Bhutan Journal of Animal Science (BJAS), Volume 7, Issue 1, Page 122-129, March 2023

EFFICIENCY OF ARTIFICIAL INSEMINATION IN PIGS AT GOVERNMENT AND PRIVATE BREEDING FARMS IN BHUTAN

SONAM PENJOR*, TENZIN PENJOR, TASHI PHUNTSHO, PEMA SHERAB, AND GYEMBO TSHETEN

National Piggery Research and Development Centre, Department of Livestock, Gelephu

*Author for correspondence: sonamp@moal.gov.bt

ABSTRACT: The study assessed the conception rate of Artificial Insemination (AI) and other reproductive parameters in government and private pig breeding farms. The study also evaluated the performance efficiency of the AI services in both government and private pig breeding farms. In private pig breeding farms, the beneficiaries under Contract Piglet Breeding (CPB) farms and Big-Ticket Initiatives (BTI) were included. The breeding unit of National Piggery Research and Development Centre (NPiRDC) was the lone government breeding farm in the study. The fresh semen collected and processed/extended from the semen processing laboratory at NPiRDC was used for AI. A total of 87 numbers; (government farm = 48, private pig breeding farms = 39) of female pigs were inseminated with extended fresh semen (3×10^9 motile sperm/dose in 100 ml semen collection tube) at 12, 24 and 36 hours after the onset of standing heat. The data were subjected to descriptive analysis and differences among the variables were measured using independent t-test. The study found that the conception rate in the government breeding farm (81.25%) was much better compared to private pig breeding farms (71.79%). Among the pigs impregnated with AI, there was no significant difference in terms of farrowing rate, litter size and stillbirth between government and private breeding farms. The study concludes that AI service in pig breeding is an efficient technology and can be widely adopted to boost pork production in the country.

Keywords: Artificial Insemination; conception rate; farrowing rate; litter size; semen

1. INTRODUCTION

Artificial insemination (AI) in pig is widely practiced in many parts of the world. The collection of boar semen for insemination was practiced since 1930 (Sterle and Safranski 2018). About 90% of the sows in most of the world's primary pork producing countries adopted AI for breeding (Waberski et al. 2019). For more than two decades, 90% of the European countries have bred pigs using AI technology (Gerrits et al. 2005). In Netherland, 98% of sows are mated through AI technology (Feitsma 2009). Similarly, 70% of piggery farmers, who practiced traditional small scale production had adopted the AI for pig breeding in North East India (Sharma et al. 2021).

With the AI, it is possible to use superior breeding boars more extensively compared to those boars used for natural mating (Vincent et al. 2018). However, the outcome of AI largely depends on semen quality and insemination procedures (Maes et al. 2011). For better conception rate, the female pigs in heat should be inseminated before ovulation and the optimum time for insemination is 24 hours prior to ovulation (Langendijk et al. 2005; Vargas et al. 2009).

AI in pig involves collection of semen from a trained boar (genetically superior), processing and then introducing it into the reproductive tract of a sow or gilt by means of a catheter (Ikani IE and Dafwang 1995; Bamundaga et al. 2018). The collected semen which are processed could be used to impregnate sows and gilts at a greater distance (Loanis et al. 2000). Further, with the use of superior boars in swine production, AI allows to improve the herd quality, potentially at lower cost compared to natural mating (Sterle and Safranski 2018). It is also reported to have lesser risk of disease transmission compared to natural breeding. In many countries, it has been reported that AI could reduce the unit cost of production (COP) of pig breeding farms compared to natural breeding. This is mainly because of no expenditure required in rearing and maintaining the boar for breeding (Munyaneza et al. 2019).

In Bhutan, piggery sector attempted to perform AI in pig using fresh semen (without processing) since 2013. Yet this attempt could not be continued due to inadequate laboratory facilities and trained technical staff. The present practices of rearing 1 boar for every 10 sow incurs additional expenditure and management, which increases the COP) of the pig breeding farms. So, with an aim to reduce the COP of the pig breeding farms, AI in pig has recently been initiated by piggery sector.

With increasing number of private pig breeding farms, and to reduce their expenditure in rearing boar for natural mating, semen processing laboratory was established within the complex of National Piggery Research and Development Centre (NPiRDC), Gelephu in 2020. This was mainly to cater the AI services to both government and private pig breeding farms and harness its advantages while enhancing piggery production in the country. Since then, numerous AI services had been rendered both to the government and private pig breeding farms. Therefore, this study aims to assess the efficiency of AI in terms of conception rate, farrowing rate and litter size in government and private pig breeding farms.

2. MATERIALS AND METHOD

2.1 Study area

The study was conducted at NPiRDC in Gelephu and private pig breeding farms under Sarpang *Dzongkhag* (district) between July 2021 and June 2022. The study area is situated at an elevation ranging from 200 to 1600 meter above sea level (masl) (Google Earth 2022). The average annual temperature of the study area is 22^{o}C, and the average annual rainfall ranges from 1200 mm to 2500 mm.

2.2 Experimental design and animal management

A total of 87 numbers of pigs; 48 from government breeding farm and 39 from private pig breeding farms were inseminated. The pigs in government breeding farm were inseminated after the onset of standing heat. Whereas, in private pig breeding farms the pigs were inseminated after receiving phone calls from piggery farmers confirming that the pigs were in standing heat. The standing heat was verified through back-pressure test, and observing the physical activity and characteristics of the pig.

A total of 8 elite boars available at NPiRDC comprising of five Duroc Jersey, one each of Large Black (LB), Large White (LW), and Landrace were included in the study.

During the study, the pigs in the government farm were fed with the concentrate feeds (produced by BMG and Dejung feed company), whereas in private pig breeding farms, the pigs were partly fed with locally available feeds (thin stillage from Army Welfare Project Ltd., kitchen waste, rice and maize bran) and partly with concentrate feeds. Water was provided *ad libitum* in both the government and private pig breeding farms.

2.3 Source of semen

During the study, semen was collected from four different breeds of boar (Duroc, Landrace, Large Black, and Large White) housed at NPiRDC for AI purpose. Semen was extended using short term boar semen extender, viz. Beltsville Thawing Solution (BTS) prepared with Gentamicin @ 50 g in one litre, following the standard protocol. Semen was collected and extended at the NPiRDC's semen processing laboratory for the entire study. Fresh chilled semen was processed based on the dose required and after observing the sows or gilts in standing heat. The processed semen was preserved for three to four days in semen fridge (Mini-tube) at temperatures between 15°C and 19°C. To avoid inbreeding in government farm, semen was processed based on the breeds of sows or gilts available (crossbreeding was done). Similarly, crossbreeding was done in the private pig breeding farms as well, according to crossbreeding guidelines.

2.4 Inseminating sows or gilts

The pigs were inseminated with two doses of fresh chilled semen containing three to five billion spermatozoa in 100 ml semen tube to have higher conception rates and larger litter size. A foam tip catheter (mini-tube Company) was used to inseminate the pigs both in government and private pig breeding farms. The first dose was inseminated within 12 hours after detecting the sows or gilts in standing heat and followed by second dose between 12 to 24 hours after the first dose. However, the gilts were inseminated in second heat period after attaining the required body weight for breeding. The intra-cervical insemination technique was used in all inseminations (Darwin 2007) and extra care was taken to minimize the back flow of semen. The conception was indicated by a non-return to estrus 18 to 24 days post-insemination (Benjamin et al. 2017). Therefore, inseminated pigs were observed for return to estrus after 18 to 24 days of insemination for the tentative confirmation of pregnancy, and those pigs that did not conceive on the first AI were inseminated again on the subsequent heat.

2.5 Data collection

The data on inseminated pigs were collected for one year from July 2021 to June 2022. The parameters such as number of AI performed, conception rate, pregnancy failure, litter farrowed, piglets born alive and stillbirth were compiled in Microsoft Excel 2010. The conception rate was calculated inclusive of pregnancy failure. The semen collection date, volume and concentration of semen, dose prepared and insemination date were recorded in excel sheet. Similarly, the incidences of repeat cases were also recorded. The following formulae were used to estimate the conception, farrowing and still birth rate.

Number of pigs conceived = Total number of AI performed – Number of repeat cases

$$\text{Conception Rate} = \frac{\text{No. of pigs conceived}}{\text{Total no. of AI performed}} X100$$

$$\text{Farrowing Rate} = \frac{\text{No. of pigs farrowed}}{\text{Total no. of AI performed}} X100$$

$$\text{Stillbirth Rate} = \frac{\text{No. of piglets born dead}}{\text{Total no. of piglets born}} X100$$

2.6 Data analysis

The data on the reproductive parameters collected were compiled in Microsoft Excel 2010 and analyzed using Statistical Packages for the Social Science (SPSS) version 23.0. The data were checked for normality test using the Shapiro-Wilk test before analysis. Tables and figures used in this study were also developed using Microsoft Excel.

The analyze data, Independent Sample t-test and descriptive statistics were employed. The results were interpreted based on the number of inseminations done and piglets born in government and private pig breeding farms.

The data were expressed as a mean ± standard deviation (SD) and the significance level was set at $p<0.05$.

3. RESULTS AND DISCUSSION

The major reproductive parameters used in the study were conception rate, farrowing rate and litter size, and the results obtained from the government and private pig breeding farms are presented in Table 1.

3.1 Conception rate

In the present study, an average conception rate of 77.01% was recorded including government and private pig breeding farms. Higher conception rate (88.9%) was reported in a commercial swine herd (Landrace multiparous sows) in Thailand by Chanapiwat et al. (2014) with fresh extended boar semen which was deposited directly into the uterine body. The variation in the conception rate could be due to the difference in site of semen deposition (intra-uterine method) since the site of semen deposition determines sperm survivability, conception rate and litter size (Ronald et al. 2013). It could also be due to the difference in environment and management practices. However, the conception rate observed in the current study was comparable to the findings of Reddy et al. (2017) who found the conception rate of 80% in a Large White Yorkshire crossbred sows in India.

The current study observed the conception rate of 81.25% in government farm and 71.79% in private pig breeding farms. The lower conception rate in private pig breeding farms could be due to incapability of piggery farmers to detect accurate standing heat and the difference in management practices, including feeding management. During the study, an average repeat cases of 22.97% was observed (18.75% in government and 28.20% in private pig breeding farms) (Figure 1). The higher repeat cases in the private pig breeding farms may be attributed to the limited knowledge and skills of the piggery farmers to precisely detect the heat signs in pigs for timely insemination.

3.2 Farrowing rate

On average, the farrowing rate of 67.81% (including both government and private pig breeding farms) was achieved during the study. The farrowing rate observed in the current study was less promising compared to 83.70% observed in European White crossbred sows by Nutthee and Tantasuparuk (2010) in Thailand, and 78.44% using Hampshire boars by Kadirvel et al. (2012) in India. The low farrowing rate in this study could be attributed to the difference in AI facilities, site of semen deposition, environment, management practices and difference in pig breeds used in the studies. Nevertheless, the farrowing rate observed in the current study was in line with the finding of Cane et al. (2019) who had also reported the farrowing rate of 71.44% in crossbred

Table 1: Average (±SD) reproductive performance in government and private pig breeding farms

Reproductive parameters	Govt. farm	Pvt. Farm	P value
Litter size (numbers)	8.76±3.52	8.96±3.99	0.836
Born Alive (numbers)	7.97±3.57	7.85±3.92	0.900
Stillbirth (numbers)	0.71±2.23	1.12±2.56	0.603

sows (Large White sow x Landrace boar) in Argentina. Though this study recorded higher conception rate in government farm (81.25%) than private pig breeding farms (71.79%), the farrowing rate in government farm (68.75%) and private pig breeding farms (66.66%) was almost equivalent. In the government farm, nine out of 48 pigs inseminated didn't conceive, and 11 out of 39 pigs inseminated in private pig breeding farms showed negative to pregnancy check. The pregnancy failure cases recorded were six in government and two in private pig breeding farms.

3.3 Litter size

A total of 522 numbers of piglets were born (government farm = 289 and private pig breeding farms = 233) from 67 pregnant pigs with an average litter size of 8.85±3.7 piglets at birth. The average litter size in the current study was comparatively lower than the findings of Kousenidis et al. (2022) and McBride et al. (2019) who reported average litter size of 13.77 and 13.4, respectively. The differences may be due to the difference in parity of sows, breed, and environment and management practices.

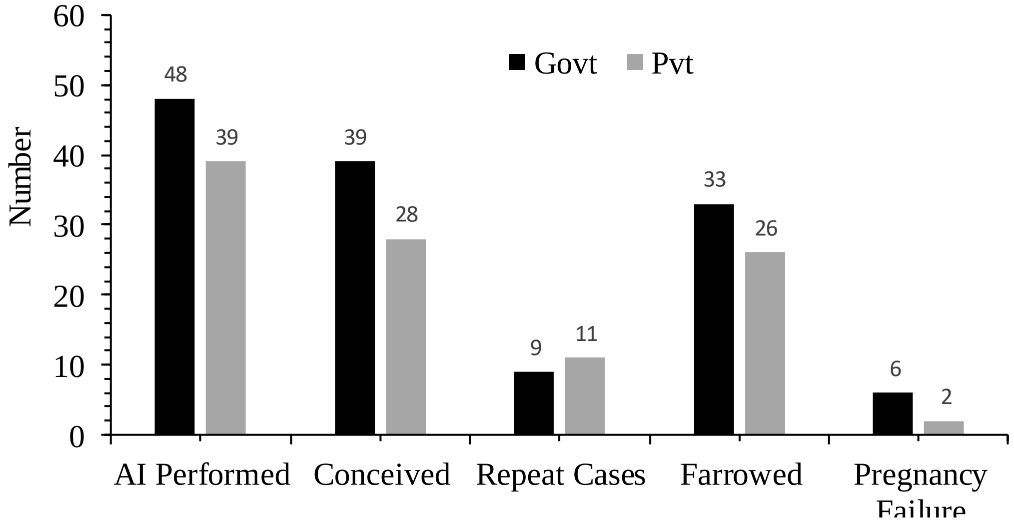

Figure 1: AI performance in government and private pig breeding farms

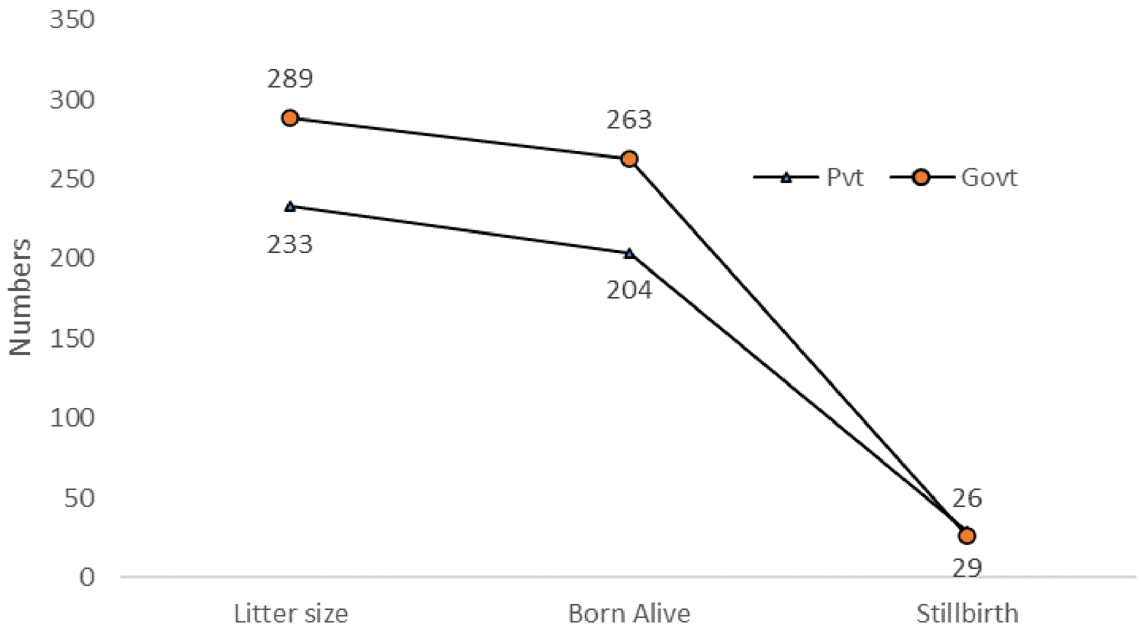

Figure 2: Share of piglets born in government and private pig breeding farms

The piglets born alive was 263 (46%) and 204 (44%) numbers in government and private pig breeding farms respectively (Figure 2). In this study, stillbirth rate of 10.53% was observed which could be due to the climatic conditions and due to improper blood supply to the foetus or space restriction in the uterus (Ronald et al. 2013). The number of piglets born dead at birth was 26 (4%) and 29 (6%) in government and private pig breeding farms respectively, and did not differ significantly (p=0.603).

As presented in Table 1, the average litter size in private pig breeding farms (8.96±3.99) was slightly higher than the government farm (8.76±3.52) with no significant difference (p=0.836). Similar observations were also found by Ronald et al. (2013), who had reported the mean litter size of 8.36±0.28 at birth in Large White pigs.

4. CONCLUSION & RECOMMENDATION

AI in pig is found promising with good performance records in terms of conception rate, farrowing rate and number of piglets born alive in both government and private pig breeding farms. The conception rate was better in government breeding farm than the private pig breeding farms. The present study concludes that AI in pig using extended semen of elite boar stored at 15ºC to 19ºC can be used to improve the pig herd and enhance piggery production in the country. However, for the success of AI in pig, farmers should possess good knowledge on heat detection, and pig in heat should be inseminated at right time. For this, the capacity development of piggery farmers in heat detection is necessary. Considering the growing trend of pig breeding farms in the country, the AI technology is expected to benefit the piggery farmers at large. Success of AI service is expected to reduce the cost of production of pig breeding farms, which in turn would help in reducing the cost of piglets, and ultimately result in producing cheaper local pork for consumers in Bhutan.

In order to ensure efficient AI service delivery, the study recommends undertaking the following interventions;

- ✓ Provide advocacy to the piggery farmers on AI technology and its benefits including heat detection
- ✓ Develop capacity of technical staff of pig farms on latest AI technologies
- ✓ Establish mini semen processing laboratory at the government breeding farms to provide AI services to interested farmers in the catchment areas
- ✓ Train interested youths on AI technology along with semen processing techniques following the Community Artificial Insemination Technician (CAIT) module of dairy.

ACKNOWLEDGMENTS

The authors would like to express our deepest appreciation and heartfelt gratitude to all the staff of the National Piggery Research and Development Centre, Gelephu and piggery farmers of Sarpang Dzongkhag for providing unconditional support for the study.

REFERENCES

Bamundaga GK, Natumanya R, Kugonza DR and Owiny DO. (2018). Reproductive Performance of Single and Double Artificial Insemination Protocol in Swine. Bull. Anim. Hlth. Prod. Afr, 66(April), 143–157.

Benjamin ED, Lali FA, Usha AP and Vishak CR. (2017). A Comparative Study On Conception Rate in Lwy Pigs by Artificial Insemination and Natural Service in Kerela. Journal of Indian Veterinary Association, 15(3):23–29.

Cane F, Pereyra N, Cane V, Patricia M and Teijeiro JM. (2019). Improved farrowing rate using intrauterine insemination in sows. Revista Mexicana De Ciencias Pecuarias, 10(3):583–594. https://doi.org/10.22319/rmcp.v10i3.4772

Chanapiwat P, Olanratmanee EO, Kaeoket K and Tummaruk P. (2014). Conception rate and litter size in multiparous sows after intrauterine insemination using frozen-thawed boar semen in a commercial swine herd in thailand. Journal of Veterinary Medical Science, 76(10):1347–1351. https://doi.org/10.1292/jvms.14-0069

Darwin R. (2007). Proper AI techniques and semen handling Swine. Veterinary Center St. Peter, MN. available at: http://www.nationalhogfarmer.com/genetics-reproduction/artificialinsemination/proper-ai-techniques.

Feitsma H. (2009). Artificial insemination in pigs , research and developments in The Netherlands , a review Inseminação artificial em suínos , pesquisa e desenvolvimento nos Países Baixos , uma revisão. Acta Scientiae Veterinariae, 37(Supl 1), 61–72.

Gerrits RJ, Lunney JK, Johnson LA, Pursel VG, Kraeling RR, Rohrer GA and Dobrinsky JR. (2005). Perspectives for artificial insemination and genomics to improve global swine populations. Theriogenology, 63(2 SPEC. ISS.), 283–299. https://doi.org/10.1016/j.theriogenology.2004.09.013

Ikani IE and Dafwang II. (1995). Pig Production Technology for Piggery Farmers. National Agricultural Extension and Research Liaison Services, Ahmadu Bello University, Zaria. Ext. Bull. 25(1):76.

Kadirvel G, Kumaresan A, Das A, Bujarbaruah KM, Venkatasubramanian V and Ngachan SV. (2012). Artificial insemination of pigs reared under smallholder production system in northeastern India: Success rate, genetic improvement, and monetary benefit. Tropical Animal Health and Production, 45(1):679–686. https://doi.org/10.1007/s11250-012-0277-z

Kousenidis K, Kirtsanis G, Karageorgiou E and Tsiokos D. (2022). Evaluation of a Numerical, Real-Time Ultrasound Imaging Model for the Prediction of Litter Size in Pregnant Sows, with Machine Learning. Animals, 12(15), 1–14. https://doi.org/10.3390/ani12151948

Langendijk P, Kemp B and Soede NM. (2005). Effects of boar contact and housing conditions on estrus expression in sows. Theriogenology, 63(2 SPEC. ISS.), 643–656. https://doi.org/10.1016/j.theriogenology.2004.09.038

Loanis E, Duguies M and Zaleski H. (2000). Best Practices for Artificial Insemination of Swine in the Pacific Islands. Manoa Honolulu:ADAP Project. July. www.adap.hawaii.edu/adap

Maes D, Lopez RA, Rijsselaere T, Vyt P and Van SA. (2011). Artificial Insemination in Pigs. Artificial Insemination in Farm Animals, May 2014. https://doi.org/10.5772/16592

McBride M, Amezcua R, Cassar G, O'Sullivan T and Friendship R. (2019). Combining fixed-time insemination and improved catheter design in an effort to improve swine reproduction efficiency. Animals, 9(10):1–7. https://doi.org/10.3390/ani9100748

Munyaneza C, Nyiramuhire V, Mubashankwaya I, Munyandamutsa F, Ndisanze O, Bagaragaza F and Mujyambere JMV. (2019). Factors influencing success of artificial insemination of pigs using extended fresh semen in rural smallholder pig farms of Rwanda. International Journal of Livestock Production, 10(4), 101–109. https://doi.org/10.5897/ijlp2018.0562

Nutthee A and Tantasuparuk W. (2010). Comparison of artificial insemination with natural mating on smallholder farms in Thailand , and the effects of boar stimulation and distance of semen delivery on sow reproductive performance. 921–924. https://doi.org/10.1007/s11250-009-9508-3

Reddy NV, Muralimohan K, Reddy KR, Latha C, Reddy KC, Sushma K and Raju G. (2017). Fertility results of Artificial

Insemination in swine performed with liquid boar semen stored at different temperatures: A comparative study. The Pharma Innovation Journal, 377(7), 377–379.
http://faostat.fao.org/site/291/default.aspx. ICAR

Ronald BSM, Jawahar TP, Gnanaraj PT and Sivakumar T. (2013). Artificial insemination in swine in an organized farm - A pilot study. Veterinary World, 6(9):651–654.
https://doi.org/10.14202/vetworld.2013.651-654

Sharma RP, Singh M, Sinha PK, Kumar B, Talli MR and Rajkhowa DJ. (2021). Understanding the intention to adopt artificial insemination technology in pig by tribal farmers. Indian Journal of Animal Sciences, 91(6):449–454.

Sterle J and Safranski T. (2018). Artificial Insemination in Swine: Breeding the Female. 1–4.

Vargas AJ, Bernardi ML, Bortolozzo FP, Mellagi APG and Wentz I. (2009). Factors associated with return to estrus in first service swine females. Preventive Veterinary Medicine, 89(1-2):75–80. https://doi.org/10.1016/j.prevetmed.2009.02.001

Vincent N, Kugonza DR and Hirwa CD. (2018). Success drivers of pig artificial insemination based on imported fresh semen. International Journal of Livestock Production, 9(6):102–107. https://doi.org/10.5897/ijlp2018.0467

Waberski D, Riesenbeck A, Schulze M, Weitze KF and Johnson L. (2019). Application of preserved boar semen for artificial insemination: Past, present and future challenges. Theriogenology, 137, 2–7.
https://doi.org/10.1016/j.theriogenology.2019.05.030