Reproductive management and performances of Bali cow kept by smallholder farmers level with different production systems in South Konawe Regency, Indonesia

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Abstract. This research aims to determine Bali cows' reproductive management and performances, kept by smallholder farmers with intensive and semi-intensive production systems in South Konawe Regency. A total of 55 farmers and 110 Bali cows was interviewed and observed. The data was captured consists of farmers' characteristics, reproductive management, and reproductive performances. An independent sample t-test analyzed the data. The farmers with intensive and semi-intensive production systems could detect the estrus well (69.57 and 59.09%) and mated by artificial insemination (AI) (70.83 and 86.11%). There was a significant difference (P <0.05) related to the first estrus age (1.98±0.82 vs. 1.92±0.18 years), the first mating age (2.84±0.23 vs. 2.77±0.34 years), service per conception with natural mating and AI (1.00±0.00 vs. 1.20±0.42 and 1.70±0.76 vs. 1.44±0.57 times). There were no significant differences in the first calving age, gestation length, postpartum estrus, postpartum mating, weaning age, calving interval, and cow reproduction index. The pre-weaning mortality and calf crops were 6.25 and 9.68%; 76.79 and 71.70%. To conclude our findings, the farmers in South Konawe Regency carry out reproductive management well. Bali cows' reproductive performance with an intensive system is better than the semi-intensive system based on the calf crop.

1. Introduction

South Konawe Regency has the most significant beef cattle population in Southeast Sulawesi Province, with 69,907 heads [1]. Generally, beef cattle in South Konawe are managed extensively by a grazing system in a natural grassland. The most significant population was Bali cattle [2,3]. Bali cattle production in South Konawe was kept by smallholder farmers and integrated with rice plantation and various crops [2]. The South Konawe Regency farmers were applied semi-intensive and intensive production systems in beef cattle farming due to decreasing grassland [4]. According to Saili [2], Bali cattle production systems in South Konawe were generally still in extensive systems but currently changing to the semi-intensive, even in the intensive system.

The semi-intensive and intensive production systems of beef cattle have different purposes. The semi-intensive system set up farmers to produce a calf and was practiced by releasing cattle on grassland during the day, housed and fed in the night. The intensive system was practiced by housing the cattle. Farmers provided the feed and water. Most farmers have an objective to produce a calf and fattened
their cattle. The difference in cattle production systems outcomes in different products and it will have a significant influence on the farmers' revenue [5].

Reproductive efficiency was an important determinant of profitability, regardless of the production system [6]. The reproductive performance of cows was highly dependent on the reproductive management applied by farmers. The leading causes of low fertility and reproductive efficiency were poor management, especially during pregnancy, calving, lactation, and weaning. Therefore, the farmers should be optimized their reproductive management for the cows [7]. Genetically, Bali cattle have advantages to adapt to environmental conditions, poor feed conditions, and parasitic diseases. However, management was applied by farmers' consequences on cows' reproduction. Therefore, this research aims to determine Bali cows' reproductive management and performances, kept by smallholder farmers with intensive and semi-intensive production systems in South Konawe Regency.

2. Materials and methods
The research was carried out from July to December 2019. A total of 55 farmers and 110 heads of their Bali cows was interviewed and observed. The samples consist of 23 farmers and 48 Bali cows with intensive production systems and 32 farmers and 62 Bali cows with semi-intensive production systems. The research located in Konda and West Ranomeeto District, South Konawe Regency based production system and condition. Depended on [1] and information from the Department of Animal Husbandry and Health of South Konawe Regency, Konda and West Ranomeeto district had represented the intensive and semi-intensive production systems. Data were compiled running a participatory rural appraisal (PRA) method to search farmers' characteristics, reproductive management, and performances. The farmers were interviewed using a semi-structured questionnaire, while the cows were observed and recorded for their reproductive performances. The cows and their recording were regularly visited during the research.

The farmers’ characteristics consisted of farmers’ age, farmers’ educational background, farmers' experience on keeping cows, experience on training attended by the farmers, the main objectives of keeping cows, and the cows' ownership. The farmers' reproductive management consisted of the age of first mating, the farmers' ability to detect the estrus sign, a mating method applied by the farmers, weaning age, and postpartum mating. The collected data of reproductive performance consisted of the age of first estrus and calving, postpartum estrus, estrus cycle, service per conception (S/C), gestation length, calving intervals, calf crop, and cow reproduction index (CRI). An independent sample t-test analyzed the significant differences (P <0.05) amongst the production system. The equation for calculating the calf crop and cows reproduction index (CRI) [8] following by:

Calf crop (%) = \( \frac{\sum_{cow} calf\ birth - \sum_{cow} calf\ mortality}{\sum_{cow}} \times \frac{12}{calving\ interval\ (months)} \times 100\% \) (1)

CRI (heads/year) = \( \frac{\sum_{cow} calf\ birth - \sum_{cow} calf\ mortality}{\sum_{cow}} \times \frac{12}{calving\ interval\ (months)} \) (2)

3. Results and discussion
3.1. Farmers characteristics
Bali cows farmers' characteristics with intensive and semi-intensive production systems in South Konawe Regency were showed in Table 1.

Most farmers in intensive and semi-intensive production systems were maturely aged above 30 years old. The farmers' age factor had an essential impact on the farmers' practical and management toward their cows. A farmer's productivity increases with age, reach some mid-age peak and decrease with further age. The farmers' age would physically affect doing work and making decisions about running a livestock business. The experience was related to age, in which older farmers usually had more experience than young farmers. Cattle farming experience was crucial in developing livestock farming management to raise livestock production [9,10]. The farmers have experience keeping their cows for
more than ten years. The cattle farming experience of the farmers passed down by the previous generation [2]. It is related to the fact that many older farmers pass down beef cattle production to younger farmers. The level of farmers' education was varied. The majority only completed elementary school, besides some farmers had higher education in junior and senior high school. The farmers in this study have received the training activity for more than 50%. The farmers mostly have the wealthy familiarity of local situations and practical knowledge or ability to handle their environment profitably. The farmers still require innovation and information based on research and development to increase their productivity [11]. The objectives of the farmers were saving and insurance, following by fertilizer producer and primary income. The objective of farmers still relevant because cattle farming was a secondary activity. The livestock played as savings because the farmers could sell their livestock any time when urgency ready cash, and it was still the principal livestock function. In line with Budisatria et al. [9], keeping animals were multifunctional purposes, the economic benefits of keeping animals were low. The condition showed by the ownership of cows was low. According to Saili and Saediman et al. [2,12], the Bali cattle ownership in Southeast Sulawesi province was low: 1-5 head per household. The condition based on farmers' characteristics indicated that farmers were categorized as traditional system operation.

### Table 1. Bali cows farmers' characteristics with intensive and semi-intensive production systems in South Konawe Regency.

| No | Variable                      | Production system | Intensive (n=23) | Semi-intensive (n=32) |
|----|-------------------------------|-------------------|-----------------|----------------------|
| 1  | Farmers' age (%)              |                   |                 |                      |
|    | a. Below 30 years old         |                   | 8.70            | 25.00                |
|    | b. 30 – 50 years old          |                   | 47.82           | 46.88                |
|    | c. Above 50 years old         |                   | 43.48           | 28.12                |
| 2  | Experience on keeping cows (%)|                   |                 |                      |
|    | a. Below 10 year              |                   | 52.17           | 43.75                |
|    | b. 10-20 year                 |                   | 39.13           | 18.75                |
|    | c. Above 10 year              |                   | 8.70            | 37.50                |
| 3  | Educational backgorund (%)    |                   |                 |                      |
|    | a. Non-school                 |                   | 8.70            | 12.50                |
|    | b. Elementary school (SD)     |                   | 34.78           | 40.63                |
|    | c. Junior high school (SMP)   |                   | 21.74           | 28.13                |
|    | d. Senior high school (SMA/K) |                   | 21.74           | 15.63                |
|    | e. University                 |                   | 13.04           | 3.13                 |
| 4  | Experience on training (%)    |                   |                 |                      |
|    | a. Never                      |                   | 34.78           | 50.00                |
|    | b. 1-10 time                  |                   | 39.13           | 40.63                |
|    | c. Above 10 time              |                   | 26.09           | 9.38                 |
| 5  | The main objective of keeping cows (%) |   |                 |                      |
|    | a. Saving and insurance       |                   | 73.91           | 62.50                |
|    | b. Fertilizer producer        |                   | 17.39           | 28.13                |
|    | c. Primary income             |                   | 8.70            | 9.38                 |
| 6  | Cows’ ownership (heads/farmer) |                   | 2.09±0.32       | 1.94±0.21            |

**ns** Non-significant differences

#### 3.2. Reproductive management and performances

Reproduction management, especially for the female animal, was playing a vital role in cows' productivity because it will impact the total number of calf produced during the lifetime of cows. The
results of reproductive management and performances of Bali cows kept by smallholder farmers with intensive and semi-intensive production systems in the South Konawe Regency were showed in table 2.

| Table 2. Reproductive management and performances of Bali cows kept by smallholder farmers with intensive and semi-intensive production systems in South Konawe Regency. |
| --- | --- | --- | --- |
| No | Variable | Intensive (n=48) | Semi-intensive (n=62) |
| --- | --- | --- | --- |
| 1 | Age of first estrus (years) | 1.98±0.82<sup>a</sup> | 1.92±0.18<sup>b</sup> |
| 2 | Estrus cycle (days)<sup>ns</sup> | 20.79±0.97 | 20.55±0.50 |
| 3 | The ability of estrus detection (%) | | | |
| | a. Poor | 4.35 | 0.00 |
| | b. Moderate | 26.09 | 40.91 |
| | c. Good | 69.57 | 59.09 |
| 4 | Age of first mating (years) | 2.84±0.23<sup>a</sup> | 2.77±0.34<sup>b</sup> |
| 5 | Mating methods (%) | | | |
| | a. Natural mating | 29.17 | 13.89 |
| | b. Artificial insemination | 70.83 | 86.11 |
| 6 | Service per conception (times) | | | |
| | a. Natural mating | 1.00±0.00<sup>a</sup> | 1.20±0.42<sup>b</sup> |
| | b. Artificial insemination | 1.70±0.76<sup>a</sup> | 1.44±0.57<sup>b</sup> |
| 7 | Gestation length (months)<sup>ns</sup> | 9.13±0.36 | 9.17±0.41 |
| 8 | Age of first calving (years)<sup>ns</sup> | 3.63±0.34 | 3.60±0.29 |
| 9 | Postpartum estrus (months)<sup>ns</sup> | 2.71±0.42 | 2.87±0.44 |
| 10 | Postpartum matting (months)<sup>ns</sup> | 3.18±0.49 | 3.39±0.57 |
| 11 | Age of weaning (months)<sup>ns</sup> | 4.87±0.75 | 4.69±0.59 |
| 12 | Pre-weaning mortality (%) | 6.25 | 9.68 |
| 13 | Calving interval (months)<sup>ns</sup> | 14.65±8.09 | 15.11±4.34 |
| 14 | Calf crop (%) | 76.79 | 71.70 |
| 15 | Cows reproduction index (heads/year)<sup>ns</sup> | 0.86±0.29 | 0.77±0.31 |

<sup>ab</sup>Different superscripts denote in the similar line represent significantly differences (P <0.05)

The first estrus and first mating age of Bali heifers kept by smallholder farmers with the intensive system were longer (P <0.05) than the semi-intensive system. The first estrus age will influence the first mating age. Previous research found that the first estrus age varied widely amongst the local breeds of cattle. In this research, the first estrus age was similar to Bali heifers in Pulukan Breeding Installation with an intensive system at 23.95±0.42 months [13] and faster from Aceh heifer with the semi-intensive system at 27.25±3.94 months [14]. The results showed that farmers in two production systems could detect the estrus sign with moderate-good (95.65 and 100%) and mated by AI (70.83 and 86.11%). In contrast with with Saediman et al. [12], that that reported the farmers in the Konawe Regency used natural mating (43.3%) and a combination of natural mating and AI (56.7%). Natural mating was done with the bull that the farmers have kept in their house. In recent years AI is increasingly accessible to farmers as the government promotes its application through the Special efforts of mandatory cattle pregnancy program (Upaya Khusus Sapi Indukan Wajib Bunting). Besides, some problems were associated with natural mating, like a limited number of superior bulls. The ability of estrus detection can support the success of AI. The condition showed with the service per conception (S/C) with AI in a semi-intensive system was smaller (P <0.05) than in an intensive system. According to Sali [2], S f Bali cows in Southeast Sulawesi Province mated by natural, and AI was 1.63 and 1.47, respectively. The age of first calving marks the onset of a cow’s reproductive life. It is closely related to the breeding interval, and earlier first calving increases the lifetime productivity of cows. There was no difference in the age
of first calving in two different production systems. The age of first calving of Indonesian local cattle breed was varied, Bali heifer was 36.8 months [13], and Peranakan Ongole was 30-36 months [15], Aceh heifers were 37-39 months [14].

The result showed no significant differences in gestation length (GL), postpartum estrus (PPE), postpartum mating (PPM), age at weaning, calving interval (CI), and Cows reproduction index (CRI). The PPE primary factors were the suckling period and nutritional status. Exposing the cows to bulls could decrease the PPE. The bull can be a bio stimulator for estrus detection and natural mating [16]. The PPE will affect the PPM of cows. The study indicated that Bali cows had a short PPM, related to Baliarti et al. [15], that stated the PPE and PPM were expected to be two to three months. Weaning age was a critical part of a cow-calf operation, it was no significant difference found of weaning managed, and pra-weaning mortality rates were relatively low. Bali cows' calving intervals in this research have a more extended period than Saili [2] reported that the CI of Bali cows in Southeast Sulawesi Province was 363-370 days. Generally, beef cattle in Indonesia have low productivity in the traditional system due to the length of CI was 18-21 months [11].

Bali cows generate high calf crop and CRI. According to Baliarti et al. [17] the CI, pra-weaning mortality, and calf crop of Bali cows kept in palm oil plantation-cattle integration were 12.31 months, 21.28%, and 66.76%, respectively. The CRI of Bali cows kept in palm oil plantation-cattle integration during the rainy and dry season was 0.69±0.36 and 0.76±0.46 [18].

Bali cattle's fertility in Southeast Sulawesi was diverse according to Saili [2], the condition due to several factors such as availability of superior bull, nutritional level, and the farmers' ability for estrus detection.

4. Conclusions

To conclude our findings, the farmers in South Konawe Regency carry out reproductive management well. Bali cows' reproductive performance with an intensive system is better than the semi-intensive system based on the calf crop.

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