Research Article

Reproductive Potential of Bali Cows Raised under Palm Oil Plantation in Manokwari Regency, West Papua, Indonesia

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Abstract | One of the countries that conducted an integration between cattle and palm oil plantations is Indonesia. The objective of this study was to characterize the reproductive potential of Bali cows kept under palm oil fields after the application of artificial insemination (AI). This study was designed as field research that involved farmers and Bali cows reared under palm oil plantations. A total of 71 heads of Bali cows that have been calving for two consecutive times were used in the present study. The parameters measured were services per conception, length of pregnancy, the interval from calving to the first AI, the interval from calving to conception, and the calving interval. The results of this study showed that the number of services per conception (±SD) at first pregnancy of Bali cows reared under palm oil field had significantly ($p<0.01$) lower than services per conception at second pregnancy (1.5±0.6 vs. 1.9±0.9) at the average of 1.45±0.58. After the first pregnancy, the average interval from calving to first AI, the interval from calving to conception, and the calving interval were 68.6±39.9 days, 90.6±37.9 days, and 363.8±38.7 days, respectively. The length of pregnancy at first and second calving were 280.1±3.7 and 279.3±4.7 ($p>0.05$), respectively. It can be concluded that Bali cows raised under palm oil plantations have a good reproductive potential.

Keywords | Bali cattle, Reproductive potential, Palm oil field, Reproductive performance, Calving interval

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INTRODUCTION

Beef cattle production is a concern for many producers all over the world. In developing countries such as Indonesia, in which smallholder farms at the most in the regions, the related institution of livestock services are working for the development of beef cattle production. As part of beef cattle production, requirements of feeding as energy intake of the cattle are the concern to develop the production. Requirements of energy intake for beef cattle production is one of the problems faced by the producers. This energy intake factor influences the productivity of the beef cattle production system (López-González et al., 2020). To solve this problem, palm oil land is one of the chosen to meet the requirements of nutrition for feeding the cattle as well.

An integration of cattle and palm oil plantations had many been conducted in many countries and one of the countries is Indonesia. One of the locations as an example

of this integration in Indonesia is Manokwari Regency, West Papua. This integration is an effort that is intended to raise the cattle to achieve high efficiency in using land, whereas the cattle can take advantage of grazing (Ayob and Kabul, 2009). The utilization of palm oil fields for raising cattle due to the demand for beef in this region is relatively higher than the supply. A high rate of slaughtering cattle has the impact of decreasing the population of cattle. Furthermore, the Livestock Statistic Book of West Papua Province (2019) recorded that the population of cattle in this area is fluctuated year by year and it was likely to decrease. For example, in 2017 the population of cattle in this region was 67,706 and it decreased to 50,991 in 2018. Therefore, one effort to maintain the development of beef cattle is to raise them in the palm oil field.

The advantage of raising cattle in palm oil fields has been smoothly described by Grinnell et al. (2022), in which that the integration could be a solution to mitigate environmental impacts by reducing deforestation, increasing beef cattle production by grazing the land, and reducing the use of herbicide due to the cattle graze the weeds over the land. In palm oil land, cattle are raised with a poor management production system, including reproductive management. Consequently, the reproductive performance of cows could not be as high as cows with better reproductive management. Although the cattle are raised under the palm oil plantation, however, with better reproductive management, there is a possibility to achieve better reproductive performance. For this purpose, proper and concern in detecting estrous by the farmers and application of artificial insemination (AI) to the cows may improve their reproductive performance.

Estrous detection is a factor for a determinant of pregnancy in cattle. The importance of estrous occurrence at AI may be as a tool that can be used in identifying the probability of the cows becoming pregnant (Sá Filho et al., 2011). Furthermore, they stated that estrous occurrence is an important factor related to follicle development. Concurrently, cows detected in estrous with a proper application of AI would increase the conception rate as well as improve reproductive performance. For that reason, it is hypothesized that some cows that are raised in the palm oil field had good reproductive performance after better management. To our knowledge, this is the first to report the reproductive potential of Bali cows raised under palm oil plantations. Therefore, the objective of this study was to characterize the reproductive potential of Bali cows kept under palm oil plantation after applying proper estrous detection and artificial insemination.

MATERIALS AND METHODS

Animal and management

This study was designed as field research that involved farmers and Bali cows reared under palm oil plantations. The present study was conducted in the Districts of Manokwari Regency, West Papua Province, Indonesia, in which this area has palm oil plantations. A total of 71 Bali cows were purposively chosen in the present study. The cows that have calved twice consecutively, particularly at the first and second calving were randomly selected from the recording book of the AI technician. The cows were reared by the farmers on a smallholder scale and controlled by AI technicians (inseminator) and Livestock and Animal Health Services staff. All cows in the study were kept under the palm oil plantation, which is known as integration between cattle and palm oil land. Under the palm oil plantation, natural grasses are growing and it is used by the farmers to let their animals for whole-day grazing.

Estrous detection and artificial insemination (AI)

Detection of estrous of the cows was performed visually by the farmers, in which the most signs of estrus detected were mounted the other or standing to be mounted. There was no estrous detection aid was used for the cows in this management. Once the cow is in estrous, the farmer informed the inseminator for performing AI using the recto-vaginal method. For those cows detected in estrous in the morning, AI was conducted in the afternoon, whereas those cows detected in estrous in the afternoon, AI was conducted in the morning (AM/PM rule).

Data collection and definition of reproductive parameters

The following data were collected from each cow with the help of three AI technicians such as farmers (owner of the Bali cows), location, date of estrous, date of AI, number of AI for each cow, and date of calving. Likewise, information regarding the diagnosis of pregnancy and the cows that become pregnant was obtained from each AI technician.

The following reproductive parameters were used to characterize reproductive performance (Yusuf et al., 2010):

- Services per conception: number of artificial in semination per pregnancy;
- Length of pregnancy: number of days during pregnancy;
- Calving to first AI interval: number of days from calving to first artificial insemination performed;
- Calving to conception interval: number of days from calving to conception; and
- Calving interval: number of days from first calving to subsequent second calving.

Statistical analyses

All data obtained in this study were tabulated using Microsoft Excel Program for Windows. Data on

reproductive performance are presented as average and standard deviation (SD). The Excel Program was also used to obtain the average and SD of services per conception, calving to first AI interval, calving to conception interval, length of pregnancy, and calving interval. Differences of services per conception between first and second pregnancies as well as the length of pregnancy between first and second calving were compared by t-Test; two-sample assuming equal variances. Power trend line equation and R-squared of calving to first AI interval after first calving, linear regression for obtaining formulation of calving interval, and all figures were calculated and constructed using Microsoft Excel Program for Windows.

RESULTS AND DISCUSSION

Reproductive performance of Bali cows after first and second pregnancy

The reproductive performance of selected Bali cows raised under palm oil plantation as an integration between cattle and palm oil is shown in Table 1. In the present study, we purposively selected the cows that have better reproductive performance under cooperation with AI technicians. For this purpose, three AI technicians were involved in the study for collecting data.

The average number of services per conception (±SD) for all Bali cows both first and second calving was 1.45±0.58. There was no significant difference the number of services per conception of Bali cows among the three AI technicians (P= 0.280). The number of services per conception at the first pregnancy of Bali cows raised under palm oil plantation had significantly ($p<0.01$) lower than services per conception at the second pregnancy (1.5±0.6 vs. 1.9±0.9) (Table 1). This suggests that Bali cows need more inseminations for subsequent pregnancy than Bali heifers. More inseminations for a pregnancy in a cow resulted in low reproductive performance. The causes of more inseminations per pregnancy are multi factors. Yusuf et al. (2010) have reported that repeat breeding cows are one of the factors increased the likelihood to become pregnant. While repeat breeders are affected by several factors such as asynchrony of detecting estrous and timing of insemination (Pursley et al., 1998), the quality of semen, a technique of insemination (Morrell, 2006), and embryonic death (Villarroel et al., 2004). However, in the present study in which that the most signs of estrous observed were mounting the other or mounted by the other, allowed to inseminate at the proper time. The success of insemination of the cow is depending upon how to fulfill all the requirements to become pregnant and maintain it until calving.

After the first pregnancy, the average interval from calving to first AI, the interval from calving to conception, and the calving interval were 68.6±39.9 days, 90.6±37.9 days, and 363.8±38.7 days, respectively. This indicated that some cows that are raised in palm oil plantations have the potential to get pregnant and calf every year. This implies that under a better management production system, the cows would be able to produce offspring as well. However, several factors may limit the cows to become pregnant such as the occurrence of reproductive disorders (Affandhy et al., 2021), although with a better production management system. Consequently, this may affect both calvings to first AI and calving to conception intervals.

The length of pregnancy at first and second calving were 280.1±3.7 days and 279.3±4.7 days, respectively (Table 1). There was no significant difference (P= 0.290) in the length of pregnancies between the first and the second calving. However, cows that calved for the second time had gestation lengths slightly longer 0.8 days in comparison to the cows that calved for the first time. This finding is in line with the previous study using Holstein Friesian cows (Nogalski and Piwczynski, 2012). A previous study by Nienartowicz-Zdrojewska et al. (2018) showed that the average gestation length for different breeds of cows was 282 days, slightly longer than the result of this study. This is probably caused by the size of the Bali cows used in the present study being smaller than the cows used in the study mentioned above. Andersen and Plum (1965)

Table 1: Reproductive performance of selected Bali cows after first and second pregnancy.

Item	Average	±SD	Range	Confidence level 95%
No. of cows observed (n)	71	-	-	-
Services per conception at first pregnancy	1.5	0.6	1 - 3	0.14
Length of pregnancy at first calving (d)	280.1	3.7	269 - 290	0.89
The interval from calving to first AI (d)	68.6	39.9	23 - 238	9.46
Services per conception at second pregnancy	1.9	0.9	1 - 4	0.20
The interval from calving to conception (d)	90.6	37.9	51 - 262	10.24
Length of pregnancy at second calving (d)	279.3	4.7	270 - 290	1.17
Calving interval (d)	363.8	38.7	310 - 539	9.52

SD: Standard deviation; AI: Artificial insemination; d: Days.

have reviewed for a long time ago that gestation length in cattle greatly varies among breeds. Afterward, many studies have been made for the reasons of different; both prolonged and shortened gestation lengths in cattle as well as optimum gestation length.

The importance of optimum gestation length is needed for the cow for subsequent calving. During parturition, it is necessary a cow in a comfortable condition. Cows with proper timing and condition at calving and without any postpartum reproductive disorder, it would be able to resume their ovarian activity as optimum as possible. In this case, a cow may have shortened intervals from calving to the first AI and conceive within a short time.

The interval from calving to first AI and conception for pregnant Bali cows after first calving

The interval from calving to the first AI concerning the percentile of Bali cows is shown in Figure 1. Figure 1shows that the interval from calving to the first AI ranged from 23 to 238 days post-calving. The trend of the interval from calving to the first AI for 71 Bali cows followed the formulation of $y = 19.566x^{0.3138}$ with $R^2 = 0.637$. This formulation suggests that for every single addition of the percentile of Bali cows, the interval from calving to the first AI increases for 1.51 days. The interval from calving (first calving) to a conception of Bali cows reared under a palm oil plantation is shown in Figure 2. A total of 55% of Bali cows were pregnant within 60 days after calving and it was increased to 86% within 85 days after calving. Accumulatively up to 115 days after calving, there was 94% became pregnant and the remaining 6% of Bali cows got pregnant between 116 to 150 days after calving. This suggests that although the cows were managed well, several disorders might be occurred to limit the Bali cows to become pregnant.

Shortened calving to the first AI interval in cows may shorten the interval from calving to conception. Cows that are inseminated earlier after calving as well as after recovery of uterine involution have a chance to become pregnant as early as possible. Therefore, the factors that may limit the interval from calving to conception must be paid attention.

Several factors affect the interval from calving to conception. For instance, a study by Temesgen et al. (2022) stated that calving to insemination interval, a season of insemination, and the breeding system had significant factors that affect calving to conception interval in dairy cattle. However, the causes of the prolonged interval from calving to conception are multifactor including factors management and cow (Yusuf et al., 2012).

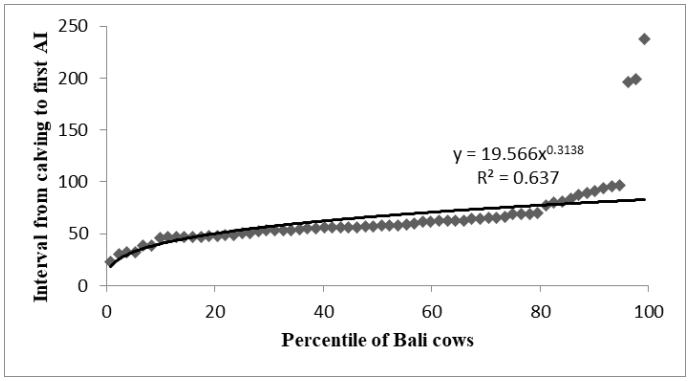

Figure 1: Interval from calving to the first AI of Bali cows after first calving.

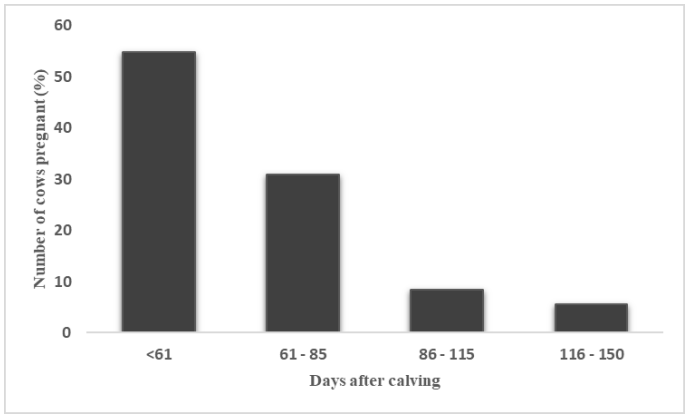

Figure 2: Interval from calving to conception for pregnant Bali cows after first calving.

Calving interval of the Bali cows raised under palm oil plantation

In the present study, our concern was to find the potential reproductive performance of Bali cattle raised under palm oil plantations. This becomes important due to one of the most important economic traits in beef production is reproductive performance (Hassan et al., 2020). The average calving interval for two consecutive calvings (first and second calving) of Bali cows was 363.8 ± 38.7 days; ranging from 310 to 539 days (Figure 3). Figure 3 also shows the trend line of Bali cows' calving interval following the linear regression formulation was $y = 1.7063x + 306.63$ with $R^2 = 0.7153$. This indicated that for every single addition of cow, the calving interval increased by 1.7063 days. Specifically, if the calving interval is grouped into four as shown in Figure 4, there was 50% of Bali cows had a calving interval within 360 days. The remaining 38%, 8%, and 5% had calving intervals of 361-390 days, 391 – 420 days, and greater than 420 days, respectively.

In the present study, the average calving interval of Bali cows raised under palm oil plantations was 363.8 ± 38.7 (Table 1), shorter by about 21 days than reported by Said et al. (2020). This difference was due to that this study was conducted purposively on the Bali cows under the surveillance of AI technicians as well as the staff of

Livestock Services in the region. Consequently, only Bali cows with better attention from the farmers were involved in the study as our objective was to screen the reproductive potential of this animal. Several factors affect the length of the calving interval; including the breed of the cows. A study of Samkange et al. (2019) demonstrated that Nguni cows had calving intervals significantly shorter than those of Afrikaner and Simmental cows. Besides the breed factor of the cows, general factors derive from genetics and environment might be the most affecting calving interval individually. A study by Werth et al. (1996) also have shown that year and parity had an interaction on calving interval. Furthermore, they also stated the low repeatability of the calving interval.

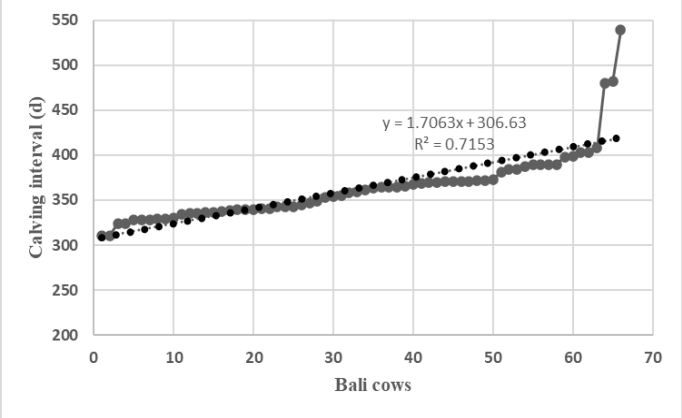

Figure 3: Calving interval of Bali cows between first and second calving.

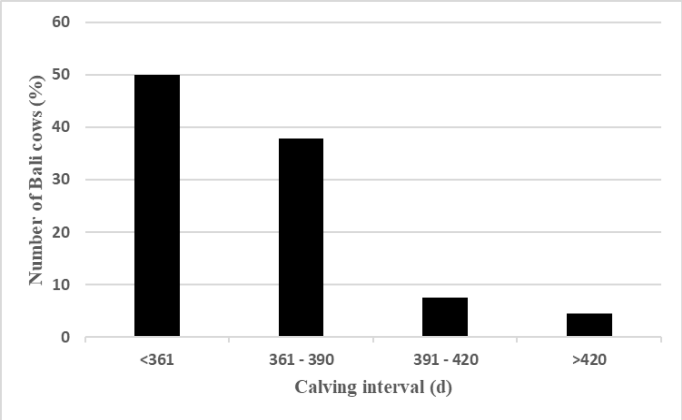

Figure 4: Calving interval of Bali cows at different groups.

CONCLUSIONS AND RECOMMENDATIONS

It can be concluded that Bali cows raised under palm oil plantations have a good reproductive potential. This implies that under better reproductive management, especially in detecting estrous by the farmers in cooperation with AI technicians, the reproductive performance of Bali cows raised under palm oil plantation could be maximized and achieved their reproductive potential.

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NOVELTY STATEMENT

To our knowledge, this is first to report the reproductive potential of Bali cows for future development, especially raised under palm oil plantation.

AUTHOR'S CONTRIBUTION

HF has contributed to the study design, collecting and analyzing of data, and writing the manuscript. ALT, MY, and HS have contributed to analyzing of data, reviewing, and writing the manuscript.

Conflict of interest

The authors have declared no conflict of interest.

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