most widespread phenomenon. The most serious animal disease constraints to livestock productivity are the parasitic and viral diseases mainly vector-transmitted that have a wide geographic distribution and whose severities are strongly influenced by the environment. There are four major dairy production systems. The main source of milk in Ethiopia is the cow, constitute 83.4% of the total annual milk output.

Key word: Constraints, Dairy, Ethiopia, Milk, Production systems.

INTRODUCTION.

Livestock play a vital role in economic development, particularly as societies evolve from subsistence agriculture into cash-based economies. Livestock products are appealing and convenient sources of nutrients. Protein and micronutrient deficiencies remain widespread in developing countries because people subsist on diets that are almost entirely made of starchy staples. Livestock also serve as a source of income through sale of the items, animals, hides and skins. Although the livestock sector has a significant contribution to the national economy and food self-sufficiency, animal productivity in Ethiopia is extremely low (ILRI, 2000). Livestock perform multiple functions in the Ethiopian economy by providing food, input for crop production and soil fertility management, raw material for industry, cash income as well as in promoting saving, fuel, social functions, and employment. In Ethiopia livestock contribute 30-40% of Agricultural Growth Domestic Product (GDP), 16-20% of national GDP and 14-16% of foreign exchanges; however shortage of feeds, livestock disease, poor management practice, poor genetic improvement and lack of organized marketing system are the major constraint that hinder the profitable production of livestock in Ethiopia (Gebregziabhare, 2010). Currently the demand for dairy products in Ethiopia exceeds the supply and this is expected to induce rapid growth in the dairy sector (Haese *et al*., 2007). Factors contributing to this include rapid population growth, increased urbanization and income growth (Ahmed *et al*., 2004). Dairy products are traditionally used in Ethiopia and milk and its products are not consumed in enough volume. Although total annual milk production in the country tends to increase, per capita milk consumption tended to decrease, and demand is not yet satisfied. For instance, per capita milk consumption decreased from 19 kg/year in 1980 to 17kg in 1993 and below 15kg in 2000 in spite of the estimated increase in annual growth rate in milk production from 1.7% during the period 1980-1993 to about 2.2% during the period 1994-2000 (FAO, 2004).

In Ethiopia, dairy production is one of the sub of livestock production that contributes to the level of the owners through important sources of food and income; even though dairying has not been fully exploited and promoted in the country reported the average milk intake of Ethiopia is 17lt per capita which is below estimated standard for African per capita consumption. Milk production systems can be broadly categorized into urban (peri-urban) and rural milk production systems based on location (Redda, 2001 and Asrat *et al*., 2013), while based on market orientation, scale, and production intensity, dairy production systems can be categorized as traditional smallholders, privatized state farms, and urban and peri-urban systems (Ahmed *et al*., 2004). Earlier reports showed that the contribution of dairy sector to the total household income is substantial. Therefore, the objective of this paper was to review the characterization of dairy cattle production system and constraints of tropics in case of Ethiopia and generating data to develop crucial information.

Dairy cattle production and Constraints affecting milk production in tropics.

Climatic factors.

Numerous experiments have shown that a prolonged period in which temperatures are more than 25 ºC, particularly in humid air conditions leads to a reduction of dry matter intake by milking cows and, therefore, a drop in their production. The other similar study indicated that dairy cattle, like other warm-blooded animals, function most efficiently in environments where they can maintain their body temperature at around 38°C. Tissue and cellular metabolism and the underlying biochemical reactions that sustain life and productive functions need body temperature to be maintained within very narrow limits. Climatic condition, poor nutritional status and low level of management contribute to a high incidence of cattle diseases, especially in the crossbred cattle (Kumar et al., 2014b).

Feed resources.

Inability to feed animals adequately throughout the year is the most widespread phenomenon. Dry- season feed supply is the paramount problem. The feed shortages and nutrient deficiencies are more acute in dry seasons. Constraints occur in many different forms, but theory and evidence both suggest that binding constraints in most systems are often very few. They can be classified in different ways, but they range from bio-physical, resource and technical constraints to those associated with socio-cultural factors, infrastructure and policy (Ayele and Derek, 2011).This system of production does not permit a place for intensive forage production and has limited possibilities for improvement. In general, sedentary stockmen are agriculturalists and rarely exploit their Animals for milk, except when they are sedentary Pastoralists.

Disease.

Disease has numerous negative impacts on dairy production in various ways such as premature death, reduced body weight, fertility, reduced yield of milk and reduced capacity for work and almost all the diseases have severe effects on overall production efficiency of animals (meat, milk, skin and loss of power) (Mulugeta and Belayeneh, 2013).The most serious animal disease constraints to livestock productivity are the parasitic and viral diseases mainly vector-transmitted that have a wide geographic distribution and whose severities are strongly influenced by the environment.

Milk production system in Ethiopian.

Most of the researchers used different approaches at different time for the classification of livestock/milk production system in Ethiopia. Beyene (2004) identified four major dairy production systems, namely: Smallholder dairy farming system in the crop-livestock mixed farming system in the highlands; Urban and peri-urban dairy system found around and inside the big cities; Pastoral/agro-pastoral system in the lowlands; Parastatal large-scale dairy farms. Based on agro-ecology characterization of the area, socio-economic structures of the human population and the species of livestock and type of breed used for milk production, Getachew and Gashaw (2001) distinguished the Ethiopian milk production system in to five categories. These are traditional pastoral livestock farming, traditional highland mixed farming, the emerging smallholder dairy farming, urban and peri-urban dairy farming and specialized commercial intensive dairy farming. The importance of the small farm sector in agriculture is emphasized in the planning of the national economy (Asaminew, 2007). In accordance with this, the overall goal of meeting food self-sufficiency in the country includes plans for increased milk production, which is based on improvements in smallholder milk production system. About 93 percent of the total milk production in Ethiopia is produced by the smallholder dairy farmers living in the villages and exercising, in most instances, traditional dairy 10 productions are the main source of milk even though they are kept primarily as draught power source with very little or no consideration given to improving their milk production capabilities and focuses on butter production rather than fluid milk (Alemayehu et al., 2012).

Dairy cattle production under Pastoralism.

According to Zegeye (2003), Pastoralism **a**s a system mainly operating in the rangelands where the peoples involved follow animal-based lifestyles, which requires of them to move from place to place seasonally based on feed and water availability. For food, pastoralists mainly depend on milk, and their accumulated wealth and savings are in the form of live animals. Milk production under the systems is strictly seasonal and range condition-dependent being surplus in the wet season and restricted in the dry season. According Getachew and Gashaw (2001), the lowland accounts for 27% of the milk produced. Dairy production is practiced almost all over Ethiopia involving a vast number of small scales, medium scale and large scale farms The rural dairy system is part of the subsistence farming system and includes pastoralist, agro pastoralist and mixed crop-livestock producers (mainly in the highland areas). The milk produced is mainly used for home consumption and feed requirements are entirely satisfied from native pasture, crop residues, and stubble grazing or agricultural by-products (Adebabay, 2009).

Dairy Cattle production system in Highland smallholders.

Highland smallholder production system operates in most highlands of Ethiopia, with increasing population, there is an ever- decreasing share of pastureland for grazing; and with the corresponding increase in the cultivated area, there is a need to continuously produce more animal draught power. As a result, the rural farmers in these areas incorporate small-scale dairy production with crop farming with the objective of producing animal power (oxen) for tilling the land (Zegeye, 2003).As reported by Getachew and Gashaw (2001), the highland area can be regarded as a mixed farming system, in which crop and livestock are interdependent. The highland smallholder milk production using indigenous cattle is the predominant milk production system. Though most of the systems of cattle and milk production are composed of the local Zebu, very few of the nation’s crossbred cattle are believed to account for much of the milk production in the mixed farming system. Moreover, similar author added his idea as cattle constituting 72.4% of the total TLU, out of which cows (28%) dominates the other herd composition. On the other hand, 40-45% of the cow’s populations are on milk each year (Getachew and Gashaw, 2001).

Milk production system in per urban and urban areas.

Urban and peri-urban dairy production systems are among the many forms of dairy production systems prevalent in the tropics and sub-tropics. Farmers in peri-urban have small size of grazing land; they use semi-grazing systems and practice under stall feeding conditions for improved animals (Ayenew et al., 2008). Cattle graze on owned or rented land. The main feed resources are agro-industrial by-products, purchased roughage and in addition they use crop residue and pastureland (Belete et al., 2010). Special inputs are linked to the type of genotype and involve artificial insemination and supplementary feeds to grazing and stall-fed roughages (Yilma *et al.,* 2011). Existence of the urban and peri-urban dairy farming is mainly motivated by availability of good market filling in the large demand-supply gap for milk and milk products, need for creation of employment opportunities. Urban dairy systems in general are in cities and/or towns and focuses on production and sale of fluid milk, with little or no land resources, they used stall feeding practices (Ayenew et al., 2008). Type of feed commonly used in this production system includes purchased concentrates and roughages of conventional and non-conventional sources (Asrat et al., 2013). The primary objective of milk produced in pre-urban and urban is to generate additional cash income (Belete et al., 2010). They are main milk supplier to the urban market (Ayenew et al., 2008). Milk is either sold to dairy 9 cooperatives, on the local informal market or directly to consumers from the farmers’ gates (Azage et al., 2007). As compared to other systems they have relatively better access to inputs and services provided by the public and private sectors, and use intensive management (Azage et al., 2013). The production system is dominated by crossbred dairy cows and most of dairy product is characterized by market orientated and by the types of inputs particularly feeds. Although some farmers produce good quality milk, hygienic quality and composition of most milk marketed in such production systems is poor (Tsehay, 2002).

Dairy Cattle productive and reproductive under different production system.

Milk yield of Dairy Cow.

Zegeye (2003) also stated that cattle are the main source of milk even though very little or no consideration given to improve their milk production capabilities. Milk production potential of temperate breeds in the tropical environments is higher than the indigenous breeds. The average milk yield /day / cow from both pregnant (8.73 liter) and non-pregnant (11.4 liter) of pure breed Holstein-Frisians were reported by in Jima town. Ketema (2014) evaluated daily milk yield of crossbreed dairy cows was found to be 4.73±3 liters at kersa Malima woreda. Fikrineh et al. (2012) reported that the average daily milk yield of local cows was about 1.71 liters compared with about 8.95 liters from crossbred cows in the Mid Rift Valley of Ethiopia. Nardos (2010) also reported that the average milk production of local and crossbred cows in Mekelle city was about 2.5 and 13 liters, respectively per head per day. The proportion of exotic inheritance contributes to differences in lactation milk yield. Astudy conducted by (Zelalem et al

2011), the total average daily milk yield excluding the amount of milk directly suckled by the calf of local and Friesian x local cows was 2.8 ± 0.47 and 7.8 ±0.19 litres 22 per cow, respectively. Various factors contribute to variations in milk yield. These include feeding systems, breed, calving season, parity number, and effects of location (Gillah et al., 2012).

Dairy Cow Lactation length.

The average lactation length of crossbred cows in North Showa zone, Ethiopia was with 333.9 days (Mulugeta and Belayeneh, 2013), lactation length of crossbred dairy cattle in North-eastern Amhara Region, Ethiopia was about 241 days (Solomon et al., 2009), lactation length of crossbred dairy cows 331.57±12.77 days in Mekelle, Tigray (Kumar et al., 2014b), 188 days for Begait cattle in Western and central Zones of Tigray (Abraham, 2009) reported the average lactation length of cross breed cow was 240 days around in East-Shoa zone. The short lactation length might be due to the reason of poor nutritional status, poor breeding management, diseases and poor management practices (Belay et al., 2012).

Dairy cattle Age at first calving and Calving interval.

Under controlled breeding system, heifers are usually mated when they are mature enough to withstand the stress of parturition and lactation. This increases the likelihood of early conception after parturition. In traditional production systems, however, breeding is often uncontrolled, and heifers are bred at the first opportunity. This frequently results in longer subsequent calving intervals. Similar study indicated that average AFC was 47.61 and 40.46 months for Fogera and F1 heifers, respectively (Addisu and Hegede, 2003). Calving interval can be divided into three periods: gestation, postpartum anoestrus (from calving to first oestrus) and the service period (first postpartum oestrus to conception). The length of the postpartum anoestrous and service periods is sometimes also called the "days open", period and is the part of the calving interval that can be shortened by improving herd management. According to Gifawosen *et al*. (2003), economic return from milk production is maximized with a calving interval of 12 months, a dry period of approximately 60 days and days open of 85 days.

Milk processing trends in Ethiopia.

According to Lemma *et al*. (2005), in East Shoa Zone of Oromia, fresh milk and fermented milk were not consumed on the daily basis as they were reserved for further processing. In the highlands of Ethiopia, milk produced by small holders is used for family consumption and to produce butter and a cottage-type cheese. For butter making, milk is collected over a period of three or four days in a clay pot. When the milk has soured and enough milk has been collected, the clay pot is shaken back and forth until butter granules are formed. This method of butter making may take from two to three hours, depending on such factors as temperature, the fat content of the milk, the acidity of the milk and the amount of milk in the clay pot. The time taken to make the butter together with the time involved in taking this butter to the marketplace is a considerable drain to the smallholders, specifically on that of the wife and family. Traditional system of butter making differs from place to place and their efficiency in terms of milk fat recovery and time requirement could vary. Here the traditional systems of butter making show low rate of fat recovery (90.53%) and longer time than the improved technologies (cream separator and butter churn) and the appropriate technology developed by ILCA (internal agitator) (Zelalem and Inger, 2000).Traditional butter making requires about 21-25 kg milk to produce 1kg of butter with moisture content of 83% and 3.2-4.5 kg Ayib can be produced from subsequent buttermilk. On the contrary, butter making using Internal Agitator and improved technology had required 20kg and 16-18kg of milk to produce 1 kg of butter respectively (Zelalem and Inger, 2000).

Milk and milk products marketing and utilization in Ethiopia.

Yilma (2011), whose report implies that 85% of dairy product in Ethiopia is used for household consumption. Commercialization of milk requires the processing of dairy product and access to market. However, Assessment on Dairy Production System and its Constraints in Horo-guduru Wollega Zone, Western Ethiopia (Belay,2015), there was no modern dairy processing and milk collection enterprise and its products were therefore marketed at local and village markets. The most marketable product was butters where fresh milk and other dairy products were rarely marketed. Concerning milk product’s seasonal market variation 65.36% of the respondents reported that the cost of dairy product gets higher during the dry season while 29.05% households responded the opposite which means milk and dairy product cost gets higher during the summer however, 5.59% of respondents reported that they do not observe significant variation. The study conducted in 2001 in Boji district in the western Ethiopia that reported the price of butter (the commonly marketable dairy product in the area) reach peak during April and low in November (Laval and Assegid, 2002). Marketing of dairy products, therefore, requires as much emphasis as to produce milk. Biological interventions to improve the nutritional and health status of dairy animal may not bring about the desired improvements of income to the producers unless viable markets absorb the produce. Lack of market can mean wastage of the milk, and the resources that went into its production (Labor, land, time).

CONCLUSION.

Livestock play a vital role in economic development, particularly as societies evolve from subsistence agriculture into cash-based economies. Livestock products are appealing and convenient sources of nutrients. Protein and micronutrient deficiencies remain widespread in developing countries because people subsist on diets that are almost entirely made of starchy staples. Livestock also serve as a source of income through sale of the items, animals, hides and skins. Ethiopia is endowed with good dairy production potential mainly due to relatively fair natural resources availability, suitable climate, and large cattle population. There are different types of milk production systems can be identified based on various criteria.

Dairy production systems in the tropics are concentrated near consumption centers. It is no coincidence that cattle and rural human population densities are highly correlated with specialized smallholder (large-scale) dairy farms generally located close to (peri-urban) or within (intra-urban) major markets, or more distant when there is an efficient market infrastructure.

Therefore, the following recommendations are forwarded for future actionincluding, training about dairy cattle production system and constraints for the livestock owners, choice of representative feed availability and climate stations for livestock enterprises, particularly in the arid and semi-arid regions and recordation of additional inputs to milk product marketing, especially in highly potential zed zones must be applied.

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