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Effect of Origin and Ownership Status on Beef Cattle Reproductive Performance and Development Strategies in Sekolah Peternakan Rakyat (SPR)

Dinda Ayu Permata Sari ^a, Muladno ^b, Syahrudin Said ^c, Nahrowi ^d, Rudy Priyanto ^b

^a Department of Animal Science, Faculty of Animal and Agriculture Science, Diponegoro University, Semarang, Indonesia

^b Department of Animal Production and Technology, Faculty of Animal Science, IPB University, Bogor, Indonesia

^c Research Center for Applied Zoology, National Research and Innovation Agency (BRIN), Bogor, Indonesia

^d Department of Nutrition and Feed Technology, Faculty of Animal Science, IPB University, Bogor, Indonesia

email: ^a dindaayufpp@lecturer.undip.ac.id

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ABSTRACT

This study aims to determine the effect of cattle origin and ownership status on the reproductive performance of beef cows in four locations of the Sekolah Peternakan Rakyat (SPR). The study locations include SPR Sungai Lilin (Musi Banyuasin Regency), Mesuji Raya (Ogan Komering Ilir Regency), Pelepat Ilir (Bungo Regency) and Wanaraya (Barito Kuala Regency). The study was conducted through a survey method with direct observation and interviews with SPR members. The variables observed included age at first calving, calving interval, empty period, and service per conception (S/C). The factors analyzed were cattle origin (within or outside the SPR) and ownership status (personal or profit-sharing). The results showed that cattle origin had no significant effect on AFC, CI, DO and S/C. Ownership status had a significant effect on AFC, CI and DO. Recommendation of reproductive optimization strategies based on livestock origin include strengthening breeding stock, standardization of the quality of parents, both from within and outside the SPR area and certification of cattle origin. In contrast, reproductive optimization strategies based on ownership status include reformulation of the profit-sharing model, incentive programs for profit-sharing farmers, development of a gradual ownership scheme.

Introduction

The demand for national beef continues to increase along with population growth, increasing community income, and changes in animal protein consumption patterns [1]. However, domestic beef production has not met national consumption needs, so Indonesia still relies on imports of live cattle

and frozen meat from abroad. To address this imbalance, increasing the national beef cattle population through optimizing local production is a strategic priority.

The beef cattle population in Indonesia is mostly owned by small-scale and traditional livestock farmers. In practice, cattle are often considered life savings or long-term economic assets [2]. Therefore, increasing the population must be carried out through an approach that strengthens the capacity of small-scale livestock farmers as the main actors in the livestock production chain, especially in breeding. One approach developed by the government is the establishment of the Sekolah Peternakan Rakyat (SPR). SPR is a model of empowering livestock farmers through a community approach based on local institutions that aims to improve the knowledge, skills, and independence in managing beef cattle businesses [3]. SPR functions as a community of farmers for learning and coaching livestock groups in technical, socio-economic aspects, and institutional strengthening. The SPR model is also used as a basis for communal breeding programs to improve the reproductive efficiency and genetic quality of cows sustainably.

In the context of breeding, the reproductive performance of cows is the main determining factor in the success of population growth. Female cows are the main source of calf births, are the basis for livestock regeneration. Reproductive performance indicators commonly used in evaluations include: age first calving (AFC), calving interval (CI), days open (DO), and service per conception (S/C) [4], [5], [6], [7]. Optimal reproductive performance will accelerate the birth cycle and increase the efficiency of calf production.

The reproductive performance of cows is influenced by various factors, both technical and socio-economic [8]. Two factors that have an influence but are often overlooked are the origin of livestock and livestock ownership status. The origin of livestock refers to the location of the source of livestock, whether it comes from within the community (local) or from outside the region (introduction). The origin of livestock can affect reproductive performance through differences in environmental adaptation, initial management, and health status [9], [10].

Meanwhile, ownership status can be related to the motivation of farmers to raise their livestock. In smallholder farmers, the ownership status is generally that the livestock is owned by themselves or the profit-sharing systems (gaduhan) model. The profit-sharing system is a local wisdom of the Indonesian people in the form of a partnership relationship between farmers or between farmers as implementers who run a cultivation business with the agreement of another party as the capital owner [11]. In this system, the livestock is owned by the investor, while the farmer is responsible for caring for and maintaining it with a profit-sharing system.

Several studies have shown that livestock origin and livestock ownership status can affect maintenance decisions, mating frequency, and reproductive productivity [12], [13]. However, studies that combine these two factors in the context of SPR are still limited. Based on this, this study aims to analyze the effect of cattle origin and ownership status on the reproductive performance of beef cattle in four SPR locations. The results of the study are expected to be the basis for formulating policy recommendations for optimizing reproductive performance for the development of community-based beef cattle farming, taking into account the effectiveness of the ownership system and livestock origin as part of the national population increase strategy.

Method

The study was conducted in 4 SPR locations consisting of SPR Sungai Lilin (Musi Banyuasin Regency), Mesuji Raya (Ogan Komering Ilir Regency), Pelepat Ilir (Bungo Regency) and Wanaraya (Barito Kuala Regency). Data collection was carried out in 2022-2023. The materials used in this study were all of female cows owned by 492 farmers in 4 SPR locations. Data were collected from a total of 959 female cows, including 382 heads in Sungai Lilin, 216 heads in Mesuji Raya, 141 heads in Pelepat Ilir and 220 heads in Wanaraya.

Data Collection

Data collection was carried out through observation and interviews with cattle owners to obtain primary data. The reproductive performance parameters recorded were age at first calving (AFC),

calving interval (CI), days open (DO) and number of services per conception (S/C). The observation variables consisted of cattle origin and ownership status. The cattle origin was categorized based on cattle originating from within and outside SPR area. Meanwhile, the ownership status variable was categorized based on personal ownership and group or profit-sharing systems (gaduhan). Secondary data as recordings from farmers and inseminators, were used as supporting data.

Reproductive Performance Analysis

Reproductive performance data (AFC, CI, DO and S/C) at 4 locations were tabulated and averaged. The data were then analyzed using non-parametric Kruskal-Wallis analysis with Minitab 17 software. The results of the data processing are presented descriptively.

Results and Discussion

Location profile

The research location was determined based on the criteria of SPR that had passed the participatory learning process and were members of the Solidaritas Alumni Sekolah Peternakan Rakyat (SASPRI). Data on the number of cattle, type of cattle, maintenance system, origin of cattle and cattle ownership status at 4 SPR locations are shown in Table 1. In general, the beef cattle population in the 4 SPR locations was dominated by local cattle (Bali and PO), as well as a few crossbred cattle. Cattle were kept in full pens (intensive), penned at night until morning and released in the grazing area from morning until evening (semi-intensive) and released in the grazing area (extensive). The characteristics of the area in the 4 locations were dominated by oil palm plantations.

The origin of the cattle came from within and outside the SPR. Cattle from within means cattle that were born and raised in the SPR area and whose parents are known. Meanwhile, cattle from outside the SPR came from government assistance for groups, or cattle purchased from outside the SPR area.

The cattle ownership status consists of personal cattle and cattle as profit-sharing system (gaduhan). The profit-sharing system applied was still traditional system, where the agreement between the investor and the farmer is based on mutual agreement. In the cow-calf system, the investor provides the dam to be raised by the farmer. Feed and maintenance management are borne by the farmer. The farmer receives income as a calf produced by the dam. Usually, the first calf is for the farmer, the second calf is for the investor, and so on.

Table 1. Number of cattle, breed, rearing system, cattle origin and ownership status of cows in 4 SPR location

Location	Number of cattle (head)	Breed	Rearing system	Cattle origin (%)	Ownership status (%)
Sungai Lilin	382	Bali cattle	Intensive, Semi intensive, Extensive	Outside group: 72,8 Within group: 27,2	Personal: 87,7 Profit-sharing: 12,3
Mesuji Raya	216	Bali cattle, PO cattle, Simmental, Limousin	Intensive, Semi intensive, Extensive	Outside group: 48,6 Within group: 51,4	Personal: 98,1 Profit-sharing: 1,9
Pelepato Ilir	141	Bali cattle, Madura cattle, Simmental, Limousin,	Intensive, Semi intensive, Extensive	Outside group: 76,6 Within group: 23,4	Personal: 95 Profit-sharing: 5

		Brahman, Angus			
Wanaraya	220	Bali cattle	Intensive	Outside group: 55,4 Within group: 44,6	Personal: 95,5 Profit-sharing: 4,5

Effect of origin of cattle on reproductive performance on cows

The average of age first calving (AFC) of beef cattle in each location ranged from 1007.6-1100.5 days (Table 2). These results show a normal range, when compared to the average AFC of several local cattle in Indonesia which have an average AFC between 26,61-43,20 months [14], [15], [16]. Based on the results of statistical analysis (Table 3), the origin of the cattle significantly affected the average AFC ($P < 0.05$). Cows originating from within the SPR area have a faster age first calving than cows originating from outside the SPR area. Cows originating from outside generally come from government assistance or cows purchased from outside the SPR area. Assisted female cows include heifers or pregnant heifers. Meanwhile, cows originating from within are cows that were born and grew up in the SPR area. AFC is influenced by the age of puberty and the time of first mating [17]. The longer the mating, the longer the AFC. The average age of mating of local cattle in community breeders is around 26-28 months [18].

Based on the results show that the cattle origin significantly affected the average of calving interval ($P > 0.05$) (Table 3). Cows originating from within the SPR had a faster calving interval (416.0 ± 77.4 days), compared to cows originating from outside the SPR (418.7 ± 68.4 days). Bareki et al., (2024) (Bareki et al., 2024) reported that cows in smallholder farmers had a minimum calving interval of 300 days and a maximum of 783 days. According to Twomey & Cromie (2023), calving interval is closely related to parity. First-parity on heifers usually have a longer calving interval than second-parity cows and so on. In the 4 research locations, the percentage of cows originating from outside the SPR was higher than cows from within the SPR. Cows from outside SPR were mostly heifers, so it can be an indication that the average calving interval of cows from outside the SPR is longer.

The origin of the cattle also had a significant effect on the days open ($P < 0.05$) (Table 3). Cows from within the SPR had a shorter average days open (130.0 ± 78.6 days) compared to cows from outside the SPR (136.7 ± 75.6 days). This result is in line with the calving interval. Days open is the distance between parturition and the next pregnancy, with a normal period of 85-120 days [21]. This means that cows at the research location had an average days open above the normal range. The length of days open is influenced by nutrition and the condition of the reproductive organs after calving. This will affect the estrus period again after calving until the cow is ready to be mated [22].

Meanwhile, statistical analysis showed that the origin of the cattle did not significantly affect on S/C ($P > 0.05$) (Table 3). The average of S/C value in the 4 research locations ranged from 1.4-3.8 times (Table 2). Service per conception (S/C) is the number of matings needed to produce pregnancy. To produce efficient maintenance, normal S/C is 1-2 times. This condition shows that most of the cattle in the research location still have S/C values above normal. The high S/C in smallholder farmers is influenced by genetic and non-genetic factors [6]. Complete parent data is the key to genetic factor analysis, while non-genetic factors are dominated by management practices from farmers such as knowledge of estrus detection, determining mating times, and appropriate artificial insemination application protocols [23], [24].

Table 2. Age first calving (AFC), calving interval (CI), days open (DO) and service per conception (S/C) of cows in 4 SPR locations based on origin of cattle

Location	Origin of cattle	AFC (days)	CI (days)	DO (days)	S/C (times)
Sungai Lilin	Within SPR	1063	429,3	81,3	3,8

	Outside SPR	1083,9	416,9	68,9	2,8
Mesuji Raya	Within SPR	1056,2	417,8	131,8	2,9
	Outside SPR	1087,8	433,6	147,6	3,2
Pelepato Ilir	Within SPR	1012,5	407,8	123,6	2
	Outside SPR	1007,6	377	93,5	1,4
Wanaraya	Within SPR	1087,2	413,7	128,1	1,9
	Outside SPR	1100,5	414,2	128,2	1,5

Table 3. Reproductive performance of cow based on origin of cattle

Reproductive performance	Within SPR (Mean $\pm$ SD)	Outside SPR (Mean $\pm$ SD)	p-Value
AFC (days)	1055,8 $\pm$ 149,5	1083,6 $\pm$ 163,0	0,009
CI (days)	416,0 $\pm$ 77,4	418,7 $\pm$ 68,4	0,02
DO (days)	130,0 $\pm$ 78,6	136,7 $\pm$ 75,6	0,02
S/C (times)	2,5 $\pm$ 2,0	2,5 $\pm$ 2,0	0,4

Effect of ownership status on reproductive performance of cows

The results showed that ownership status had no significant effect on the age first calving ($P>0.05$) (Table 5). However, the results of observations showed that cows owned by personal tended to have faster AFC (1066.9 $\pm$ 155.7 days) compared to the profit-sharing model (1081.8 $\pm$ 148.3 days). Two profit-sharing models that are usually applied by farmers, such as calf and parent rolls. Parent roles are usually from government assistance and are managed by groups. While calf rolls are managed by personal. Simamora et al., (2024) reported that dynamics within groups can be a factor inhibiting livestock development. This can be an indication of a relationship with livestock management, which is shown by the reproductive performance of the managed cows.

Ownership status also has no significant effect on calving interval, days open and number of S/C ($P>0.05$) (Table 5). However, calving interval and days open in personally owned cows tend to be faster than in the profit sharing system. In the profit-sharing system of female cattle with the aim of breeding, profit sharing is obtained from the calves produced. The first calf belongs to the breeder who raises it, the second calf to the investor (owner of the dam) and so on. Based on this agreement, the beef cows must reproduce well to produce calves every year so that the breeder makes a profit. This is in line with the opinion of Amam et al., (2025) which states that the attitude and motivation of breeders have a positive relationship with the performance of cattle raised in the profit-sharing (gaduhan) partnership system.

Ownership status plays a major role in determining efficiency, because cattle ownership status can reduce technical inefficiency [26]. Pramusintha et al. (2017) stated that the average level of technical efficiency of beef cattle breeding businesses managed by the farmers themselves tends to be lower than cattle managed using the profit-sharing system. So far, there have been no regulations in the SPR that regulate the profit-sharing system between members, so the mechanism carried out still varies depending on the agreement between investor and farmer. Profit-sharing system (gaduhan) of beef cattle based on income (50:50) can increase technical efficiency compared to the profit-sharing of the results of the profit-sharing of the parent roll or the calf roll (Pramusintha et al., 2017).

Table 4. Age first calving (AFC), calving interval (CI), days open (DO) and service per conception (S/C) of cows in 4 SPR locations based on ownership status

Location	Ownership status	Age of Calving (days)	Calving Interval (days)	Days open (days)	S/C (times)
Sungai Lilin	Personal	1074,6	420,3	72,3	3,1
	Provit sharing	1106,8	422,9	74,9	3
Mesuji Raya	Personal	1069,8	425	139	3,1
	Provit sharing	1043,5	548	262	1
Pelepat Ilir	Personal	1007,9	403,5	119,4	1,9
	Provit sharing	990	365,3	79,3	1
Wanaraya	Personal	1088,7	414	128,2	1,7
	Provit sharing	1068,6	421,1	135,1	1,7

Table 5. Reproductive performance of cow based on ownership status

Reproductive performance	Personal (Mean $\pm$ SD)	Group/ provit sharing (Mean $\pm$ SD)	p-Value
AFC (days)	1066,9 $\pm$ 155,7	1081,8 $\pm$ 148,3	0,15
CI (days)	417,2 $\pm$ 73,1	425,0 $\pm$ 68,1	0,9
DO (days)	131,2 $\pm$ 77,3	139,0 $\pm$ 75,0	0,3
S/C (times)	2,5 $\pm$ 2,0	2,5 $\pm$ 2,1	0,3

Reproductive optimization policy strategy based on cattle origin

Based on the analysis results at 4 SPR locations, the origin of livestock affects AFC, CI and DO. Cattle originating from within the SPR tend to have better performance than cattle originating from outside the SPR. Based on these conditions, development strategies that can be carried out include: 1) Strengthening breeding stock; 2) Standardization of the quality of parents, both from within and outside the SPR area; 3) Certification of cattle origin. Adaptive quarantine is carried out on parents from outside the SPR area, which aims to prevent infectious diseases, adapt to the new environment so the farmer can assess physiological conditions and initial productivity so that can increase the efficiency of cattle maintenance. Quarantine activities were adjusted to the infrastructure conditions in each location. Simple quarantine that can be carried out on people's farms can be done with an adaptive quarantine approach, such as monitoring the health and adaptation of livestock for the first 2-3 weeks after arrival. Adaptive quarantine is carried out for the purpose of initial observation of health and adaptation.

Standardization of dam quality can be prepared in collaboration with local governments. For example, only dam with $S/C \leq 2$, days open ≤ 5 months and calving interval < 15 months can be recommended. In addition, minimum standards for age and parity can also be applied if farmer want to bring in cattle from outside the SPR area. Implementation of performance-based cattle origin certification can help farmers get superior beef cattle and facilitate supervision of reproductive quality.

Reproductive optimization policy strategy based on ownership status

Based on the results, ownership status did not significantly affect reproductive performance, but personal dam tended to perform better than those in the profit-sharing system. These results can be an evaluation that the motivation of farmers who implement a profit-sharing system has less impact on reproductive performance. This can affect maintenance efficiency. Several policy strategies that can be recommended for optimizing reproduction related to ownership status include: 1) reformulation of the profit-sharing model; 2) incentive programs for profit-sharing farmers; 3) development of a gradual ownership scheme.

It is necessary to develop a profit-sharing agreement model based on reproductive performance, where the sustainability of profit-sharing cooperation depends on the achievement of beef cows reproductive performance. In breeding efforts, this is important because the results of profit-sharing systems was the calf of dam raised by profit-sharing farmers. Providing incentives based on reproductive achievements, for example bonuses for calves born healthy in a certain period can motivate farmers to improve their livestock management. In addition, it is necessary to implement a gradual ownership scheme, where profit-sharing cattle can become the property of farmers after meeting certain reproductive performance criteria, for example after producing two healthy calves, so that it can spur increased responsibility and performance of farmers.

Based on the implementation of the policy strategy, it is expected that the efficiency of beef cattle reproduction in SPR areas will increase, the resilience of local seeds will be maintained, the welfare of livestock farmers will increase through a more productive livestock ownership system and livestock development programs will become more sustainable based on scientific data.

Conclusions

The origin of cattle affects age first calving, calving interval and days open, but does not affect on the number of service per conception. The status of cattle ownership significantly not affects all reproductive parameters. Reproductive optimization strategies based on livestock origin include strengthening breeding stock, standardization of the quality of parents, both from within and outside the SPR area and certification of cattle origin. While reproductive optimization strategies based on ownership status include reformulation of the profit-sharing model, incentive programs for profit-sharing farmers, development of a gradual ownership scheme.

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