
Review on Reproductive and Productive Performance of Dairy Cow in Ethiopia

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Abstract: Ethiopia has largest livestock population in Africa. Despite the largest cattle population, its productive and reproductive performance is very low productivity is relationship between inputs and outputs. The information about reproductive and productive performance in Ethiopia is limited for smallholder. Therefore; the objective of this review paper was to highlight the overall aspects of reproductive and productive performance parameters under Ethiopian condition. Reproductive performance is a trait of outstanding importance in dairy cow enterprises. The production of milk depends heavily on reproductive activity. Reproductive performance traits include number of service per-conception (NSC), calving interval (CI) and days open (DO). Productive performance traits include lactation length (LL), lactation yield (LY) and daily milk yield (DMY) are important criteria for profitable dairy farming. In Ethiopia, crossbred dairy cattle mainly are crosses of zebu with Holstein-Friesian and the mean reproductive performance like CI and productive performance like LL were near to the optimum. The mean values of reproductive and productive traits lower in case of indigenous breed than Friesian and their crosses. However, information is limited about the reproductive and productive performance of dairy cows in smallholder, urban and peri-urban dairy farms in the tropics, particularly in Ethiopia. With efficient management of cows, it is possible to improve performance traits. It is concluded that by improving genetic makeup of dairy cow it is possible to improve the reproductive and productive performance of dairy cattle in Ethiopia.

Keywords: Dairy, Cow, Performance, Traits, Ethiopia

1. Introduction

Ethiopia has largest livestock population in Africa. The cattle population in Ethiopia is estimated 59.5 million, with about 55.5% females and 45.5% males [1]. From the total of cattle population estimated in the country, 98.2% are local breeds, 1.62% hybrid and 0.18% exotic breeds. The livestock subsector has an enormous contribution to Ethiopia's national economy and livelihoods of many Ethiopians. The subsector contributes about 16.5% of the national Gross Domestic Product (GDP) and 35.6% of the agricultural GDP. It also contributes 15% of export earnings, 30% of agricultural employment and support 80% of all rural population [2].

Despite the largest cattle population, its productive and reproductive performance is very low productivity [3]. This low productivity performance is due to; feed shortage (in terms of quality and quantity), lack of access to land, disease prevalence, low level of management, poor breeding

management like accurate heat detection and timely insemination, delayed days open, late age at first calving, long calving interval, short lactation length and low milk production [4]. Differences in breeding efficiency due to environment and between breeds heredity also factor in the variation of reproductive performance [5].

Reproductive performance is a trait of outstanding importance in dairy cattle enterprises though; the production of milk depends heavily on reproductive activity [5]. Possible genetic improvement in nearly all traits of economic importance is closely tied to reproductive rate [5]. Reproductive performance traits include number of service per-conception (NSC), calving interval (CI) and days open (DO) and productive performance traits include lactation length (LL), lactation yield (LY) and daily milk yield (DMY) are important criteria for profitable dairy farming [6]. However, information is limited about the reproductive and productive performance of dairy cows in smallholder, urban

and peri-urban dairy farms in the tropics, particularly in Ethiopia [7].

This review article supports researchers to understand more the reproductive and productive performance under Ethiopian condition. It also helps policy makers to draw sound decisions in order to improve reproductive and productive performance of cattle. The review paper gives information to farmers and bovine breeders regarding reproductive and productive performances improvement of cattle. Therefore, the objective of this review paper was to highlight the overall aspects of reproductive and productive performance parameters under Ethiopian condition.

2. Reproductive Performance

The productivity of cattle depends on their reproductive performance [8]. Reproductive performance of dairy cows is determined by traits like age at first services (AFS), age at first calving (AFC), calving interval (CI), days open (DO) and number of service per conception (NSC). Milk yield per day (MY/D), lactation milk yield (LMY) and lactation length (LL) are considered as an indicator of the productive performance [9].

The level of management and breeding practice, management difference, variation of climatic condition over season of birth, year of birth and year of calving might be lower the value of reproductive traits [10]. Adequate plane of nutrition before and after calving, good breeding management and keeping the health condition of animals in the farm will help to increase the onset of cycling activity in the breeding season and help to minimize the longer DO and CI. The year of calving and year of births influence the performance of the existing breed and the great attention should be given for the inconsistent management practice across the years [10]. Cattle production is found to be important enterprise and significantly contribute to poverty alleviation, food security, improved family nutrition and income and youth employment [11].

2.1. Age at First Calving (AFC)

Age at first calving is the period between birth and first calving and influences both the productive and reproductive life of the female, directly through its effect on her lifetime calf crop and milk production and indirectly through its influence on the cost invested for up-bringing [12]. The overall mean of age at first calving based on different genetic make-up (blood level) of HF and Borana crossbred was obtained as 34.6, 33.7, 33.3 and 33.96 months in 50% (F1), 75% (F2), 87.5% (F3) and $\geq 93.75\%$ (F4), respectively [13]. *Bos indicus* heifers reach puberty at older ages than *Bos Taurus* heifers. *Bos indicus*, but not *Bos indicus* x European, heifers reach puberty at too old of an age to calve at 2 years of age [14].

2.2. Age at First Service (AFS)

AFS is the age at which the breeding heifers reach for

sexual maturity and accepting mating for the initial period. The economy of the farm can be feasible by showing estrous as early as possible for female animal [15]. Average age at puberty ranges from 8 to 10 months for European type dairy cows and 17-27 months for zebu dairy cows. The recommended body weight of Holstein at the first service is 340 kg. Holstein cattle reach puberty at about 37.21 months of age [10] than their cross with zebu which reach puberty at about 24.8 months of age [16].

Table 1. Value of age at first service (AFS) and age at first calving (AFC) of dairy cattle in Ethiopia.

Breeds	AFS (months)	AFC (months)	Sources
Friesian	32.71	42.13	[10]
Kereyu	45.7	54.1	[3]
Fogera	47.2	59.9	[17]
Arsi	----	50.8	[18]
Horro	----	34.4	[19]
Ogaden	4.07year	4.99year	[20]
Friesian x Zebu (F1)	49.49 months	----	[21]
	24.3	3.05year	[4]
	24.8months	35.3 months	[16]
Friesian x Arsi (F1)	-----	33.9	[19]
Friesian x Fogera	40.6	----	[22]
¾ Friesian x ¼ Boran	31.4	40.95	[10]
7/8 Friesian x 1/8 Boran	29.88	40.16	[10]
Pure HF x Pure boran (F1)	25.16	34.6	[13]
Pure HF x F1 breed (F2)	23.8	33.7	[13]
Pure HF x F2 breed (F3)	23.7	33.36	[13]
Pure HF x F3 breed (F4)	24.34	33.96	[13]

2.3. Calving Interval (CI)

Calving interval is the time between two consecutive parturitions, and preferably should be in the range of 12 to 13 months. Calving interval has a great economic importance on the life time milk production and productive life of dairy animals, which ultimately affects the economics of the owners. It is known that the extended calving intervals detrimentally affect the longevity as a productive life, since the cow with longer calving interval has fewer lactation numbers throughout the same age of herd life compared with cows with shorter calving intervals [9]. The calving interval of Friesian cow is 413.04 days which have low interval than zebu cattle [10]. In modern dairies, the general practice is to breed early and cross breeding of zebu with Friesian, with the aim of establishing calving interval of 12 to 13 months, which is considered optimum; hence, the calving interval is considered as an important index of reproductive and productive performance.

2.4. Days Open (DO)

It is the interval between date of calving and date of successful conception. It is one of the best indicator variables, which is most commonly used to measure fertility performance in dairy cattle [23]. Days open directly affect CI, which plays a vital role in the achievement of dairy farms. Days open is the part of the calving interval that can

be shortened by improved herd management. Long days open and consequently, prolonged CI may affect the overall economic revenues of the dairyherd [24]. The average day open period of Friesian cattle is 139.58 days [10] which is lower than the cross of Friesian with Zebu cattle which have 5.19 months [4].

2.5. Number of Service Per Conception (NSPC)

Number of service per conception has been defined as the number of services required for a successful conception [23]. The number service per conception depends largely on the breeding system used. It is higher under uncontrolled, natural breeding than hand mating and artificial insemination (AI) [6]. The measurement of service per conception is determined on a herd or flock basis by dividing total services by the number of pregnancies. Service per conception have little value for a large population of animals, but is a valid measurement of a single herd or an individual female. On herd basis unidentified sterile female make the calculation less meaningful. The average NSPC for Holstein Friesian cattle is 1.3 [10] which is lower than their cross breeds with Zebu cattle (F1) 1.56 [4].

Table 2. Value of Calving Interval (CI), Day Open (DO) and Number of service per conception (NSPC) of dairy cattle in Ethiopia.

Breeds	CI (months)	DO (months)	NSPC	Sources
Friesian	413.04day	139.58day	1.3	[10]
Kereyu	18	---	---	[3]
Fogera	25.5	---	---	[17]
Arsi	578day	285day	1.28	[18]
Ogaden	439day	---	---	[19]
Horro	492.86 day	---	---	[21]
Friesian x Zebu (F1)	2.16year	---	---	[20]
Friesian x Arsi (F1)	21.36	5.19	1.56	[4]
Friesian x Fogera	427day	---	---	[19]
$\frac{3}{4}$ Friesian x $\frac{1}{4}$ Boran	---	305day	1.59	[22]
7/8Friesian x 1/8Boran	397.13day	128.99day	1.42	[10]
Pure HFxPureboran (F1)	406.33day	135.96day	1.37	[10]
PureHFxF1breed (F2)	13.2	75.5day	1.2	[13]
PureHFxF2breed (F3)	14.42	82.68day	1.34	[13]
Pure HfxF3 breed (f4)	15.3	81.4day	1.4	[13]
	14.63	84.4day	1.3	[13]

3. Productive Performance

The lactation performance of dairy cattle is usually measured by determining the total milk yield per lactation or per year, average daily milk yield, lactation length. Generally, the reproductive performance and lactation performance of dairy cattle are closely associated with each other. Breeding failure has a clear negative influence on milk production and farm income and determines the future sustainability of a

dairy farming operation. Milk production level and lactation persistency are crucial factors determining the appropriate calving interval [23].

3.1. Lactation Length (LL)

Lactation length refers to the time of period from when a cow starts to secrete milk after parturition to the time of drying off. Lactation length is an important production trait as it influences the total milk yield. In the majority of improved dairy farms, a lactation length of 305 days usually accepted as a benchmark. This standard allows for calving every 12 months with a 60-day dry period. The 12-month interval has considered "Ideal" for many years. If a cow milked longer than 305 days, her yield for the first 305 days taken as the lactation yield. Some cows are not milked for a full 305 days because they go dry or the lactation terminated for any of several reasons (example; breed). In general the mean of lactation length of indigenous Arsi and Arsi cross Friesian (F1) dairy cow is 272 days and 356 days, respectively [19]. The lactation length of indigenous dairy cattle is lower than pure exotic and cross; hence, the cross breeding is important practices of modern dairies to improve lactation performance of indigenous dairy cow.

3.2. Lactation Milk Yield (MY/L)

Performance of dairy cows could be judged from the milk it produces during a specified period of lactation. Lactation yield in lactation length is known as lactation yield. The lactation yield in Ethiopian breeds is very low compared to exotic breeds and this is depending on number of calving, frequency of milking, persistency of yield. Variation observed in lactation milk yield from lactation to lactation in the same animal. The main cause of difference attributed to the physiology of lactation is the specified set of genes and their response with non-genetic factors [9]. Normally in dairy cattle 30-40% increase in milk production from first lactation to maturity is observed. After 3 or 4 lactation the production starts declining.

3.3. Daily Milk Yield (MY/D)

Daily milk yield is a very important production efficiency trait, which is a combination of milk yield and lactation length [9]. Cows with high milk yield per day of lactation length (MY/DLL) are cost-effective producers and have extra lactation milk yield. In the estimates of MY/DLL, milk yield on average basis of the lactation length were calculated without taking into account the initial low production, peak yield and the declining in production in the last phase of the lactation [9]. The overall mean of daily milk yield of indigenous dairy Zebu cross with Friesian (F1) cow were reported by [4] as 8.52L/day which is higher than Horro breed 1.36L/day and Arsi breed 2.7L/day.

Table 3. Value of milk yield per day (MY/D), milk yield per lactation (MY/L) and age lactation length (LL) of dairy cattle in Ethiopia.

Breeds	MY/D/Cow	MY/Lactation	LL months	Sources
Zebu x HF	8.52L	2333.63L	9.13	[4]
Horro	1.36L	302.62L	9.15	[20]
Arsi	2.7L	809L	272day	[19]
Arsi x HF	5.7L	1977L	356day	[19]
	6.38L	1925L	----	[25]
Pure HFxPureboran (F1)	----	2520L	10.7	[13]
	7.02L	2136L	-----	[25]
PureHFxF1breed (F2)	----	3467L	11.6	[13]
PureHFxF2breed (F3)	----	3579L	12.6	[13]
Pure HfxF3 breed (f4)	----	3554L	11.8	[13]

4. Conclusions

Reproductive performance is a trait of outstanding importance in dairy cattle enterprises. The production of milk depends heavily on reproductive activity. Reproductive performance traits include number of service per-conception (NSC), calving interval (CI) and days open (DO) productive performance traits include lactation length (LL), lactation yield (LY) and daily milk yield (DMY) are important criteria for profitable dairy farming. In Ethiopia, crossbred dairy cattle mainly are crosses of zebu with Holstein-Friesian. The mean reproductive performance like CI and productive performance like LL were near to the optimum; however the mean values of reproductive and productive traits lower in case of indigenous breed than Friesian and their crosses. With efficient management of cows, it is possible to improve performance traits. Possible genetic improvement in virtually all traits of economic importance is closely tied to reproductive rate. It is concluded that by improving genetic makeup of dairy cow it is possible to improve the reproductive and productive performance of dairy cattle in Ethiopia.

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