Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.6, No.7, 2016

A Review on Dairy Cattle Breeding Practices in Ethiopia

Debir Legesse Belay*
South Agricultural Research Institute (SARI), Hawassa Agricultural Research Center,
P.o.Box 2126, Hawassa, Ethiopia

Abstract
This paper was aimed to review and indicate dairy cattle breeding practices including mating system, breeding objectives, traditional selection practice of farmers, reproduction, estrus detection and time of insemination and the gaps that exist in Ethiopia. There is no such a satisfactory cattle's breeding system and reproduction performance in the country in general and particularly at the farmers' level. More farmers practiced natural, unplanned and uncontrolled mating system. Communal grazing land is the main source of breeding bull in most part of Ethiopia with exception of few AI service. Therefore, in Ethiopia, there is a need to use breeding objectives in line with vibrant and effective breeding policies for both AI and natural service for sustainable and effective animal breeding practice. Besides, breeding records such as breeding dates, pregnancy rates and days to first service used to monitor fertility are other advantages of breeding practices that should be given attention. Equally, importance, genetic conservation should not be underestimated in improving dairy cattle. In conclusion, animal breeders, policy designers and any development practitioners have to give due attention to transform the existing agrarian breeding practices targeting towards dairy productivity and production with careful consideration of genetic conservation of local cattle breeds.
Keywords: Breeding Practice; Dairy Cattle; Ethiopia

INTRODUCTION

Dairy cattle and livestock make an essential contribution to agriculture, food and rural development. They provide products and services such as milk, meat, draught power and manure for fertilizers and fuel (FAO, 2010; Mekonen *et al.,* 2012). Dairy farming is seen as one of the few agricultural activities that can provide enough income to maintain the economic viability of smallholder farms (Staal *et al.,* 1996), and it has the potential to generate income and employment in order to improve the welfare of smallholders (Walshe *et al*., 1991).

Smallholders in tropical countries do have a broad perspective of dairy production and need effective livestock genetic improvement programs to advance their livelihood (Bebe *et al*., 2003). In order to develop the genetic disposition of the animals, selection and breeding methods can be used (Raganitsch *et al*., 1990, Willam and Simianer 2011). Breeding methods distinguished in to pure breeding and crossbreeding systems (Willam and Simianer, 2011). In order to frame sustained genetic improvement programs it is necessary to know which breeds the farmers consider most suitable for their environment, their perceptions of breed attributes and the factors that affect their breeding decisions (Bebe *et al.,* 2003).

In dairy cattle breeding, most of the dairy farmers in the highland, midland and the lowland areas of Ethiopia used natural mating by using indigenous breeding bull (Tesfa, 2009). Along with natural mating, some farmers used AI in highland and midland areas. Some of the farmers also preferred seasons for mating for their dairy cattle. They mate their cows in such a way that the calving falls during the wet season to take the advantage of abundant feed supply which promotes better milk production and hence a better chance of survival of calf (Tesfa, 2009). With perspectives of livestock production in Ethiopia, this paper aimed in reviewing the trained of dairy cattle breeding practices, breeding objectives, selection methods, trait preference, mating practices, culling mechanisms and constraints of breeding practices.

Breeding Objectives

Breeding objective is defined as the reason (s) for which animals are specifically bred for, it assumes that the farmers have made a deliberate choice to genetically improve the next generation of animals in terms of their performance in relation to their parent generations (Godadaw *et al*., 2014). The breeding objective in any livestock species is to increase profit by improving production efficiency (Charfeddine, 2000). Similarly, Piotr *et al*. (2004) also reported that the cattle-breeding objectives were focused on the enhancement of milk yield, under the assumption that profit would increase with increase in milk yield per cow. According to Zewidu (2004) and Godadaw *et al*. (2014), the first important breeding objective by the farmers in North Amhara region was obtaining better milk yield. An efficient, systematic and operational breeding strategy is necessary to bring about any substantial improvement in the dairy sector.

Breeding structures provide systems for gathering information about the assessment of animals in the production system and conditions that allow selection of parents (males and females) of the future progeny, besides the mating of these livestock in a desired manner (Van Der Werf, 2004).

Development of the dairy sector in Ethiopia as in any other developing countries can further be augment with the selection within the local cattle besides crossbreeding (Yilma, 2011). However, any formal pedigree and performance recording systems are virtually non-existent with the livestock keepers in most of the tropical countries, thus under those condition the only option left is to select animals based on their phenotypic traits like body size, udder size etc (Bebe *et al*., 2003). Production circumstances have given rise to interest in directly reducing cost of production, and breeding objectives are moving from increasing yield to economic efficiency. A breeding programme must consider and address how superior animals will disseminate their genes quickly throughout the whole population.

Sustainable and effective animal genetic improvement programs need to be planned, implemented and maintained in order to accomplish a meaningful development in livestock productivity through genetic improvement (Desta, 2002). From the dairy farmer's point of view, the first breeding objective is efficient reproduction (e.g. short calving intervals and regular lactations) and the long-term breeding objective is the genetic improvement related to market and production conditions (Walshe *et al*., 1991).

In most of the countries in the tropics, both AI and natural service are practiced as methods of breeding. For effective breeding practice, one should consider techniques and options of improving the genetic performance of cattle. In most of the tropical countries, smallholder dairy farming is predominant (Walshe *et al*., 1991, Devendra 2001). Smallholder farmers do have a broad perspective to dairy production and pursue several breeding objectives such as increase of milk production, adaptability of animals to local feed conditions and diseases, manure production and cattle as capital assets (Kahi *et al*., 2000). Moreover, farmers in various cattle production systems have different trait preferences and breeding strategies that need an investigation before designing any sustainable breeding plan (Mwambene *et al*., 2012). In Northern Ethiopia, Arado cattle keepers consider draught ability, disease and heat resistance as important attributes of this breed and practice uncontrolled mating of the animals (Genzebu *et al*., 2012). Jiregna (2007) indicated primary criteria used to select breeding bulls in Danno district were body height, body size, body length, body condition, physical appearance, coat color, hump size, prepuce sheath, temperament, body conformation (shape), horn size and potential for traction use for the same breed Horro cattle.

Marketable traits such as milk yield, growth rate and reproductive performances and non-marketable traits such as draught power output, coat color and adaptability, practice pure breeding and have developed a culling mechanism for maintaining the desired quality of their animals (Ayantu *et al*., 2012). In Southwestern Ethiopia, Sheko cattle breeders consider milk production, fertility (age at first calving, calving interval and lifetime calf crop) and traction as the most important attributes of the breed. In addition, natural and non-selective mating is practiced and results in a non-descript herd structure (Taye *et al*., 2010).

Breeding Policies

The genotype of crossbred animals kept by producers is likely to include any percentage of foreign genetic material due to unsystematic breeding practices, unplanned mating schemes, uncontrolled AI services and bull distribution. Crosscutting threats include lack of awareness of the significance of AnGR among decision-makers and lack of consultation with livestock keepers and other relevant stakeholders (FAO, 2009), both of which contribute too many threats arise because of policy and management decisions. Designing of a breeding program also needs to take into consideration a mechanism that ensures conservation of animal genetic resources (Aynalem *et al*., 2011). However, crossbreeding was and still is perceived as “the way forward” to improve productivity of indigenous livestock under smallholder conditions and development policies has largely ignored adapted farm animal genetic resources. Moreover, no information is available on the status of the national dairy cattle genetic improvement program that guide policy makers, development planners and breeders to redesign appropriate breeding programs that respond to the current scenarios in Ethiopia (Kefena *et al*., 2011)

Mating system

Mating in the context of animal breeding means pairing of female and male animals for the purpose of reproduction on a farm using natural or artificial (AI) methods (Willam and Simianer, 2011). In Ethiopia, the most commonly mating methods practiced are natural and artificial methods. The natural methods use bull mating while the artificial ones employed artificial insemination (AI) system.

Natural Mating

The use of bulls for natural service remains widespread in Ethiopia (Kelay, 2002). In natural mating the bull testicles should have a distinct neck and should not be fibrotic or flaccid in consistency. This is essential because testicles must be a reasonable distance away from the internal body temperature (Jensen, 1997). Azage et al. (1997) also indicated that there is a direct relationship between scrotal circumference and semen production. Bulls should also have good body condition and have morphologically sound feet and legs and healthy eyes to perform the service properly.

As indicated in a study by Ayantu *et al.* (2012) and Azage *et al.* (2013) uncontrolled mating predominates under the extensive livestock husbandry system especially in the rural areas. Findings of a study by Solomon *et al.* (2014) also indicated that majority of the farmers in Metekel zone depend on natural mating in absence of artificial insemination facilities. Finding by Asrat *et al.* (2013) further indicated that under mixed crop-livestock production system of Boditti district most of the farmers depend on natural mating using native bulls, while others depend on AI. In few cases, there are farmers who are using both natural service and artificial insemination. According to Ayantu *et al*.(2012) and Derje (2015) more farmers practiced natural, unplanned and uncontrolled mating system and keeping of sire was not practiced by smallholder farmers rather they use for both breeding and drought power. Jirenga (2007) also reported that farmers in Danno district keeping of sire solely for breeding was not practiced. Communal grazing land is the main source of breeding bull in most part of Ethiopia (Shiferaw, 2006, Ayantu *et al*, 2012).

A study made by Desta (2002) indicated that many farmers in Ethiopia prefer natural mating as the conception results from the AI services is not successful. A study made by Zewudu (2004) reported that majority of the farmers in Dembia and Fogera districts obtained their replacement (breeding) animals from their own farm and sometimes from their relatives and neighbors. In the rural lowland areas of Metema, majority farmers breed their cow with any available bull in the village. This is because most of the farmers do not own breeding bulls and they use bulls from neighbors or use open mating in the communal grazing land (Azage, 2013).

Artificial Insemination (AI)

In Ethiopia, AI was first introduced in 1938 in Asmara, the then part of Ethiopia, however the process was interrupted due to the 2nd World War and restarted in 1952 (Yemane *et al.,* 1993). It was again discontinue due to unaffordable expenses of importing semen, liquid nitrogen and other related inputs. In 1967, an independent service was again restarted in the then Arssi Region, Chilalo Awraja under the Swedish International Development Agency (SIDA).

Artificial insemination (AI) is a process in which sperm is collect from male animals and artificially introduced into the female reproductive tract for the purpose of fertilization (Ball and Peter, 2004). Artificial insemination offers several advantages over the natural service. The reason most commonly advocated is as a means of genetic improvement and others include cost effectiveness, disease control, safety breeding, flexibility, and fertility management (Ball and Peter, 2004; Holm *et al.,* 2008). AI also plays important role to increase the yielding capacity of cows and is the appropriate and cheapest way of genetic improvement. Breeding programs has to be well organized and excited in a very reliable way and AI is fully functional when it linked with good animal husbandry such as effective heat detection (Noakes *et al*., 2009). Besides, the availability of accurate heat breeding records such as breeding dates, pregnancy rates, ineter-estrus intervals, and days to first service used to monitor fertility are other advantages of AI (Sinishaw, 2005). However, AI includes poor conception rate due to poor heat detection and inefficiency of AI technicians, dissemination of reproductive diseases and poor fertility rates if AI centers are not equipped with appropriate inputs and are well managed (Gebeyehu, 2005).

Number of Service Per Conception and Repeat Breeder

Number of service per conception (NSPC) is defined as the number of services/ inseminations required for a successful conception (Menale *et al.,* 2011). It depends largely on the breeding system used and influenced by both genetic and non-genetic factors viz. season (availability of feed), semen quality and quantity and parity (Gebrekidan *et al.,* 2012). Numbers of service per conception in some part of Ethiopia are in Table 1.

Table 1 Number of service per conception (NSPC) zebu and cross breed cattle

Breed	NSPC	Sources
Native	2.2	Kumar *et al.(*2014)
Horro	2.1	Demissu *et al. (*2014)
Fogera	1.28	Menal *et al. (*2011)
Horro-Jersey	1.8	Demissu *et al.(* 2014)
Native-Friesian	1.56	Belay *et al. (*2012)
Eastern low lowland Crossbred	2.2	Emebet (2007)
Native-Friesian	1.3	Nibret (2012)

Selection Practice and Traits Preference of Dairy Cattle

As it is true for many other tropical developing countries, the cattle genotypes of Ethiopia have evolved largely because of natural selection for the traits such as survivability, ruggedness, heat tolerance and tolerance for diseases and seasonal shortage of feed (Abeygunawardena and Dematewewa, 2004). Selection can be two types; man-made and natural selection. Nature selection competent animals but man selects useful animals with preferred traits. Now a day, manmade selection takes in to account both the usefulness and the survival of the animals. Jiregna (2007) indicated primary criteria used to select breeding bulls in Danno district were body height and length, body condition, physical appearance, coat color, hump size, prepuce sheath, temperament, body conformation (shape), horn size and potential for traction use.

Cattle keepers in Ethiopia prefer to select their herd based on marketable traits such as milk yield, growth rate and reproductive performances of the heifers/cows, steers/bulls. However, traits such as coat color and adaptability are traditionally taken into account when selecting the dairy cattle (Ayantu *et al.,* 2012). The interventions by the modern breeders hence should take into account adaptive traits for overall improvement of the herds. Horro cattle are traditionally reared for high fat content in milk (Ayantu *et al.,* 2012) while Kereyu cattle are prefered for high milk yield as fresh milk usually consumed by the pastoral community (Shiferaw, 2006).

Culling and Castration for Male Cattle Practices

According to Ayantu *et al*. (2012), farmers in Horro district have developed culling mechanism for maintaining the desired quality of their animals. The author also indicated that culling of male animal is done at age of seven year after using the animal for both draught and breeding for three years. For Bako and Horro cattle farmers use different methods to cull unproductive animals from their herd and in most cases they cull through selling, castration and slaughter (Ayantu *et al*., 2012, Dereje, 2015). A report by Solomon (2010) about Boran pastoralist and agro pastoralist also indicated the same method of culling of Boran cattle from the herd is employed.

Majority of farmers in North Amhara region male animal castration is common breeding management practices to make bulls tame for different farming activities, to avoid the difficulty with breeding bulls running around for mating and to remove unwanted bulls from mating (Godadaw *et al*., 2014). Bull castration practiced by farmers at the age of 6.78 years for different reasons of which castration to use for traction and fattening. Jirenga (2007) similarly reported that the age of castration of bulls in Danno district is about six years. On the other hand, there are reports that indicated of which castration of bull is done at 4.08 years for Mursi and 4.2 years for Borana cattle, (Endashaw, 2010; Solomon, 2010). Early castration is preferable to resist the shock of castration and to some extent the bull was contributes its genetic make up to its offspring. Castrated oxen are preferable for traction and fattening since the energy for sperm production goes to fatten the animal and for traction (Endashaw, 2010; Solomon, 2010).

Estrus Detection and Time of Insemination

Knowledge of estrus behavior and the estrus to ovulation interval is essential for estimating the best time to artificially inseminated cattle (Reolofs *et al.,* 2010). Inaccurate estrus detection leads to delayed insemination, reduced conception rates and thus extended calving intervals (Daris, 1998). Livestock keepers visually observe the signs of estrus and thus with experience can accurately estimate the time of the standing estrus.

Findings by Miah *et al.* (2004) indicate that if insemination is carried out later than 22 hrs from the inception of estrus results in poor conception. A cow that is first seen in estrus in the morning is usually inseminated in the afternoon of the same day, whilst a cow seen in estrus in the afternoon is inseminated early the next day (Arthur, 2001). Time and season of insemination is the most important factors to optimize CR of the cows (Miah *et al.,* 2004). According to Jane *et al.* (2009), standing heat can occur any time in a 24-hour period. However, the most likely time for a cow or heifer to show heat signs is at night but the season of the year can influence this, with more cows showing heat at night in hot weather and more showing heat during the day in cold weather. Hot weather, high production, crowded conditions, and high stress environments may reduce mounting activity. Observers must distinguish among cattle coming in to heat, in standing heat, and going out of heat. Females that are in standing heat, were in standing heat yesterday, or will be in standing heat tomorrow are the most likely herd mates to mount other cows or heifers in heat (Jane *et al.,* 2009).

Reproductive Performance of Dairy Cattle

Reproductive performance is often a major determinant of biological and economic efficiency of livestock production in the tropics. Production of milk also depends heavily on reproductive performance of cows (Kiwuwa *et al*., 1983). Reproductive performance of dairy cows is influenced by different factors including gene, season, age, production system, nutrition, management, environment and diseases (Shiferaw *et al*., 2003). Reproductive performance traits like age at first service (AFS), Age at first calving, number of services per conception (NSC), days open (DO) and calving interval (CI) are the bases for a profitable dairy farming (Mukasa-Mugerewa 1989).

Age at First Service

According to Gidey (2001), age at first service (AFS) is the age at which heifers attain body condition and sexual maturity for accepting service for the first time. By showing estrous as early as possible, a female animal can contribute more to the economy of the farm. Age at first service of some zebu and crossbred dairy cattle in some part of Ethiopia is presented in Table 1.

Table 1 Average age at first service of different zebu and crossbred cattle

Breed	Age at first service (months)	Sources
Horro	47.52 (male) and 53.3 (female)	Jiregna (2007)
Horro	46.56 (male) and 48.42 (female)	Ayantu *et al.*(2012)
Semen and Wegera	55.6 (male) and 57 (female)	Zewdu (2004)
HorroX Jersey	33.3±10.9	Demissu *et al.* (2014)
Frisian X Fogera	36.8±0.8	Gebeyehu *et al.*(2005)

Age at First Calving

Age at first calving determines the beginning of the cow's productive life and influences her lifetime productivity (Ojango and Pollott, 2001). A recent study reported that dietary supplementation of heifers during their period of growth reduces the interval from birth to age at first service and birth to age at first calving (Amin *et al.,* 2013). Age at first calving of zebu breeds and crossbred cattle of some parts of Ethiopia is presented in Table 2.

Table 2 Age at first calving of different zebu and crossbred cattle

Breed	Age at first calving (months ±SE)	Sources
Horro	58.08±0.07	Ayantu *et al.* (2012)
Fogera	50.8± 0.36	Menal *et al.* (2011)
Local/Dandi	50.59±6.94	Belay *et al.* (2012)
Horro X Jersey	42.2±11.45	Demissu *et al.* (2014)
Fresian X Zebu	36	Belay *et al.* (2012)

Longevity and Reproductive Lifespan

Herd life of cows affects the profitability of dairy farms. According to (Mukasa-Mugerwa *et a*l. 1989) reported that herd life productivity of Ethiopian indigenous cattle was 11 to 13 years. (Gidey, 2001) also reported that lifetime productivity of fogera cattle was 9.6 years. The mean for herd life and effective productive herd life of fresian-Boran crossbred in Chefa farm of Ehiopia was 7.9 years (Gosh, 2005). Kumar and Reddy (1989) reported on Karan Swiss and Karan Fries cattle observed a longer herd life for F_1 breed groups. Dejene (2014) revealed that the reproductive life time of the breeding bull and female was 9.86 and 11.5 years in the lowland, and 7.68 and 10.9 years in mid-highland areas, respectively and the female was giving calves on average 7.1 in lowland and 6.6 in midland area. The lifetime productivity of a cow is influenced by age at puberty, age at first calving and calving interval (Ensminger, 1969), genetic makeup and the health status of the cow (Goshu, 2005) and management and feeding standards (Abdulai and Huffman, 2005).

Summary and Conclusion

Cattle comprise the majority of the livestock population in Ethiopia and are reared across all the agro-ecologies. However, productivity of cattle is limited by several constraints that include natural uncontrolled and unorganized breeding practice, high prevalence of diseases, poor reproductive performance, limited feed availability and poor marketing system and lack of recording system. To address these constraints indigenous knowledge of farmers and designing appropriate mating systems with full participation of farmers is the best option in improving breeding practice of dairy cattle in Ethiopia.

Breeding strategies need to involve farmers, considering the existing breeding practices, management systems and their trait preferences. Selection of livestock production system is key factor for obtaining animals for breeding and has a strong influence on reproductive performance of the herd. Exploring indigenous knowledge of managing the herd, setting of breeding objectives and finally designing appropriate mating systems with full participation of farmers is of paramount importance in improving dairy cattle. In conclusion, farmers should be train on various aspects of improving cattle productivity (nutritional, health and breeding management) in communal areas and developing their entrepreneurial skills. It is recommended to consider preferential traits of farmers for the improvement and sustainability of the dairy cattle.

Reference

Abdulai A., & Huffman W.E. 2005. The Diffusion of New Agricultural Technologies: The Case of Crossbred-Cow Technology in Tanzania. American Journal of Agricultural Economics 87 (3), 645-659.

Abeygunawardena H and Dematewewa C M B. 2004. Pre-pubertal and postpartum anestrus in tropical Zebu cattle. Animal Reproduction Science 82–83 (2004) pp 373–387.

Arthur G. H. 2001. Arthur's Veterinary Reproduction and Obstetrics. Eighth edition, Pp. 430- 767.

Amin M.R, Habib M.A. & Bhuiyan A.K.F.H. 2013. Reproductive Potential of Red Chittagong cattle in Bangladesh. Journal of Tropical Resources and Sustainable Science.1(10).71-86.

Asrat Ayza, Yilma Zelalem and Ajebu Nurfeta. 2013. Characterization of milk production systems in and around Boditti, South Ethiopia. Liv. Res. for Rural. Deve. *Volume 25, Article #183.* Retrieved April 1, 2016, from http://www.lrrd.org/lrrd25/10/ayza25183.htm.

Ayantu M, Haile A., Dessie T. and Mekasha Y. 2012. On farm characterization of Horro cattle breed production systems in western Oromia, Ethiopia. Livestock Research for Development 24 (100). Retrieve June 25, 2015 from http.//www.lrrd.org/lrrd24/6/meko24100.htm.

Azage, T. and Alemu, G. 1997. Prospects for peri-urban dairy development in Ethiopia. In: Proceedings of the Fifth National Conference of the Ethiopian Society of Animal Production.15-17 May 1997, Addis Ababa, Ethiopia. pp. 28-39.

Azage T., Gebremedhin, B., Hoekstra, D., Belay, B. and Mekasha, Y. 2013. Smallholder dairy production and marketing systems in Ethiopia. IPMS experiences and opportunities for market-oriented development. IPMS of Ethiopian Farmers Project Working Paper 31. Nairobi. ILRI.

Ball P. J. H and Peter A. R. 2004. Reproduction in Cattle .Third edition, Fibiol. Pp.1-13.

Bebe, B.O., Udo, H.M.J., Rowlands G.J., and Thorpe W. 2003. Smallholder dairy systems in the Kenya highlands: breed preferences and breeding practices. Liv. Production Sci. 82, 117-127.

Belay D., Azage T. and Hegde B.P. 2012. Smallholder livestock production system in Dandi district, Oromia Regional State, central Ethiopia. Global Veterinaria, 8 (5). 472-479.

Charfeddine N.2000. Economic aspect of defining breeding objectives in selection programmes. CIHEAM, Options Mediterraneennes, Serie A, 43:9-17.

Daris W. 1998. Compendium of Animal Reproduction. 5th ed. Intervet International B.V. 5e

Demissu H., Fekadu, B. & Gemeda D. 2014. Dairy Productive Potential, Challenges and Production opportunities of Horro and their F1 Jersey Crossbred Cows. A Case of Guduru Livestock production and Research Center and Its Surroundings, West Oromia, Ethiopia. Science, Technology and Arts Research Journal. 3(4). 79-84.

Dereje Bekele. 2015. On Farm Phenotypic Characterization of Indigenous Cattle and Their Production Systems in Bako Tibe and Gobu Sayo Districts of Oromia Region, Ethiopia.M.Sc Thesis. Haramaya University, Haramaya.

Desta, K. B. 2002. Analyses of Dairy Cattle Breeding Practices in Selected Areas of Ethiopia. PhD thesis. Humboldt-Universität zu Berlin,Germany 37. 247-252.

Devendra C.2001. Smallholder dairy production systems in developing countries:characteristics, potential and opportunities for improvement-A review. Asian-Australian Journal of Animal Science 14, 104-113.

Emebet Mureda and Zeleke Mekuriaw Z. 2007. Reproductive Performance of Crossbred Dairy Cows in Eastern lowlands of Ethiopia.Livestock Research for Rural Development. *Volume 19, Article #161.* Retrieved April 1, 2016, from http://www.lrrd.org/lrrd19/11/mure19161.htm

Endeshaw Terfe. 2010. Characterization of Mursi Cattle Breed in Its Production Environment, In Selamago, Woreda, Southwest Ethiopia. M.Sc. Thesis, Haramaya University, Haramaya.

Ensminger M. E. 1969. Animal science. Interstate Printers and Publishers, Danville, Illinois, USA. 1253 pp.

FAO/IAEA 2009: Selection and breeding of cattle in Asia: strategies and criteria for improved breeding. Animal Production and Health Section International Atomic Energy Agency Vienna International Centre, 1400 Vienna, Austria.

Food and Agriculture Organization of the United Nations (FAO) (2010). Breeding strategies for sustainable management of animal genetic resources. Food and Agriculture Organization, Rome, Italy, FAO Animal Production and Health Guidelines Number 3, XVII-122.

Gebeyehu G., Asmare A. and Asseged B. 2005. Reproductive performances of Fogera cattle and their Friesian crosses in Andassa ranch, Northwestern Ethiopia, Livestock Research for Rural Development *Volume 17, Article #131.* Retrieved April 1, 2016, from http://www.lrrd.org/lrrd

Gebrekidan T.W., Zeleke M.Z. & Gangwar S.K. 2012 Reproductive and productive performance of dairy Cattle in central zone of Tigray, Northern Ethiopia. International J of Advanced Biological Research. 58-63.

Genzebu D., Hailemariam M., Belihu K. 2012. Morphometric characteristics and livestock keeper perceptions of "Arado" cattle breed in Northern Tigray, Ethiopia. Livestock Research for Rural Development 24 (1), Article #6.

Gidey Yifter. 2001. Assessment of calf crop productivity and total herd life of Fogera cows at Andasa ranch in northwestern Ethiopia. MSc thesis. Alemaya University, Ethiopia.

Godadaw M., Zewdu W. and Workneh A. 2014. Breeding practices in indigenous dairy cattle breeds in Northern Amhara, Ethiopia. Livestock Research for Rural Development. *Volume 26, Article #62.* Retrieved April 1, 2016, from http://www.lrrd.org/lrrd26/4/misg26062.htm

Goshu G.2005**.** Breeding efficiency, lifetime lactation and calving performance of Friesian-Boran crossbred cows at Cheffa farm, Ethiopia. *Livestock Research for Rural Development.17 (73).*

Holm D.E., Thompson P.N. and Irons P.C. 2008. The economic effects of an estrus synchronization protocol using prostaglandin in beef heifers. Theriogenology, 70.1507–1515.

Jane A.P., Rhonda, C. and Jamie, E. L. (2009): Estrus Detection in cattle. Animal and Dairy Sciences Article: Brown Loam Branch Research and Experiment Station, Mississippi State University Extension Service.

Jensen, W. 1997. Evaluating bull for breeding soundness. Central Coast Highlights, Newsletter, December, 1997.

Jiregna Dessalegn. 2007. Characterization of cattle genetic resources in their production system context in Danno district, west Showa, Oromia, Ethiopia. An MSc Thesis presented to the School of Graduate Studies of Haramaya University, Haramaya, Ethiopia.

Kahi AK., Nitter G., Thorpe W., Gall C.F. 2000. Crossbreeding for dairy production in the lowland tropics of Kenya-Prediction of performance of alternative crossbreeding strategies. Livestock Production Science 63, 55-63.

Kelay B. 2002. Analyses of Dairy Cattle Breeding Practices in Selected Areas of Ethiopia. Dissertation, DVM, Ethiopia. pp. 2-3.

Kefena Effa, Zewdie Wondatir, Tadelle Dessie and Aynalem Haile. 2011. Genetic and environmental trends in the long-term dairy cattle genetic improvement programmes in the central tropical highlands of Ethiopia. Journal of Cell and Animal Biology 5(6): 96-104. Available online at http://www.academicjournals.org/JCAB, retrieved on 12 January 2016

Kiwuwa G.H., Trail J.C., Kurtu M.Y., Worku G.M., Anderson F.M. and Durkin J. 1983. Crossbred dairy cattle productivity in Arsi Region, Ethiopia. International Livestock center for Africa (ILCA). Research report No. 11, 1-29.

Kumar S and Reddy K M. 1989. Herd life and productive life among Karan Swiss and Karan Fries cattle. Indian Journal of Dairy Science 42:277-279.

Kumar N., Yemane A., Berihu G. and Yohannes H. 2014. Productive and Reproductive Performance of Local Cows under Farmer's Management in and around Mekelle, Ethiopia. IOSR Journal of Agriculture and Veterinary Science, Volume 7, Issue 5 Ver. III. PP 21-24.

Menale M., Mekuriaw Z., Mekuriaw G. & Taye M. 2011. Reproductive performance of Fogera cattle at Metekel Cattle Breeding and Multiplication Ranch, North West Ethiopia. Journal of Animal and Feed Research, 1(3).99-106.

Miah A.G., Salma U. and Hossain M.M. 2004. Factors Influencing conception rate of local and crossbred cows in Bangladesh. International Journal of Agriculture and Biology, 6(5): 797-801.

Mukassa Mugerwa E.1989. A review of reproductive performance of female Bos indicus (Zebu) cattle. ILCA, Monograph No. 6. International Livestock Center for Africa, Adis Ababa, Ethiopia.

Mwambene P.L., Katule AM., Chenyambuga S.W., Mwakilembe P.A.A. 2012. Fipa cattle in the southwestern highlands of Tanzania: desired attributes, breeding practices and productive performance. Animal Genetic Resources 51: 45-56.

Nibret M. 2012. Study on Reproductive Performance of Crossbred Dairy Cows under Small Holder Conditions in and Around Gondar, North Western Ethiopia. Journal of Reproduction and Infertility 3:38-41

Noakes D.E., Parkinson T.J. and England G.C.W. 2009. Veterinary Reproduction and Obstetrics. 8th ed. China, Sounders Elsevier, pp. 750-760.

Ojango, J. M. K. and Pollott G. E. 2001. Genetics of milk yield and fertility traits in Holstein- Friesian cattle on large-scale Kenyan farms. Journal of Animal Science. 79.1742–1750.

Piotr G., Krzysztof M., Zygmunt H. and Ewa D. 2004. Heritability's of and genetic and phenotypic correlations between condition score and production and conformation traits in Black-and-White cows. p89.

Raganitsch G., Huber H., Raith F. 1990. Tierzucht und Tierhaltung Landwirtschaftliche Nutztiere-Halten, FOttern, ZOchten. Leopold Stocker Verlag, Graz, Band 1, 67-85.

Roelofs, J., F. López-Gatiusc, R.H.F., Hunterd, F.J.C.M. and van Eerdenburge. 2010. When is a Cow in Estrus? Clinical and practical aspects. Theriogenology, 74: 327–344.

Shiferaw G. 2006. In-situ phenotypic characterization of Kereyu cattle type in Fentalle district of Oromia , Ethiopia. An MSc Thesis Presented to the School of Graduate Studies of Haramaya University, Haramaya, Ethiopia.

Shiferaw Y., Tenhagen B. A., Bekana M. and Kassa T. 2003. Reproductive performance of crossbred cows in different production systems in the central highlands of Ethiopia. Trop. Anim. Health and Prod. 35. 551-561.

Sinishaw W. 2005. Study on semen quality and field efficiency of AI bulls kept at the National Artificial Insemination Center. MSc thesis, Addis Ababa University, Faculty of veterinary Medicine, Debre Zeit. Ethiopia. 13-17.

Solomon T. 2010. On farm phenotypic characterization of Borana cattle Breed in Dire district of Borana Zone, Oromia Region, Ethiopia. MSc Thesis, Haramaya, University.

Solomon Z.A., Binyam K., Bilatu A, Ferede A and Gadisa M. 2014. Smallholder cattle production system in Metekel zone, northwest Ethiopia. Research Journal of Agriculture and Environmental Management. 3(2) 151-157.

Staal S., Delgado C.L., Nicholson C.F. 1996. Smallholder dairying under transaction costs in East Africa. International Food Policy Research Institute-Market and Structural Studies Division, Washington D.C., USA, 1.

Taye T.D., Ayalew W., Hegde B.P. 2010. Breeding practices and mating strategies of Sheko cattle in southwestern Ethiopia. Advances in Animal Biosciences 1(2):393-394. 1 (2), 393-394.

Tesfa Gebremicheal. 2009. Reproductive performance of indigenous dairy cattle in south Wollo.MSc Thesis, Mekelle University, Ethiopia. 65p.

Van der werf J. 2004. An overview of animal breeding programs.http.//www.genome.iastate.edu

Walshe M.J., Grindle J., Nell A., Bachmann M. (1991). Dairy Development in SubSaharan Africa-A Study of Issues and Options. World Bank, Washington D.C., World Bank Technical paper number 135-Africa Technical Department Series, 1-71.

Willam A. and Simianer H. 2011. Tierzucht-Grundwissen Bachelor. UTB Verlag, Stuttgart, 41-274.

Yemane B., Chernet T. and Shiferaw T. 1993. Improved Cattle Breeding. National Artificial Insemination Centre. Addis Ababa, Ethiopia. Pp. 15.

Yilma Z., Emannuelle G.B and., Ameha S. 2011. A Review of the Ethiopian Dairy Sector. Ed. Rudolf Fombad, Food and Agriculture Organization of the United Nations, Sub Regional Office for Eastern Africa (FAO/SFE), Addis Ababa, Ethiopia, 81P.

Zewdu Wuletaw. 2004. Indigenous Cattle Genetic Resources, Husbandry Practices and Breeding Objectives in Northewestern Ethiopia. M.Sc Thesis presented to the School of Graduate Studies of Haramaya University, Haramaya, Ethiopia.