Journal of Reproduction and Infertility 10 (1): 01-06, 2019
ISSN 2079-2166

DOI: 10.5829/idosi.jri.2019.01.06

Review on Reproductive Performance of Cross Breed Dairy Cattle in Ethiopia

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Abstract: Ethiopia is believed to have the largest livestock population in Africa. Ethiopia holds a substantial potential for dairy development mainly due to its large livestock population coupled with the relatively suitable environment for livestock production. The success of dairy production in general and crossbreeding programs in particular needs to be monitored regularly by assessing the productive performance under the existing management system. Productive and reproductive performance of cattle is influenced by feed, genetics, disease and management Practices. Ethiopia holds large potential for dairy development mainly due to its large livestock population, the favourable climate for improved high yielding animal breeds and the relatively disease free environment. Three major dairy production systems are reported, these are traditional small holders, peri urban and urban dairy production systems. This review aimed to investigate the reproductive performance of cross-breed dairy cattle. The measures of reproductive performance include age at first calving, days from parturition to first service or day open, calving interval, number service per conception and breeding efficiency. The estimated age at first calving for Ethiopian cattle ranges from 35-62 months. The reproductive efficiency of dairy herd can be evaluated by measuring pregnancy rate, percentage of cows calving each year and number of live calves born each year. Artificial insemination service has been considered a significant vehicle to upgrade the existing reproductive performance of cattle breeds by implementing the cross-breeding program in order to increase the cattle production. The reproductive performance crossbreed dairy cattle in Ethiopia are not as expected from crossbreed dairy herd so it needs to be improved. Efficient heat detection, good management practices and committed and efficient artificial insemination technician were recommended to improve reproductive performance of crossbreed dairy cattle.

Key words: Artificial Insemination · Crossbreed · Ethiopia · Reproductive Efficiency and Reproductive Performance

INTRODUCTION

Ethiopia is believed to have the largest livestock population in Africa. The livestock sector has been contributing considerable portion to the economy of the country and still promising to rally round the economic development of the country. The total cattle population for the country is estimated to be about 53.99 million. Out of this total cattle population, the female cattle constitute about 55.48 percent and the remaining 44.52 percent are male cattle. On the other hand, 98.95 percent of the total cattle in the country are local breeds. The remaining are hybrid and exotic breeds that accounted for about 0.94 percent and 0.11 percent, respectively [1].

Ethiopia holds a substantial potential for dairy development mainly due to its large livestock population coupled with the relatively suitable environment for livestock production [2]. Like most dairy production systems found in the tropics, the Ethiopian dairy production system includes large numbers, from small to large sized and subsistence to market oriented farms [3].

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The reproductive performance of the breeding female is probably the single most important factor that is a prerequisite for sustainable dairy production system and influencing the productivity.

Genetic improvement of the indigenous cattle basically focusing on crossbreeding has been practiced for the last five decades. The success of dairy production in general and crossbreeding programmes in particular needs to be monitored regularly by assessing the productive performance under the existing management system. However, information is limited about the productive performance of dairy cows in smallholder urban and peri urban dairy farms in the tropics, particularly in Ethiopia [4].

Artificial insemination service has been considered a significant vehicle to upgrade the existing reproductive performance of cattle breeds by implementing the cross-breeding program in order to increase the cattle production. Cattle's breeding is mostly uncontrolled in Ethiopia making genetic improvement difficult and an appropriate bull selection criteria have not yet been established, applied and controlled. Although artificial insemination is the most commonly used and valuable biotechnology [5], but it has been applied in Ethiopia for over 30 years the efficiency and impact of its use has not been well-documented [6]. Reproductive problems related to cross breed dairy cows under farmers' conditions are immense [7]. It is widely believed that the AI service in the country has not been successful to improve reproductive performance of dairy industry [8]. From the previous scanty studies, AI service is weak and even declining due to inconsistent service delivery in the smallholder livestock production systems of the Ethiopian highlands [9]. The problem is more aggravated by wrong selection and management of AI bulls along with the poor motivations and skills of inseminators [10].

Productive and reproductive performance of cattle is influenced by feed, genetics, disease and management practices [11]. Livestock productivity in Ethiopia is said to be poor due to a number of reasons among which is the low genetic capacity of the indigenous cattle [2]. In Ethiopia, the poor genetic potential for substandard feeding, poor care and management practices are the main contributors to low productivity [12].

The objectives of this paper were to review the reproductive performance of cross-breed dairy cattle and effectiveness and performance of artificial insemination.

Cattle Production in Ethiopia: Ethiopia is a home for many livestock species and suitable for livestock production and believed to have the largest livestock population in Africa [13]. An estimate indicates that the country is a home for about 54 million cattle, 25.5 million sheep and 24.06 million goats. From the total cattle population, 98.95% are local breeds and the remaining are hybrid and exotic breeds. Nearly all goat and 99.8% of the sheep population of the country are local breeds [2]. The livestock subsector has an enormous contribution to Ethiopia's national economy and livelihoods of many Ethiopians and still promising to rally round the economic development of the country. Livestock play vital roles in generating income to farmers, creating job opportunities, ensuring food security, providing services, contributing to asset, social, cultural and environmental values and sustain livelihoods. The subsector contributes about 16.5% to the National Gross Domestic Product (GDP) and 35.6% to the Agricultural GDP [14].

It is known that selection based improvement for productivity has not been performed on the indigenous cattle in the required levels. Nevertheless, the indigenous cattle are known to have special merit of coping with the harsh environments of the country. On the other hand, the high performing exotic cattle cannot cope with the harsh environments of the country. Therefore, improvement on the indigenous cattle for productivity without losing traits, which are essential for survival, has been proposed [15].

Artificial Insemination: Artificial insemination (AI) has been defined as a process by which sperm is collected from the male, processed, stored and artificially introduced into the female reproductive tract for the purpose of conception [5]. Semen is collected from the bull, deep-frozen and stored in a container with liquid nitrogen at a temperature of minus 196 degrees centigrade and made for use. Artificial insemination has become one of the most important techniques ever devised for the genetic improvement of farm animals. It has been widely used for breeding dairy cattle as the most valuable management practice available to the cattle producer and has made bulls of high genetic merit available to all [5, 16].

Artificial insemination (AI) in Ethiopia was introduced in 1938 in Asmara, then part of Ethiopia, which was interrupted due to the Second World War and restarted in 1952 [17]. It was again discontinued due to unaffordable expenses of importing semen, liquid nitrogen and other related inputs required. In 1967, an independent service was started in the Arsi Region, Chilalo Awraja under the Swedish International Development Agency (SIDA). The technology of AI for cattle has been introduced at the farm level in the country over 35 years ago as a tool for genetic improvement [18]. The efficiency

of the service in the country, however, has remained at a very low level due to infrastructure, managerial and financial constraints and also due to poor heat detection, improper timing of insemination and embryonic death [18].

Semen Collection and Assessment of Ejaculates: Semen collection has been considered like harvesting any other farm crop since effective harvest of semen involves obtaining the maximum number of sperm of the highest possible quality in each ejaculate to make maximum use of sires. This involves proper semen collection procedures used on males that are sexually stimulated and prepared. The initial quality of semen has been determined by the male and cannot be improved even with superior handling and processing methods. However, semen quality can be lowered by improper collection and the processing techniques [18].

Procedure for Collection of Semen from the Bull: Standard semen collection procedures normally include sexual stimulation, sexual preparation and collection of the semen. Sexual stimulation providing a stimulus situation that elicits mounting behavior in the bull is termed "Sexual Stimulation". The stimulation process has been best practiced by exposing the bull to a mount animal in a collection environment and allow moving briefly around female/teaser for a couple of minutes. Sexual preparation has been found to determine the intentional prolongation of sexual stimulation. It is achieved through a series of false mounts (allowing the bull to mount but not ejaculate) and restraint and ultimately results in an increase in the quantity and quality of sperm ejaculated. In dairy bulls, one false mount plus two minutes of restraint plus two additional false mounts before each ejaculation will help obtaining the maximum amount of good quality semen [19].

Cross Breeding in Ethiopia: Ethiopia is believed to have the largest livestock population in Africa. Though no exhaustive identification and characterization work has been conducted, it is suggested that there are over 25 types/breed of indigenous cattle, the most popular one including, Borena, Horro, Fogera, Arsi, Kerayu and Nuer [20]. In spite of large and diverse animal genetic resources, the productivity (i.e., meat and milk) of livestock remained low in many developing countries including Ethiopia [21].

In Ethiopia as part of some efforts, genetic improvement of the indigenous cattle has been proposed [22]. Consequently, since selections among indigenous breeds is too big and is slow task to bring about the desired genetic change quickly, cross breeding has been proposed to combine the high productivity of European and better adaptability of Ethiopian indigenous breeds in the cross breeds [21]. The success of such cross breeding programme has varied depending on several factors. These factors include the simultaneous implementation of reasonable standard of animal nutrition, disease control and husbandry and improved infrastructure status [20]. Accordingly, cross breeding as a quick way for increasing milk production has been practiced for the last 50 years but with little success [22]. Closer examination of the production condition of dairy farmers showed that they faced several constraints and wide spread abortion has been reported in relatively large dairy herds [23]. Several factors including the management situation that the animals are exposed to have contributed to the observed variations [24].

Dairy Production System in Ethiopia: Ethiopia holds large potential for dairy development mainly due to its large livestock population, the favourable climate for improved high yielding animal breeds and the relatively disease free environment [25]. Numerous authors used different approaches at different times for the classification of dairy production in Ethiopia [24]. Generally, three major dairy production systems are reported based on location or scale of market orientation and production intensity as criteria. These are traditional small holders, peri urban and urban dairy production systems [25].

Traditional Small Holder Dairy Production Systems: The traditional small holder system is part of the subsistence farming system, which includes pastoralist, agro-pastoralist and mixed crop producers. It supplies 97% of the total national milk production and 75% of the commercial milk production. This sector is largely dependent on low producing indigenous breeds of cattle, which produce about 400-680 kg of the milk/cow per lactation period. The milk produced is mainly consumed by the house hold in the traditional system [25].

Peri Urban Dairy Production Systems: This system is found in the outskirts of the capital city and regional cities and mostly concentrated within a radius of 100km around Addis Ababa, which is includes dairy farms (ranging from small holder to commercial farmers [26]. The main feed resources in this system include agro-industrial by products and purchased roughage. The system comprises

small and medium sized dairy farms that own cross breed dairy cows. The primary objective of milk production in this system is to generating additional income to the household [25].

Urban Dairy Production System: The urban dairy production system consists of dairy farms ranging from small holder to specialized businessmen owned farms, which are mainly concentrated in major cities of the country [25]. Their main source food purchased hay and the primary objective is to get additional cash income from milk sale [25, 27]. Herd size is mostly due to urbanization, land size limitation and economic capacity [24]. But when compared with peri urban farmers who processed more milk, urban farmers owned larger herd's but farmed less land and sold a greater proportion of liquid milk [27].

Reproductive Performance of Dairy Cattle: There are several measures of reproductive performance such as age at first calving, days from parturition to first service or day open, calving interval, number service per conception and breeding efficiency [28]. Also, Lobago [4] stated that the reproductive efficiency of dairy herd can be measured by measuring pregnancy rate, percentage of cows calving each year and number of live calves born each year. Although each of these measures affects the profitability of dairy business in slightly different ways, the calving interval affects both total milk production the dairy herd and the number of calves born [4].

Age at First Calving: Age at first calving determine the beginning of the cow's productive life and influence her life time productivity [29]. The time taken by animal to attain puberty and sexual maturity were depending among others on the quality and quantity of feed available, which affect the growth rate [25]. Under controlled breeding system, heifers are usually mated when they are mature enough to with stand the stress of parturition and lactation. This increases the likelihood of early conception after parturition [24].

Breed difference among cattle had also significant effect on age at first calving. Estimated age at first calving for Ethiopian cattle ranges from35-62 months [24]. Zewdie [25] reviewed that the average age at first calving in Bos indicus cattle is about 44 months, 34 months in Bos Taurus and *Bos indicus* and *Bos Taurus* crosses in tropics, 44.61 and 40.46 months for fogera and F1 heifers, respectively; and the borena crosses with Holstein-friesian (F1 crossbred dairy cows) show delayed age at first conception (53.2months).

Number of Service per Conception: The number of insemination requires producing a live calf is one of the most useful parameters of reproductive efficiency and effectiveness of artificial insemination, which mainly depends on breeding system used. High environmental temperature and reduced efficiency of inseminators contribute to the higher rate of number of service per conception [30]. It is higher under controlled natural breeding than hand mating and artificial insemination. This might be due to inefficiency of artificial insemination operation and/ or might be because insemination resulting from improper heat detection by herds men.

Days Open (DO): An increase in the number of days between calving and conception, also known as days open, affects life time production and generation interval. Days open should not exceed 80 to 85 days, if a calving interval of interval of 12 months is to be achieved. This requires re-established of ovarian activity soon after calving and high conception rates. Habtamu *et al*., [30] noted that the higher interval between to effective service day could probably be due to delayed resumption of ovarian activity after calving and management factors such as heat detection, decision of breeding after parturition, nutrition and disease control. Cows that are conditioned at calving or those that lose excess body weight are more likely to have a prolonged interval to interval to first oestrus, which could result in longer days open [31]. In addition, allowing calves to suckle their dams up to weaning may interfere with ovarian function [29]. Suckling stimulus delays the release of GnRH from the hypothalamus by stimulating the release of ß-endophin, which is known to suppress cyclical [31].

Calving Interval: Calving interval is a function of calving to conception interval (CCI) or days open, which is considered to be most important component determining the length of calving interval and gestation length, which is more or less constant [25]. Gestation length varies slightly due to breed, parity, calve sex, calve size, dam age, year and moth of calving [4], Melaku *et al.* [29] observed longer gestation length in seventh parity and shorter gestation length in the second parity showing that older cows carried their cows for longer days than younger cows because of relatively larger uterus.

The calving interval influenced by cow and management/ environment related factors, such as method and efficiency of heat detection, type and efficiency of breeding service and ability of the cow to resume regular ovarian cyclicity after calving, display an overt heat signs

and conceive with the given service [4]. Generally speaking, the duration of this period is influenced by nutrition, season, milk yield, parity, suckling and uterine infection [24].

Lactation Length: In most dairy farms, according to Lobago [4], a lactation length of 305 days is commonly accepted as standard; however, this standard lactation length might not be acceptable for small holder dairy cows in which the lactation length is extended considerably in most cases. An extended lactation period has practical significance for small holder dairy farmers as it provides compensation for the usually extended calving interval and suitability depends particularly on cow milk potential, the ability to grow pasture or feed supplements economically, management expertise, environmental constraints, herd size and labour availability [4].

CONCLUSION

Ethiopia holds large potential for dairy development mainly due to its large livestock population, the favourable climate for improved high yielding animal breeds and the relatively disease free environment. Productive and reproductive performance of cattle is influenced by feed, genetics, disease and management Practices. The reproductive performance traits were vary based level of management, knowledge of feeding, breeding management such as heat detection and artificial insemination, record keeping might have contributed considerably to delayed age at first service, day open, age at first calving, long calving interval and low milk production.

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