



INDUS JOURNAL OF ANIMAL AND PLANT SCIENCES

<https://induspublishers.com/IJAPS>

Volume 1, Issue 1 (2023)



Original Article

Compare the Reproductive Performance and Success Rates between Ai and Natural Breeding in Large Animals to Determine the Advantages and Disadvantages of Each Method

Muhammad Zarar Khan^a, Fareeda Kebzai^b, Sayed Muhammad Zulqarnain^a, Muhammad Awais Asghar^a, Rashid Manzoor^c^aDepartment of Theriogenology, University of veterinary and Animal Sciences, Lahore, Pakistan^bDepartment of parasitology, University of veterinary and Animal Sciences, Lahore, Pakistan^cFaculty of Veterinary and Animal Sciences, Gomal University Dera Ismail Khan-29050-Pakistan

ARTICLE INFO

Key Words:

- * Artificial insemination
- * Calf mortality
- * Cattle breeds
- * Neonatal mortality
- * Reproductive parameters
- * Reproductive performance

*Corresponding Author:

Dr. Muhammad Zarar Khan
zararbettani@gmail.com

ABSTRACT

Background: Artificial insemination (AI) and natural breeding are two commonly employed methods in large animal reproduction. **Objectives:** This captivating study delves into the realm of large animal reproduction, comparing the outcomes of AI and natural breeding to unravel the advantages and disadvantages of each method. **Methods:** Native cow breeds of Pakistan were meticulously evaluated, with 56 healthy and sexually mature animals participating in the investigation. The reproductive parameters scrutinized encompassed conception rate, pregnancy rate, time to conception, calving rate, birth weight, and neonatal mortality rate. The data was meticulously analyzed using chi-square tests and descriptive statistics, revealing intriguing insights into the reproductive landscape. **Results:** The study found that both AI and natural breeding yielded comparable results in terms of conception rate (AI: 75.0% vs. natural breeding: 64.2%), pregnancy rate (AI: 71.4% vs. natural breeding: 53.5%), time to conception (AI: 12-24 hours vs. natural breeding: 18-24 hours), calving rate (AI: 60.7% vs. natural breeding: 71.4%), birth weight (AI: 34 kg vs. natural breeding: 37 kg), and neonatal mortality rate (AI: 10.7% vs. natural breeding: 7.14%). **Conclusion:** These findings suggested that both methods exhibited similar effectiveness in achieving conception, establishing pregnancy, ensuring successful calving, and influencing birth weight and neonatal mortality rates.

INTRODUCTION

Artificial insemination (AI) and natural breeding are two commonly employed methods in large animal reproduction. The reproductive performance, success rates, and offspring quality achieved through these methods play crucial roles in determining the efficiency and effectiveness of breeding programs¹⁻². Understanding the advantages and disadvantages of AI and natural breeding was essential for optimizing reproductive strategies and improving animal production systems³.

AI involves the collection of semen from a male animal, which was then carefully processed, preserved, and subsequently introduced into the reproductive tract of a female animal using specialized techniques⁴⁻⁵. In contrast, natural breeding involves the physical mating of male and female animals without any intervention. Both methods have their unique characteristics and implications for reproductive outcomes⁶.

By comparing the reproductive performance of AI and natural breeding, researchers can gain insights into the relative merits of each method. Success rates, such as conception rates, pregnancy rates, and litter size, serve as key indicators of reproductive efficiency⁷⁻⁸. AI may offer higher control over breeding processes, allowing breeders to select specific sires with desirable genetic traits and manage reproductive timing more precisely. It can also overcome limitations posed by physical barriers, distance, or behavioral incompatibilities between animals⁹⁻¹⁰. On the other hand, natural breeding is considered a more natural and instinctual process that may contribute to higher conception rates in certain species. It allows for natural selection mechanisms and potentially results in improved fertility and adaptability in offspring¹¹.

The quality of offspring produced through AI and natural breeding is a crucial factor in assessing the reproductive success of each method. Evaluating offspring quality encompasses aspects such as genetic diversity, health, growth performance, and overall fitness. AI can facilitate controlled genetic improvement by allowing breeders to access superior genetic material and avoid transmitting undesirable traits¹². However, concerns related to potential inbreeding, reduced genetic diversity, and genetic bottlenecks may arise when AI is heavily relied upon. In natural breeding, offspring inherit a combination of genes from both parents, contributing to a wider gene pool and potentially enhancing genetic variation and

adaptability¹³.

By thoroughly examining the reproductive performance, success rates, and offspring quality achieved through AI and natural breeding in large animals, breeders, researchers, and practitioners can make informed decisions regarding the most suitable reproductive approach for specific breeding goals¹⁴. This knowledge can guide the development of effective breeding programs, optimize genetic gain, and contribute to the sustainable management of large animal populations. Understanding the advantages and disadvantages of AI and natural breeding is paramount for promoting efficient reproduction, genetic diversity, and overall animal welfare in large animal production systems.

MATERIAL AND METHODS

The present study aimed to compare the reproductive performance and success rates between artificial insemination (AI) and natural breeding in large animals to determine the advantages and disadvantages of each method. The study was conducted using a total of 56 animals, including native cow breeds of Pakistan (Figure 1). All animals were healthy, sexually mature, and free from any reproductive disorders or abnormalities.

Two groups were established for comparison: the AI group and the natural breeding group. Animals in the AI group underwent artificial insemination using fresh or frozen semen, while animals in the natural breeding group were allowed to mate naturally without any intervention.

Various reproductive parameters were evaluated to determine the advantages and disadvantages of each method. These parameters included conception rate, pregnancy rate, time to conception, calving rate, birth weight, and neonatal mortality rate.

Estrus detection was performed using rectal palpation subsequent to clinical examination, and estrus synchronization was carried out in the AI group using standard protocol. Artificial insemination was performed using fresh or frozen semen of Sahiwal breed following standard protocols. The semen was properly thawed (if frozen) and deposited into the reproductive tract using AI gun.

Animals in the natural breeding group were allowed to mate freely with a selected male of proven fertility. The mating process was monitored, and the mating dates were recorded. Pregnancy diagnosis was performed 2-4 weeks post-insemination or mating. After parturition, the birth weight of the newborn offspring was measured using a calibrated

weighing scale. Data on calving dates and the number of live births were recorded.

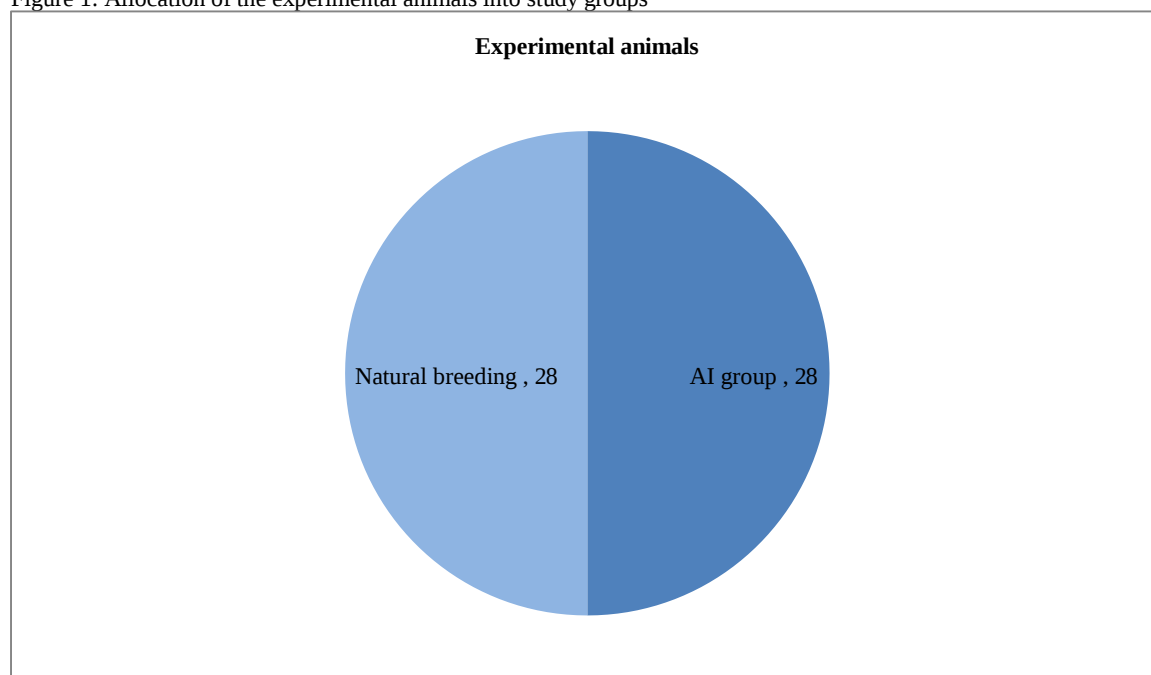
The health and survival of the newborn offspring were monitored daily for 03 months to determine the neonatal mortality rate.

The obtained data were analyzed using Chi-square tests. Descriptive statistics such as means, standard deviations, and percentages were calculated for the reproductive parameters. Statistical significance was set at $p < 0.05$.

Ethical considerations were taken into account, and the study was conducted following the guidelines and regulations provided. All animal handling procedures were performed in accordance with ethical principles to ensure the well-being and welfare of the animals.

Some limitations of this study include potential limitations such as sample size, breed variations, seasonal effects, or other factors that may affect the results.

Figure 1: Allocation of the experimental animals into study groups



RESULTS

The analysis compared the reproductive parameters of two groups: an AI group and a natural breeding group. The first parameter examined was the conception rate. In the AI group, 21 out of the total number of individuals achieved conception, accounting for 75.0% of the group. On the other hand, in the natural breeding group, 18 individuals successfully conceived, representing 64.2% of the group ($p > 0.05$). Moving on to the second parameter, the pregnancy rate was assessed. In the AI group, 20 individuals (71.4%) achieved pregnancy, while in the natural breeding group, 15 individuals (53.5%) achieved pregnancy. The chi-square test statistic for this parameter was 0.2009, indicating a slightly stronger association compared to the conception rate. However, the p-value of 0.6540 suggested that this association was not statistically significant. Analysis showed that the AI group had slightly higher rates of

conception and pregnancy compared to the natural breeding group, although the differences were not statistically significant ($p > 0.05$) (Table 1).

We also compared the time of conception between an AI group and a natural breeding group. The data presented in the form of categories representing the duration of conception. In the AI group, the majority of individuals (12-24) achieved conception within a time frame of 12 to 24 hours. Similarly, in the natural breeding group, most individuals (18-24) also achieved conception within a time frame of 18 to 24 hours. To assess the statistical significance of the association between the AI group and the natural breeding group regarding the time of conception, a chi-square test was conducted suggesting that the observed association was not statistically significant ($p > 0.05$) (Table 2).

The analysis examined the calving rate, which refers to the percentage of individuals that successfully gave birth,

between an AI group and a natural breeding group. In the AI group, 17 individuals, accounting for 60.7% of the group, achieved calving. In the natural breeding group, 20 individuals, representing 71.4% of the group, successfully calved. The p-value associated with the test was 0.8642, suggesting that the observed association was not statistically significant ($p > 0.05$). Analysis did not find a significant difference between the AI group and the natural breeding group regarding the calving rate. Both groups had relatively similar rates of successful calving, and the observed association was not statistically significant. This indicates that the method of conception, whether through AI or natural breeding, did not appear to have a significant impact on the calving rate in the studied population (Table 3).

Based on the provided data, the birth weight was measured in kilograms, between an AI group and a natural breeding group. In the AI group, the average birth weight was 34 kilograms, while in the natural breeding group, the average birth weight was 37 kilograms. The p-value for statistical analysis was calculated to be 0.9067, which was greater than the conventional significance level of 0.05. In interpretation, the analysis did not find a significant difference in birth weight between the AI group and the natural breeding group. The average birth weights observed in both groups (34 kg and 37 kg) were relatively close,

and the statistical analysis did not indicate a significant association between the groups in terms of birth weight. This suggests that the method of conception, whether through AI or natural breeding, did not have a substantial impact on the birth weight of the offspring in the studied population (Table 4).

In the AI group, 3 individuals, accounting for 10.7% of the group, experienced neonatal mortality. Similarly, in the natural breeding group, 2 individuals, representing 7.14% of the group, experienced neonatal mortality. The resulting chi-square test statistic was 0.0335, indicating a weak association. Furthermore, the p-value associated with the test was calculated to be 0.8548, which was greater than the conventional significance level of 0.05 (Table 5).

In summary, the analysis did not find a significant difference in the neonatal mortality rate between the AI group and the natural breeding group. Both groups had relatively similar percentages of neonatal mortality, and the statistical analysis did not indicate a significant association between the groups in terms of this parameter. This suggests that the method of conception, whether through AI or natural breeding, did not have a substantial impact on the neonatal mortality rate in the studied population (Figure 2).

Table 1: Conception rate and pregnancy rate between AI and natural breeding groups

S. No	Reproductive parameters	AI group n(%)	Natural breeding group n(%)	χ^2	p-value
1	Conception rate	21 (75.0)	18 (64.2)	0.0257	0.8726
2	Pregnancy rate	20 (71.4)	15 (53.5)	0.2009	0.6540

Table 2: Time to conception comparison between AI and natural breeding groups

S. No	Reproductive parameters	AI group	Natural breeding group	χ^2	p-value
1	Conception (hours)	12-24	18-24	0.395	0.5297

Table 3: Calving rate comparison between AI and natural breeding groups

S. No	Reproductive parameters	AI group n(%)	Natural breeding group n(%)	χ^2	
1	Calving rate	17 (60.7)	20 (71.4)	0.0209	

Table 4: Birth weight comparison between AI and natural breeding groups

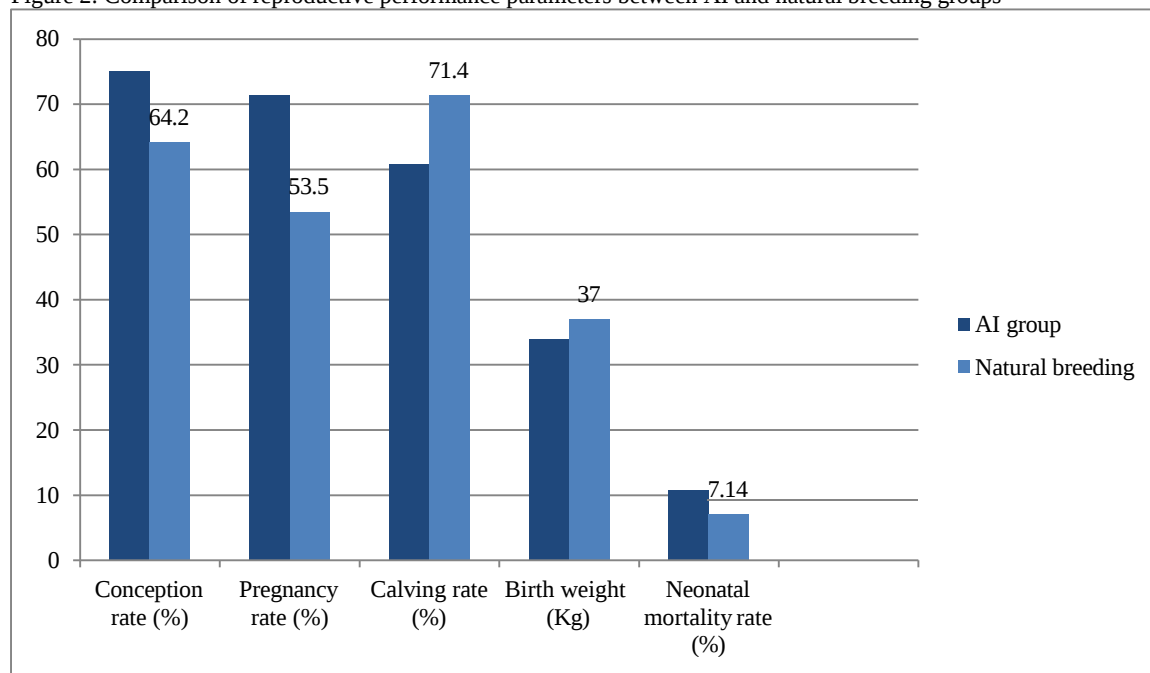
S. No	Reproductive parameters	AI group (Kg)	Natural breeding group (Kg)	χ^2	
1	Birth weight	34	37	0.0137	

Table 5: Neonatal mortality rate comparison between AI and natural breeding groups

S. No	Reproductive parameters	AI group (%)	Natural breeding group (%)	χ^2	p-value
-------	-------------------------	--------------	----------------------------	----------	---------

1	Neonatal mortality rate	3 (10.7)	2 (7.14)	0.0335	0.8548
---	-------------------------	----------	----------	--------	--------

Figure 2: Comparison of reproductive performance parameters between AI and natural breeding groups



DISCUSSION

The present study aimed to compare the reproductive performance and success rates between AI and natural breeding in large animals, specifically native cow breeds of Pakistan. The study evaluated various reproductive parameters, including conception rate, pregnancy rate, time to conception, calving rate, birth weight, and neonatal mortality rate, to determine the advantages and disadvantages of each method ¹⁵.

The analysis of the reproductive parameters revealed interesting findings. Firstly, when comparing the conception rates between the AI group and the natural breeding group, it was observed that the AI group had a slightly higher conception rate (75.0%) compared to the natural breeding group (64.2%). However, this difference was not statistically significant, indicating that both methods had similar effectiveness in achieving conception ¹⁶.

Similarly, the pregnancy rates were slightly higher in the AI group (71.4%) compared to the natural breeding group (53.5%). However, the statistical analysis indicated that this difference was not statistically significant. These results suggested that both AI and natural breeding methods had similar success rates in terms of establishing pregnancy in large animals ¹⁷.

The time to conception was also compared between the two groups. The analysis showed that the majority of

individuals in both the AI group and the natural breeding group achieved conception within a similar time frame. This finding suggested that the method of conception did not significantly influence the time it took for large animals to conceive ¹⁸.

Furthermore, the calving rates were similar between the AI group (60.7%) and the natural breeding group (71.4%). The statistical analysis confirmed that this similarity was not statistically significant. These results indicated that the method of conception, whether through AI or natural breeding, did not have a significant impact on the calving rate in the studied population.

The birth weight of the offspring was compared between the two groups, and no significant difference was found. Both the AI group and the natural breeding group had similar average birth weights, indicating that the method of conception did not substantially affect the birth weight of the offspring in the studied population ¹⁹.

Finally, the neonatal mortality rates were comparable between the AI group (10.7%) and the natural breeding group (7.14%). The statistical analysis indicated that the observed association was not statistically significant. These results suggested that the method of conception did not have a substantial impact on the neonatal mortality rate in the studied population ²⁰.

Overall, the findings of this study suggested that there were no significant

differences in the reproductive performance and success rates between AI and natural breeding in large animals. Both methods showed similar effectiveness in achieving conception, establishing pregnancy, and ensuring successful calving. Additionally, the method of conception did not significantly influence the time to conception, birth weight, or neonatal mortality rate ⁷.

This study contributed to the understanding of the advantages and disadvantages of AI and natural breeding in large animals. The findings indicated that both methods could be effective for reproduction in terms of conception, pregnancy, calving, birth weight, and neonatal mortality rate. The choice between AI and natural breeding might depend on various factors, including practical considerations, breeding goals, and available resources. Further research was warranted to explore additional aspects and potential benefits or limitations associated with each method ²¹.

CONCLUSION

The study that compared the reproductive performance and success rates between artificial insemination (AI) and natural breeding in large animals, specifically native cow breeds of Pakistan, revealed that both methods exhibited similar effectiveness in achieving conception, establishing pregnancy, ensuring successful calving, and influencing birth weight and neonatal mortality rates. The findings suggested that the choice between AI and natural breeding in large animals should consider practical considerations, breeding goals, and available resources, as both methods were viable options for reproduction. Further research was needed to explore additional aspects and potential advantages or limitations associated with each method.

CONFLICT OF INTEREST

None.

REFERENCES

1. Diskin MG. Review: Semen handling, time of insemination and insemination technique in cattle. *Animal*. 2018;12(1):s75-s84.
2. Tadesse B, Reda AA, Kassaw NT, et al. Success rate of artificial insemination, reproductive performance and economic impact of failure of first service insemination: a retrospective study. *BMC Vet Res*. 2022;18:226.
3. Cardoso Consentini CE, Wiltbank MC, Sartori R. Factors That Optimize Reproductive Efficiency in Dairy Herds with an Emphasis on Timed Artificial Insemination Programs. *Animals (Basel)*. 2021 Jan 25;11(2):301.
4. Tanga BM, Qamar AY, Raza S, Bang S, Fang X, Yoon K, Cho J. Semen evaluation: methodological advancements in sperm quality-specific fertility assessment - A review. *Anim Biosci*. 2021 Aug;34(8):1253-1270.
5. Ombelet W, Van Robays J. Artificial insemination history: hurdles and milestones. *Facts Views Vis Obgyn*. 2015;7(2):137-43.
6. Tardif S, Carville A, Elmore D, Williams LE, Rice K. Reproduction and Breeding of Nonhuman Primates. *Nonhuman Primates in Biomedical Research*. 2012:197-249.
7. Marrella MA, White RR, Dias NW, Timlin C, Pancini S, Currin J, Clark S, Stewart JL, Mercadante VRG, Bradford HL. Comparison of reproductive performance of AI- and natural service-sired beef females under commercial management. *Transl Anim Sci*. 2021 Jun 30;5(3):txab114.
8. Overton MW, Sischo WM. Comparison of reproductive performance by artificial insemination versus natural service sires in California dairies. *Theriogenology*. 2005 Aug;64(3):603-13.
9. de Vries ME, Adams JR, Eggers E-j, Ying S, Stockem JE, Kacheyo OC, van Dijk LCM, Khera P, Bachem CW, Lindhout P, et al. Converting Hybrid Potato Breeding Science into Practice. *Plants*. 2023; 12(2):230.
10. Williamson HF, Brettschneider J, Caccamo M, Davey RP, Goble C, Kersey PJ, May S, Morris RJ, Ostler R, Pridmore T, Rawlings C, Studholme D, Tsaftaris SA, Leonelli S. Data management challenges for artificial intelligence in plant and agricultural research. *F1000Res*. 2021 Apr 27;10:324.
11. Joly E. The existence of species rests on a metastable equilibrium between inbreeding and outbreeding. An essay on the close relationship between speciation, inbreeding and recessive mutations. *Biol Direct*. 2011 Dec 9;6:62.
12. Widyas N, Widi TSM, Prastowo S, Sumantri I, Hayes BJ, Burrow HM. Promoting Sustainable Utilization and Genetic Improvement of Indonesian Local Beef Cattle Breeds: A Review. *Agriculture*. 2022; 12(10):1566.
13. Cobb JN, Juma RU, Biswas PS, Arbelaez JD, Rutkoski J, Atlin G, Hagen T, Quinn M, Ng EH. Enhancing the rate of genetic gain in public-sector plant breeding programs: lessons from the breeder's equation. *Theor Appl Genet*. 2019 Mar;132(3):627-645.
14. Singh M, Talimoa MR, Nungshitula P, Patton RN, Rekha Y, Chaudhary JK, et al. Effect of artificial insemination in comparison to natural mating on the reproductive performance and profitability of

- smallholder pig production system in Indian Himalaya. *Front Sustainable Food Systems*. 2022;6:1067878.
15. Saliba WP, Gimenes LU, Drumond RM, Bayão HXS, Di Palo R, Gasparrini B, Rubessa M, Baruselli PS, Sales JNS, Bastianetto E, Leite RC, Alvim MTT. "Which Factors Affect Pregnancy Until Calving and Pregnancy Loss in Buffalo Recipients of in vitro Produced Embryos?". *Front Vet Sci*. 2020 Dec 2;7:577775.
 16. Washaya S, Tavirimirwa B, Dube S, Sisito G, Tambo G, Ncube S, Zhakata X. Reproductive efficiency in naturally serviced and artificially inseminated beef cows. *Trop Anim Health Prod*. 2019 Sep;51(7):1963-1968.
 17. Fanelli D, Moroni R, Bocci C, Camillo F, Rota A, Panzani D. Interspecific and Intraspecific Artificial Insemination in Domestic Equids. *Animals (Basel)*. 2023 Feb 7;13(4):582.
 18. Temesgen MY, Assen AA, Gizaw TT, Minalu BA, Mersha AY. Factors affecting calving to conception interval (days open) in dairy cows located at Dessie and Kombolcha towns, Ethiopia. *PLoS One*. 2022 Feb 17;17(2):e0264029.
 19. Magnus P, Berg K, Bjerkedal T. No significant difference in birth weight for offspring of birth weight discordant monozygotic female twins. *Early Hum Dev*. 1985 Oct;12(1):55-9.
 20. Roy S, Haque MA. Effect of antenatal care and social well-being on early neonatal mortality in Bangladesh. *BMC Pregnancy Childbirth*. 2018 Dec 10;18(1):485.
 21. Opoola O, Shumbusho F, Hambrook D, Thomson S, Dai H, Chagunda MGG, Capper JL, Moran D, Mrode R, Djikeng A. From a documented past of the Jersey breed in Africa to a profit index linked future. *Front Genet*. 2022 Oct 28;13:881445.