

Retrospective Study

Survival Rate of Calves and Assessment Reproductive Performance of Heifers and Cows in Dida Tuyura Ranch, Borana Zone, Southern Ethiopia

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ABSTRACT

Background and Aim

The study was conducted at Dida Tuyura Cattle Breeding and Improvement Ranch in Borana zone, southern Ethiopia, with the aims of determining the mortality rate of Ethiopian Boran calves and assessment of the reproductive performance of heifers and cows.

Materials and Methods

The study was based on the retrospective record of calves, heifers, and cows. The data was taken from 1994-2010 on the calf survival rate and 1994-2005 on reproductive performance of the breed in the ranch were used for this study. The retrospective data collected over the years were used to identify factors associated with calf survival or death.

Results

The mortality rate of calves before weaning and after weaning was 13.3% and 11.2%, respectively. Age, sex and birth weight of calf had a significant effect on survival rate. The overall mean values age at first service, age at first calving, calving interval, days open and gestation length were 42.52, 51.67, 20.67, 11.30 and 9.30 months, respectively. Parity had a significant effect on both the calving interval and days open. Gestation length was not significantly affected by parity, sex, and birth weight of calf.

Conclusion

From the present study, it can be concluded that the obtained calf survival rate and reproductive performance are not sufficient to achieve the established objective of the ranch.

Keywords

Boran, Calf survival, Ethiopia, Reproductive performance.

INTRODUCTION

Ethiopia, with its 52 million heads of cattle has the largest cattle population in Africa.¹ Cattle production plays an important role in the economies of farmers and pastoralists and the country at large. The agricultural sector in Ethiopia, engaging 80% of the population, contributes 52% of the gross domestic product (GDP) and 90% of the foreign exchange. The livestock sub-sector contributes an estimated 12% total GDP and over 45% to agricul-

tural GDP.² Cattle produce a total of 1.5 million tones of milk and 0.331 million tones of meat annually.³ In addition, 14 million tones of manure are used annually primarily for fuel, and six million oxen provide the draught power required for the cultivation of cropland in the crop-livestock mixed production system.⁴

Boran, a popular cattle breed, is predominantly utilized and widely distributed across various countries of Africa. The Ethiopian Boran breed is one of the cattle breeds widely used in

Ethiopia.^{5,6} Available archaeological records indicate that Zebu cattle are the most recent types of cattle to be introduced into Africa. Recent molecular genetics, as well as archaeological evidences^{7,8} also showed that the introduction of Zebu cattle into Africa centered in East Africa rather than through the land connection between Egypt and the Near East. Their hardened hooves and lighter bones enable them to endure long migrations. These adaptive attributes have facilitated their importation and spread by Indian and Arabian merchants across the Red Sea to the drier agro-ecological regions of the Horn of Africa.⁹

The Ethiopian Boran breed originally descended from the first introduction of Zebu into Africa from West Asia. The breed established its presence first in semi-arid and arid pastoral Borana plateau of southern Ethiopia. The Borana pastoralist community maintains it. Pastoral movements and migrations led to spread of the Ethiopian Boran to the eastern rangelands in Ethiopia as well as into northern Kenya and southwestern Somalia. The Orma Boran, the Ethiopian Boran, and the Kenya Boran have evolved from these migrations, whereby only the Orma and the Ethiopian Boran are existing on the Borana plateau.^{5,8}

The Ethiopian Boran subtype is considered to be the original pure one. The breed is well survived to semi-arid tropical conditions, has a high degree of heat tolerance, is tolerant to many of disease prevailing in the tropics and has the ability to survive long periods of feed and water shortage.¹⁰ Besides, comparisons of the reproductive performance of Ethiopian Boran with other indigenous Ethiopian breeds indicated that Boran cattle calve at a younger age and have shorter calving interval.^{5,11}

Now-a-days the existence of this breed is threatened due to various underlying causes, the most important include: bush encroachment and recurrent droughts, poor herd management and difficulties in access to markets.¹² With these facts in mind, Dida Tuyura cattle breeding and improvement ranch are established which is the only available ranch involved in the improvement of Ethiopian Boran cattle. It was established in 1987 on 5550 hectares of land with the objective of conserving and improving Ethiopian Boran breed through selection and controlled breeding. It also supplies pure Ethiopian Boran bulls and heifers for local pastoralist community and other concerned bodies. Calf survival rate and reproductive parameters are among the most important traits affecting progress in selection. So far, little is known about the calf survival rate and reproductive performance of this breed, especially in Dida Tuyura ranch. Therefore, the present study was designed to:

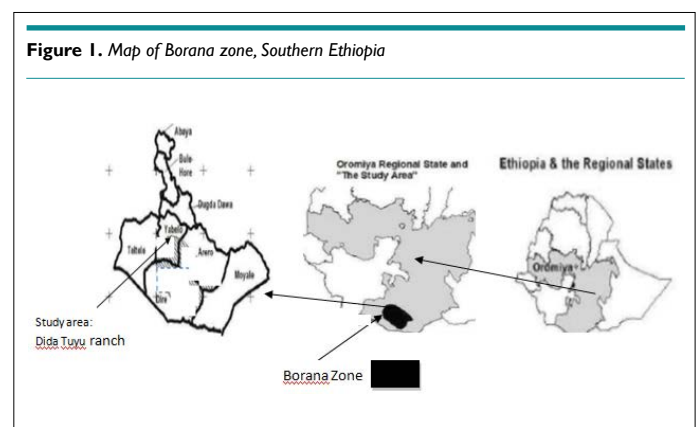
- To depict the long-term trend of calf mortality or survival rate in Ethiopia Boran calves
- To identify factors that are associated with a calf mortality rate
- To evaluate the reproductive performance of Ethiopia Boran cattle and

- To assess the non-genetic factors affecting the reproductive performance under ranch condition.

MATERIALS AND METHODS

Study Area

The Dida Tuyura Ethiopian Boran cattle breeding and improvement ranch is found in the Borana plateau (southern rangelands) Borana Zone of Yabello district and is situated at about 550 km south of Addis Ababa and 20 km north of Yabello town. It is part of the Borana plateau which covers 95,000 km², or 8.5% of the total area of Ethiopia and 14.6% of the lowland areas. Yabello district is characterized by a rather semi-arid climate. Annual mean daily temperature varies from 19 to 24 °C. The average annual rainfall, as registered by the National Meteorological Service Agency of Yabello station is 600 mm. The rainfall distribution is bimodal, but erratic and unreliable in distribution. About 59% of annual precipitation occurs from March to May and 27% from September to November.¹²



Study Animals and Management

In Dida Tuyura Cattle Breeding and Improvement Ranch, the Ethiopian Boran breed is maintained. They are reasonably large and have a good general body conformation. Their color is mainly white, light gray, fawn or light brown with gray, black or dark brown shading on head, neck, shoulders, and hindquarters. The horns are thick at the base, very short, erect and pointing forward. The hump is well developed in the male, is of pyramidal shape and overhanging to the rear or to one side. The dewlap is well developed. In the male, the preputial sheath is pendulous while in the female, the udder is well developed. Average wither height is 118 to 124 cm in males and 116 to 120 cm in females. Body weight ranges from 318 to 680 kg in males and 225 to 454 kg in females. The breed is known by its tolerance to heat stress and seasonal feed shortage.¹³

The management of the ranch is an extensive system. Animals are herded in a group based on age and sex. They constantly graze natural pasture, year-round. Dry (hay) grass was collected from the field, stored and used as a source of feed in the dry

period. Supplementary feed during the long dry season was given in limited amount for all groups of cattle. Ponds in ranch are the water source for cattle (once per day) except calves. There is ad libitum tape water source for calves and weak animals.

Calves suckle their dams once a day from 4 or 5-days of birth up to 2 months of age. After 2-months; calves are allowed to run with their dams until weaning at six months of age. Based on weight, body conformation, and health status, both males and females are selected for the further breeding program. Animals were grouped into 1 (male) ratio to 30-50 (females) during the mating period (June, July, and August). Heat detection was practiced during grazing time by observation of unskilled herd's men and experience in natural mating. Pregnancy was confirmed by rectal palpation. Different categories of cattle like heifers, cows, bulls and weaned calves were kept separately outside but calves less than six months age were kept in common pens.

Veterinary medicaments and requirements budget were supplied by Oromia Pastoral Development Commission. Cattle greater than six month age in the ranch were routinely vaccinated against Anthrax, Blackleg, Pasteurellosis, Contagious Bovine Pleura Pneumonia and Foot and Mouth disease. Preventive measures for both external and internal parasites were also carried out regularly.

Study Design

A retrospective type of study was carried out to evaluate the calf survival rate and reproductive performances of Ethiopia Boran cattle in the ranch. Recorded data from 1994-2010 on the calf survival rate and 1994-2005 on reproductive performance of the breed in the ranch were used for this study. Recent data can't be obtained due to poor recording system on the ranch for both calves and cows. Only the data of cows and calves with complete information were included in the study.

The retrospective data collected over the years were used to identify factors associated with calf survival or death. For reproductive performance traits, Ethiopian Boran heifers born from 1994 to 2005 were used to determine the age at first service and age first at calving. Additional cows that gave birth from 1994 to 2005 at varying parity levels were included in the study to determine calving interval (CI), days open (DO), gestation length (GL) and non-genetic factors associated with them.

Data Collection and Analysis

Data of Ethiopian Boran cattle breed calves in Dida Tuyura ranch, collected from 1994 to 2010, were used. Information on calf identification number, birth date, sex of calf, birth weight, weaning date, a terminal event like death and their dates were collected. A total of 929 survival records were available for analyzing the survival rate of Ethiopian Boran calves. At the same time, reproductive trait records (1994-2005) were used to estimate age at first service (AFS), age at first calving (AFC), calving interval (CI), days

open and gestation length (GL), respectively.

Collected data were entered into Microsoft spread excel sheet and analyzed using SPSS (version-20). The percentage of calves died was calculated with descriptive statistics. The effect of age, sex and birth weight calf on calf survival rate was analyzed by X². In addition, descriptive statistics were used to summarize mean and standard error of reproductive performance parameters. The effect of different factors on the reproductive performance parameters was analyzed by General linear model.

RESULTS

Calf Mortality and Survival Rate

The mortality and survival rates of 929 calves were presented in Table 1. The cumulative mortality rate of calves was 24.5 % with 13.3% before weaning and 11.2% after weaning. The mortality rate of calves was compared for different age, sex, and three birth weight categories. The comparison indicated a statistical significance difference ($p < 0.05$) in the probability of calf survival between different age, sexes and varying body weight categories (Tables 1 and 2).

Table 1. Calf Mortality and Survival Rate in Dida Tuyura Cattle Breeding and Improvement Ranch from 1994 to 2010

Out Come	Number of Animals	Percentage	p value
Dead before weaning age	124	13.3	0.023
Dead after weaning age	104	11.2	
Survived	701	75.5	
Total	929	100.0	

Table 2. Associations of Sex and Birth Weight of Calf with Calf Survival Rate

Factors	Number at birth	Dead (%)	Survived (%)	p value
Over all	929	24.5	75.5	
Calf sex				
Males	701	75.5	929	0.026
Females	929	100.0	929	
BW of calf				
≤20Kg	286	11.2	19.6	0.041
21-25Kg	443	9.1	38.5	
>25 Kg	200	4.2	17.4	

Reproductive Performance

The overall mean values and standard errors of age at first service, age at calving, calving interval, days open and gestation length of Ethiopian Boran heifers and cows at Dida Tuyura cattle breeding and improvement ranch were 42.52 ± 1.02 , 51.67 ± 1.00 , 20.67 ± 0.57 , 11.30 ± 0.57 and 9.30 ± 0.05 months, respectively (Table 3).

Table 3. Mean Reproductive Parameters of Heifers and Cows in the Study Site

Parameters	No. of observations	Mean±SE
Age at first service	70	42.52±1.02
Age at first calving	70	51.67±1.00
Calving interval	155	20.67±0.57
Days open	155	11.30±0.57
Gestation length	155	9.30±0.05

Calving interval and days open were significantly affected by parity ($p < 0.05$) at Dida Tuyura ranch. Gestation length was not significantly influenced ($p > 0.05$) by parity level, sex and birth weight of calf (Tables 4 and 5).

Table 4. Squares Means and Standard Error (LSM±SE) of CI and DO in Association with Parity

Parity level	CI (Months)	Days Open (Months)	p value
	Mean±SE	Mean±SE	
Overall	20.67±0.57 (n=258)	11.30±0.57 (n=258)	
1	-	12.64±0.77 (n=153)	<0.05
2	22.00±0.77 (n=153)	9.89±1.01 (n=72)	
3	19.31±1.00 (n=72)	8.99±1.68 (n=21)	
4	8.36±1.69 (n=21)	6.73±1.52 (n=12)	
5	16.12±1.54 (n=12)	-	

Table 5. Least Squares Means and Standard Error (LSM±SE) of Gestation Length and Its Association with Parity, Sex and Birth Weight of Calf

Factors	GL(Months)	p value
	Mean±SE	
Overall	9.30±0.05(n=427)	
Parity		>0.05
1	9.23±0.05(n=169)	
2	9.30±0.05(n=153)	
3	9.41±0.08 (n=72)	
4	9.33±0.12 (n=21)	
5	9.25±0.19 (n=12)	
Calf sex		>0.05
Male	9.33±0.72 (n=219)	
Female	9.26±0.60 (n=208)	
BW of calf		>0.05
≤20Kg	9.33±0.09 (n=118)	
21-25Kg	9.22±0.08 (n=190)	
>25Kg	9.38±0.58(n=119)	

DISCUSSION

The cumulative mortality rate of calves in the present study was 24.5%. Globally, mortality rate over 5% is considered to be too high^{14,15} and a mortality rate of 20% can reduce net profit by 38%.¹⁶ The mortality rate was higher in pre-weaned than weaned calves and this was found statistically significant. In early age im-

mune system of young calf is under development. Colostrums can provide passive immunity only against those diseases for which dam possesses antibodies.¹⁷ The pre-weaning mortality rate of the study was higher than findings of Amuamuta et al¹⁸, Kivaria et al¹⁹ who reported 9.4 % and 10%, respectively. This difference in pre-weaning mortality rate might be attributed to the absence of individual pens and poor housing system in the current study site. However, Lobago et al^{20,21} were reported higher pre-weaning mortality than present finding but within ranges of 15%-25% for dairy farms, which might be associated lack of colostrums and poor management system in the farms studied. Post weaning mortality rate was lower than previous reports.^{22,23,18} The difference in post-weaning mortality could be due to the difference in management which includes timely vaccination, deworming and proper feeding of the animals.

The present study also showed that calves with lower birth weight had a significantly higher mortality rate compared to moderate and higher body weight calves ($p < 0.05$). This finding was in harmonious with previous literatures²⁴⁻²⁶ who illustrated that calves with lower birth weight have poor vitality and survival ability. The sex-dependent study showed lower mortality rate for females compared to males. This finding conforms well to report of Amuamuta et al,¹⁸ Debnath et al,²⁵ Mekonnen et al.²⁷ This difference between sexes in mortality rate might be due to preferential care and management for females for the purpose of early growth and breeding.

The mean age at first service observed in the present study at Dida Tuyura cattle breeding and improvement ranch was 42.52 months. The current result was in line with the previous finding of Ali et al²⁸ who reported 42.45 months for non-descript Deshi/Indigenous cows in Bangladesh. The present finding was much greater than the published findings by Mureda et al²⁹ with 26.5 months in Dire Dawa town,³⁰ with 23.2 months in Gondar town and Dinka³¹ with 24.9 months in Asella town for cross breeds. However, the mean AFS obtained in the current study was lower than local Horro heifers who indicated 48.9 months.³² The variation between Ethiopia Boran breed and other breeds of age at first service might be due to the difference in management, environment, and difference in genotype. Association of management, environment, and genotype with AFS was evidenced by Gifawosen et al.³³

The AFC of Ethiopian Boran heifer in Dida Tuyura ranch was found to be 51.67-months. This finding is within the range expected for *Bos indicus* cattle in tropics and reported values the range 35.1 to 53-months.^{34,35} In addition, the present finding was comparatively supported by Melaku et al³⁶ who reported 50.83 months for Fogera cattle. However, other authors indicated lower age at first calving were Mekuriaw et al³⁷ for Ogaden cattle,^{38,39} for cross breeds. Obtained age at first calving in the current study was shorter than 58.3 months for cattle under smaller holder condition in Zimbabwe, 59.73-months for Horro heifers and 54.1-months for Kereyu Sanga cattle reported by Demissu et al,³² Masama et al,⁴⁰ Garoma,⁴¹ respectively. The longer average age at first calv-

ing reported for Ethiopian Boran cattle might be associated with scarcity of feed and shortage of water for the long dry season of the year in the study area. Regardless of the breed, the association of feed availability with attaining age at first calving for heifers was reported.⁴²

The calving interval of this study was within estimates of 12.2 to 26.6-months for Zebu cattle reported by Abrha⁴³ and also closely agreed with the finding of Yifat et al⁴⁴ for Boran cows at Tatesa cattle breeding center who reported 20.75-months. This finding was higher than 17.81 months found by⁴⁵ for Ethiopian Boran herd maintained at Abernossa ranch and 15.00 months reported by Habtamu et al⁴⁶ for Jersey breed in Wolaita Sodo dairy farm. In addition,⁴⁷ for Boran cows at Mkwaja ranch of Tanzania,³⁸ for crossbreed and Habib et al⁴⁸ for Red Chittagong cattle at Nucleus herd in Bangladesh were reported shorter calving interval than present finding. But the finding was much lower than 26-months of traditionally managed Ethiopian high land Zebu.³⁵ The variation of calving interval among the observation of different researches might have resulted due to different sample size, genotype, number of parity, forage availability in any particular year, disease condition and days open.

The current study showed that calving interval becomes shorter as the parity increased. Generally, longer calving interval was seen in second parity might be due to the stress of sucking calf in young growing animals in early parities thus delays the onset of postpartum heat. In later parities, there is physical maturity with advancing of the age of cows. The report was consistent with finding of Ibramhim et al,⁴⁹ Negussie et al⁵⁰ on indigenous and cross breeds. However, other scholars Agyemang et al,⁵¹ Haile-Mariam et al⁵² reported a non-significant effect of parity on calving interval (CI).

The mean days open was 11.30-months which was in accordance with finding of Yifat et al⁴⁴ who indicated for 11.34-months. However, this finding was higher than previous reports.^{53,54} Relatively longer do in the present study might be due to sucking of calves up to weaning age which may interfere with ovarian function. The interference of sucking of calves until weaning age on ovarian function was indicated.⁵⁵ Significant association of parity on DO was obtained in this study. The finding was in harmonious with other authors^{56,57} who reported a significant effect of parity on DO. However, Gifawosen et al,³³ Yohannes et al⁵⁸ indicated non-significances of calving parities on DO.

The overall mean gestation length in the current study was 279-days (9.30-months) which was in comparison with a report of Tegegne et al.⁵⁹ Although gestation length is more or less constant within a given species⁶⁰ but relatively shorter GL has prevailed from studies of Swensson et al⁶¹ for Arsi cattle. Slightly longer GL (291-days) was found by the studies of Alberro³⁴ for Ethiopian high land Zebu cattle.

In the current study, GL was not significantly affected by the parity level ($p>0.05$). The result was in agreement with the

report of Yifat et al,³⁹ Habib et al⁴⁸ who found an absence of significant effect of parity on GL.^{36,62} indicated a significant effect of parity on GL. In addition, the present study also noted the non-significant effect of sex and birth weight of calf on the GL. Likewise, the non-significant influence of sex of calf on GL was reported by Melaku et al³⁶, Haile-Mariam et al,⁵² Addisu.⁶³ However, Mukasa-Mugerwa et al,⁶⁴ Getinet et al⁶⁵ were found a significant influence of sex of calf on the GL. The significant effect of the birth weight of calf on the GL was reported by³⁷ which were not supported by the present study.

CONCLUSIONS AND RECOMMENDATIONS

From the result of this study, it could be concluded that calf survival rate and reproductive performance of Ethiopian Boran cattle are within the range of values reported for other tropical and particularly Ethiopian cattle breeds. Given the fact that the study ranch raise their own replacement stock and distribute heifers and bulls to the community and other concerned bodies, obtained calf survival rate and reproductive performance have great hindrance to fulfill the demand of community and concerned bodies and to improve productivity through the distribution of heifers and bulls. Considered factors associated with calf survival and reproductive performance (parity) have a significant effect on traits indicating great effort should be made towards mitigating negative impacts of those factors associated with calf survival and reproductive performance. Thus, the present study suggests that factors associated with calf survival rate and reproductive performances are the serious problems in achieving established the objective of the ranch. Therefore, it is recommended that a detailed study on the factors affecting calf survival rate and reproductive traits as well as the determination of the impacts of each factor on the calf survival rate and reproductive traits should be studied especially through follow-up to improve calf survival rate and reproductive performance.

CONFLICTS OF INTERESTS

The authors declare that they have no conflicts of interest.

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