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Non-genetic Factors Influence Birth Weight of Friesian and Friesian x Fipa Cattle Calves in One Highland Farm of Tanzania

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Short Research Article

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ABSTRACT

Calving records were extracted from record books at TALIRI Uyole farm from 2013 - 2022, to study and determine the influence of breed, sex, season of birth, and year of birth on weight at birth of pure Friesian and its crosses (F1 Friesian x Fipa and 75% Friesian x Fipa) calves which, are grazed under natural pasture. The least squares mean of BWT in Friesian, F1 and 75% calves were 25.51±0.98 kg, 26.45 ± 1.23 and 25.26 ± 0.94, respectively. It was observed that sex of calf and

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year of birth had significant (*P*<0.05) influence on birth weight, the males being heavier than the females by 1.86 kg of the mean birth weight. Breed and season of birth of calves were not associated (*P>0.05*) with variation in mean birth weight of its crosses at birth, whereas variations on BWT at birth were noted in F1, which had higher BWT compared to other breed/cross, and calf born in the wet season showed slightly higher BWT than calves born in the dry season. Under natural pasture grazing, the available fodder was of poor quality, and no agronomic management practices were followed, whereas it was reverse in the wet season, thus the nutrient demand for body maintenance, reproduction, and production activities are impaired.

Keywords: Birth weight; calf; Sanga cattle.

1. INTRODUCTION

The demand for good dairy cattle to increase milk production under smallholder farmers is a major constraint in many countries in Africa and particularly in Tanzania. During 2011 to 2015, researchers at the Tanzania Livestock Research Institute (TALIRI) Uyole, came up with a project funded by the Tanzania Commission for Science and Technology (COSTEC) to enhance the availability of good dairy cattle by crossing pure breed Friesian and Fipa local cattle. The results of this project obtained F1 and 75% Friesian x Fipa cross-bred cattle, which were disseminated to smallholder farmers to boost up their productivity (reproduction and production). The reasons for using these two breeds for cross-breeding program under this project were due to their unique or desired characteristics, which smallholder farmers prefer against other Tanzanian local cattle in the countries [1], whereas Friesian cattle are preferred for the highest milk yield among the dairy cattle breeds available in the country. Fipa cattle is a stabilized crossbred of 'Sanga and Zebu' [1,2]. Sanga cattle is the name of indigenous cattle of some local areas in Africa. They are identified as a subspecies with the scientific name *Bos taurus africanus* [3,4].

The Fipa breed has a good mothering ability, low birth challenges, high body weight at birth and high fertility, is tolerant to harsh conditions/draught, and is adaptable to parasites, pests and diseases). In contrast, Friesian (*Bos taurus*) are predominantly found in temperate countries, which have good productivity and require external inputs, whereas poor adaptation to tropical and intolerant of hash conditions, diseases, and pests [5]. Therefore, crossbreeding of Fipa (*B. taurus africanus*) with Friesian *(B. taurus*) as used under this crossbreeding, adaptive the high-production potential of the exotic breed with the adaptation traits (to abiotic and biotic stresses), e.g., drought tolerance, cold tolerance, resistance, or tolerance to diseases or parasites of the indigenous breeds [6,7].

There has been no study conducted to understand the reproduction and production traits of these crossbred dairy cattle to establish scientific information for future breeding programs on stabilizing these cross breeds in the country. Therefore, the study aimed to seek the genetic and non-genetic factors associated with variation on birth weight (BWT) and existing variations of BWT between Friesian, F1, and 75% crosses.

Weight at birth is the first characteristic of an animal that can be easily recorded and a vital trait to be measured in the life of an individual, which does not change much during the first few days of life. Early studies from 1950s till to date, have established the importance of BWT with its positive genetic correlation with other vital traits in animals. For beef cattle, investigators have shown the importance of birth weight in predicting weaning weight, weight at 1st year, weight gain to weaning, rate of gain during fattening, or rate of gain from birth to slaughter [8, 9,10,11,12,13].

Weight at birth is critical information that bears on calf survival and growth rates and can be utilized in adjusting weights taken at different times during their growth. The scientific reports reported that within a number of species an association has been found between birth weight and viability; an experiment on pigs has revealed that pre-weaning mortality and disease susceptibility are higher in low birth weight in pigs [14]. Studies on cattle indicate that high BWT was associated with increased perinatal calf mortality and dystocia in dairy cattle [15]. Hence there is a need to establish information on genetical and non-genetical factors influencing weight at birth of Friesian, F1, and 75% crosses and variation on weight at birth of these breeds under grazing management system.

This information is useful for further selection and breeding programs of Friesian and Fipa cattle in Tanzania. Hence the objective of this study was to establish information on variation on BWT and factors influencing BWT at birth on Friesian, 50% Friesian x Fipa, and 75% Friesian x Fipa breeds.

2. MATERIALS AND METHODS

2.1 Study Location

Data were obtained from cattle record books at the Tanzania Livestock Research Institute (TALIRI), Uyole farm. TALIRI Uyole is located at Kilimo Uyole, about 10 km from Mbeya City center, with an altitude of about 1850 meters above sea level. It lies between latitudes 08.92044'-08.92011'S and longitudes 33.54053'-33.53063'E. The centre renders its services in the Southern Highlands zone, comprising six regions (Iringa, Mbeya, Ruvuma, Rukwa, Katavi, and Njombe). The zone is situated between latitudes 7° and 9°S and longitudes 30° and 38°E with an elevation of 475 and 3000 meters above sea level, an average annual temperature range between 6.8°C and 22.4°C, and an annual rainfall range of 600 to 2600 mm per annum.

2.2 Animal Herds Management and Breeding

There are two cattle herds kept at TALIRI Uyole: Friesian dairy cattle and crosses of Fipa and Friesian (Friesian x Fipa). The groups are grazed separately to avoid unplanned mating of the two herds. The main breeding method is natural mating, practiced as a farm breeding strategy, using a Friesian bull, which is the main source of genetic materials. These bulls are bought from other public farms and changed every two to three years to minimize the effect of inbreeding since the two herds sizes are small it is easy to change the bull to increase heterosis (hybrid vigor) within the herd. During the COSTEC project, the female Fipa cattle were used for crossbreeding with Friesian bulls as the source of genetic materials to obtain F1 and 75% Fipa x Friesian crossbreds under the breeding strategies [16]. All animals (Friesian, F1, and 75% Fipa x) bred kept on paddock during the day and nights with no weather protection facility. A weather protection facility is provided for born calves up to a weaning stage, which is normal for 3 to 4 months depending on the health condition of the calf.

2.3 Feeds and Feeding

Animals are grazed on natural pastures with a very limited supply of input in the form of feed (e.g., use of feeding concentrate, feed supplements, or additives). During the wet season, natural pastures are plentiful, while in the dry season, availability of natural pastures is low, and animals are forced to graze on crop residues that are of poor quality.

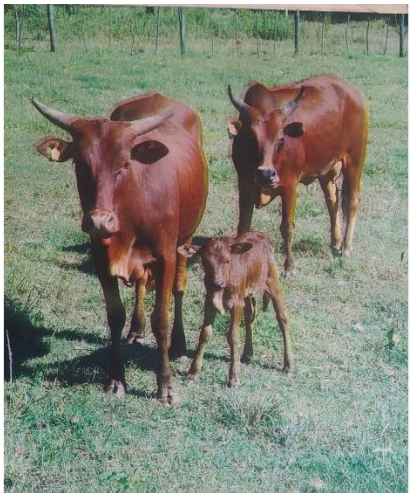

Fig. 1. Fipa Cattle and F1 Calf

Fig. 2. Frlesian X Fipa Calves

2.4 Data Collection

Data used in this study were obtained from the Tanzania Livestock Research Institute farm, southern highland zone, collected during the project implementation duration. The data comprised weights at birth of Friesian, F1 and 75% cross, A total of 160 birthweight were recorded from the birth of cattle calved between 2013 and 2022. In addition, calves' number, breed of calf sex. Season/month calves born and a year of birth were recorded.

2.5 Statistical Analysis

BWT data obtained were analyzed using the general Linear Model (GLM) procedure of the SAS. Differences among means of a trait for

different factors were analyzed by PDIFF/SAS. The following statistical model was employed for analysis:

$$Yijkl = \mu + Bi + Sej + Sk + Yl + eijkl$$

Where Yijkl = is dependent variable, μ = is overall mean, Bi = fixed effect of the breed, Se = fixed effects of sex, Sk= fixed effect of season of birth, Yl = fixed effect of year a calf born, eijkl = random error term.

3. RESULTS AND DISCUSSION

3.1 Influence of Breed on Birth Weight

The least squares mean of weight at birth in Friesian, F1 (Friesian x Fipa), and 75% Friesian x Fipa crossbred calves were 25.51±0.98, 26.45 ± 1.23, and 25.26 ± 0.94 kgs, respectively. FI crosses had a slightly higher weight than Friesian breeds and 75% Friesian x Fipa crosses. Normally pure breeds expressed a higher birth weight, whereas the difference can be due to the fact that pure breeds were less adapted to harsh conditions, diseases and pests intolerance; similarly, they need a substantial amount of feed under grazing conditions in tropical conditions, hence they underperform in terms of reproduction and production [1]. From Table 1, it was observed that as the exotic blood increased to 75% cross, the weight at birth weight decreased as well. On the other hand, these BWTs were higher as compared to other cross breeds body weights and reported 23.9 kg in Sanga × Friesian cattle in Ghana [17]. Similarly, Kibwana et al. [18] reported a weight at birth of 23.8 kg in a non-supplemented group of animals and 24.8 kg in supplemented group in the DRC. In Ethiopia, Haile et al. [19] observed 26 kg in Friesian × Boran. Moreover, the recorded mean weights at birth were slightly lower as compared to other crossbreds reported 28.03 kg by Mandal and Sachdeva [20], 28.4 kg by Muhammed et al. [21], and 33.3 kg by Segura-Correa et al. [11] in Brown Swiss × Guzerat in Mexico. In New Zealand, under temperate conditions, cattle are supplemented with additional nutrients in the exotic breeds noted to have a higher birth weight of 38.4 kg in female Friesian and 41.8 kg in male Friesian calves [22].

3.2 Sex of Calf and Year of Birth

Sex of the calf and year of birth had a significant (P<0.005) effect on body weight at birth, with males being heavier than the females by 1.86 kg. Similar results were reported by Kayastha et al. [23], Olson et al. [24] in the crossbred cattle, and Singh et al. [25]. Hence, there are many factors that influence the size of the foetus, such as the size of the maternal environment of a dam, and parity. The superiority in BWT might be due to the higher concentration of androgen hormone of male fetus serum [26].

Table 1. Effect of breed, sex, season, and year of birth on body weight at birth

Factor		Birth weight (lsm)
Breed	CrossF1	26.45 ± 1,23
	CrossF2	25.26 ± 0.94
	Friesian	25.51 ± 0.98
Sex	Female	24.81 ± 0.52^{b}
	Male	26.67 ± 0.48^{a}
Season	Wet	25.80 ± 0.37
	Dry	25.48 ± 0.61
Year	2013	22.77 ± 1.46^{b}
	2014	20.14 ± 1.85^{b}
	2020	29.08 ± 0.77^{a}
	2021	28.31 ± 0.78^{a}
	2022	28.39 ± 0.83^{a}

Note, a,b Values within each subclass with different superscripts differ significantly (P≤0.05), N=160

3.3 Seasons Influence on Birth Weight

Season had no significant effect on body weight, whereas, the mean weight at birth of calves born in the wet season was slightly higher compared to the birth weight of calves born in the dry period. Limited availability and quality of forages for the grazing cattle during the dry season may influence negatively in terms of their nutritional status, which may affect the availability of nutrients for foetal development. Similarly, Kuralkar et al. [27] also observed a significant influence of the season of calving on birth weight. Further, it was observed that calves born during 2020-2022 were heavier than those born during 2013-2014. This variation in birth weight due to year could be attributed to availability of quality fodder on the grazing area and also variation on management conditions over the years. Bilgic and Alic [28] also recorded similar results on the effect of year of birth on birth weight. Under the study area, no agronomic practices were applied to improve natural pasture in the grazing area; thus, the pasture may be of poor quality, while, in the dry season, there is a scarcity of pasture in the grazing land.

4. CONCLUSION

The results of this study indicate that the year of birth and sex of calf were associated with variation in mean birth weight in all Friesian, and

Friesian x Fipa crosses. This shows the inheritance of the desirable descriptors and values of Friesian and Fipa by F1, such as tolerance to harsh condition, and requirement of low inputs. Hence, there is a need to search for funds that will support the implementation of this cross-breeding program and the collection of data, which will be used for the selection of individuals within these breed groups for genetic stabilization in the future.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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