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Original article

Comparison of reproductive performance of Ongole cross and Ongole-Limousin cross in Bekri district, Central Lampung regency, Lampung province, Indonesia

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ABSTRACT

This study aims to compare the reproductive performance of the Ongole cross (PO) and Ongole-Limousin cross (Limpo) on smallholder farmer in Bekri district, Central Lampung regency, Lampung province, a Indonesia. This study used 30 PO cows, 30 Limpo F1 (first filial) cows and 30 Limpo F2 cows. Sample cows had at least two parities and had never had a history of reproductive disorders. This study used primary and secondary data related to sample cows. Primary data was obtained from interviews with farmers and secondary data was obtained from the Department of Plantations, Livestock and Fisheries of Central Lampung regency, and inseminator recording. Data were described descriptively and analyzed using a one-way Analysis of Variance in Statistical Product and Service Solution (SPSS) version 23. The result showed that the services per conception of Limpo F2 cows was higher ($p < 0.05$) than for PO and Limpo F1 cows. Days open and calving interval for Limpo cows (F1 and F2) were longer ($p < 0.05$) than for PO cows. Days open and calving interval for Limpo F1 cows were not significantly different ($p > 0.05$) than for Limpo F2 cows. Reproductive performance of PO cows was better compared to Limpo F1 and Limpo F2 cows. However, there was a data discrepancy between reproductive performance and data on rearing systems, feed quality, and signs of estrus observed by farmers. It could be concluded that PO cows had better reproductive performance than Limpo cows.

Keywords: calving interval, days open, estrus sign, rearing system, services per conception

INTRODUCTION

Beef cattle productivity was closely related to reproductive factors. Sustainability of production would not occur if cattle reproduction did not run as it should (Prastiya *et al.*, 2022). To increase cattle productivity, farmers in Indonesia had recently preferred Limousin-Peranakan Ongole (Limpo) cross cows over local cows (Peranakan Ongole, PO), because the productivity and reproductive performance of Limpo cows were better than PO

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cows (Agustine *et al*., 2019). Limpo cattle had a higher birth weight, and higher selling price for male calves than that of PO cattle (Putra *et al*., 2020). The assumption that the reproductive performance of cows Limpo was better than PO cows was questionable. Ardiyansyah *et al*., (2023) reported that the reproductive performance of PO cows was better than Limpo cross cows raised in the lowlands. It was further suggested that further studies were needed regarding the factors that influenced the differences in reproductive performance of PO and Limpo cows, including environmental factors and the zootechnical abilities of farmers.

One area that has a fairly large population of PO and Limpo cows is Bekri district, Central Lampung, Indonesia. Apart from Limpo F1 cows, farmers in Bekri district also raise Limpo F2 cows (the offspring of F1 resulted from insemination with frozen semen of Limousin bull). Limousin cows originated from the province of Limousin in central France which is a sub-tropical area. One of the characteristics of Limousin cows is that they have a comfort zone at sub-tropical temperatures and the availability of good feed (McIntosh *et al*., 2023). Meanwhile, Bekri district has a tropical climate and during the dry season, farmers have difficulty providing adequate feed. Hypothetically, Limpo cows would not be able to adapt well, resulting in a decrease in reproductive performance. This study aims to determine the comparison of reproductive performance of PO, Limpo F1, and Limpo F2 cows based on environmental factors and zootechnical capabilities of farmers in the Bekri district area. Reproductive performance could be used to calculate breeding cycle time of existing cattle so that it could be used to estimate future cattle populations (Riyanto *et al*., 2015). Reproductive performance could be measured using the parameters services per conception (S/C), days open (DO), and calving interval (CI) (Mutmainna *et al*., 2022).

MATERIALS AND METHODS

This study was conducted on smallholder farms in Bekri district, Central Lampung regency (Figure 1). This study was carried out from December 2021 to January 2022. Central Lampung regency is astronomically located between 104˚35'00"-105˚50'00" East longitude and 4˚'30'-4˚15' South latitude. Geographically, the height of the Bekri sub-district is 53 m above sea level. Tropical climate with a temperature range of 20-33°C, rainfall of 2,264-2,868 mm, number of rainy days of 90-176 days/year, and humidity of 81.06-87.08% (Central Statistics Agency, 2021).

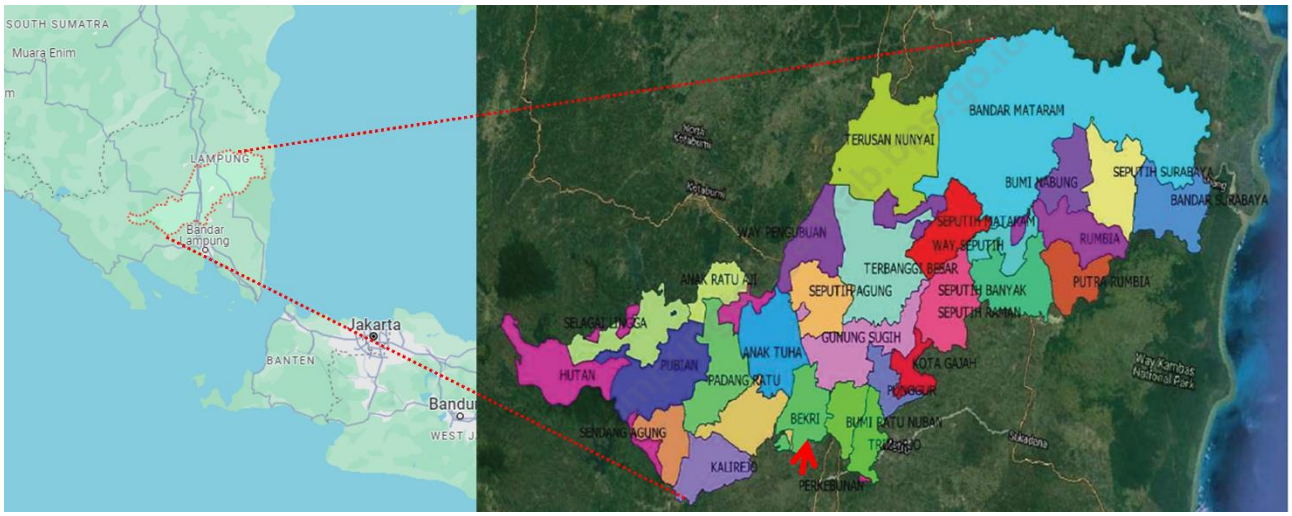

Figure 1 Research location, Bekri district, Central Lampung regency, Lampung province, Indonesia (red arrow) (Central Statistics Agency, 2021).

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Samples in this study were PO, Limpo F1, and Limpo F2 cows with the criteria of having at least two parities and no reproductive disorders. The number of samples for each was 30 cows which were determined by purposive sampling. After sample allocation, secondary data search and primary data collection were carried out. Primary data was obtained through questionnaires and interviews with farmers who owned the sample cows. The data collected was the farmer's identity, cow ownership, cow identity, cow rearing system, and farmer zootechnical (rearing system, provision of animal feed, and estrus detection) knowledge.

Secondary data was obtained from inseminator recording to determine S/C, DO, and CI of sample cows. S/C was the number of inseminations to produce pregnancy from several artificial inseminations. DO was the distance (days) between the time of parturition until the cow became pregnant again. CI was the time distance (days) from one calving to the next calving (Salman *et al*., 2021). Data were tabulated descriptively and analyzed using One-way Anova from SPSS version 23.

RESULTS

Services per conception of Limpo F2 cows was greater ($p < 0.05$) than for PO and Limpo F1 cows. Days open and calving interval for Limpo cows (F1 and F2) were longer ($p < 0.05$) than for PO cows. Days open and calving interval for Limpo F1 cows were not significantly different ($p > 0.05$) compared to Limpo F2 cows (Table 1).

Table 1 Reproductive performance of PO, Limpo F1, and Limpo F2 cows on smallholder farms in Bekri district, Central Lampung, Indonesia

	S/C (times)	DO (days)	CI (days)
PO	1.17 ± 0.38 [a]	124.63 ± 20.45 [a]	407.20 ± 20.90 [a]
Limpo F1	1.33 ± 0.48 [a]	141.40 ± 26.59 [b]	424.27 ± 26.55 [b]
Limpo F2	2.17 ± 0.65 [b]	152.87 ± 22.78 [b]	435.40 ± 21.85 [b]

S/C: services per conception; DO: days open; CI: calving interval; PO: Peranakan Ongole (Ongole cross); different superscripts in the same column indicate real differences ($p < 0.05$).

Cattle rearing system

Sixty-three percent (19/30) of the PO sample cows were reared intensively and 37% (11/30) were reared semi-intensively. Of the Limpo F1 cows, 80% (24/30) were reared intensively and 20% (6/30) were reared semi-intensively, while 100% (30/30) of Limpo F2 cows were reared intensively (Figure 2).

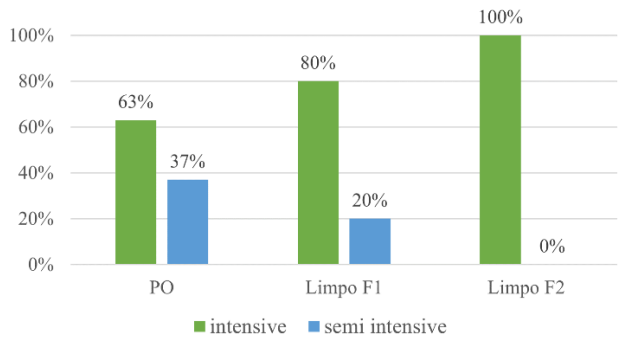

Figure 2 Beef cow rearing system on smallholder farms in Bekri district, Central Lampung, Indonesia

Type of feed

The feed given to PO cow samples was forage (70%, 21/30), forage and concentrate (20%, 6/30), and forage and hay (10%, 3/30). Of the Limpo F1 cows, 60% (18/30) were fed forage, and 40% (12/30) were fed forage and concentrate. The Limpo F2 cows, 63% (19/30) were fed forage and 37% (11/30) were fed forage and concentrate. Limpo F1 and F2 cows were not given forage and hay (Figure 3).

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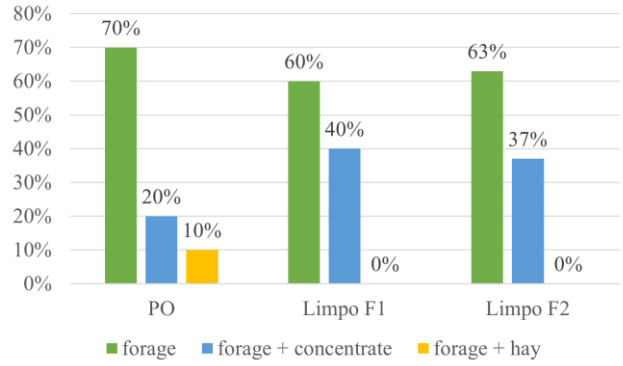

Figure 3 Types of feed given to cows on smallholder farms in Bekri district, Central Lampung, Indonesia

Signs of estrus

Figure 4 shows the signs of estrus detected in sample cows. As many as 23% (7/30) of PO cows showed signs of estrus in the form of a reddened, swollen, warmer vulva (estrus sign A), 40% (12/30) showed signs of viscous clear mucus coming out of the vulva, bellowing, riding and standing to be mounted by another cow (estrus sign B), and 37% (11/30) showed all signs (estrus sign A + B). In Limpo F1 cows, 10% (3/30) showed estrus sign A, 30% (9/10) showed estrus sign B, and 60% (18/30) showed both, estrus sign A and B. In Limpo F2 cows, 23% (7/30) showed estrus sign A, 14% (4/30) showed estrus sign B, and 63% (19/30) showed all estrus signs A and B.

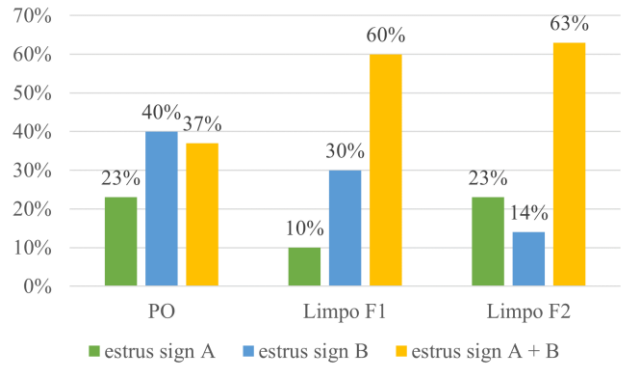

Figure 4 Signs of estrus detected in sample cows on smallholder farms in Bekri district, Central Lampung, Indonesia; estrus sign A: reddened, swollen, and warmer vulva; estrus sign B: thick mucus discharge from the vulva, bellowing, riding, and standing to be mounted by another cow.

DISCUSSION

The sustainability, profit, and productivity of every cattle farming business were determined by reproductive performance (Widyas *et al*., 2022). Reproductive performance was influenced by the geography of where cattle were kept in terms of temperature, climate, and weather. Cattle originating from sub-tropical areas often experienced reduced reproductive performance when kept in tropical areas (Cooke *et al*, 2020). The research location is in the lowland (53 m above sea level) with flat topography, and a combination of wet and dry land. Secondary study data obtained showed that the temperature in Bekri district ranged between 28-33°C with humidity 81-87%. The comfort zone for sub-tropical cows ranged between 13-25°C and for tropical cows ranged between 22-30°C (Aryogi and Adinata, 2015).

Services per conception

The S/C value was determined by the number of artificial inseminations that resulted in pregnancy (Ulfah *et al*., 2022). The normal S/C for cows in Indonesia ranged between 1.6-2.0. The lower the S/C value meant the higher the cow's fertility (Mutmainna *et al*., 2022). The S/C for PO cows (1.17 ± 0.38) and Limpo F1 (1.33 ± 0.47) on smallholder farms in Bekri district was classified as good because it was lower than the normal S/C value range. S/C in Limpo F2 (2.17 ± 0.64) was not good because it was higher than normal S/C. The S/C value of PO cows in Bekri district was better than the results of several studies in different areas i.e. 1.5 (Iskandar and Faisal 2011), 1.42 (Ihsan and Wahjuningsih, 2011), and 1.24 (Kristahun *et al*., 2020). Likewise, the S/C value of Limpo cows for both F1 and F2 in Bekri district, was much better than the results of a study conducted by Nasuha *et al*. (2019) in Tuban Regency (2.60 ± 0.8).

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The success of artificial insemination in producing pregnancy in cows was influenced by several interrelated factors, including the farmer, inseminator, frozen semen, and the physiology of the recipient cows (Mastuti *et al*., 2023). In this study, based on estrus detection reports by farmers, inseminators could determine the right time to inseminate the estrus cows. The quality of the semen and the inseminators' skills in handling frozen semen and performing artificial insemination were important factors (Lieberman *et al*., 2016). Furthermore, fertilization to produce pregnancy occured when the reproductive physiological conditions of a healthy estrus cows resulted ovulation which coincided with the presence of fertile spermatoza in the oviduct (Oliver and Basit, 2023). Frozen semen in Indonesia was produced by government-owned artificial insemination centers which guarantee the quality according to Indonesian National Standards. The Indonesian National Standard for frozen bovine semen (SNI 4869.1.2017) states that bovine frozen semen has a minimum motility standard of 40%, minimum individual movement (++), and a minimum concentration of 25 million spermatozoa/0.25 mL. Inseminators as field implementers of artificial insemination in cows are personnel who are trained and certified to maintain frozen semen according to standard operating procedures and carry out artificial insemination on estrus cows at the right time (INSA, 2021).

In this study, the S/C value of Limpo F2 cows (2.17 ± 0.648) was worse than that of PO cows (1.17 ± 0.379) and Limpo F1 cows (1.33 ± 0.479). Based on the rearing system, some PO and Limpo F1 cows were still reared semi-intensively (37 and 20%), while all Limpo F2 cows were reared intensively. In intensive rearing, livestock were reared continuously in cages until they were harvested, so cages were a necessity. All the cows' needs were supplied by the farmers, including feed and drink. In semi-intensive system, cows had the chance of grazing and also caged with feed provided by the farmers, or a combination of extensive and intensive systems. In intensive rearing, the farmer's interaction with the cows was more frequent, so the observation of estrus should be better than in semi-intensive rearing (Sulfiar *et al*., 2022). The best signs of estrus that resulted in pregnancy after insemination must be comprehensive, including redness, visible swelling and warmth on the vulva, mucus discharge, bellowing, mounting, and standing to be ridden by another cow (Ramadhana *et al*., 2022). In this study, complete signs of estrus were observed in 60% of Limpo F1 cows and 63% of Limpo F2 cows, whereas in PO cows only 37%. There was no correspondence between the poor S/C of Limpo F2 cows and the intensive rearing system and there were complete signs of estrus compared to PO cows and Limpo F1 cows.

Days open

The DO value from this study was not ideal. Normal DO values ranged between 60-90 days and were classified as normal if they were not more than 120 days (Ananda *et al*., 2019). The best time to inseminate cows was 60 days after parturition, because it took at least 50-60 days for cows to achieve complete uterine involution after parturition (Braga Paiano *et al*., 2019). The DO value of PO cows in this study was better than those in the study conducted by Ihsan and Wahjuningsih (2011) (130.27 ± 27 and 149 ± 24.19 days) in Malang Regency. However, the DO of PO cows in this study was not as good as in the study conducted by Fauziah *et al*. (2016) (115 ± 15 and 117 ± 15 days). DO in Limpo cows in this study was better than in research conducted in other areas (172.9 ± 19.21 days) (Fauziah *et al*., 2016).

In this study, the DO of PO cows was shorter than that of Limpo F1 and Limpo F2 cows. DO in cows was influenced by reproductive health, weaning, and nutrition (Temesgen *et al*., 2022). In this study, all sample cows had normal estrus cycles and did not experience reproductive disorders. Calves that were always kept with their dams so that they were weaned late resulted in longer DOs. During breastfeeding, the dams produced the hormone prolactin. High prolactin levels

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inhibited the release of GnRH which is needed for FSH and LH secretion, so that follicle growth was disrupted (Xavier *et al*., 2018). Based on the rearing system, 37% of PO cows and 20% of Limpo F1 cows were reared semi-intensively. Meanwhile, all Limpo F2 cows were reared intensively. In intensive rearing, calves were usually weaned immediately, thereby, the dams would immediately come into estrus again, resulting in short DO (Pugliese *et al*., 2021). Meanwhile, for cows that were grazed (in a semi-intensive rearing system), the calves always followed their mother in the pasture, so the DO should be longer (Iyai *et al*., 2020; Abidin *et al*., 2023). The quality of feed given to Limpo cows was also better than PO cows. In Limpo F1 cows, 60% were given forage only and the remaining 40% were given forage and concentrate. In Limpo F2 cows, 63% were given forage only and the remaining 37% were given forage and concentrate. Limpo cows were not given low-quality feed (grass and hay). Meanwhile, the majority of PO cows (70%) were only fed grass, 20% were fed grass and concentrate, and even 10% received poor feed intake (grass and hay). Thus, the intensive rearing system and better feeding of Limpo cows (F1 and F2) in this study were not in sync with DO values that are worse (longer) than for PO cows.

Calving interval

The calving interval for PO, Limpo F1, and Limpo F2 cows in this study was not ideal, because it was more than one year. A good calving interval was 12 months or 365 days, which included nine months of pregnancy and three months to get pregnant again (Temesgen *et al*., 2022). The CI value in this study was better than in other studies on PO cows in Malang regency, i.e. 414.97 ± 25.53 days (Nuryadi and Wahjuningsih, 2012) and 372.5 ± 36.46 days (Hamzah and Esti, 2020). The calving interval for Limpo cows (F1 and F2) were longer than for PO cows. The CI value was determined by the DO and S/C values. If the DO and S/C values exceeded normal limits, the CI would be long (Salman *et al*., 2021). The rearing system (intensive vs semi-intensive), estrus detection (complete, incomplete), and feed quality (grass, concentrate, hay) could not explain why the S/C value of Limpo F2 cows was worse than that of PO and Limpo F1 cows.

Limpo F1 cows were the first offspring resulting from a cross between Limousin cows and Ongole cross, which means they have a proportion of genetic trait of 50% Limousin and 50% Ongole cross (Trifena *et al*., 2011). Ongole cross could still adapt well to the environment in Bekri district. However, the S/C value in Limpo F2 cows had a much higher difference compared to PO and Limpo F1 cows, even though it was close to normal S/C values, this was because the proportion of Limpo F2 genetic traits was 75% Limousin and 25% Ongole cross (Trifena *et al*., 2011), so that Limousin traits was more prominent so that they were less well adapted to the study locations with high temperature and humidity and increased S/C. Therefore, it is necessary to carry out further studies regarding the genetic traits of Limpo cows, especially to study the dynamics of follicular and endocrine wave growth to determine the possibility of delayed ovulation. Delayed ovulation in cows after estrus reduced the chances of successful fertilization (Endo *et al*., 2022). Even though the inseminator (based on his experience) had carried out artificial insemination immediately based on the time when signs of estrus appeared, when the spermatozoa had arrived at the fertilization site, the ovum was not yet ready (ovulation had not occurred). The lifespan of post-thawed spermatozoa in the oviduct of estrus cows ranged 12-24 hours (López-Gatius, 2022). So, if ovulation occurred after the spermatozoa died, then fertilization did not occur. Likewise, the rearing system, estrus detection, and feed quality could not explain why the DO value in Limpo F1 and Limpo F2 cows was worse than in PO cows. It was necessary to study the post-partum and endocrine conditions of the uterus environment which were related to post partum estrus.

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CONCLUSION

From the study results, it could be concluded that Ongole cross cows had better reproductive performance compared to Limpo cows for both F1 and F2, based on services per conception, days open, and calving interval. The reproductive performance in this study might not be related to the rearing system, feeding and estrus detection competence of farmers.

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AUTHOR'S CONTRIBUTIONS

Puspa Permata Sukma (PPS), Ira Sari Yudaniayanti (ISY), Pudji Srianto (PS), Sri Pantja Madyawati (SPM), Sri Mulyati (SM), Abdullah Hasib (AH).

PPS and ISY: conceived the idea, designed the mainframe of this manuscript, PPS: acquired, the analysis and interpretation of data, PPS and SM: manuscript drafting. PS, SPM, and AH: critically read and revised the manuscript for intellectual content. All authors read and approved the final manuscript.

CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

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