

Non- Genetic Factors influence birth weight of Friesian and Friesian x Fipa Cattle calves in one Highland farm of Tanzania

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 year of birth had significant ($P < 0.05$) influence on birth weight, the males being heavier than the female 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 on 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 was practiced followed, whereas it was reverse in wet season, thus the nutrients demand for body maintenance, reproduction and production activities are impaired.

Keywords: *birth weight, calf, Sanga cattle*

2. Introduction

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 Tanzania Livestock Research Institute (TALIRI) Uyole came up with a project funded by Tanzania commission for science and technology (COSTEC) to enhance availability of good dairy cattle by crossing pure breed Friesian and Fipa local cattle in results of this obtained F1 and 75% Friesian x Fipa cross bred cattle which were disseminated to small holder farmers to boost up their productivities (reproduction and production). The reasons for using these two breeds for cross breeding programme under this project was due to their unique or desired characteristics which smallholder farmers prefer against other Tanzanian local cattle in the countries (Mwambene *et. al.*, 2012) whereas Friesian are preferred for highest milk yield among the dairy cattle available in the country. Fipa cattle is a stabilized crossbred of 'Sanga and Zebu' (Rege and Tawah, 1999, Mwambene *et. al.*, 2012). Sanga cattle is name of indigenous cattle of some local areas in Africa. They are identified as a subspecies with the scientific name *Bos taurus africanus* (Sanga cattle – Wikipedia 2024), (Kim *et al.* 2020.)

The Fipa breed has a good mothering ability, low birth challenges, high body weight at birth and high fertility, tolerant to harsh conditions/draught and adaptability to parasites, pests and diseases. In contrast, Friesian (*Bos Taurus*) are predominantly found in temperate countries which have good productivity and requires external inputs whereas poor adaptation to tropical and intolerant of harsh conditions, diseases and pests (Roschinsky *et. al.*, 2015). Therefore, crossbreeding of Fipa (*B.taurus africanus*) with Friesian (*B. taurus*) as used under this crossbreeding, adaptive the high-production potential of 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.

There was no study has been conducted to understand the reproduction and production traits of these cross bred dairy cattle to establish scientific information for future breeding program 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% cross.

Weight at birth is the first characteristics of animal can be easily recorded and vital trait to be measured in the life of an individual **Which do not change much during the first** few days of life. Early studies from 1950's **till to date**, have established importance **of** BWT with its positive genetic correlation with other vital traits in **animal**. **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 (Willard 1948, Munkaosi, 1955, Oni et al., 1988, Segura-Correa et al., 2017, Assan et al., 2002, Coffee *et. al.*, 2022)

Weight at birth is critical **information, which bear 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 pig have reveal that pre-weaning mortality and disease susceptibility are higher in low birth weight in **pigs** (Wolf, Žáková, & Groeneveld, 2008). **Studies** on cattle **indicate that**, high BWT was associated with increased perinatal calf mortality and dystocia in dairy cattle (Johanson and Berger, 2003). Hence there is a need to establish information on **genetical and non-genetical** factors influencing weight at birth of Friesian, F1 and **75% cross** and variation on weight at birth of these breed under grazing management system. This information is useful for further selection and breeding programme of Friesian and Fipa cattle in Tanzania. Hence the objective of the study is 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

3. Materials and Methods

3.1. Study location

Data were recorded from cattle Record books at the Tanzania Livestock Research Institute (TALIRI), Uyole farm. TALIRI Uyole is located at 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 of 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, average annual temperature range between 6.8°C -22.4°C and annual rainfall range between 600 to 2600 mm per annum.

3.2. 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 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 after every two to three years to minimize the effect of inbreeding since the two herds size 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 cross breeding with Friesian bull as the source of genetic materials to obtain F1 and 75% Fipa x Friesian crossbred under the breeding strategies. All animals (Friesian, F1 and 75% Fipa x) bred kept on paddock during the day and nights with no weather protection facility, weather protection facility is provided for born calves up to a weaning stage which is normal for 3 to 4 months depending on health condition for the calf.

3.3. Feed and feeding

Animals are grazed on natural pasture and very limited supply of input in the form of feed (e.g. use of feeding concentrate, feed supplements or additive). During the wet season natural pasture are plenty while in dry season availability of natural pasture is low and animals are grazed on crop residues which are of poor quality.

3.4. Data source/ 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 birth weights were recorded from birth of cattle calved between 2013 – 2022. In addition, calves' number, breed of calf sex. Season /month calves born and a year of birth were recorded.

3.5. Statistical analysis / Data analysis

BWT data obtained were analyzed using General Linear Model (GLM) procedure of the SAS. Differences amongst means of a trait for different factors were analyzed by PDIFF/SAS. The following statistical model was employed for analysis:

$$Y_{ijkl} = \mu + B_i + S_{ej} + S_{k+} + Y_l + e_{ijkl}$$

Where Y_{ijkl} = is dependent variable, μ = is overall mean, B_i = fixed effect of the breed, S_e = fixed effects of sex, S_{k+} = fixed effect of season of birth, Y_l = fixed effect of Year a calf born, e_{ijkl} = random error term

4. Results and discussion

4.1. Influence of breed on birth weight

The least squares mean of weight at birth in Friesian, F1 (Friesian x Fipa) and 75% Friesian x Fipacrossbred 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 breed and 75% Friesian x Fipacrosses. Normally pure breed shows higher birth weight, whereas the difference can be due to the factor that pure breed was less adopted to harsh condition, diseases and are pest intolerance, similarly they need higher substantial amount of feed under grazing condition in the tropical conditions hence they under perform in term of reproduction and production (Mwambene et al., 2012). From table one it is was observed that as the exotic blood increase to 75% cross, the weight at birth weight decreases as well. On other hand these BWTs were higher as compared to other cross breeds body weight and reported 23.9 kg in Sanga × Friesian cattle in Ghana, (Apori and Hagan 2014). Similarly, Kibwana *et al.* (2015) reported a weight at birth of 23.8 kg in non-supplemented group of animals and 24.8 kg in supplemented group in DRC. In Ethiopia Haile *et al.* (2011) observed 26 kg in Friesian × Boran. More over the recorded mean weights at birth were slightly lower as compared to other crossbreds reported 28.03 kg by Mandal and Sachdeva, 1999, 28.4 kgs by Muhammed *et al.* 2015 and 33.3 kgs by Segura-Correa *et al.* 2017 in Brown Swiss × Guzerat in Mexico. In New Zealand, under temperate condition cattle are supplemented with additional nutrient in the exotic breeds noted to have higher birth weight of 38.4 kgs in female Friesian and 41.8 kgs in male Friesian calves (Hickson *et al.*, 2015)

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 ($P \leq 0.05$), N=160.

4.2. 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, males being heavier than the female by 1.86 kg. Similar results were reported by Kayastha *et al.* (2008), Olson *et al.* (2009) in the crossbred cattle and Singh *et al.* (2011). Hence, there are many factors which influence size of foetus, such as the size of maternal environment of a dam, parity the superiority in BWT might be due to higher concentration of androgen hormone in of male fetus serum (Manzi *et al.* 2012).

4.3. Seasons influence on birth weight

Season had no significant effect on body weight whereas, mean weight at birth of calves born in wet season were slightly higher compared to birth weight of calves born in 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 effect the availability of nutrients for foetal development. Similarly, Kuralkaret *et al.* (2005) also observed significant influence of 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, 2004 also recorded similar results on the effect of year of birth on birth weight, weight. Under the study area no agronomic practices were applied to improve natural pasture in grazing area, thus the pasture may be of poor quality, while, in the dry season, there are scarcity of pasture in the grazing land.

Conclusion and recommendation

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, Friesian and Fipa crosses with a higher BWT compare to Friesian and 75% cross. This indicates that the inheritance of the desired descriptors and values of Friesian and Fipa by F1 (e.g. tolerance to harsh condition and requirement of low inputs). Hence there is a need to continue (searching for fund to support the programme) implementing this cross-breeding programme and collection of reproduction and production data which will be used for selection of individual animals within these breed groups for cross-breeding programme and genetic stabilization in the future.

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References

- Apori, S.O. and Hagan, J.K., 2014. The effect of non-genetic factors on the reproductive performance of Sanga and Friesian x Sanga crossbred dairy cattle breeds kept under hot and humid environment. *Tropical Animal Health and Production*, 46, 1045–1050.
- Assan, N., Makuza, S., Mhlanga, F., & Mabuku, O.2002. Genetic Evaluation and Selection Response of Birth Weight and Weaning Weight in Indigenous Sabi Sheep. *Asian-Australasian Journal of Animal Sciences*, 15(12), 1690–1694
- Bilgic N and Alic, D. 2004. Genetic and phenotypic parameter estimates of birth weight in Holstein Friesian calves. *J Agric Sci (Turkey)*, 10: 72-75
- Coffie, I., Kagya-Agyemang, J.K., Amposah, M. And Afriyie, A.B.,2022, Factors Influencing Reproductive and Calf Growth Performance Of Sanga Cows In The Ashanti Region, *Ghana Ghanaian Journal Of Animal Science*, Vol. 13:2. 2022
- Haile, A., Joshi., B.K., Ayalew, W., Tegegne, A., Singh, A., 2011. Genetic evaluation of Ethiopian Boran cattle and their crosses with Holstein Friesian for growth performance in central Ethiopia. *J. Anim. Breed. Genet.* 128(2):133-40.
- Hicksona R.E, Zhangb I.L, Naughton L.R, 2015. Brief Communication: Birth weight of calves born to dairy cows in New Zealand. *Proceedings of the New Zealand Society of Animal Production* 75:257-259.
- Johanson, J. M., and Berger P.J. 2003. Birth weight as a predictor of calving ease and perinatal mortality in Holstein cattle. *J. Dairy Sci.* 86:3745–3755
- José C. Segura-Correa, Juan G. Magaña-Monforte, Jesús R. Aké-López, Victor M. Segura-Correa, José A. Hinojosa-Cuellar and Mario M. Osorio-Arce,2017, Reed and

Environmental Effects On Birth Weight, Weaning Weight And Calving Interval Of Zebu Cattle In Southeastern Mexico, *Tropical and Subtropical Agroecosystems*,20:297-305

- Kayastha R. B, Zaman G. and Goswami R. N.2008. Studies on the birth weight of indigenous cattle of Assam. *Indian Journal of Animal Research* 42: 3.
- Kibwana, D.K; Makunyavira, A.M.; Hornomic, J.L. 2015. Effect of improved feeding and housing, Friesian blood level and parity on milk production of Ankole x Friesian cows. *Pakistan Veterinary Journal* (2015)35(1), 76–80.
- Kim, K., Kwon, T., Dessie, T. *et al.* The mosaic genome of indigenous African cattle as a unique genetic resource for African pastoralism. *Nat Genet* **52**, 1099–1110 (2020). <https://doi.org/10.1038/s41588-020-0694-2>
- Köhler-Rollefson, I. 2005. *Indigenous Breeds, Local Communities. Documenting Animal Breeds and Breeding from a Community Perspective.* Sadri, Rajasthan, India. ISBN No. 81-901624-1-1.
- Kuralkar S, Ali S, Takarkhede R and Sahatpure S. 2005. Genetic analysis on birth weight in crossbred calves. *Journal of Bombay Veterinary College* 13(1–2): 78–80.
- Mandal A and Sachdeva G K. 1999. Genetic analysis of birthweight of calves in cattle. *Indian Journal of Animal Sciences* 69(11): 979–80.
- Manzi M, Junga J O, Ebong C and Mosi R O. 2012. Factors affecting pre and post-weaning growth of six cattle breed groups at Songa Research Station in Rwanda. *Livestock Research for Rural Development* 24 (4): 68–70.
- Muhammed E M, Mathew S, Xavier F and Naseema K T. 2015. Heritability of birth weight among crossbred cattle in Kerala under farm conditions. *Journal of Indian Veterinary Association* 13(1): 35–38.
- Munkaosi,F.1995 The Effect of Birth Weight on Some Economic Characteristics. *Animal Breeding Abstr.*, 23: 1058.

Mwambene PL, Katule AM, Chenyambuga SW, Mwakilembe PAA. 2012. Fipa cattle in the southwestern highlands of Tanzania: socio-economic roles, traditional management practices and production constraints. *Animal Genetic Resources/Ressources génétiques animales/Recursos genéticos animales*. 2012;51:1-14. doi:10.1017/S2078633612000112

Mwambene PL, Katule AM, Chenyambuga SW, Plante Y, Mwakilembe PAA. 2021. Fipa cattle in the southwestern highlands of Tanzania: molecular characterization. *Animal Genetic Resources/Ressources génétiques animales/Recursos genéticos animales*. 51:31-43. doi:10.1017/S2078633612000392

Olson K.M. Cassell B G, McAllister A J and Washburn S P. 2009. Dystocia, stillbirth, gestation length, and birth weight in Holstein, Jersey, and reciprocal crosses from a planned experiment. *Journal of Dairy Science* 92: 6167–71.

Oni O. O., Buvanandra V. and Dim N.I, 1988, Factors affecting birt weight and performance to weaning of Bunaji calves J. Agric Sc. Comb 11: 407 -410

Rege, J.E.O. &Tawah, C.L. 1999. The state of African cattle genetic resources II. Geographical distribution, characteristics and uses of present-day breeds and strains. *Anim. Genet. Resour. Info.*, 26: 1–25. (available at <ftp://ftp.fao.org/docrep/fao/012/x3565t/x3565t00.pdf>).

Roschinsky, R., Kluszczynska, M., Sölkner, J., Puskur, R., & Wurzinger, M. 2015. Smallholder experiences with dairy cattle crossbreeding in the tropics: From introduction to impact. *Animal*, 9(1), 150–157. doi:<https://doi.org/10.1017/S1751731114002079>

Sanga cattle - Wikipedia, site visited on 18th August,2024.

Segura-Correa, José C.; Magaña-Monforte, Juan G.; Aké-López, Jesús R.; Victor M.; Hinojosa-Cuellar, José A.; Osorio-Arce, Mario M. 2017. Breed and Environmental effects on birth weight, weaning weight and Calving Interval of zebu cattle in South Eastern Mexico. *Tropical and Subtropical Agroecosystems*,20(2):297-305.

Effect of HolWillard. H.S, 1948. stein Birth Weight on Calf Gain and Final Weight. Wyoming Agr. Expt. Sta., Bull., 286: 14.

Wolf, J., Žáková, E., & Groeneveld, E. 2008. Within-litter variation of birth weight in hyperprolific Czech Large White sows and its relation to litter size traits, stillborn piglets and losses until weaning. *Livestock Science*, 115(2-3), 195- 205. doi: <https://doi.org/10.1016/j.livsci.2007.07.009>