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# Environmental factors influence the lactation performance of crossbred dairy cattle in Ethiopia: A review

## Fikadu Wodajo Tirfie

Ethiopian Institute of Agricultural Research (EIAR), Holetta Agricultural Research Center, P.O. Box 2003 Addis Ababa or 31 Holetta, Ethiopia

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***Corresponding Author***
*Fikadu Wodajo Tirfie*
***E-mail:*** *fikadu121084z@gmial.com*
*Phone: +251919198563*

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**ABSTRACT**

**The effect of environmental factors on the lactation performance of crossbred dairy cattle in Ethiopia is discussed in this review. The efficiency of dairy farming systems is largely determined by the herd's lactation performance. The evaluation of lactation performance of dairy cattle is critical for the overall development of the dairy industry. Non-genetic (environmental) factors (parity, calving season, and calving year) significantly influenced common lactation performance indicators (daily milk yield (DMY), lactation milk yield (LMY), 305day milk yield (305DMY), and lactation length (LL)). Improving cow management (such as feeding, housing, disease control, and seasonal breeding) should be required to improve the lactation performance of crossbred dairy cattle.**

## INTRODUCTION

In Ethiopia, genetic improvement of indigenous cattle has primarily focused on crossbreeding. For decades, crossbred cattle, predominantly zebu crosses with Holstein-Friesian cattle, have been used for milk production (Niraj et al 2017). The efficiency of dairy farming systems is largely determined by the herd's lactation and reproductive performance. The evaluation of lactation and reproductive performance of dairy cattle is critical for the success of the entire dairy industry development (Wondossen, 2018)

Evaluation of crossbreeding achievement and generation of performance information could provide valuable documentation for developing a future national breeding policy. Lactation performance is commonly measured by daily milk yield (DMY), lactation milk yield (LMY), 305day milk yield (305DMY), and lactation length (LL). Information on the influence of environmental factors on economic traits is thought to be very important in developing proper management practices for trait improvement.

Some research has been conducted on the lactation performance of some Ethiopian crossbred dairy cattle. The current review looks at the impact of the environment on the lactation performance of crossbred dairy cattle in Ethiopia.

### Effect of environment on lactation performance of cross breed dairy cattle in Ethiopia

Animal performance is influenced not only by genetic merit, but also by nutritional, management, health, and environmental factors. Milk yield and milk-related traits are influenced by a variety of factors, including feed quantity and quality, breed, parity, season, milking intervals, and milking frequency, as well as diseases (Nitsuh, 2018; Wubshet, 2018).

Dairy cattle lactation performance is typically measured by total milk yield per lactation or per year, average daily milk yield, lactation length, milk production persistency, and milk composition (Zewdu et al 2013). The milk produced by a dairy animal during a specific period of lactation is used to judge its lactation performance.

### Effect of calving season

According to Haile et al. (2009), the calving season had no effect on all milk production traits (daily milk yield, lactation length, lactation milk yield and 305 day milk yield). This finding is comparable to Destaw's (2018) research at the Alage Agricultural Technical Vocational Educational Training (ATVET) College dairy farm (Table 1). The effect of management and weather conditions on daily milk yield varied significantly between seasons. Cows that calved during the dry and main rain seasons produced more daily milk yield than cows that calved during the short rain season. The calving season had a significant impact on daily milk production. The lower daily milk yield could be attributed to changes in weather and pasture productivity during this season (Tadesse, 2014).

Season had a significant effect on the average daily milk yield at Menkorer Agro Industry Enterprise Dairy Farm (MAIEDF) in Debre Markos town Nitsuh (2018), which is higher during the long rainy season. This may be related to the lowest temperature recorded during the long rainy season in the Ethiopian Highlands, as well as better forage availability; it may favor high-quality exotic breeds from temperate regions.

The calving season had no effect on lactation milk yield (LMY) at the Holleta bull dam station and the Debre Zeit genesis dairy farm (Alewya, 2014). Tadesse et al. (2010), Direba (2012), Abdu (2014), Haile (2014), and Destaw (2014) all reported the same result (2018). Cows calving during the long rainy season produced the most milk, due to the low environmental temperature and the availability of high-quality fodder.

On the other hand, calving season had an effect on lactation milk yield Niraj et al (2014) at Gondar, accounting for 1.91% of the total variation in the trait. Cows calving in July-October (1482.05+68.90 liters) had significantly higher LMY than cows calving in November-February (1376.39+74.50 liters) and March-June (1364.23+84.32 liters) (Table 1). According to Tadesse (2014), the calving season has a significant effect on lactation length. This was agreed upon by Destaw et al (2016) and Nitsuh (2018) in their reports on Alage & Ardaita Agricultural Technical Vocational Educational Training College and Menkorer Agro Industry Enterprise Dairy Farm (MAIEDF) (Table 1). According to some research, the calving season had no significant effect on the lactation length of crossbred dairy cattle (Abdu, 2014; Alewya, 2014; Niraj et al 2014; Destaw, 2018; Kefale, 2018; Wubshet, 2018).

At Holleta and Debre Ziet agricultural research center dairy farm (Haile et al 2009; Yosef, 2006) and Alage Agricultural Technical Vocational Educational Training (ATVET) College dairy farm, 305 day milk yield was not significantly affected by season (Destaw, 2018). According to Wubshet (2018), it had a significant effect on 305 day milk yield at Elfora Cheffa Dairy Farm in Oromia Zone of Amhara Region.

**Table 1: Effect of calving season on lactation trait (LMY, LL, 305DMY and DMY)**

| Traits | | | | Study Site | Authors |
|---|---|---|---|---|---|
| LMY | LL | 305DMY | DMY | | |
| * | - | - | - | BARC | (Sisay, 2015). |
| NS | NS | - | - | Holleta and D/Z | (Alewya, 2014). |
| ** | NS | - | - | Gondar | (Niraj et al 2014) |
| NS | NS | NS | NS | Holleta and D/Z | (Haile et al 2009) |
| NS | - | - | - | Central high land | (Tadesse et al 2010) |
| **** | NS | - | * | HARC | (Kefale, 2018) |
| - | NS | * | - | Cheffa ELFORA | (Wubshet, 2018) |
| - | - | NS | - | HARC | (Yosef, 2006) |
| NS | NS | - | - | Adea'Berega | (Direba, 2012) |
| NS | NS | - | - | SCBMC | (Abdu, 2014) |
| NS | NS | - | * | ATVETC | (Haile, 2014) |
| * | * | - | - | Alage & Ardaita TVETC | (Destaw et al 2016) |
| * | *** | - | *** | MAIEDF at D/M | (Nitsuh, 2018) |
| NS | NS | NS | NS | ATVETC | (Destaw, 2018) |
| * | * | - | * | HARC | (Tadesse, 2014) |

*LMY= Lactation Milk Yield, LL=Lactation Length, 305DMY= 305 Day Milk Yield, DMY= Daily Milk Yield, **** = Significant at p<0.0001, *** = Significant at p< 0.001, ** = Significant at p< 0.01, *=Significant at p<0.05 and NS = Non- Significant or p>0.05, - not available*

**Effect of parity**

According to Wondossen et al (2018), parity had a significant effect on daily milk yield, revealing that the mean daily milk yield of the herd increased from parity one to parity three. The increasing trend in DMY could be attributed to the fact that cows calving in the first parity were not mature enough to produce more milk due to physiological conditions such as udder development and energy reserve for both body maintenance and milk production; however, increased production was observed in later parities with the attainment of maturity. Other researchers have also reported the significance of parity on daily milk yield with varying levels of significance (Table 2) (Demeke et al 2003; Haile et al 2009; Gebregziabher et al., 2014; Haile, 2014; Destaw, 2018; Kefale, 2018 and Nitsuh, 2018).

One of the non-genetic (environmental) factors that had an effect on the lactation milk yield of crossbred dairy cattle was parity. Parity was found to have a significant effect by Wondossen et al (2018), Demeke et al. (2003), Tadesse et al (2010), and Destaw et al (2016). First lactation cows produced the least amount of milk, while third parity produced the most. The primary cause of variation in the given set of genes and their interactions with non-genetic factors is lactation physiology (Wondossen et al 2018).

The significant effect of parity on lactation milk yield may be due to differences in udder size, feed requirements related to gastro intestinal tract development and environmental conditions during lactation. In fact, as animal's age, they will use feed for maintenance, production, and reproduction rather than growth. As a result, the feed used for heifer growth will be used for milk production in older animals (Nitsuh, 2018). Jersey Cattle Breeding and Multiplication Center at Wolaita Zone, parity had not a significant impact on lactation performance (Table 2) (Abdu, 2014)

According to the findings of Kefale (2018), parity had a significant effect on lactation length. The first parity had the longest lactation length, while the eighth parity had the shortest lactation length. Milk yield increased with lactation length, but lactations longer than one year did not appear to be advantageous. The daily milk yield decreases in the later stages of lactation, affecting lifetime production. Furthermore, longer lactations lengthen the calving interval, reducing the number of calves that can be born during a cow's lifetime (Alewya, 2014).

Lactation length was significantly influenced by parity due to the increase in efficient feed utilization by dairy animals as they aged. As animals age, their uterus recovery time decreases, and they can more efficiently use feed for both milk production and uterus recovery (Nitsuh, 2018). This is consistent with studies conducted at HARC by Demeke et al (2003), Yosef (2006), Kefena et al (2011), Tadesse (2014), Selamawi et al (2017), and Kefale (2018).

According to Haile (2014) on Alage Agricultural Technical Vocational Educational Training (ATVET) College dairy farm; Destaw et al (2016) on Alage & Ardaita TVETC; and Nigusu (2012) on Adama milk shade /east shewa, the effect of parity has no effect on lactation length (Table 2). According to Haile et al (2009), Kefena et al (2011), Selamawi et al (2017), Destaw (2018), and Wubshet (2018) at HARC and DZARC dairy farms, parity affected the 305 day milk yield (305DMY) . However, parity had no effect on 305-day milk yield for cross-bred dairy cattle at the Holleta agricultural research center herd (Table 2) (Yosef, 2006).

According to Wubshet (2018) study, milk yield increased from parity 1-5, then declined due to decline

in body condition and degeneration of the body system over the recurring pregnancies. It will depend on the cow's ability to keep the condition at a survivable level. In addition, because the heifers were still growing, the feed that was given to them was channeled toward their growth. Milk yield increased as the parities progressed because the feed requirements for growth decreased (Wubshet, 2018).

**Table 2: Effect of parity on lactation trait (LMY, LL, 305DMY and DMY)**

| Traits | | | | Study Site | Authors |
|---|---|---|---|---|---|
| LMY | LL | 305DMY | DMY | | |
| *** | ** | - | ** | Wolkite town | (Wondossen et al *2018)* |
| ** | * | - | - | Holleta and D/Z | (Alewya, 2014). |
| ** | ** | - | - | Gondar | (Niraj et al 2014) |
| ** | ** | ** | ** | Holleta and D/Z | (Haile et al 2009) |
| *** | *** | - | *** | Holleta | (Demeke et al 2003) |
| *** | - | - | - | Central high land | (Tadesse et al 2010) |
| *** | *** | *** | - | HARC | (Kefena et al 2011) |
| **** | **** | - | **** | HARC | (Kefale, 2018) |
| - | * | ** | - | Cheffa ELFORA | (Wubshet, 2018) |
| - | - | NS | - | HARC | (Yosef, 2006) |
| **** | **** | - | - | Adea'Berega | (Direba, 2012) |
| **** | - | - | **** | BARC & HARC | (Gebregziabher et al 2014) |
| NS | * | - | - | SCBMC | (Abdu, 2014) |
| *** | NS | - | *** | ATVETC | (Haile, 2014) |
| *** | NS | - | - | Alage & Ardaita TVETC | (Destaw et al 2016) |
| - | NS | - | *** | Adama milk shade /east shewa | (Nigusu, 2012) |
| *** | *** | - | ** | MAIEDF at D/M | (Nitsuh, 2018) |
| ** | *** | *** | *** | ATVETC | (Destaw, 2018) |
| *** | *** | *** | - | HARC | (Selamawi et al 2017) |
| ** | ** | - | ** | HARC | (Tadesse, 2014) |

*LMY= Lactation Milk Yield, LL=Lactation Length, 305DMY= 305 Day Milk Yield, DMY= Daily Milk Yield, **** = Significant at p<0.0001, *** = Significant at p< 0.001, ** = Significant at p< 0.01, *=Significant at p<0.05 and NS = Non- Significant or p>0.05, - not available*

**Effect of calving year**

The year of calving had a significant effect on the lactation performance of crossbred dairy cattle. The daily milk yield varied significantly depending on the calving year. The variation in milk yield observed over time may be related to the availability of quantity and quality forage, the feeding system, the size of the herd, the management system, and environmental conditions such as temperature, humidity, and disease, which vary from year to year (Nitsuh, 2018). Demeke (2003) and Tadesse (2014) at the Holleta Agricultural Research Center Dairy Farm (HARC), Haile (2014) and Destaw (2018) at the Alage Agricultural Technical Vocational Educational Training College (ATVETC), and Nitsuh (2018) at the Menkorer Agro Industry Enterprise Dairy Farm (MAIEDF) in Debre Markos town study report found that the year of calving had a significant effect on daily milk yield (Table 3).

According to Nitsuh (2018)'s study on MAIEDF at D/M, Calving year had no significant effect on lactation milk yield (LMY), which could be attributed to adequate supply of concentrate feed to the cow, high availability and quality of feed resources, and regular feeding management. According to Demeke (2003), Tadesse et al (2010), Kefena et al (2011), Alewya (2014), Haile (2014), and Destaw (2014), the calving year has a significant impact on the lactation milk yield of cross breed dairy cattle (2018).

According to a study conducted at Cheffa ELFORA by Wubshet (2018), the calving year had no effect on lactation length (LL). This was not agreed upon by Selamawi et al (2017) at Holleta agricultural research center and Nitsuh (2018) at Menkorer Agro Industry Enterprise Dairy Farm Debre Markos (Table 3).

According to a study conducted at the Holleta Agricultural Research Center, the year of calving had a significant effect on 305 day milk yield (Kefena et al 2011). A similar report was published for another study conducted at the Alage Agricultural Technical Vocational Educational Training (ATVET) College dairy farm (Destaw, 2018). This is consistent with and comparable to research at Cheffa ELFORA in the Oromia zone of the Amahara region (Wubshet, 2018). Other researchers in different agro ecology and sites reported similar findings. There was a significant difference in the calving year on 305 day milk yield at Holleta and Debre ziet agricultural research center dairy farm (Haile et al 2009; Yosef, 2006; Selamawi et al 2017).

**Table 3: Effect of calving year on lactation trait (LMY, LL, 305DMY and DMY)**

| Traits | | | | Study Site | Authors |
|---|---|---|---|---|---|
| LMY | LL | 305DMY | DMY | | |
| *** | *** | - | - | Holleta and D/Z | (Alewya, 2014). |
| ** | ** | ** | ** | Holleta and D/Z | (Haile et al 2009) |
| *** | *** | - | *** | Holleta | (Demeke, 2003) |
| *** | - | - | - | Central high land | (Tadesse et al 2010) |
| *** | *** | *** | - | HARC | (Kefena et al 2011) |
| **** | **** | - | **** | HARC | (Kefale, 2018) |
| - | NS | ** | - | Cheffa ELFORA | (Wubshet, 2018) |
| - | - | ** | | HARC | (Yosef, 2006) |
| **** | **** | - | | Adea'Berega | (Direba, 2012) |
| * | * | - | | SCBMC | (Abdu, 2014) |
| *** | *** | - | *** | ATVETC | (Haile, 2014) |
| *** | NS | - | - | Alage & Ardaita TVETC | (Destaw et al 2016) |
| NS | *** | - | *** | MAIEDF at D/M | (Nitsuh, 2018) |
| *** | *** | *** | *** | ATVETC | (Destaw, 2018) |
| *** | *** | *** | - | HARC | (Selamawi et al 2017) |
| ** | ** | - | ** | HARC | (Tadesse, 2014) |

*Note; LMY= Lactation Milk Yield, LL=Lactation Length, 305DMY= 305 Day Milk Yield, DMY= Daily Milk Yield, **** = Significant at p<0.0001, *** = Significant at p< 0.001, ** = Significant at p< 0.01, *=Significant at p<0.05 and NS = Non- Significant or p>0.05, - not available*

## CONCLUSION

The effects of non-genetic (environmental) factors (parity, calving season, and calving year) on lactation performance (daily milk yield (DMY), lactation milk yield (LMY), 305day milk yield (305DMY), and lactation length (LL)) were investigated. Non-genetic or environmental factors such as year of calving, season of calving, and parity had a significant effect on lactation traits and can be used as a selection criterion for increased production efficiency in crossbred dairy cattle. Lactation performance of crossbred cows requires improvement in overall dairy cow management. Crossbred cows were sensitive to seasonal and periodic changes in milk production performance. It may be difficult for them to increase and sustain their production capacity. As a result, improving environmental factors and cow management are required to mitigate the effects of periodic and seasonal changes.

### Recommendation

To improve lactation performance of crossbred dairy cattle, cow management (such as feeding, housing system disease control, and seasonal breeding) should be improved.

## REFERENCES


Abdu Esmael 2014 Estimation of phenotypic and genetic parameters for production, reproduction and survival traits of Jersey cattle at sodo cattle breeding and multiplication center, Wolaita Zone. Msc Thesis, Haramaya University.

Alewya Heyredin 2014 Comparative study of reproductive and productive performance of Holstein Friesian dairy cows at Holetta bull dam station and genesis Farms. Msc Thesis Addis Ababa University Bishoftu, Ethiopia

Destaw Worku 2018 Effects of period of calving, season of calving and parity on milk production performance of Holstein Friesian dairy Cows in Alage ATVET College, Ethiopia. J. Anim. Feed Res., 8(4): 97-104.

Destaw Worku, Kefyalew Alemayehu and Mussie H. Melekote 2016 Comparative milk production performance evaluation of Holstein Friesian cattle breeds in the two different agro ecological systems: The case in Alage and Ardaita ATVET College dairy farm, Oromia region, Ethiopia. Advances in Biological Research 10 (5): 295-303.

Direba Hunde 2012 Survival, reproductive and productive performance of pure Jersey cattle at Adea Berga dairy research center in the central highlands of Ethiopia. Msc Thesis: A thesis submitted to University of Natural Resources and Life Sciences, Vienna.pp. 90

Gebregziabher Gebreyohannes, Skorn Koonawootrittriron, Mauricio Aguirre Elzo and

Thanathip Suwanasopee 2014 Genotype by environment interaction effect on lactation pattern and milk production traits in an Ethiopian dairy cattle population. Kasetsart J. (Nat. Sci.) 48 : 38 – 51.

Haile, A.; Joshi, B. K.; Ayalew, W.; Tegegne, A. and Singh, A. 2009 Genetic evaluation of Ethiopian Boran cattle and their crosses with Holstein Friesian in central Ethiopia: milk production traits. Animal. 3:4, pp 486–493.

Haile Berihulay 2014 Evaluation of reproductive performance of Holstein Friesian dairy cows at Alage Agricultural Technical Vocational Educational Training College dairy farm, South Western Ethiopia. Msc Thesis Haramaya University

Kefale Getahun 2018 Genetic and non-genetic parameter estimation for productive and reproductive performances of crossbred dairy cattle at Holetta Research Center. Msc Thesis, Haramaya University, Haramaya

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 Vol. 5(6), pp. 96-104.

M Tadesse, J Thiengtham, A Pinyopummin and S Prasanpanich 2010 Productive and reproductive performance of Holstein Friesian dairy cows in Ethiopia. Livestock Research for Rural Development. 22 (2).

Nigusu Fekade 2012 Evaluation of urban and peri-urban dairy production systems in Adama milk shed, East Shoa zone, Oromia national regional state, Ethiopia. Msc Thesis, Haramaya University.

Niraj Kumar, Alemayehu Eshetie, Abreha Tesfaye and Hailelule Aleme Yizengaw 2014 Productive performance of indigenous and HF crossbred dairy cows in Gondar, Ethiopia. Veterinary World 7(3): 177-181.

Niraj Kumar Berihu Gebrekidan, Nigus Abebeand and Etsay Kebede 2017 Performance of crossbred dairy cows under farmers' management in and around Debre Zeit, Ethiopia. Ethiopian Journal of Veterinary Science and Animal Production (EJVSAP),1(1): 66-72.

Nitsuh Walelign 2018 Productive and reproductive performance of crossbred dairy cattle at Menkorer Agro Industry Enterprise Dairy Farm Debre Markos Ethiopia. Msc Thesis .Haramaya University, Haramaya. Pp.74.

S. Demeke, F. W. C. Neser and S. J. Schoeman 2003 Estimates of genetic parameters for Boran, Friesian, and crosses of Friesian and Jersey with the Boran cattle in the tropical highlands of Ethiopia: milk production traits and cow weight. J. Anim. Breed. Genet. 121 (2004), 163–175

Selamawi V. Thesiger, Amhaisaac Baruch and Berhane Hersi Lencho 2017 Genetic trends for selected crossbred dairy cows produced at Holetta Agricultural Research Center, Ethiopia. World Journal of Environmental Biology Research. Vol. 1 (3), Pp. 015-023.

Sisay Eshetu 2015 Productive and Reproductive Performance of Dairy Cows (Horro, Horro x Friesian and Horro x Jersey) at Bako Agricultural Research Center Msc Thesis , Haramaya University.

Tadesse Birhanu 2014 Estimation of crossbreeding parameters in Holstein Friesian and Ethiopian Boran crosses for milk production and reproduction traits at Holetta Agricultural Research Center, Ethiopia. MSc Thesis. Haramaya University. pp.83.

Wondossen Ayalew, Yohannes Besufekad and Wahid M. Ahmed 2018 Productive and reproductive performance of crossbred dairy cows in Tropical Highland, South Western, Ethiopia. Journal of Reproduction and Infertility 9 (1): 01-08

Wubshet Kassa 2018 Estimation of genetic and non-genetic parameters for reproduction and production traits of Holstein Friesian dairy herd at ELFORA Cheffa dairy farm, Oromia zone of Amhara Region, Ethiopia. Msc Thesis, Haramaya University, Ethiopia.pp.93

Yosef Tadesse 2006 Genetic and non-genetic analysis of fertility traits in Holetta and Ada'a Berga Dairy Herds. Msc Thesis, Alemaya University.pp.143.

Zewdu Wondifraw, B. M. Thombre and D. V. Bainwad 2013 Effect of non-genetic factors on milk production of Holstein Friesian × Deoni crossbred cows. International Journal of Livestock Production. Vol. 4(7), pp. 106-112.

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