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Reproductive Performance and Population Dynamics of Cattle in Rembang District, Central Java Province

Rifal Maulana¹, Atien Priyanti Sudarjo Putri², Aryogi³, Bayu Andri Atmoko³, Agus Wibowo⁴, Siti Andarwati⁵ and Panjono^{1*}

¹Department of Animal Production, Faculty of Animal Science, Universitas Gadjah Mada, Yogyakarta, 55281, Indonesia

²Research Center for Behavioral and Circular Economics National Research and Innovation Agency, South Jakarta, 12710, Indonesia

³Research Center for Animal Husbandry, National Research and Innovation Agency, Jakarta, Cibinong, Bogor, 16915, Indonesia

⁴Departement of Agriculture and Food of Rembang Regency, Rembang, 59217, Indonesia

⁵Department of Livestock Socio-economic, Faculty of Animal Science, Universitas Gadjah Mada, Yogyakarta, 55281, Indonesia

ABSTRACT

Rembang Regency has the fourth largest cattle population in Central Java Province. Cattle farming in Rembang Regency is mostly conducted by farmers and family farmers with 2 to 4 cattle. The objective of this study was to measure the reproductive performance, *natural increase* (NI), and population dynamics of cattle in Rembang District, Central Java. The study was conducted using a survey method by collecting data from 400 farmers and 1,275 cattle in five subdistricts in Rembang District. The results showed that the reproductive index value of cows was 0.77 head/year, the natural increase (NI) value was 55.06%, and the average growth of cattle in Rembang District from 2017 to 2022 was 2.81% per year. Based on the results of this study, it can be concluded that the reproductive performance is quite good but there are still many cows with poor reproductive performance in the population and based on population dynamics data, it is concluded that many cattle transported out of Rembang Regency.

Keywords: Reproductive performance, Natural increase, Population dynamics, Rembang Regency

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* Corresponding author:

E-mail: panjono@ugm.ac.id

Introduction

Cattle are large ruminant livestock commodities that play an important role as meat producers in Indonesia. As one of the leading commodities, cattle are the focus of the government in meeting domestic meat demand with the meat self-sufficiency program. Beef self-sufficiency is the ability to supply 90-95% of the domestic beef demand with local beef (Kusuma *et al.*, 2017). Efforts to increase domestic meat production must be balanced with the development of breeding businesses, until now the need for livestock seeds both in quantity and quality in the country has not been met. One of the factors affecting this is the unidentified location of livestock pockets in areas that are sources of seeds. The difficulty in identifying the location of livestock pockets is because most of the breeding businesses are carried out by farmers or breeders with a small scale of ownership, scattered locations, and uncontrolled livestock mutations (Kusuma *et al.*, 2017).

Rembang Regency has the 4th highest cattle population in Central Java Province. Based on data from the Agriculture and Food Service Office of Rembang Regency in 2021, the cattle population in Rembang Regency reached 147,494 heads. The development of cattle farming in Rembang Regency is mostly kept by farmers as savings with ownership of 2-4 heads in each family. Sources of feed for cattle come mostly from agricultural waste from food crops and natural grass from community forests (Prasetya *et al.*, 2019). Rembang District is included in Group 1 along with Kebumen and Blora, which are potential areas to provide safety inputs for cattle breeds (Susanti *et al.*, 2014). Based on this, Rembang Regency has the potential to develop cattle to increase the population and quality of cattle in Indonesia.

Efforts to increase the cattle population to fulfill meat demand cannot be separated from the performance aspects of the cow. The reproductive performance of the cow is very important to note because it can be used as a reference to calculate the time of the livestock breeding cycle and

estimate the livestock population in the future (Riyanto *et al.*, 2015). *Natural increase* (NI) has a close relationship with population development because the NI value can be a reference to the number of productive adult females with good handling and management in an area. The NI value will be better if the high birth rate is balanced with a low mortality rate and the calculation is done every year (Budiarto *et al.*, 2013).

Previous research related to cattle in Rembang Regency included the development of cattle farming (Susanti *et al.*, 2014), botanical composition of forage for cattle (Lukiwati and Budiyanto, 2010) and analysis of feed carrying capacity (Prasetya *et al.*, 2019). Research related to reproductive performance and population dynamics of cattle in Rembang Regency has not been conducted previously. Therefore, this research needs to be carried out so that the potential of Rembang Regency as a producer of beef cattle can be identified and improved. The objective of this study is to measure the reproductive performance, *natural increase* (NI), and population dynamics of cattle in Rembang Regency.

Materials and Methods

The study was conducted from November 2022 to January 2023 in Rembang District, Central Java. A total of 400 farmers were used as respondents in this study spread across five subdistricts in Rembang District, namely Rembang City, Sarang, Sulang, Kragan, and Sedan Subdistricts. This study involved 1,275 cattle raised by farmers. The tools used in this study were questionnaires to facilitate the interview process with farmers, and stationery to record the results of the interview. Supporting data included annual cattle population data in Rembang Regency obtained from the annual data of the Agriculture and Food Service Office of Rembang Regency and the Central Bureau of Statistics of Rembang Regency.

The research was conducted using the survey method by conducting direct interviews with farmers with the help of questionnaires. Farmers were selected based on their length of farming experience and the type of farming business undertaken. Questionnaires were prepared to obtain data on the number of livestock ownership, reproductive performance, and livestock mutations. Reproductive performance data was used to calculate the value of the Cow Reproduction Index (CRI), and Natural Increase (NI). Data obtained from the Agriculture and Food Service Office of Rembang Regency and the Central Bureau of Statistics of Rembang Regency were used to obtain data on cattle population dynamics. The following formula was used:

Cow Reproduction Index (CRI). The Cow Reproduction Index (CRI) is obtained by calculating the total number of offspring alive until weaning from each cow per year.

$$CRI = NC \times (1-M) \times (365/CI)$$

Notes:

CRI = Cow Reproduction Index

NC = Number of Calves (head)

M = Mortality (%)

CI = Calving intervals (day)

Natural increase (NI). The NI score is estimated by calculating the percentage of births and deaths of cattle to the total population (Hardjosubroto *et al.*, 1990).

a. The percentage of births was obtained by the formula:

$$\text{Percentage of birth} = \frac{\text{number of cattle births per year}}{\text{total population per year}} \times 100\%$$

b. The percentage of mortality was obtained by the formula:

$$\text{Percentage of death} = \frac{\text{number of cattle deaths per year}}{\text{total population per year}} \times 100\%$$

c. the natural increase (NI) score was obtained by the formula:

$$NI = \text{percentage of births per year} - \text{percentage of deaths per year}$$

Population dynamics. Population dynamics were obtained from data on the cattle population in Rembang District for the last 6 years, the population data were averaged to obtain population growth data per year.

Results and Discussion

Cow performance

Table 1 shows that the age at first mating and first calving of cattle cow in Rembang District had an average age of 19.19±3.86 mon and 28.36±4.08 mon, respectively. Wicaksana and Arifin (2020) stated that the average age of first mating for cattle is 2.4±0.57 years. Boda *et al.* (2020) stated that the age of first calving for local cattle is 32.02 ± 0.01 mon. Budisatria *et al.* (2019) stated that the age of first mating in cattle is influenced by the achievement of puberty age. Long puberty age will cause the age of first mating to be longer.

Table 1. Reproductive performance of cattle cows in Rembang District, Central Java Province

Variable	Mean±SD
Age at first mating (month)	19.19±3.86
Age at first calving (month)	28.36±4.08
Postpartum mating (month)	5.03±1.41
Service per conception (time)	2.03±0.29
Days open (day)	188.63±16.02
Calving interval (month)	14.11±0.49
Calving rate (%)	0.86
Weaning age (month)	4.81±1.07
Survival rate (%)	94.50
CRI (head/year)	0.81

The postpartum mating value of cows in Rembang Regency is 5.03±1.41 mon. Based on Riyanto *et al.* (2015), it is known that the PPM of

Ongole grade cows is 4.42 mon. Warman *et al.* (2021) stated that the value of postpartum mating can be influenced by the emergence of estrus after calving and maintenance management carried out by farmers. The average service per conception of cattle cow in Rembang Regency is 2.03 ± 0.29 times. Toelihere (1994) stated that generally the normal service per conception value is 1.6 to 2 times. Based on these results, it is known that the value of service per conception is still relatively good.

The average number of days open for cattle cow in Rembang Regency was 188.63 ± 16.02 . Riyanto *et al.*, (2015) stated that days open in cattle cow ranged from 88-172 d. Ananda *et al.* (2019) stated that normal days open range from 60-90 d and do not exceed 120 d. Based on these results, it can be seen that the days open value of cattle cow in Rembang Regency is higher than the literature. Gumilar *et al.* (2013) stated that the value of days open can be influenced by farmers' lack of knowledge about signs of calving or due to deliberate ignoring or prolonging the empty period.

The average calving interval of cattle cow in Rembang Regency was 14.11 ± 0.49 mon. Samberi *et al.* (2010) stated that the average calving interval of cattle cow is 12.62 mon. Based on these results, it is known that the value of the calving interval in Rembang Regency is still relatively high. Kristyari *et al.* (2021) stated that factors that can affect the calving interval are postpartum estrus, the distance of cows mated after calving, calf weaning age, and service per conception.

The average age of calf weaning was 4.81 ± 1.07 mon. Zulkarnaen *et al.* (2022) stated that calves were weaned at the age of 205 d. The pre-weaning mortality value obtained was 4.24 ± 10.47 . Rahayu (2014) stated that in tropical areas, the percentage of preweaning calf mortality under the age of three months can reach 20%-50%. Talib *et al.* (1998) stated that preweaning calf mortality is usually caused by low birth weight, disease, low cow's milk production, and the physical condition of the animals. Subandriyo *et al.* (1994) stated that efforts that can be made to reduce the rate of preweaning calf mortality are through improvements in the care of old pregnant cows, and lactating cows, and improved husbandry management.

The value of the birth rate in Rembang Regency is 0.86%. Romano *et al.* (2017) stated that the calving rate is the percentage between the number of cows who give birth and the initial number of pregnant cows. Hariadi *et al.* (2011) stated that reproductive efficiency is said to be good if the birth rate reaches 55 to 65%. Factors that can affect the birth rate are the length of mating after giving birth. The value of the broodstock reproduction index in Rembang Regency is 0.81 head/year. These results are still below the expected standard. Ball and Peter (2004) stated that the cow reproductive index is said to be good if a cow can produce one calf within one year. The value of the cow reproductive index can be

influenced by the calving interval. Kristyari *et al.* (2021) stated that factors that can affect the calving interval are postpartum estrus, distance between cows mated after calving, calf weaning age, and service per conception.

Natural increase and population dynamics

The natural increase value is obtained by finding the difference between the percentage of births and the percentage of deaths. Table 2 shows that the natural increase value in Rembang Regency reached 55.06%. The natural increase value is influenced by reproductive productivity, percentage of cows in the population, percentage of births, mortality rates, and breeding patterns (Hardjosubroto, 1992). The birth rate is influenced by feeding management, housing, reproductive management, and disease control (Sumadi, 2009). The natural increase value is obtained by calculation:

$$\text{Natural Increase} = 74.76\% - 7.65\%$$

Table 2. Natural increase

Variable	Number	Percentage (%)
Birth (head)	782	74.76
Death (head)	80	7.65
Population (head)	1,275	
Natural increase (%)		55.06

The low value of natural increase indicates that there are still many cows who have poor reproductive performance in the population, the occurrence of post-weaning deaths can also cause low natural increase values. To overcome this, selection can be done to separate productive and unproductive cows. Improvements in husbandry management can also be made to reduce mortality and maximize reproductive performance. Kusuma *et al.* (2017) stated that natural increase has a close relationship with population development because a high natural increase value can indicate that in the area there are a number of productive females with good handling and management.

Post-weaning calf mortality in Rembang District is mostly caused by worms that cause digestive disorders. Motus *et al.* (2018) stated that calf mortality at the age of 6-19 mon is mostly caused by metabolic disorders and parasitic attacks. Toxocariasis can be caused by poor feeding management and cage sanitation. Rast *et al.* (2014) stated that helminthiasis can cause a decline in livestock productivity and waste of livestock resources which results in large economic losses. Winarso *et al.* (2015) stated that the impact of worms is suboptimal growth, reduction in feed conversion rate, weight loss, and decreased endurance. Toxocariasis can be prevented by improving cage hygiene and routinely checking the health condition of livestock. Suroiyah *et al.* (2018) stated that treatment with anti-parasites is highly recommended to treat toxocariasis.

Table 3 shows that the cattle population in Rembang Regency increased from 2017-2022. The average increase in population was 3,889 heads or 2.81% each year. The average value of

population growth is relatively low when compared to the previous natural increase value.

Table 3. Dynamic of cattle population in Rembang District, Central Java Province

Year	Population	Head	Growth	
			—	%
2017	132,388			
2018	134,602	2,214		1.67
2019	136,756	2,154		1.60
2020	137,001	245		0.18
2021	147,494	10,493		7.66
2022	151,833	4,339		2.94
Rerata	140,013	3,889		2.81

Based on data from the Agriculture and Food Service Office of Rembang Regency in 2021, the existing population of adult female beef cattle was 75,286 heads. Based on the natural increase value, Rembang Regency should be able to produce around 50,000 cattle each year. This value is very far from the average growth of only 3,889 heads per year. Based on this, it can indicate that 52.25% of the livestock left Rembang Regency. The large number of livestock leaving Rembang Regency is due to the large number of farmers from outside who are looking for seeds and feeders in the Rembang Regency area.

Cattle farming is an industry with a chain of activities not limited to *on-farm* activities but upstream and downstream activities as supporting business units. Upstream activities include the production of breed stock, feed, and inputs, while downstream is post-harvest handling, which has a role in improving the quality and added value of beef. Based on population dynamics data, it is known that many feeder cattle or cattle breeds leave Rembang Regency. This may cause the industry to grow only in the upstream sector. Rianto and Purbowati (2009) stated that upstream and downstream industrial activities need to be integrated to form a strong cattle industry system. It is necessary to limit livestock traffic so that not too many livestock leave so that the downstream sector can obtain production raw materials easily and the downstream sector can develop. The development of the livestock sector will support the economic development of a region (Indrayani *et al.*, 2022).

Conclusion

The performance of cattle cows in Rembang Regency is quite good, with a reproductive index value of 0,81 head/year and a natural increase value of 55,06%. The average percentage of cattle population growth per year in Rembang Regency is smaller than the natural increase value. The average increase in cattle population in Rembang Regency from 2017 to 2022 is 2,81% each year. Based on this data, it is known that many livestock transported out of Rembang Regency every year, this can have an impact on the development of the livestock industry, especially in the downstream sector due to the limited population of seeds or feeders available.

Conflict of interest

The authors have no conflict of interest to declare. All authors have seen and agree with the contents of the manuscript.

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Author's contribution

The authors confirm contribution to the paper as follows: study conception and design: P, Methodology: BA, SA, and P, Data Collection: RM, BA, BWP, and HM, Data Analysis: RM, BA, Validation: BA, AW, and P, Writing manuscript-original: RM, BA, BWP and HM, Writing manuscript-review/revision: AP, A, BA, AW, SA dan P

Ethics approval

This study was approved by the Administration Committee of Experimental Animals, Universitas Gadjah Mada with Approval number: 00124/EC-FKH/Eks/2021.

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