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Milk Yield and Reproductive Performances of Dairy Cows at Bako Agricultural Research Center

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Abstract **– This study was conducted with the objective to evaluate and compare the lactation milk yield and reproductive performances of pure local and crossbred cows at Bako Agricultural Research Center, West Shoa Zone. The data used in this study include age at first service, age at first calving, number of service per conception, days open, calving interval and lactation milk yield of Pure Horro, Horro-Friesian and Horro-Jersey dairy cows at the research center. The independent variables examined were breeds and season. Least squares means were analysed using GLM (General Linear Model) procedure of SAS, 2016 (Version 9.4) with probability level of (P<0.05). The overall mean for breed and season for age at first service, age at first calving, was 36.07 and 46.5 months, respectively. The data was collected for 37 years (1974-2011) on three breed-groups namely indigenous Horro, Horro-Friesian and Horro-Jersey. The mean age at first service was 33.44 ± 0.7, 31.32 ± 1.0 and 46.79 ± 1.0 for Horro-Friesian, Horro-Jersey and pure Horro respectively. The overall mean value of days open was 87.98 months, for which Horro-Jersey showed significant difference (P<0.05) from pure Horro and Horro-Frisian. The overall mean value of calving interval was 13.31 months for which Horro-Jersey showed significant difference (p<0.05) as compared to pure Horro and Horro-Frisian while no significant difference was observed between Horro-Frisian and pure Horro. The overall mean value of lactation milk yield was 1351.71 kg for which the three breed-groups studied showed significant difference (p<0.05). It was found out that Frisian and Jersey crosses were better in terms of the performances evaluated for age at first service, age at first calving, number of services per conception, days open, calving interval and lactation milk yield.**

Keywords **– Dairy Cows, Ethiopia, Reproductive Performance.**

I. INTRODUCTION

The economy of Ethiopia is dominated by agriculture and cattle which play a vital role in agricultural production. Similarly, cattle are used to generate critical cash in times of scarcity, provide collateral income for local informal credit and serve other socio-cultural benefits in Ethiopia (Ulfina *et al.,* 2005). Due to the pivotal role that dairy production plays in the economy of the country as well as the enhancement of the nutritional status of the citizens, development of the sector is crucial. To be effective, the efforts to improve the productivity of smallholder dairy production and improve its market orientation needs to be supported and informed by detailed understanding of the current and dynamic conditions of production, marketing, processing and consumption of milk and dairy products (Asfaw, 2009). Even though, the nation own huge livestock resources, the per capita consumption of milk is estimated to be only 20 kg/year as compared to 27 kg for other African countries and 100 kg for the world (FAO, 2010). Indigenous cattle have been naturally selected for years towards adaptive traits under harsh tropical environment and unique product qualities. These include resistance to diseases and parasites, longevity and adaptation to poor quality feeds and high fat milk. In spite of the enormous livestock resource and great potential for increased livestock production, the productivity is disproportionally lower due to a number of economic, technical, policy and institutional challenges (Tefera, *etal.,* 2010). The Horro cattle breed, is one of the 27 cattle breeds identified so far in Ethiopia (DAGRIS, 2007). The breed occupies the highland of western Ethiopia, mainly in the Horro Guduru area as well as adjoining parts of Western Shoa and Illubabor (DAGRIS,

2007). Although, milk production of indigenous cows is not up to the mark, we cannot ignore them because they possess some unique characteristics, for example, have more disease resistance capacity, survive well under threatened level of nutrition and well-adjusted under hot and humid climatic conditions. Adaptation to their environment and resistance to Trypanosomosis disease in Horro cattle is the most likely explanation for economic importance of the breed (Stein *et al,* 2011).

The present scenario of dairy production in Ethiopia reflect the lack of efficient selection program, absence of periodic evaluation of the genetic progresses attained, use of sires with low breeding value and neglect ion of traits of reproductive efficiency.

Cross breeding of indigenous and exotic breeds (Holstein Friesian and Jersey) as a means to improve production and productivity via breed complementarities and hetrosis have been a trend as a means of breed improvement at Bako Agricultural Research Center. However, no concrete information is available regarding the effectiveness of crossbreeding programme (Indigenous x Exotic) on reproductive and productive performances of indigenous and its crossbreds animals therefore, the present study was initiated with the following objectives to evaluate and compare the productive and reproductive performances of indigenous Horro and its crossbred cows at Bako Agricultural Research Center.

II. Materials and Methods

2.1. *Description of the Study Area*

Bako Agricultural research center is located in Oromia Regional State West Shoa Zone, at about 257 Km away from the capital city Addis Ababa. The center is located 8 km from Bako town, at an altitude of 1650 m.a.s.l. and lies within 09°6'N latitude and 37°09'E longitude.

2.1.1. *Agro-Ecological and Major Economic Activity of the Study Area*

The area is known for its mixed crop livestock farming system while the dominant grass species include hyperheniya (*Hyperheniaanamesa*) and sporobolus (*Sporobuluspraminidals*) grass and the legumes include neonotonia (*Neonotonia weights*). The rainy season covers May to September and receives annual rainfall of 1431 mm with maximum precipitation in the month of June to August.

2.1.2. *Foundation Stock of the Herd at Study Site*

Horro cattle, an intermediate sanga-zebu, of medium to large in size and expanding through western Oromia. Horro cows are used as dual purpose animals (milk and meat) and are low milk yielders. Horro breed have good adaptation to poor environment such as inadequate management as compared to its crosses such as Horro-Friesian and Horro-Jersey cows.

In the tropics and sub-tropics the introduction of genes from improved breeds has increased the milk yields of cows, through exploitation of breed complementarities and hybrid vigor.

This has been justified when good management and breeding strategies are applied and health care are improved. So that Horro cows have been crossed with Holstein Friesian and Jersey breed to the blood level of 50% to improve milk production and productivity.

2.2. *Data Source and Collection*

At Bako Agricultural Research Center there is records of productive and reproductive performances of breeds under study starting from (1974-2011G.C) for 37 years which starts with ear tagging, birth weight, birth date, date of first service, number of service per conception, date of first calving, days open, calving interval up to culling/ death so that for the purpose of this research the data was collected from records which started from identification number for all parameters studied with emphasis for its quality and soundness.

2.2.1. *Feeding Management*

The feeding system at the farm is mainly based on grazing natural pasture (*Cynodonspp* and *Hyparrheniaspp*) for approximately eight hours (8 AM to 5 PM). The pasture are neither irrigated nor fertilized. Provision of hay (Rhodes grass and natural pasture) or silage (Rhodes grass and maize silage) at night is practiced depending on condition of the grazing and availability. Concentrate supplement is restricted to milking cows at time of milking and pregnant cows during the last trimester of pregnancy. Milking cows are supplemented with concentrate composed of maize grain, noug cake (*Guizotia abyssinica*) and minerals while they are milked. Daily concentrate supplement of about ½ kg was given to each lactating cow prior to milking. Cows are hand milked twice a day, mated naturally and through artificial insemination (AI) and managed in a loose housing system.

2.2.2. *Animal Management*

At study site, heifers are bred at least at the age of two years when they attained a body weight of 180-200 kg. Pregnant cows had been isolated at the last trimester of pregnancy and kept indoor with limited grazing and exercise in nearby paddock. Calving occurred all year round. After calving, cows will be inseminated after 45 days post parturition after reproductive organs are renewed from last parturition stress.

2.3. *Breeding program at Bako Agricultural Research Center*

Calves are separated from their dams at birth, weighed, tagged and fed colostrums from a bucket for the first five days of their life. A total of 227 liter of milk is fed to each calf and a concentrate mix 49.5% maize grain (Zea maize), 49.5% seed cake (*Guizotia abyssinica*) and 1% salt is offered until weaning (six months), there after male and female calves are kept indoors (day and night) until six months of age in individual pens except for about two hours of exercise in a nearby paddock every day.

After six months of age, weaned calves are maintained on natural pastures for approximately eight hours a day and supplemented with silage or hay adlib during the return from grazing and are kept as a group (male and female separately), while concentrate is supplemented to heifer calves depending on availability. Heifers are bred at least at two years when they attained a body weight of 180-200 kg. Heat detection is done visually twice a day from 06:00 AM to 08:00 AM in the morning and from 05:00 PM to 06:00 PM in the evening by a trained inseminator, teaser bulls and throughout the grazing time by the herdsmen. Cows and heifers observed in heat are bred either naturally (bull) or inseminated with frozen semen (Holstein Friesian and Jersey) 12 hour after heat period purchased from Kality National Artificial Insemination Center. Those that were bred and hence, not returned to estrus were checked for pregnancy after two months and other reproductive management will continues as routine works.

2.3.1 *Data Management*

The data collected were entered into Microsoft excel software for preliminary assessment of data distribution.

Year and parity effect was not included in the analysis since its incomplete. The fixed effects studied were breed, season of birth and birth date. Four seasons were established based on weather and climatic conditions of the area: June to August as summer season, September to November as autumn, December to February as dry season and March to May as spring season.

2.3.2. *Data Analysis*

The General Linear Models (GLM) procedure of SAS (SAS 2016, version 9.4) was used for data analysis. Mean of different traits were then tested by Duncan Multiple Range test. The model used for data analysis given below :

Statistical Models

$$Y_{ijkl} = S_i + B_j + B_k + e_{ijkl}$$

Where

Y_{ijkl} = Dependent variable(milk yield per lactation, age at first service, age at first calving, number of services per conception, days open and calving interval).

S_i = Effect of i^{th} season (i = 1, 2, 3, 4).

B_j = Effect of j^{th} breed (j = 1, 2, 3).

B_k = Effect of k^{th} birth date as covariate.

e_{ijkl} = Random error.

III. Results and Discussion

3.1 *Reproductive Performance of Dairy Cows*

3.1.1 *Age at First Service (AFS) and Age at First Calving (AFC)*

Results of adjusted AFS and AFC by breed-group and season are presented in Table 1. There was a statistically significant difference ($p<0.05$) among the breed-groups for the trait AFS; whereas there was no statistically significant difference ($p>0.05$) found for the effect of breed-group on AFC. Statistically, there was no significant difference ($p>0.05$) among the breed-groups and season in adjusted AFS and AFC.

Table 1. Least squares means (±SE) of age at first service (in months) and age at first calving (in months) by breed and season for the cows studied.

Fixed effect	N	LSM ± SE AFS	LSM (± SE) AFC
Breed-group		*	***NS***
Horro-Friesian (HF)	216	33.44 ± 0.65^{b}	43.69 ± 0.70^{b}
Horro-Jersey (HJ)	89	31.32 ± 1.02^{b}	42.02 ± 1.09^{a}
Pure Horro (HH)	91	46.79 ± 1.03^{a}	57.69 ± 1.11^{b}
Season		***NS***	***NS***
Autumn	112	37.59 ± 0.92	47.38 ± 0.99
Dry Season	108	37.50 ± 0.97	48.10 ± 1.04

Summer	89	36.44 ± 1.05	47.53 ± 1.13
Spring	87	37.21 ± 1.04	48.20 ± 1.12
Over all Mean	396	36.07	46.52

LSMs within column, not carrying the same superscripts are significantly different. NS = not significant, * = significant ($p<0.05$), AFS = age at first service, AFC = age at first calving

HH breed was found to be significantly different ($p<0.05$) from both HJ and HF with respect to the traits AFS and AFC; whereas no significant difference ($p>0.05$) was observed between HF and HJ for the traits AFS and AFC.

A significant difference was observed between HJ and HF for AFC. The result of present study showed no seasonal effect for AFS and AFC which could be due to uniform management in terms of supplementary feed. The influence of season of calving could arise from feed availability which could affect the nutritional status and the fertility of animals (Gizaw *et al,* 2011).

3.1.2 *Number of Service Per Conception (NSPC)*

Results of adjusted NSPC by breed-group and season are presented in Table 2. There was a statistically significant difference ($p<0.05$) for the effects of breed-group and season.

Table 2. Least squares means (±SE) of number of services per conception (in months) by breed and season for the cows studied.

Fixed effect	**N**	**LSM (±SE) NSPC**
Breed-group		*
Horro-Friesian (HF)	216	1.69 ± 0.07^{a}
Horro-Jersey (HJ)	89	1.75 ± 0.11^{a}
Pure Horro (HH)	91	1.34 ± 0.11^{b}
Season		*
Autumn	112	1.47 ± 0.1^{b}
Dry Season	108	1.46 ± 0.10^{b}
Summer	89	1.95 ± 0.11^{a}
Spring	87	1.5 ± 0.11^{b}
Over all mean	396	1.61

LSMs within column, not carrying the same superscripts are significantly different. NS = Not significant, * = Significant ($p<0.05$), NSPC = Number of services per conception.

Only HH breed showed significant difference ($P<0.05$) from HF and HJ for the trait number of service per conception. However, HF and HJ were not significantly different from each other for the traits NSPC. The result of the present study for HH cows on the number of services per conception was lower than the on-station research report on Fogera breed which was 1.54 (Gidey, 2001). Similarly, the mean value of NSPC of the present study was lower than 2.02 reported by (Haileyesus, 2006) for local breed. Similarly, it was lower than 2.2 reported by Emebet (2007) and 4.91 reported by Adebabay (2009).

It was observed that the effect of dry season, autumn and spring season were not significantly different but su-

mmer season (June, July and August) had significant effect on number of service per conception. Similarly Gebeyehu *et al* (2005) and Haileyesus (2006) reported non-significant effect of season on number of service per conception.

This could be attributable to the availability and quality of grazing land during the main rainy season that could have enhanced the conception rate of the cows and realize the fact that the capacity of conception of the cow are majorly due to genetic make-up rather than non-genetic factor such as seasonal variation.

3.1.3 *Days Open (DO)*

Results of adjusted DO by breed-group and season are presented in Table 3. There was a statistically significant difference ($p<0.05$) for the effect of breed-group for the trait NCPC; whereas no statistically significant difference ($p>0.05$) was found for the effect of season on the trait.

Table 3. Least squares means (± S.E.) of days open by breed and season for the cows studied.

Fixed effect	N	LSM (±SE) DO
Breed-group		*
Horro-Frisian	216	91.46 ± 1.29^{a}
Horro-Jersey	89	79.18 ± 2.00^{b}
Pure Horro	87	88.13 ± 2.03^{a}
Season		***NS***
Autumn	112	87.34 ± 1.81
Dry Season	108	85.68 ± 1.91
Summer	89	86.63 ± 2.06
Spring	87	85.39 ± 2.05
Overall mean	396	87.98

LSMs within column, not carrying the same superscripts are significantly different. NS = Not significant, * = Significant ($p<0.05$), DO = Days open.

The result of the present study demonstrated that HJ breed-group was significantly different ($p<0.05$) for days open; whereas no significant difference was observed between HF and HH for DO. The mean value of days open obtained for HH breed-group in this study was shorter than 215.7 days reported for highland indigenous cows (Azage, 1981) and shorter than 250.7 days reported for lowland indigenous cows (Azage, 1981).

The effect of season of calving had no significant effect on days open. But, as a contrary to this result, the results of Kefena *et al*., 2006; Haileyesus, 2006 and Habtamu *et al* 2010 showed that summer season had significant effect ($P<0.05$) on days open, while the other seasons had no significant effect ($P>0.05$) on days open, showing that DO is affected by non genetic factors.

3.1.4. *Calving Interval (CI)*

Results of adjusted CI by breed-group and season are presented in Table 4. There was a statistically significant difference ($p<0.05$) for the effect of breed-group on CI; whereas no statistically significant difference ($p>0.05$) was found for the effect of season on CI.

Table 4. Least squares means (± S.E.) of calving interval (in months) by breed and season for the cows studied.

Fixed effect	N	LSM (±SE) CI
Breed-group		*
Horro-Friesian (HF)	215	13.43 ± 0.17[a]
Horro-Jersey (HJ)	89	12.76 ± 0.26[b]
Pure Horro (HH)	91	13.59 ± 0.26[a]
Season		***NS***
Autumn	111	13.278 ± 0.23
Dry Season	108	13.13 ± 0.25
Summer	89	13.50 ± 0.27
Spring	87	13.14 ± 0.27
Over all mean	395	13.31

LSMs within column, not carrying the same superscripts are significantly different. NS = Not significant, * = Significant ($p<0.05$), CI = Calving interval.

According to present study HJ breed-group showed significant different ($p<0.05$) on calving interval while HF and HH cows had no significant effect on calving interval. The variation among breeds might be due to genetic variation and non genetic factor such as heat detection, feeding and post-partum reproductive problems.

The results obtained in this study for crossbred cows is lower than 17.8 months reported by Emebet (2007), 15.55 months reported by Haileyesus (2006), 16.2 months by Adebabay (2009). HF cows and HH cows had comparable calving interval. The results of the present study revealed that calving interval across all seasons were not significantly different due to uniform management practice.

IV. Productive Performance of Cows

The effect of breed-group was significantly different ($p<0.05$), with lactation milk yield value being highest for HF, followed by HJ even if the yield potential of Horro crosses were not up the mark which calls for further study but lactation milk yield for indigenous cow was comparable with previous lactation milk yield for HH cows in the study area.

3.1 *Milk Yield Per Lactation*

Results of adjusted LMY by breed-group and season are presented in Table 5. There was a statistically significant difference ($p<0.05$) for the effects of breed-group and season on LMY.

Table 5. Least squares means (±SE) of lactation milk yield (LMY, in kg) by breed and season for the cows studied.

Fixed effect	N	LMY(±SE) kg
Breed-group		*
Horro-Friesian (HF)	216	1768.15 ± 15.28a
Horro-Jersey (HJ)	89	1293.01 ± 23.70[b]
Pure Horro (HH)	91	425.34 ± 24.06[c]

Season		*
Autumn	112	1130.46 ± 21.47[b]
Dry Season	108	1171.98 ± 22.63[ab]
Spring	89	1127.40 ± 24.26[b]
Summer	87	1218.83 ± 24.42[a]
Overall mean	396	1351.71

LSMs within column, not carrying the same superscripts are significantly different. NS = Not significant, * = Significant ($p<0.05$), LMY = Lactation milk yield.

According to the present research finding HF cows had significant difference ($p<0.05$) from HJ and HH breed-groups. Crossbred cows had significant difference ($p<0.05$) on lactation milk yield which is attributed to their genetic potential while HH cows posses low lactation milk yield due to their low milk production potential.

No significant difference was observed for season of calving was significant different ($p<0.05$) for lactation milk yield except in summer season which could be due to availability of enough and good quality grazing land as compared with other seasons.

V. CONCLUSION

Among breed-groups studied only HJ had significant effect ($p<0.05$) on number of days open while HH and HF had no significant effect on days open. Summer season had shown significant effect on number of days open whereas no significant effect of autumn, dry and spring season was observed.

Among three breed-groups studied only HH showed significant effect ($p<0.05$) on calving interval. Season of calving had no significant effect on calving interval, which could be attributable since similar management rendered in the research centre all animals.

Breed-group effect was found significant ($p<0.05$) on lactation milk yield which indicate that each genotype had its own performance for lactation milk yield with highest value for HF, followed by HJ and HH.

HJ cows were found to be significantly different ($p<0.05$) for age at first calving while HF did not show significant difference on AFS and AFC and HH cows had significant effect ($p<0.05$) on age at first service.

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REFERENCES

[1] Adebabay Kebede, 2009. Characterization of Milk Production Systems, Marketing and On-Farm Evaluation of the Effect of Feed Supplementation on Milk Yield and Milk Composition of Cows at Bure District, Amhara Region, Ethiopia. M.Sc. thesis, Bahir Dar University, 112 pp. Africa. *Agriculture, Ecosystems and Environment* 135: 98–110.
[2] Asfaw Negassa 2009 Improving smallholder farmers' marketed supply and market access for dairy products in Arsi Zone, Ethiopia. Research Report 21. ILRI (International Livestock Research Institute). Nairobi, Kenya.
[3] Azage Tegegne, Galal, E.S., E. and Beyene, K., 1981. A study on the reproduction of local zebu and F1 crossbred (European x zebu) cows. I. Number of services per conception, gestation length and days open till conception. *Ethiopian journal of agricultural science*. Pp. 3; 1-14.
[4] DAGRIS (Domestic Animal Genetic Resources Information System) 2007 International Livestock Research Institute (ILRI). Addis Ababa, Ethiopia (Accessed in Nov. 2007 (http://dagris.ilri.cgiar.org/).

[5] Emebet Mureda and Zeleke Mekuriaw, 2007. Reproductive performance of crossbred dairy cows in eastern lowlands of Ethiopia. *Livestock Research for Rural Development. Volume 19, Article No 161. Retrived* March 22, 2011, visited on March 16 http:// www.lrrd.org/lrrd19/11/mure19161.htm
[6] FAO. 2010. *Status and prospects for smallholder milk production - A global perspective,* by T. Hemme and J. Otte. Rome.
[7] Gebeyehu Goshu., Asmare, A. and Asseged, B., 2005. Reproductive performance of Fogera cattle and their Friesian and their crosses in Andassa ranch, Northwestern Ethiopia. Livestock Research for Rural Development. Visited on March 9, 2011, http://www.ci pav.org.co/lrrd.17/12/cont1712.htm.
[8] Gidey Yifter., 2001. Assessment of Calf Crop Productivity and Total Herd Life of Fogera Cows at Andassa Ranch in North-western Ethiopia. M.Sc. Thesis, Alemaya University. Dire Dawa, Ethiopia.119p.
[9] Gizaw Kebede, Mulgeta Kebede, Tesfaye Midexa and Sisay Eshetu, 2011 Comparative Reproductive Performance of Horro (zebu) with Horro-Friesian and Horro-Jersey Females in sub humid Environment of Bako; Livestock Research for Rural development 23 (8) 2011.
[10] Habtamu Lemma, Kelay Belihu, and Desie Sheferaw. 2010. Study on the reproductive performance of Jersey cows at Wolaita Sodo dairy farm, Southern Ethiopia. *Ethiop. Vet. J., 14 (1), 53-70.*
[11] Haileyesus Abate, 2006. "Evaluation of Artificial Insemination Service Efficiency and Reproductive Performance of f_1 Friesian Crosses" North Gonder Zone, Amhara. M.Sc. Thesis, Alemaya University, Ethiopia.
[12] Kefena Effa, B.P. Hegde and Tesfaye Kumsa. 2006. Lifetime Production and Reproduction Performances of Bostaurus x Bosindicus Crossbred Cows in the Central Highlands of Ethiopia. *Eth. J. Anim. Prod. 6(2*) : 37-52.
[13] Stein J, Ayalew W, Rege J.E.O., Mulatu W., Lemecha H., Tadesse Y., Tekle T. and Philipsson J. 2011 Trypanosomosis and phenol typic features of four indigenous cattle breeds in an Ethiopian
[14] Swenson, C., Schaar, J., Brannang, E. and Meskel, L.B., 1981. Breeding activities of the Ethio Swedish integrated rural development project. Part III. Reproductive performance of zebu and crossbred cattle. World Animal Review. Pp. 38; 31-36.
[15] Statically analysis system, General Linear Model, Version 9.0 2016.
[16] Tefera, T.L. et al. "Commercializing dairy and forage systems in Ethiopia: An Innovation Systems Perspective." ILRI – IPMS. Working Paper No. 17. 2010.
[17] Ulfina G, Zelalem B, Jemal D, Gemeda D, Chala M, Irena D, Diriba G, Lemma G, Workneh A and Adam D 2005 Survey of cattle production and marketing practices in Danno District, western Ethiopia, using PRA tools. PRA Report.

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