Farmers' Perception of Dairy Cattle Reproductive Performance in the Central Highlands of Ethiopia

Samuel Diro[1*], Tadele Mamo[1], Wudineh Getahun[1], Aster Yohannis[1], Takele Mebratu[1], and Rehima Musemma[2]

[1]EIAR, Holeta Agricultural Research Center, Holeta; [2]EIAR, Head Quarter, Addis Ababa;
*Corresponding author: samueldiro85@gmail.com

ABSTRACT

This study was designed to assess the perception of dairy farmers regarding reproductive performance (age at first calving and calving interval) of dairy cattle using data collected in the central highlands of Ethiopia. The study covered two zones of Oromia (Special Zone around Finfinne and North Shewa) and one zone of the Amhara region (North Shewa). The multistage sampling technique was employed to select the sample households (farmers) using purposive and random sampling techniques. A total of 564 crossbreeds and 152 local zebu cattle from 289 randomly selected dairy farmers were examined. The data collection was done using a structured questionnaire. Both descriptive and inferential statistics were used to analyze the data. The logistic regression model was also used to identify factors affecting farmers' recognition of dairy cattle delayed conception. The result revealed that the mean lactation length for crossbreed and local zebu cows was 299 and 284 days, respectively. The mean calving interval of crossbreed cows was 19.19 months for delayed cows and 12.4 for normal cows implying 6.79 months delay, compared to the optimal calving delivery. On the other hand, the average calving interval of local zebu cows was 24.03 months for delayed cows and 14.53 for normal cows showing 9.53 months delay. The study also pointed out that 28% of the sample farmers recognize delayed conception of their cows/heifers for which disease was one of the main reasons as they perceived. The respondents reported that poor feeding, management, and genetic setup are other problems that contributed to the problem. The result revealed that the delayed conception rate for the local zebu cows was 26% while it was 32% for the crossbreed cows. The delayed conception rate was also 36% and 25% for local zebu and crossbreed heifers, respectively. The result of the logistic regression model also exhibited that access to dairy extension services, family size, number of cows, distance to veterinary clinics, and access to expert advice affect the recognition of dairy cattle conception performance positively and significantly. The finding suggests emphasizing effective extension services and knowledge distribution to create awareness of dairy cattle's reproductive performance for the proficient intervention of the problem.

Keywords: calving interval; crossbreed; delayed conception; lactation length; local zebu

INTRODUCTION

Poor reproductive efficiency of dairy animals includes increased calving intervals and delay age at first calving. This poor reproductive performance sometimes said to be infertility has become a leading expensive health issue in the dairy industry (Falvey and Chantalakhana, 1999; Lucy, 2001; Hare *et al.*, 2006). According to Falvey and Chantalakhana (1999), infertility is a reduced ability or temporary inability to reproduce which is different from sterility (a complete and permanent inability to reproduce). Infertility has both direct and indirect effects throughout the farm system. Poor fertility reduces genetic gain, increases veterinary costs, decreases milk production, disrupts the pattern of milk production, cuts calf sales, and increases the cost of artificial insemination (AI). The problem of poor reproductive performance finally leads to increased calving interval and involuntary culling which contributes to economic loss (FAWC, 2009; Laven, 2018). The causes of delayed conception are many and can be complex (Arthur, 1982). However, infectious and non-infectious are the two main possible causes of delayed conception in dairy cattle. Non-infectious causes of infertility include nutrition,

management, and genetic, and stress (Mayne *et al.*, 2003; Christine and Soren, 2010). On the other hand, the infectious causes of infertility are that resulted from bacteria, viruses, and protozoa (Falvey and Chantalakhana, 1999). The presence of diseases may be subclinically present but are still capable of quickly reducing the fertility on a cattle farm. In addition to a reduced chance of conception, increased embryonic mortality, and/or abortion percentage, these diseases also result in suboptimal milk productions (Mayne *et al.*, 2003).

Recognizing the delayed conception of dairy cows is used to identify different interventions to overcome the reproductive inefficiency of cow/heifer (Mayne *et al*., 2003). Among others, the use of good herd recording procedures, medical treatment, nutritional intervention, and the use of efficient AI techniques are some of the interventions proposed for infertile cows/heifers.

The Ethiopian highlands possess a high potential for dairy development. This area occupies the central part of Ethiopia and covers over 40% of the country's area. In the central highlands, the agricultural production system is predominantly subsistence smallholder mixed farming, with crop and livestock husbandry typically practiced within the same management unit. As mentioned before, the livestock sector in general, and the dairy subsector, in particular, is constrained by different factors and delayed conception is one. Although the contribution of dairy products to the livestock sector as well as to the agricultural sector at large is considerably high in the highland farming system, limited information is available on the level of delayed conception of dairy farms. This information gap is exacerbated by the dearth of empirical findings on the awareness and perception level of the dairy producers in the area. Thus, this study was conducted to assess dairy farmers' perception of delayed conception of dairy cattle under peri-urban and smallholder dairy production systems of the central highlands of Ethiopia, to identify their perception regarding causes of delayed conception and investigate factors affecting farmers' recognition of dairy cattle reproductive performance in the study areas.

METHODOLOGY

Study area

The study was conducted in three zones, Special Zone around Finfinne and North Shewa zone of Oromia National Regional State and North Shewa zone of Amhara Regional State. Oromia Special Zone Surrounding Finfinne (Addis Ababa) is found in the central part of the Oromia Regional State, surrounding the capital city-Addis Ababa. It consists of six districts namely Akaki, Berek, Mulo, Sebeta-Awas, Sululta, and Welmera, and eight major towns. The major food crops produced in the zone are cereals, pulses, oilseeds, and other crops such as vegetables, fruits, root crops, and stimulants are also grown. The area is the major milk shed of the country. Different dairy improved technologies and practices have been generated and disseminated by Holeta Agricultural Research Center for the area including improved dairy cattle. Welmera is a district sampled for this study.

North Shewa-Oromia zone: The zone shares common boundaries with the East Shewa zone to the southeast, west Shewa zone to the southwest, and Amhara National Regional State to the north, northeast, and Finfinne special zone in the south. Teff, wheat, barley, maize, sorghum, horse beans, field peas, lentils, chickpeas, vetch, Niger seed, rapeseed, and linseed are the most widely cultivated crops in the zone. Livestock rearing is a common agricultural activity in the zone. The area is also a prominent milk supplier to Addis Ababa city. Two districts namely Degem and Debrelibanos districts were selected for the study.

North Shewa-Amhara zone: The agroecology is predominantly highland with few areas of midland. Most parts of the zone are hilly or mountainous, but there are some plains. The economy of

the zone is highly dependent on agriculture in which livestock rearing makes an important contribution to household incomes. The area is known for its moderately good productivity and is considered to be self-sufficient in grain. Teff, beans, wheat, and pulses are ranked in importance in terms of cash earned from sales. Sheep, cattle, poultry, and a few goats and equines are the livestock kept in the area. The source of animal feed is pasture and crop residues. Livestock possession, particularly oxen holding, and cultivated land area are the main determinants of wealth. Crop pest and diseases, shortage of rain, and livestock diseases are the main hazards which affect crop and livestock. Sale of more labor and livestock, sale of more firewood and trees, and use of carry-over stock are coping strategies variously of households during bad times (NSW, 2007). Basona Werana and Angolelana Tera districts of the zone were selected for the study.

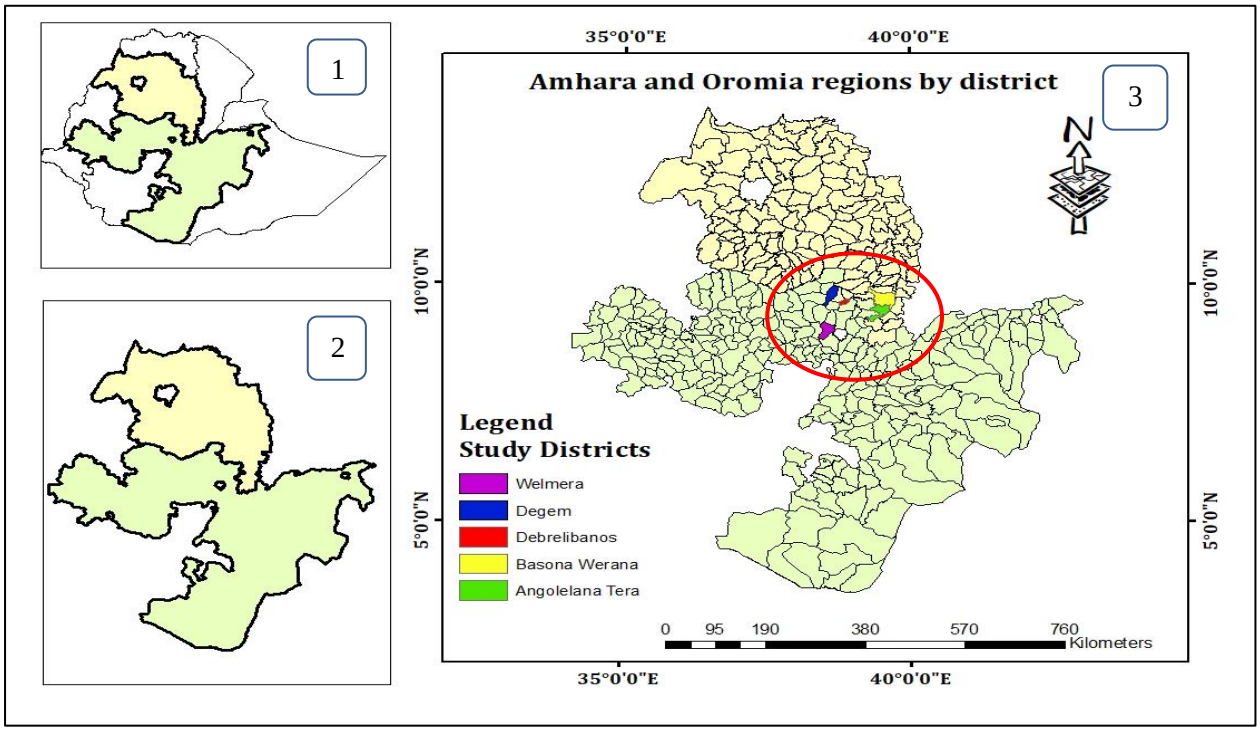


Figure 1: Map of the study areas

Sampling procedure

A multi-stage sampling technique was employed to select the sample from a population for the study which involved both purposive and random sampling techniques. First, regions, zones, and districts were purposively selected based on the importance of the dairy sector and dairy investment trends. Then, kebeles were picked randomly. Finally, dairy farmers/households were randomly selected from the sampling frame/list of farmers that exist at the Peasant Association (PA) level to select a total of 298 dairy farmers that were allocated to each district based on the proportion to the population size.

A total of 289 dairy farming households were interviewed from Oromia and Amhara national regional states. About 60% of respondents were from Oromia and the rest 40% were from the Amhara region. A total of 564 crossbreeds and 152 local zebu cattle were examined. Districts, the proportion of the households, and the number of peasant associations selected from each district are presented in Table 1 below.

Table 1: Study areas and proportion of selected households

Zones	Districts	Number of households	The proportion of households (%)	Number of PAs
Finfinne Special zone	Walmara	52	18	3
North Shewa Oromia	Degem	60	20	2
	Debrelibanos	66	22	2
North Shewa Amhara	Basona Werana	60	20	2
	Angolelana Tera	60	20	2
Total		298	100	11

Data collection and analysis

Data on reproductive performance was collected using a structured questionnaire administered to sampled farmers. The questionnaire was filled using computer-aided personal interviews (CAPI) designed by Census Survey Processing System (CSPro) software. Before implementing the actual survey, the questionnaire was pretested in non-sampled villages. The pretest was not only used to test the appropriateness of the tool in collecting the required data, but also to evaluate the trained enumerators on the capability of administering the questionnaire. Information related to dairy production, reproduction, and utilization was gathered from the respondents. Farmers' perception of dairy cattle's conception performance was also assessed. Furthermore, socio-demographic, institution, and economic features of the sample households were also collected. The collected data were cleaned, organized, and analyzed using Stata version 12.1 software. Both descriptive and inferential statistics were used to analyze the data. The logistic regression model was used to identify factors affecting farmers' recognition of dairy cattle's poor reproductive performance.

For the farmer to recognize or not to recognize dairy cattle poor conception performance, a reaction threshold of different factors affects (Hill and Kau, 1973; Pindyck and Rubinfeld, 1998). As such, at a certain value of stimulus below the threshold, no recognition is observed while at the critical threshold value, a reaction is stimulated. This is modeled as:

$Y_I = \beta X_i^* + \mu_i$ …… (1)

Where Yi is equal to one (1) which stands for recognizing poor conception performance and zero (0) otherwise and X* represents the combined effects of the independent variables (Xi) at the threshold level.

The above binary probability model involves the estimation of the probability of recognition of a given conception problem (Y) as a function of independent variables (X). The probability of recognizing and non-recognizing is also modeled as:

$prob(Y_i = 1) = F(\beta' X_i)$ …… (2)

$prob(Y_i = 0) = 1 - F(\beta' X_i)$ ……..…… (3)

Where Y_i is the observed response for the i^{th} observation of the response variable Y and X_i is a set of independent variables associated with the i^{th} individual, which determines the probability of recognizing (P). The function, F may take the form of a normal, logistic, or probability function. The empirical model for the logit model estimation is specified as:

$z_i = \log\left(\frac{p_i}{1-p_i}\right) = \alpha + \beta' X_i + \varepsilon_i$…… (4)

Where X_i is the combined effect of X explanatory variables that enhance or prevent farmers to recognize poor conception performance in their dairy cattle and $\log\left(\frac{p_i}{1-p_i}\right)$ is the log-odds in favor of farm households' probability of recognition of dairy cattle poor conception performance.

Category of cattle reproductive performance

A crossbreed cow is said to be reproductively poor if and only if its calving interval is above 14 months. On the other hand, crossbreed heifer is called reproductively poor if the age at first calving of the heifer is 36 months. Hence, the age at first calving for the normal crossbreed heifers' ranges between 25 and 36 months in normal condition. Otherwise, it is considered reproductively poor (37 months and above) as suggested by Falvey and Chantalakhana (1999) and Mulugeta and Belayeneh (2013). The calving interval for local zebu cow is between 12 and 19 months and the age at first calving for the local zebu heifers ranges between 36 and 48 months. If these conditions are not fulfilled, they are considered reproductively poor.

RESULTS AND DISCUSSION

Characteristics of the sample households

The descriptive result showed that 95% of the respondents were male-headed and the rest 5% were female-headed households. The overall mean age of the household head was 45 years with a standard deviation of 12 years. The result also showed the highest education level in the Finfinne special zone and the lowest in the north Shewa-Amhara zone with the overall mean of 3.93 years which is statistically significant at a 10% significance level. The mean dairy farming experience was 11.64 years which is statistically different among study zones at a 5% significance level. The mean family size was 6.08 which is the highest in the North Shewa-Oromia zone and the lowest in the North Shewa-Amhara zone (Table 2).

Table 2: Sociodemographic characteristics of the respondents

Particulars	Finfinne Special Zone (n=52)	North Shewa Oromia (n=126)	North Shewa Amhara (n=120)	Overall (n=298)	*P-value*
	Mean ±SD	Mean ±SD	Mean ±SD	Mean± SD	
Age of HH head	46.10 ±12.9	43.48±12.1	46.74±12.4	45.23±12.4	0.108
Education of HH head	4.58 ±4.1	4.22±3.5	3.33±3.5	3.93±3.6	0.062*
Farming experience (yrs.)	10.44 ±13.6	15.42±10.5	14.93±11.6	14.36±11.6	0.027**
Labor force	3.06 ±1.7	3.07±1.8	3.11±1.7	3.09±1.7	0.972
Total family size	6.06 ±2.1	6.21±2.6	5.94±2.2	6.08±2.3	0.667

*** p<0.01, ** p<0.05, * p<0.1
HH: Household

The sample farmers of the north Shewa-Oromia zone owned significantly the largest land size compared to the other zones. The mean landholding in the study area was 3.33 hectares. Large land for hay, grazing land, and improved forage land was allocated by the farmers of the North Shewa Oromia region where relatively larger total land exists. A large proportion of land for livestock feed was allocated at the North Shewa-Oromia zone and a low proportion at Finfinne special zone. The area is also known for commercial hay production and supply. The mean land allocated to feed was 28% of the total area which is significant at α=0.05 (Table 3).

Table 3: Land ownership of the respondents

Land size in hectares	Oromia Special Zone Around Finfinne (n=52)	North Shewa Oromia (n=126)	North Shewa Amhara (n=120)	Overall (n=298)	P-value
	Mean± SD	Mean± SD	Mean± SD	Mean± SD	
Total land owned	2.88±1.99	3.68±1.80	3.16±1.71	3.33±1.82	0.012**
Homestead land	0.18±0.09	0.44±0.78	0.22±0.12	0.31±0.53	0.001***
Cropland	1.77±1.31	1.99±1.24	2.01±1.23	1.96±1.25	0.498
Forest/tree land	0.20±0.52	0.07±1.65	0.12±0.21	0.11±0.28	0.014**
Grazing land [A]	0.44±0.79	0.49±0.57	0.48±0.63	0.48±0.64	0.877
Hay grassland [B]	0.23±0.71	0.39±0.60	0.23±0.26	0.29±0.52	0.029**
Forage land [C]	0.03±0.09	0.24±0.40	0.13±0.22	0.16±0.31	0.000***
Cattle feed [A+B+C]	0.70±0.63	1.12±0.89	0.84±0.77	0.93±0.90	0.031***
% allocated to feed	24	30	27	28	0.046**

*** p<0.01, ** p<0.05, * p<0.1

Dairy farmers' access to services

The accessibility of different livestock service providing institutions was also assessed in this study. The result revealed that the proportion of the sample household's access to artificial insemination (AI) service was 82% which is the highest in the North Shewa Amhara zone and the lowest in Finfinne special zone. The overall access to experts' advice regarding dairy cattle management was 81%. Moreover, the North Shewa-Oromia zone is more accessible to AI services. Finfinne special zone is less accessible to both AI services and experts' advice (Figure 1).

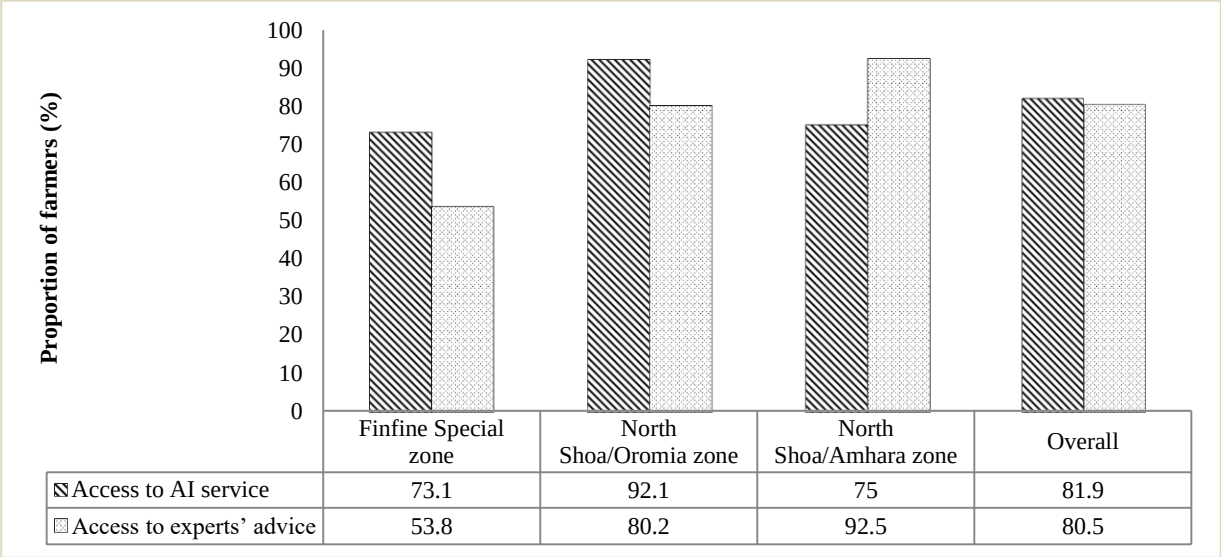


Figure 1: Farmers' access to AI and experts' advice

The result also shows that 50% and 30% of dairy farmers had access to dairy extension services and training on dairy cattle management, respectively. Farmers of North Shewa-Oromia have more access to both dairy extension services and training. However, Finfinne special zone dairy farmers have lower access to both extension service and training (Figure 2).

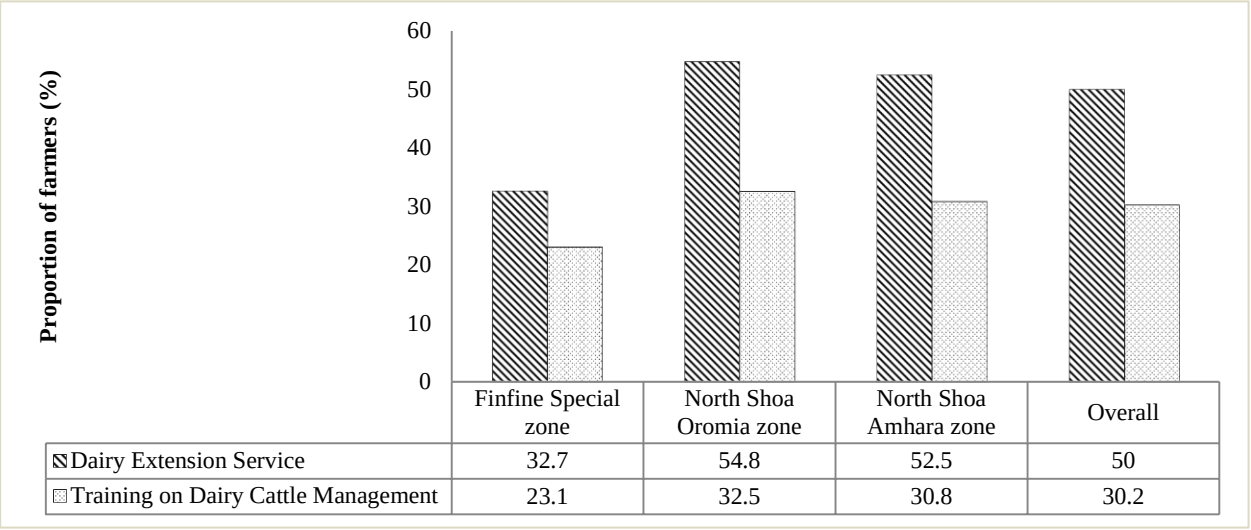


Figure 2: Access to extension service and training

Livestock production and productivity

Livestock ownership

The result of the survey showed that households' livestock holding is low which realized the mixed farming feature of the area. The mean crossbreed and local zebu dairy cattle holding are statistically different in number among the study zones. The mean number of lactating cows was 1.66 which is highest in the north Shewa-Oromia zone (1.71) and lowest in the North Shewa-Amhara zone (1.55). The mean livestock holding was 10.12 TLU (Tropical livestock units) (Table 4).

Table 4: Livestock ownership of the sample households in the study zones

Livestock	Finfinne Special Zone (n=52)	North Shewa Oromia (n=126)	North Shewa Amhara (n=120)	Overall (n=298)	P-value
	Mean± SD	Mean± SD	Mean± SD	Mean± SD	
Crossbreed cows	0.98±1.27	2.37±1.73	1.75±0.78	1.88±1.43	0.000***
Local cows	1.73±2.05	0.36±0.89	0.50±0.78	0.65±1.24	0.000***
Crossbreed heifers	0.48±0.87	0.96±0.88	0.71±0.77	0.78±0.85	0.001***
Local heifers	0.65±0.97	0.14±0.43	0.15±0.48	0.23±0.61	0.000***
Crossbreed oxen	0.29±0.75	1.18±1.28	1.35±1.03	1.09±1.16	0.000***
Local oxen	2.17±1.45	0.92±0.94	0.88±0.98	1.12±1.11	0.000***
Crossbreed bulls	0.33±0.86	0.52±1.49	0.37±0.69	0.42±1.12	0.464
Local bulls	0.50±1.02	0.09±0.35	0.12±0.48	0.17±0.58	0.000***
Crossbreed calves	0.81±1.14	1.16±1.11	1.26±0.90	1.14±1.04	0.032**
Local calves	0.87±1.03	0.17±0.46	0.28±0.62	0.33±0.70	0.000***
Lactating cows	1.71±1.26	1.75±0.96	1.55±0.82	1.66±0.97	0.243
TLU	10.64±6.54	9.58±4.90	10.48±4.48	10.12±5.07	0.276

*** p<0.01, ** p<0.05, * p<0.1

Dairy cattle productivity

The productivity of cows in the study zones was also assessed. The results showed that mean milk for crossbreed cows was 8.04 liters/day, which is highest at the north Shewa-Amhara zone and lowest at Finfinne special zone. For local zebus, the highest milk yield was observed at north Shewa-Oromia and the lowest was observed at Finfinne special zone with a mean of 2.82 lit/day. The result showed significant local zebu milk yield differences among the study zones at α=0.1 (Table 5). Recent empirical studies showed that the average daily milk yield of exotic cows was 8.78 and 5.83 for the urban and peri-urban areas, respectively. On the other hand, the average daily milk yield of local cows was 2.56 and 1.87 for the urban and peri-urban areas, respectively (Gebrekidan *et al.*, 2012). The study conducted by Dayanandan (2011) also revealed that the mean daily milk production of crossbred cows was found to be 8.7 liters in the central highlands of Ethiopia.

Table 5: Milk yield of cows in the study areas

Daily milk yield (lit/day)	Finfinne Special Zone (n=52)	North Shewa Oromia (n=126)	North Shewa Amhara (n=120)	Overall (n=298)	P-value
	Mean± SD	Mean± SD	Mean± SD	Mean± SD	
Crossbreed Cow	7.68±2.81	7.98±3.25	8.23±2.58	8.04±2.96	0.550
Zebu/Local Cow	2.38±1.52	3.27±1.24	3.26±1.73	2.82±1.61	0.050*

*** p<0.01, ** p<0.05, * p<0.1

Feeding regime

Farmers in the study zones were using two main feeding regimes namely open grazing and stall feeding. Most of the farmers at each study zones are using stall feeding and open grazing. On average 74% of sample farmers were using both open grazing and stall feeding together. The use of both feeding regimes together was reported highest at the North Shewa Amhara zone and lowest at the North Shewa Oromia zone. On the other hand, it was reported that the highest proportion of farmers practiced open grazing at Finfinne special zone and while stall feeding was reported the highest at North Shewa Oromia zone (Figure 3).

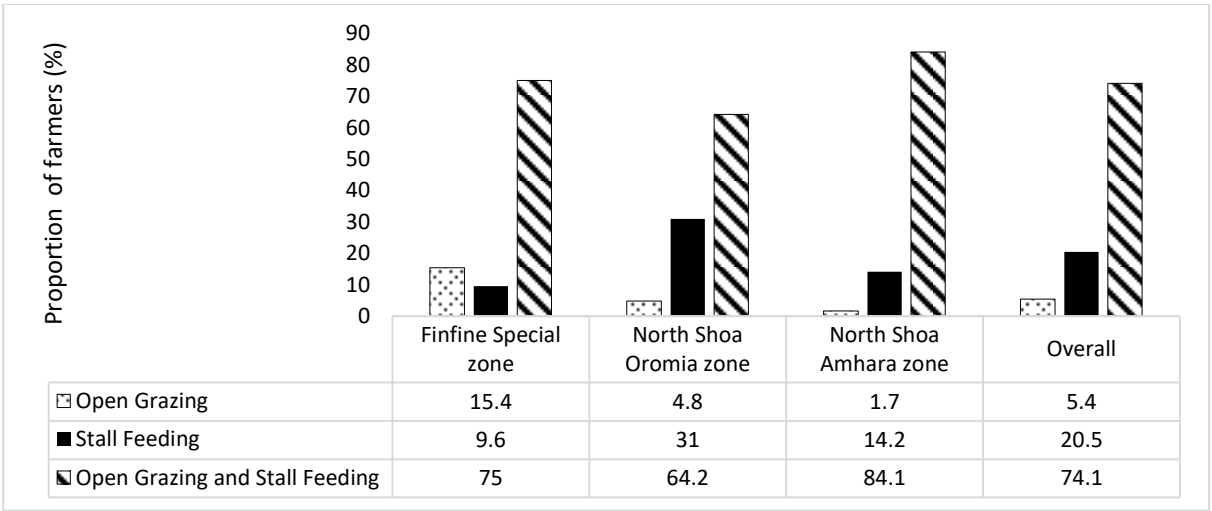


Figure 3: Feeding regime on the study zones

Dairy cattle reproduction

Lactation length, age at first calving, calving interval, breeding methods, and conception rate were the most common dairy cattle reproductive and milk production traits examined in this study. Major findings on these reproductive and milk production traits are reported in the following sub-sections.

Lactation length

Lactation length in the study zones was seen both for crossbreed and local zebu cows. The result showed that the mean lactation length for crossbreed cows was 9.96 months (299 days) which is the highest in the North Shewa-Amhara zone and the lowest in Finfinne special zone with a statistically significant difference among the study zones. The lactation length of the local zebu cattle is relatively lower than that of crossbreed cows with a mean of 9.46 months (284 days) which is also the highest in the North Shewa Amhara zone and the lowest in the North Shewa-Oromia zone. There was a significant difference between lactation length of crossbreed and local dairy cows in the North Shewa Oromia zone and North Shewa Amhara regions. However, the overall mean comparison result exhibited no significant difference between the lactation length of crossbred and local cows with a mean of 9.84 months (Table 6). The lactation length reported in this study is relatively higher than the study conducted by Gebrekidan *et al.,* (2012) which reported the average lactation length of the local, cross, and exotic breed being 6.5, 7.48, and 8.82 months, respectively.

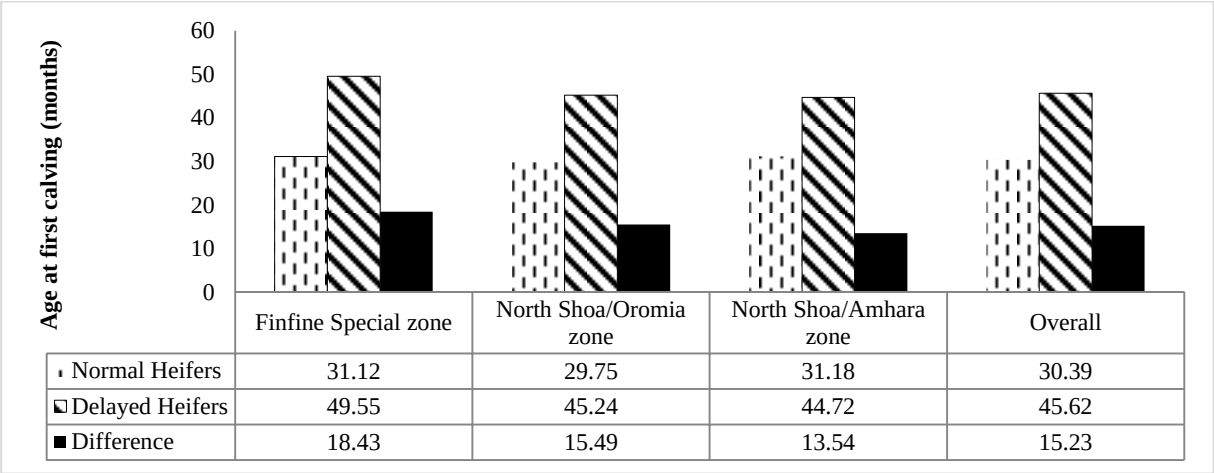
Table 6: Lactation length of dairy cows in the study areas

Lactation length in months	Finfinne Special Zone (n=52)	North Shewa Oromia (n=126)	North Shewa Amhara (n=120)	Overall (n=298)	P-value
	Mean± SD	Mean± SD	Mean± SD	Mean± SD	
Crossbreed Cow	9.11±1.98	9.68±1.69	10.63±2.12	9.96±1.97	0.000***
Zebu/Local Cow	9.50±2.69	8.17±1.75	9.96±2.47	9.46±2.54	0.124
Overall	9.33±2.23	8.99±1.71	10.11±2.33	9.84±2.13	
P value	0.459	0.031**	0.048**	0.392	

*** p<0.01, ** p<0.05, * p<0.1

Age at first calving

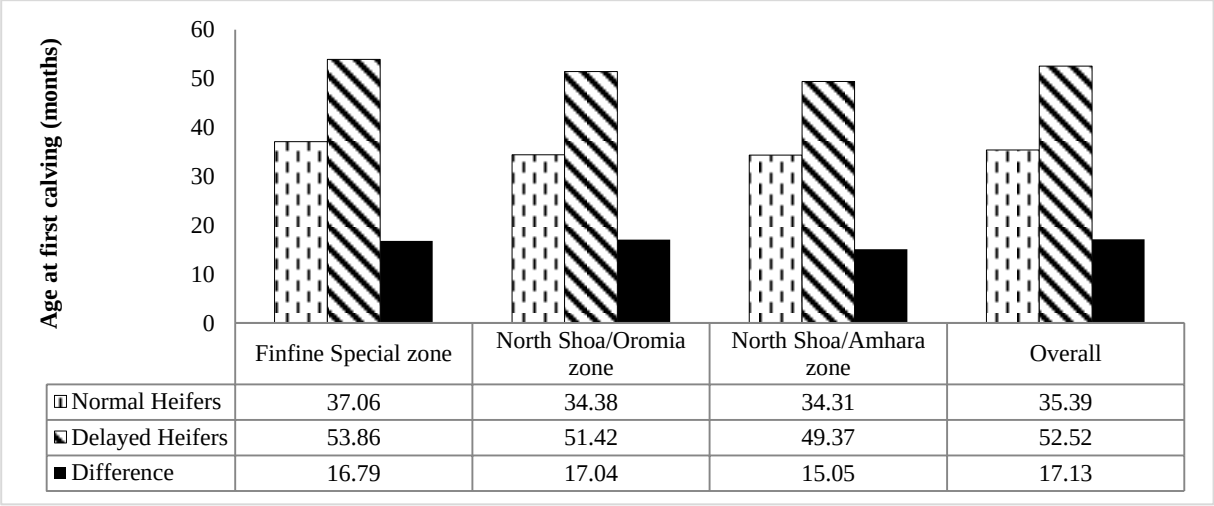
Age at first calving affects the reproductive performance of heifers. The result of the survey showed the mean age at first calving for fertile crossbreed heifers was 30.39 months and while it was 45.62 for delayed heifers implying the overall mean difference/delay of 15.23 months between them. However, there is a variation in ages at the first calving among the study zones with the highest and the lowest at Finfinne special zone and North Shewa-Amhara zone, respectively (Figure 4).



	Finfine Special zone	North Shoa/Oromia zone	North Shoa/Amhara zone	Overall
Normal Heifers	31.12	29.75	31.18	30.39
Delayed Heifers	49.55	45.24	44.72	45.62
Difference	18.43	15.49	13.54	15.23

Figure 4: Age at first calving for crossbreed heifers in the study areas

Age at first calving for local zebu heifers also showed that the overall mean for fertile heifers was 35.39 months whereas it was 52.52 months for the delayed heifers implying the average difference of 17.13 months. However, there is a variation among the study zones with the highest and the lowest recorded at the North Shewa-Oromia zone and North Shewa-Amhara zone, respectively (Figure 5). Long first calving interval results in fewer numbers of calves and less milk yield in the lifetime of the cow. Besides, farmers also incur unnecessary costs of carrying these unfertile heifers until they become productive and generate milk. The overall estimated average age at first calving was found to be 40.9 months, of which 47.16 months for local cows, and 37.95 months for crossbreed cows (Mulugeta and Belayeneh, 2013).

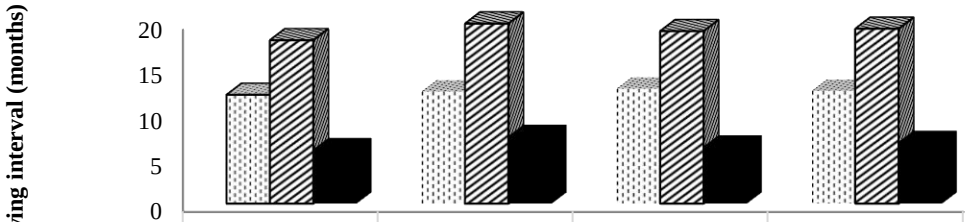


	Finfine Special zone	North Shoa/Oromia zone	North Shoa/Amhara zone	Overall
Normal Heifers	37.06	34.38	34.31	35.39
Delayed Heifers	53.86	51.42	49.37	52.52
Difference	16.79	17.04	15.05	17.13

Figure 5: Age at first calving for local zebu heifers in the study areas

Calving interval

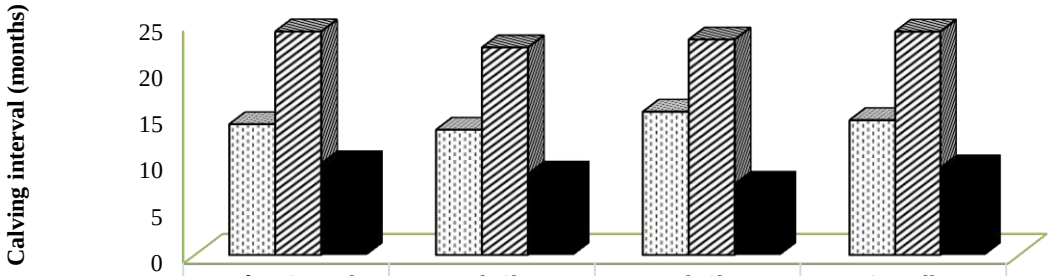
Calving interval is the most important trait which affects the reproductive performance of the dairy cows. The mean calving interval of crossbreed cows was found to be 12.4 months for fertile cows and 19.19 for delayed cows which showed 6.79 months delay. However, there is a variation in calving interval among the study zones with the smallest delay at Finfinne special zone and the largest delay at the North Shewa-Oromia zone (Figure 6).



	Finfine Special Zone	North Shoa Oromia zone	North Shoa Amhara zone	Overall
Normal cows	11.96	12.32	12.64	12.4
Delayed cows	17.94	19.76	18.93	19.19
Difference	5.98	7.44	6.29	6.79

Figure 6: Calving interval of crossbreed cows in the study areas

The calving interval of the local zebu cows also revealed that the overall mean calving interval of 24.03 months for the delayed and 14.5 for the fertile cows implying the delay of 9.53 months. For local zebu cows, the highest delayed months were observed at Finfinne special zone while the lowest was in the North Shewa-Amhara zone (Figure 7). This result is almost similar to the previous studies conducted by Mulugeta and Belayeneh (2013) which shows the mean calving interval of local and crossbreed dairy cows was 23 months (24.94 months for local cows and 22 months for crossbred) indicating more delayed calving interval in local cows.

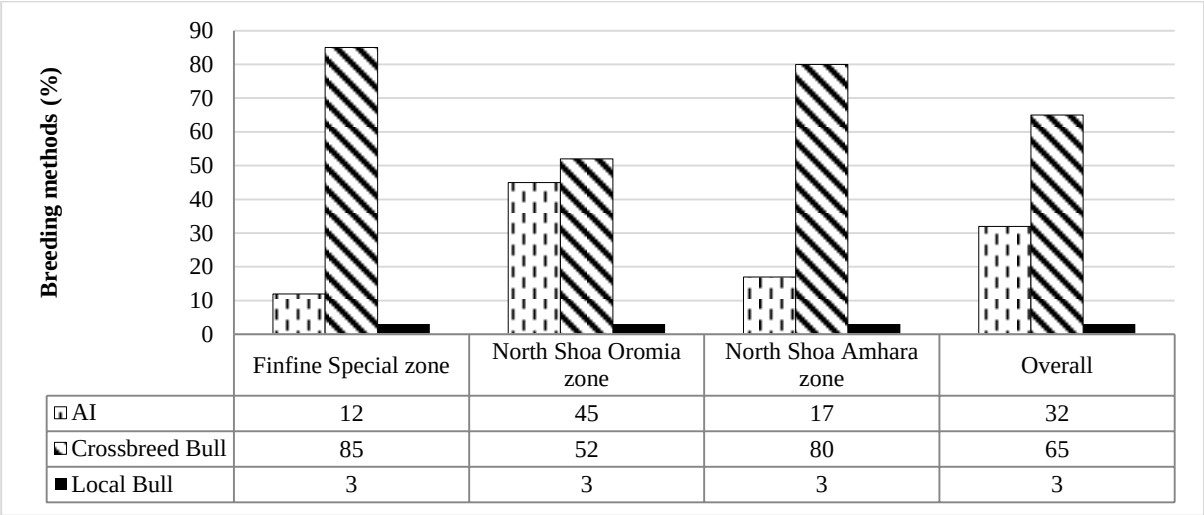


	Finfine Special Zone	North Shoa Oromia zone	North Shoa Amhara zone	Overall
Normal cows	14.07	13.47	15.41	14.5
Delayed cows	24.05	22.33	23.18	24.03
Difference	9.98	8.86	7.77	9.53

Figure 7: Calving interval of local zebu cows in the study areas

Breeding methods

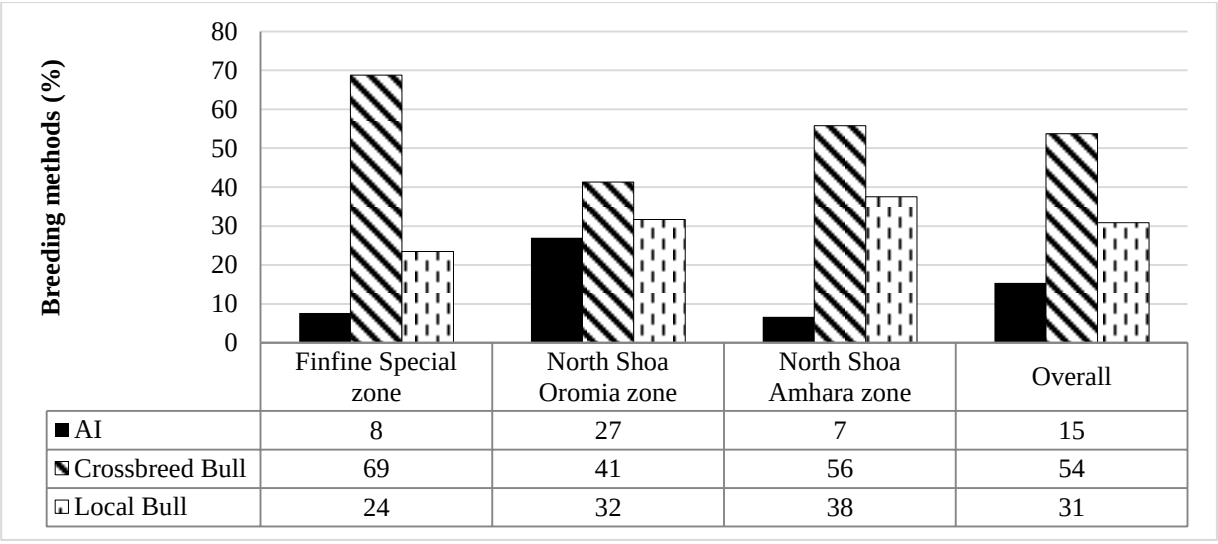
Farmers are practicing the different breeding methods for both crossbreed and local zebu cows and heifers. Most dairy farmers in study areas use crossbreed bulls followed by AI to breed crossbreed cows and heifers. Artificial insemination (AI) is highly used in the North Shewa Oromia zone (45%) with an overall mean of 32% (Figure 8).



	Finfine Special zone	North Shoa Oromia zone	North Shoa Amhara zone	Overall
AI	12	45	17	32
Crossbreed Bull	85	52	80	65
Local Bull	3	3	3	3

Figure 8: Breeding system for crossbreed cows/heifers in the study areas

The result showed that the majority of farmers use crossbreed and local bulls to breed local cows and heifers. Relatively better use of AI for local cows was observed North Shewa Oromia zone (27%). The overall mean of AI use in the study areas was 15% (Figure 9).

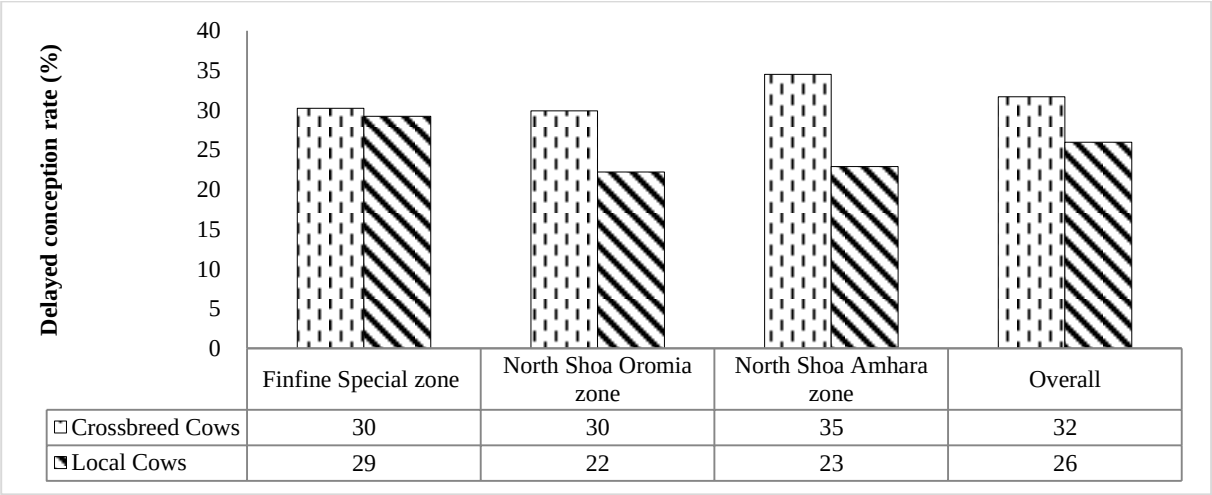


	Finfine Special zone	North Shoa Oromia zone	North Shoa Amhara zone	Overall
AI	8	27	7	15
Crossbreed Bull	69	41	56	54
Local Bull	24	32	38	31

Figure 9: Breeding system for local zebu cows/heifers in the study areas

Dairy cattle fertility and reproductive status

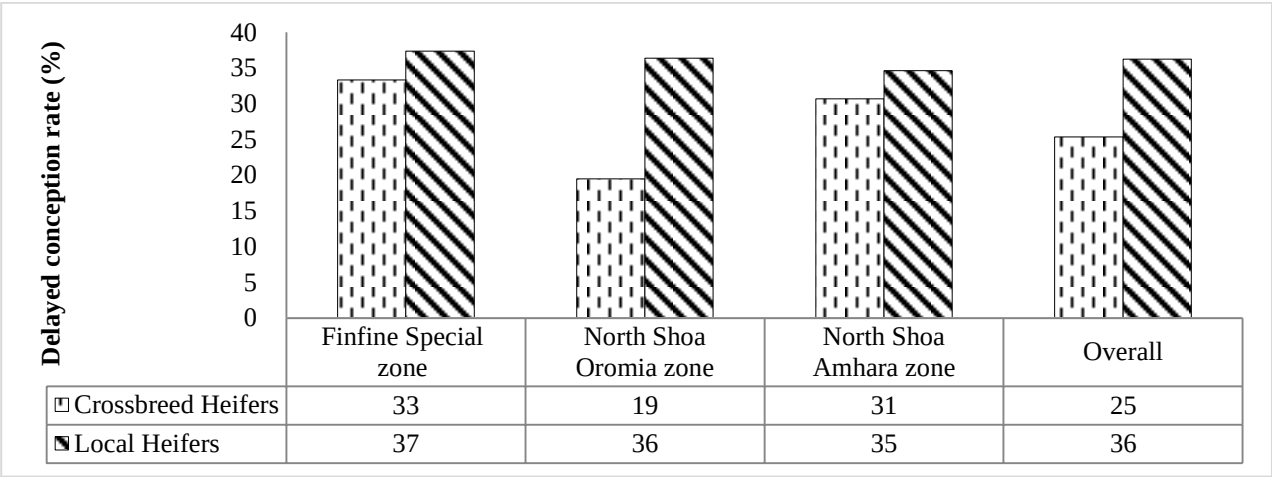
The study assessed the delayed conception status of both local and crossbreed dairy cows and heifers, respectively. The results showed that the mean poor reproductive performance rate of the local zebu cows was 26% and vary among the study zones. For instance, local zebu cows had a higher poor reproductive performance rate at Finfinne special zone than at North Shewa. This might be because Finfinne special zone dairy farmers have less access to AI and poor reproductive performance rate test. The poor reproductive performance rate of crossbred cows was larger (35%) at the North Shewa Amhara zone than the overall average of 32% (Figure 10).



	Finfine Special zone	North Shoa Oromia zone	North Shoa Amhara zone	Overall
Crossbreed Cows	30	30	35	32
Local Cows	29	22	23	26

Figure 10: Proportion of animals (cows) with delayed conception

The reproductive performance of local zebu heifers also revealed that the mean delayed conception rate was 36% with a high rate at Finfinne special zone and a low rate at the North Shewa Amhara zone. Higher (33%) poor reproductive performance of crossbred heifers was reported at Finfinne special zone and the lowest (19%) at the North Shewa Oromia zone. The mean poor reproductive performance rate of crossbreed heifers was 25% (Figure 11).



	Finfine Special zone	North Shoa Oromia zone	North Shoa Amhara zone	Overall
Crossbreed Heifers	33	19	31	25
Local Heifers	37	36	35	36

Figure 10: Proportion of animals (heifers) with delayed conception

Farmers' perception of delayed conception

Dairy farmers' perception of the poor reproductive of their cows has an important implication to reduce its effects. The study result shows that 34% of North Shewa-Amhara zone farmers recognized the poor reproductive performance of their cows. On the contrary, only 19% of the farmers of the Finfinne special zone recognized the poor reproductive performance with the overall mean of 28% (Figure 12), indicating a lower level of farmers' perception of the poor reproductive performance of their cows.

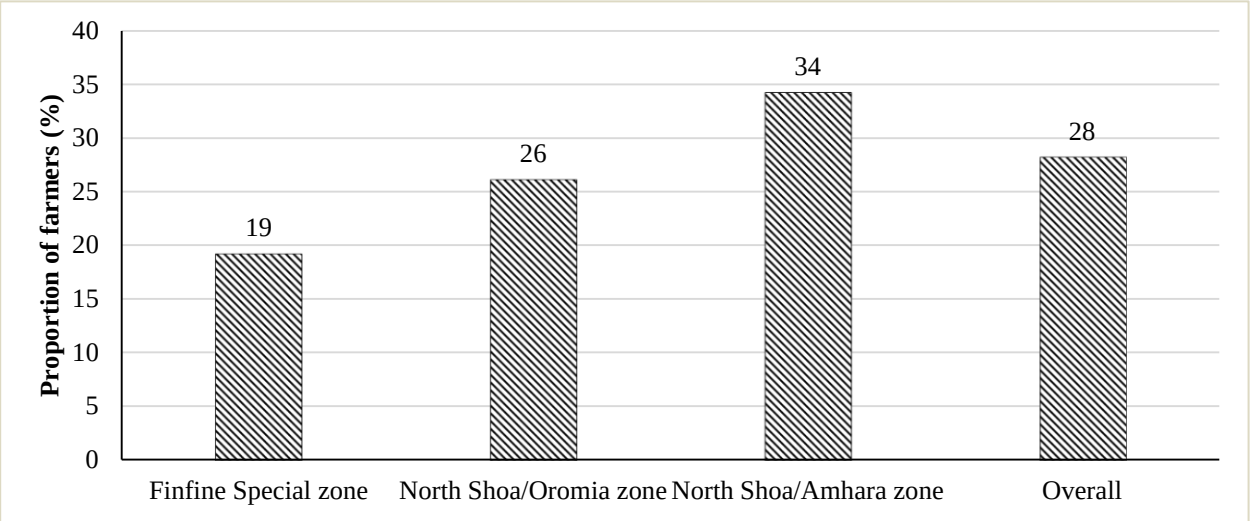


Figure 12: Farmers' recognition of delayed conception

Farmers make a different decision after they recognize the delayed conception of their cows. Based on the survey result, 66% of the farmers reported that they did nothing with the infertile/reproductively poor cows/heifers. However, there is a variation among the study zones regarding the farmers' decision to do nothing with the infertile cows. For instance, most of the sample farmers (84%) did nothing while 8%, 6%, and 2% decided to cull, followed medical treatment, and practiced home treatment in Finfinne Special zone. On the other hand, the decision made to cull was the highest in the North Shewa-Oromia zone and the lowest in Finfinne special zone. Overall, the decision made to cull infertile cattle was 16% implying that culling due to delayed conception was not common in the study areas. About 13% of farmers were provided medical treatment and very few of them reported to treat delayed conception at home. The trend and experience of medical treatment for delayed conception were the highest in the North Shewa-Amhara zone (17%) and the lowest in Finfinne special zone (Figure 13).

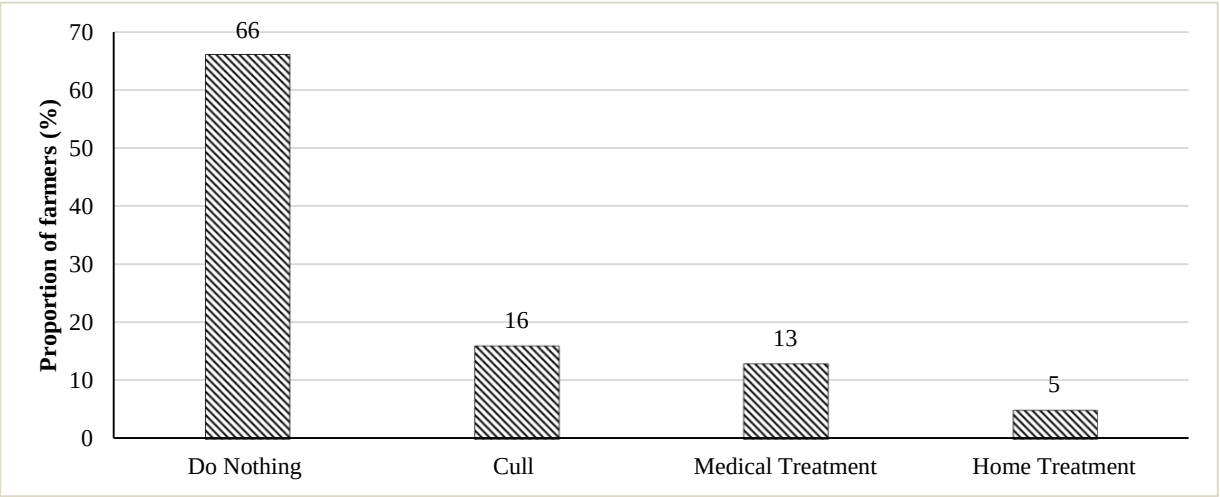


Figure 13: Farmer's decision on infertile/reproductively poor cows/heifers

Farmers' perception of the cause of poor reproductive performance has also been assessed in this study. The result revealed that 81% of the farmers in the study zones believed that disease was the main cause. Besides, they also reported that poor feeding, management, and genetic problem were also the major causes of poor reproductive performance. However, there is a variation among the study zones regarding the causes. For example, sample farmers of the Finfinne special zone reported poor feeding, genetic problem, and management as the most important causes. On the other hand, farmers of North Shewa-Oromia and North Shewa-Amhara zone reported disease, poor feeding, and management as the three major causes of delayed conception in dairy cows and heifers (Figure 14).

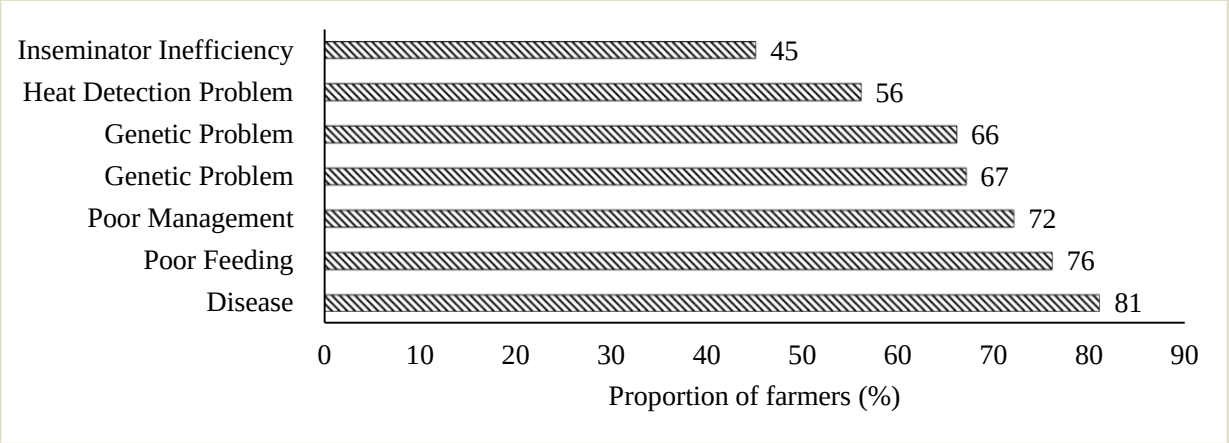


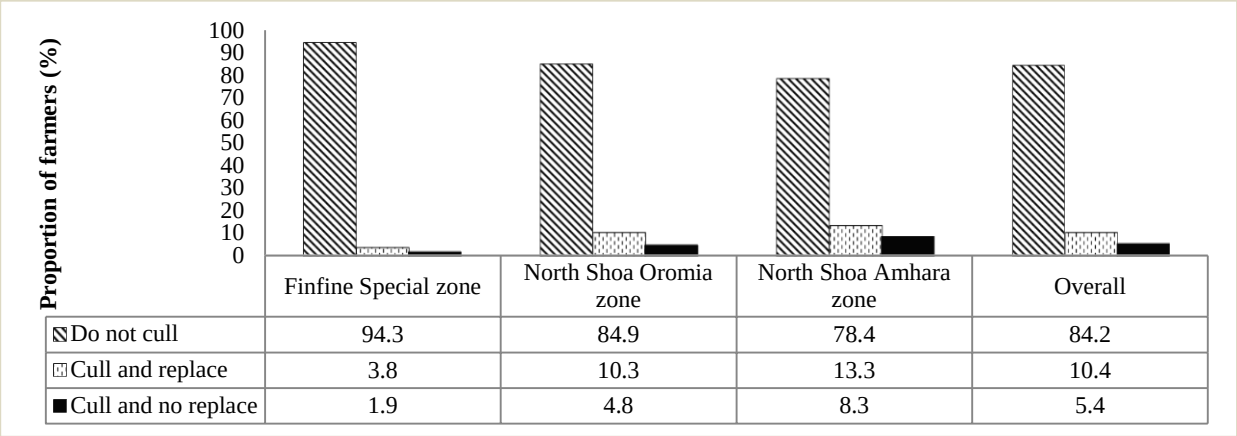
Figure 14: Farmers' perception of the cause of delayed conception

Dairy farmers have a long period of culling experience of their unproductive cattle due to different reasons. The result showed that 21% of the sample households culled their cows due to old age. As the age raises, the productivity declines and farmers decide to cull to avoid carrying costs. The second important reason for culling was reported (16% of sample farmers) to be poor production/productivity. Besides, feed shortage, inadequate space for cattle, and conception delay were also reported as some of the reasons for the culling of cows and heifers. There is a variation among the study zones in terms of the reason why they culled their cows. For example, age and feed shortage was the main reason for culling at Finfinne special zone while both delayed conception and age (old) were at the north Shewa-Oromia zone. Furthermore, about 26% of the sample farmers at the North Shewa-Amhara zone used age as the main reason for culling cows (Table 7).

Table 7: Reasons for culling dairy cow/heifer (proportion of respondents)

Farmer's list of reasons for culling	Finfinne Special Zone (n=52)	North Shewa Oromia (n=126)	North Shewa Amhara (n=120)	Overall (n=298)
Inadequate space	12	12	12	12
Feed shortage	17	15	12	13
Poor reproductive performance	10	16	8	11
Old age	29	17	26	21
Other health problem	0	8	5	5
Poor production	15	8	15	16
Financial requirement	10	9	13	11
Delay in conception	7	15	9	11

It was indicated that the selling price of infertile cows/heifers is low as compared to normal and fertile cows/heifers. More than 67% of the sample farmers reported that they sold the infertile cows at a lower price as compared to the fertile ones. In general, farmers' decisions made on infertile cows revealed that about 84% of respondents did not cull the cows/heifers even if the cattle are infertile. The decision made not to cull was the highest at Finfinne's special zone (94%) and the lowest at the North Shewa-Amhara zone (78%). Furthermore, some 10% of the sample households culled and replaced and the rest 5% culled and but not replaced the cows. Culling and replacing were reported to be the highest in the North Shewa-Amhara zone (13%) and the lowest in Finfinne special zone (Figure 15).



	Finfine Special zone	North Shoa Oromia zone	North Shoa Amhara zone	Overall
Do not cull	94.3	84.9	78.4	84.2
Cull and replace	3.8	10.3	13.3	10.4
Cull and no replace	1.9	4.8	8.3	5.4

Figure 152: Farmers` decisions on replacing cows/heifers with poor reproductive performance

Factors affecting farmers' recognition of dairy cattle infertility

Different factors were considered to observe factors affecting farmers' recognition of the poor reproductive performance of their dairy cattle. Region dummy (Amhara) is positively associated with the knowledge of recognizing the infertility problem in their dairy cows. On the other hand, male-headed households are more likely to judge cattle reproductive performance. The coefficient of the marginal effect of the male was 0.129 which implies that being male increases the recognition of poor reproductive performance by 12.9%. The reason could be that males know and evaluate the cattle's performance during rearing and feeding. Dairy extension service and expert advice had a positive impact on the dairy farmers' knowledge to recognize infertility (delayed fertility) of milking cows. This is due to farmers' exposure to awareness and knowledge during extension and expert contact. Family size was positively associated with the dairy farmers' knowledge to recognize infertility in Ethiopia. This is because, in large families, there is a higher probability of overlooking dairy cows including heat detection and following-up the herd. Furthermore, their level of understanding and recognizing the infertility problem in their herd can be higher in a larger family.

The number of cows was positively associated with dairy cattle reproductive performance evaluation. This implies specialization in dairy farms and hence frequent follow-up to their dairy cows. As a result, their level of recognizing infertility problem in their dairy farm is higher than those who are not specialized in dairy farms. Another important result is the distance to veterinary clinics measured in kilometer. The result indicated that dairy farmers who have located a far distance from the veterinary clinic had a higher probability of recognizing the infertility problem in their dairy farms (Table 8). Meena *et al.* (2012), in their study in India, indicated a positive and significant correlation

between knowledge of cattle reproductive performance and age, milk production, extension contact, and credibility of the information source.

Table 8: Factors affecting farmers' recognition of dairy cattle infertility: a result of logistic regression

Variables	Coefficient	SE	dy/dx	SE
Household head sex [Male]	0.740	0.508	0.129*	0.072
Access to dairy extension [Yes]	0.605***	0.179	0.122***	0.035
Region [Amhara]	0.376*	0.202	0.077**	0.041
Household head age in years	-0.004	0.009	-0.001	0.002
Household education in years	-0.022	0.026	-0.005	0.005
Total family size	0.082*	0.045	0.017*	0.009
Dairying experience	0.003	0.009	0.001	0.002
Total number of cows	0.202**	0.094	0.041**	0.019
TLU in livestock number	0.019	0.029	0.004	0.006
Training on dairy cattle management	-0.269	0.190	-0.054	0.037
Distance to veterinary clinics in km	0.108**	0.047	0.022**	0.010
Access to expert advice	0.961***	0.275	0.170***	0.040
Use of AI	-0.112	0.195	-0.023	0.040
Constant	-4.551***	0.756		

Number of observations = 289
Pseudo r^2 = 16.403
Chi-square = 70.783
Prob > chi2 = 0.000
*** p<0.01, ** p<0.05, * p<0.1

CONCLUSIONS AND IMPLICATION

The study was conducted to evaluate farmers' perception of dairy cattle reproductive performance in the central highlands of Ethiopia. Based on the study results, the mean calving interval of crossbreed cows was 12.4 months for fertile cows and 19.19 for delayed cows, implying a difference of 6.79 months. The calving interval of local zebu cows was 24.03 months for delayed cows and 14.53 for normal cows with a difference of 9.53 months. The mean age at first calving for normal crossbreed heifers was 30.39 months and 45.62 for delayed heifers. Farmers perceived that disease is the main cause of delayed conception. Poor feeding, poor management, and genetic problem were also reported as other causes of poor reproductive performance. The proportion of crossbred and local zebu cows with poor reproductive performances in the study areas were 26 and 32%, respectively. Similarly, 36% local zebu heifers and 25% crossbred heifers were reported to have delayed conception rate in the areas. Based on these findings, the following recommendations have been proposed.

- Emphasis must be given to effective extension services and knowledge transfer to improve awareness on dairy cattle reproductive performance followed by proficient intervention to tackle the problem. Awareness must also be created among the farmers regarding the causes of delayed conception in dairy cattle. Moreover, farmers should be trained on proper heat detection and overall management of the animal.
- It is necessary to have a record to revisit cattle fertility, reproduction, and production status. The record-keeping practice among the farmers should be developed to maintain scorecards which would assist the producer, planner, and researcher in discerning the characteristics, fertility, and performance of animals for future planning and improvement of production.

- Further research is required at a wider scale integrated with clinical diagnoses that enable to generalize about the findings and help policymakers to design appropriate dairy development interventions.

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