



International Journal of Veterinary Sciences and Animal Husbandry



ISSN: 2456-2912

NAAS Rating (2026): 4.61

VET 2026; 11(6): 191-196

© 2026 VET

www.veterinarypaper.com

Received: 14-04-2026

Accepted: 18-05-2026

Putu Jodi Wiraguna Tangkas
Master Student, Faculty of
Veterinary Medicine, Udayana
University, Denpasar, Bali,
Indonesia

I Made Kardena
Veterinary Epidemiology and
Economics Laboratory, Faculty
of Veterinary Medicine, Udayana
University, Denpasar, Bali,
Indonesia

Ida Bagus Kade Suardana
Veterinary Virology Laboratory,
Faculty of Veterinary Medicine,
Udayana University, Denpasar,
Bali, Indonesia

I Gusti Ngurah Bagus Trilaksana
Veterinary Reproduction
Laboratory, Faculty of
Veterinary Medicine, Udayana
University, Denpasar, Bali,
Indonesia

**Desak Nyoman Dewi Indira
Laksmi**
Veterinary Reproduction
Laboratory, Faculty of
Veterinary Medicine, Udayana
University, Denpasar, Bali,
Indonesia

Tjok Gde Oka Pelayun
Veterinary Reproduction
Laboratory, Faculty of
Veterinary Medicine, Udayana
University, Denpasar, Bali,
Indonesia

Juliana
Department of Agriculture, Food
Security, and Fisheries, Bangli
Regency, Bali, Indonesia

Corresponding Author:

I Made Kardena
Veterinary Epidemiology and
Economics Laboratory, Faculty
of Veterinary Medicine, Udayana
University, Denpasar, Bali,
Indonesia

Economic assessment of a five-year reproductive control strategy for repeat breeding in Bali cattle

**Putu Jodi Wiraguna Tangkas, I Made Kardena, Ida Bagus Kade
Suardana, I Gusti Ngurah Bagus Trilaksana, Desak Nyoman Dewi Indira
Laksmi, Tjok Gde Oka Pelayun and Juliana**

DOI: <https://www.doi.org/10.22271/veterinary.2026.v11.i6c.3522>

Abstract

The national demand for beef remains unmet due to sub-optimal reproductive efficiency, particularly driven by repeat breeding (RB). This condition prolongs calving intervals, ultimately hindering national meat production. This study aimed to estimate the potential economic losses associated with RB in Bali cattle within Bangli Regency, Bali Province, and to evaluate the economic viability of a five-year RB control strategy compared to a non-intervention scenario. Based on data from local inseminators, the region registered 4,455 breeding females in 2022, with a mean RB prevalence of 19.4% and an average calf price of IDR 6,493,525. Economic analysis revealed that over a five-year period, RB caused total economic losses of IDR 5,612,158,852. However, the cost-benefit analysis of implementing a control program demonstrated a Net Present Value (NPV) of IDR 3,848,961,888 and a Benefit-Cost Ratio (BCR) of 4.59, confirming the program's financial viability. Compared to the non-intervention baseline which projected staggering five-year losses of IDR 33,672,953,111, the control strategy generated a net profit of IDR 19,677,198,937, yielded an additional 854 calf births, and prevented the premature slaughter of 1,295 productive females. These findings underscore that addressing repeat breeding in Bali cattle is imperative, as structured intervention yields significant direct and indirect economic benefits for sustainable livestock production.

Keywords: Cost benefit analysis, repeat breeding, Bali cattle

1. Introduction

The Indonesian government is actively intensifying efforts to boost national meat production to achieve food self-sufficiency, as mandated by the Ministry of Agriculture Decree No. 484/KPTS/RC.020/M/8/2021. Despite these regulatory frameworks, the country experienced a steady increase in beef imports from 2014 to 2022 (Kementan, 2022). This persistent reliance on foreign markets stems from a widening gap between domestic beef production capacity and surging public consumption (Ariningsih, 2014) ^[1]. If this import dependency continues to escalate, national food security risks being dominated by foreign commodities rather than domestic products, which directly threatens the livelihoods of local smallholder farmers (Marhendra *et al.*, 2014) ^[7]. Currently, domestic beef production fails to meet minimum community demands, largely due to deep-seated bottlenecks in livestock reproductive management (Sawo, 2017) ^[11].

As an indigenous breed, Bali cattle (*Bos javanicus*) play a pivotal role in sustaining Indonesia's beef supply. These cattle are characteristically known for high reproductive efficiency, highlighted by a relatively short calving interval of approximately one year (Pelayun *et al.*, 2014) ^[8]. However, achieving optimal population growth remains hindered by prevalent reproductive disorders (Pelayun *et al.*, 2020) ^[9], among which repeat breeding (RB) is a major contributor to declining reproductive efficiency (Juliana *et al.*, 2015; Suputra *et al.*, 2023) ^[6, 13]. Repeat breeding is a complex, multifactorial syndrome influenced by various physiological and environmental factors (Yusuf *et al.*, 2010) ^[14], with global prevalence rates fluctuating widely between 5.5% and 33.3% (Gustafsson & Emanuelsson, 2002) ^[5].

This reproductive anomaly severely undermines livestock productivity, translating into substantial financial strains for farmers. The economic drain associated with RB includes prolonged feeding periods, repeated artificial insemination costs, and escalating veterinary expenses, all of which directly erode farmers' net income (Diro *et al.*, 2021) ^[4]. The macroeconomic impact of such reproductive failures can be catastrophic; for instance, annual losses due to reproductive disorders in the Indian states of Assam and Bihar reached USD 59 million and USD 453.9 million, respectively, across just 534 farming units (Deka *et al.*, 2021) ^[3]. Addressing the root causes of RB requires a multifaceted approach. The initial step demands intensive farmer education and improved communication with local animal health services. Subsequent clinical interventions depend on the specific etiology; however, since RB is frequently triggered by ovarian hypofunction or delayed ovulation, hormonal therapy is widely adopted. This therapeutic strategy has proven highly effective, yielding a 67% success rate in resolving repeat breeding cases (Suputra *et al.*, 2023) ^[13]. In Indonesia, comprehensive economic analyses regarding the management of reproductive disorders in Bali cattle remain scarce. Nevertheless, RB cases remain widespread and continue to stagnate livestock population dynamics in Bali Province. Bangli Regency represents one of the major centers for Bali cattle production in the province. Although most cattle here are managed under extensive farming systems, reproductive issues are prominent. Local animal health authorities estimate that RB accounts for approximately 10% of all reproductive disorders in the region (Dinas Pertanian, personal communication, 2024). Consequently, this study aims to estimate the potential economic losses caused by repeat breeding in Bali cattle under extensive management systems. Furthermore, this research evaluates and compares the economic viability of a structured intervention program against a non-intervention baseline over a five-year projection.

2. Materials and Methods

2.1 Research design and study site

An observational study was conducted from April to July 2024 in Bangli Regency, Bali Province. Epidemiological and economic data regarding the prevalence of repeat breeding

(RB) in Bali cattle (*Bos javanicus*), alongside the operational costs required for intervention programs, were primary-sourced through structured interviews. Stakeholders interviewed included cattle traders, smallholder farmers, field veterinarians, and institutional animal health officers from the local Department of Agriculture, Food Security, and Fisheries (*Dinas Pertanian, Ketahanan Pangan dan Perikanan*). To evaluate the baseline financial impacts of RB, calf market values were determined through targeted surveys involving Bali cattle traders at the Kayuambua animal market and local farmers. Epidemiological metrics for RB were validated by field veterinary officers. Field-derived data were systematically cataloged into an electronic spreadsheet (Microsoft Excel). For each parameter, minimum, maximum, and mean values were calculated, with the mean values serving as the deterministic baseline for economic modeling. A Cost-Benefit Analysis (CBA) framework was employed to assess the economic viability of a structured control strategy targeting RB over a five-year analytical horizon, with 2024 designated as the baseline year (T₀). The total Bali cattle population in Bangli Regency was derived from the 2022 census data (N=53,650), within which the baseline population of productive breeding females was established at 4,455 heads. All monetary metrics were calculated in Indonesian Rupiah (IDR). Future cash flows were discounted using a social discount rate of 5% to compute the Net Present Value (NPV) and Benefit-Cost Ratio (BCR), consistent with veterinary economic standards (Singh *et al.*, 2018) ^[12].

2.2 Production parameters and economic input modeling

The economic losses incurred by farmers due to RB are highly contingent upon the reproductive efficiency of the herd. In this study, the regional prevalence of RB was modeled based on the reported ranges by Gustafsson and Emanuelsson (2002) ^[5], spanning from 5.5% to 33.3%. In accordance with Sari *et al.* (2020) ^[10], optimal reproductive performance for an adult female Bali cow is operationally defined as the capacity to produce one calf annually (Calving Interval ≈12months). Consequently, the economic penalty of reproductive failure induced by RB was quantified using the opportunity cost of lost calf production as the reference endpoint. The complete input parameters utilized in the CBA framework are detailed in Table 1.

Table 1: Deterministic input parameters used in the cost-benefit analysis

No	Parameters	Minimum	Mean	Maximum	Unit	Source/Reference
A	CBA Variable Parameters					
1	Calf market price	4,000,000	6,493,525	13,000,000	IDR / head	Field Survey (2024)
2	Productive female Bali cattle	—	4,455	—	heads	Dinas Pertanian, ketahanan pangan dan perikanan (2022)
3	Prevalence of repeat breeding	5.5	19.4	33.3	%	Gustafsson & Emanuelsson (2002) ^[5]
4	Clinical efficacy of intervention	—	67.0	—	%	Suputra <i>et al.</i> (2023) ^[13]
B	Direct Consumable Costs					
5	Veterinary operational fees	50,000	100,000	150,000	IDR / head	Field Veterinarians
6	Insemination gloves (100 pcs)	87,000	89,000	88,000	IDR / box	Field Veterinarians
7	Non-detergent soap	10,000	15,000	20,000	IDR / unit	Field Veterinarians
8	Disposable syringes (5 mL)	65,000	70,000	75,000	IDR / box	Field Veterinarians
9	Hypodermic needles (18 G)	60,000	65,000	70,000	IDR / box	Field Veterinarians
10	Gonadotropin-Releasing Hormone (GnRH)	—	652,000	—	IDR / vial	Field Veterinarians
11	Sterile water for injection (20 mL)	7,000	8,000	9,000	IDR / ampoule	Field Veterinarians
C	Technical Capacity Building Costs					
12	Veterinarian & inseminator training	—	75,000	—	IDR / person	Regional Expenditure Standard
13	Keynote speaker honorarium	—	400,000	—	IDR / hour	Regional Expenditure Standard
14	Moderator honorarium	—	700,000	—	IDR / person	Regional Expenditure Standard
15	Workshop catering	30,000	40,000	50,000	IDR / person	Field Survey (2024)
16	Institutional travel allowance	—	75,000	—	IDR / person	Regional Expenditure Standard

17	Workshop promotional banners	—	350,000	—	IDR / unit	Regional Expenditure Standard
18	Local ceremonial offerings (<i>Banten</i>)	—	150,000	—	IDR / activity	Regional Expenditure Standard
19	Venue rental	3,000,000	4,000,000	5,000,000	IDR / day	Expert Opinion
20	Technical pocketbooks	10,000	20,000	30,000	IDR / copy	Expert Opinion
D	Recurring Operational Costs					
21	Active surveillance and monitoring	15,000	20,000	25,000	IDR / head / visit	

2.3 Data analysis and mathematical modelling

2.3.1. Estimation of baseline economic losses

Direct economic losses due to RB were calculated as a function of prevalence, the susceptible breeding female population, and the average economic value of a calf. Variable maintenance inputs, such as supplementary feed costs and informal household labor, were excluded from the model because the regional production system relies predominantly on extensive grazing or backyard smallholder management, making standardized cost estimations highly volatile. The annual economic loss (L) was calculated using the following deterministic formula:

$$L = P \times N \times H$$

Where:

L = Total estimated annual economic loss from repeat breeding cases in Bali cattle (IDR/year)

P = Prevalence of repeat breeding within the population (%)

N = Total population of sexually mature, reproductive female Bali cattle in the study area

H = Average market price of a healthy weaned calf (IDR/head)

2.3.2. Cost-benefit and comparative scenario analysis

The cumulative present value of benefits (PVB) and costs (PVC) associated with the implementation of the therapeutic control strategy was projected over a 5-year timeline. To test the economic feasibility of the intervention, the Net Present Value (NPV) and Benefit-Cost Ratio (BCR) were evaluated using standard financial formulas:

$$NPV = \sum_{t=1}^n \frac{B_t - C_t}{(1+r)^t}$$

$$BCR = \frac{\sum_{t=1}^n \frac{B_t}{(1+r)^t}}{\sum_{t=1}^n \frac{C_t}{(1+r)^t}}$$

Where B_t represents the financial benefits at year t , C_t represents the intervention costs at year t , and r denotes the discount rate (5%). A comparative descriptive analysis was subsequently executed to evaluate the economic trajectory of the cattle population under two distinct policy scenarios: (i) a non-intervention baseline ("counterfactual scenario") versus (ii) a structured veterinary handling program ("intervention scenario").

2.3.3 Sensitivity analysis

Given the structural constraints of field data availability, the baseline demographic and epidemiological parameters (cattle population and baseline RB prevalence) were assumed to remain stationary over the 5-year evaluation period. While the primary economic valuation was established on mean inputs, a deterministic sensitivity analysis was conducted to assess the robustness of the model. This was achieved by systematically substituting the baseline RB prevalence with its minimum (5.5%) and maximum (33.3%) bounds to evaluate the elasticity and variance of the resulting NPV and BCR estimates.

3. Results

3.1. Baseline economic losses from repeat breeding

Based on a baseline population of 864 reproductive female Bali cattle diagnosed with repeat breeding (RB), the total projected economic loss in Bangli Regency in the absence of an intervention program was estimated at IDR 33,672,953,111 over a five-year period. This macroeconomic drain corresponds to a constant annual opportunity loss of IDR 5,612,158,852, reflecting the unrealized market value of potential calf production (Table 2).

Table 2: Projected annual economic losses due to untreated repeat breeding in Bali cattle in Bangli Regency

Period/Year	Economic loss without control program (IDR)
T ₀ 2024	- 5,612,158,852
T ₁ 2025	- 5,612,158,852
T ₂ 2026	- 5,612,158,852
T ₃ 2027	- 5,612,158,852
T ₄ 2028	- 5,612,158,852
T ₅ 2029	- 5,612,158,852
Total	- 33,672,953,111

3.2 Cost-benefit analysis of the reproductive control program

The financial metrics evaluated over the five-year implementation of the RB control strategy demonstrated high economic viability. The cumulative Present Value of Benefits (PVB) reached IDR 5,542,872,940 under a non-discounted model, and IDR 4,921,512,435 when adjusted with the 5% social discount rate.

Temporally, the maximum financial returns were achieved in Year 2 (T₂ / 2026), yielding a discounted PVB of IDR 3,393,595,678 (undiscounted: IDR 3,741,439,235). This substantial spike in revenue represents the market commercialization of 576 calves born to previously subfertile cows that successfully conceived post-treatment. Conversely, the lowest benefit trajectory was recorded in Year 5 (T₅ / 2029), generating a discounted PVB of IDR 108,574,650 (undiscounted: IDR 138,571,824) from the final cohort of 192 calves (Table 3).

Table 3: Present Value Benefit of handling repeat breeding in Bali cattle in Bangli for five-year program

Period/Year	Benefit (IDR)	Present Value Benefit (IDR)
T ₀ 2024	0	0
T ₁ 2025	0	0
T ₂ 2026	3,741,439,235	3,393,595,678
T ₃ 2027	1,247,146,412	1,077,331,961
T ₄ 2028	415,715,471	342,010,146
T ₅ 2029	138,571,824	108,574,650
Total	5,542,872,940	4,921,512,435

The cumulative Present Value of Costs (PVC) for the program amounted to IDR 1,108,090,140 (undiscounted) and IDR 1,072,550,547 (discounted). Operational expenditures peaked at the initiation phase (T₀ / 2024) at IDR 234,089,077 due to upfront capital mobilization for technical extension services, information-education-communication (IEC) campaigns, human resources training, and clinical

consumables for the baseline pool of 864 affected cows. Program maintenance costs subsequently declined, reaching a minimum discounted value of IDR 140,037,243 (undiscounted: IDR 178,726,951) by Year 5 (T₅ / 2029) (Table 4).

Table 4: Present Value Cost of handling repeat breeding in Bali cattle in Bangli for five-year program

Period/Year	Cost (IDR)	Present Value Cost (IDR)
T ₀ 2024	234,089,077	234,089,077
T ₁ 2025	226,483,026	215,698,120
T ₂ 2026	194,247,675	176,188,368
T ₃ 2027	183,502,558	158,516,409
T ₄ 2028	179,920,853	148,021,331
T ₅ 2029	178,726,951	140,037,243
Total	1,108,090,140	1,072,550,547

The programmatic Net Present Value (NPV) over the five-year duration was established at IDR 3,848,961,888. The annual NPV achieved its maximum in Year 2 (T₂ / 2026) at IDR 3,217,407,310, concurrent with peak calf sales. Conversely, negative financial yields were recorded during the initial investment phases (T₀ and T₁) and the final year

(T₅), where cash outflows outpaced discounted benefits (Table 5). Aggregating these financial streams yielded a highly favorable Benefit-Cost Ratio (BCR) of 4.59.

Table 5: Consolidated annual financial matrix of the repeat breeding control program

Period/Year	PVB (IDR)	PVC (IDR)	NPV (IDR)
T ₀ 2024	0	234,089,077	-234,089,077
T ₁ 2025	0	215,698,120	-215,698,120
T ₂ 2026	3,393,595,678	176,188,368	3,217,407,310
T ₃ 2027	1,077,331,961	158,516,409	918,815,552
T ₄ 2028	342,010,146	148,021,331	193,988,816
T ₅ 2029	108,574,650	140,037,243	-31,462,593
Total	4,921,512,435	1,072,550,547	3,848,961,888

3.3. Scenario comparison: non-intervention vs. programmatic control

The economic dividends of the veterinary intervention program are directly linked to clinical success rates. Out of the 864 chronically subfertile cows treated, the active pool of repeat breeders decreased progressively to just 4 cases by Year 5 (T₅ / 2029), effectively yielding a cumulative output of 854 calves over the project cycle (Table 6).

Table 6: Calculation of the total of repeat breeders treated and the potential calves produced in Bali cattle in Bangli for five-year handling program

Period/Year	Population of repeat breeders in Bali cattle	Calves produced from the treated repeat breeding female Bali cattle
T ₀ 2024	864	0
T ₁ 2025	288	0
T ₂ 2026	96	576
T ₃ 2027	32	768
T ₄ 2028	11	832
T ₅ 2029	4	854

Due to the physiological lag between hormonal therapeutic intervention, conception, and gestation, no financial benefits materialized during the first two years (T₀ and T₁). Profitable returns commenced in Year 2 (T₂ / 2026) at IDR 3,741,439,235 and grew to a cumulative gross revenue of IDR

19,677,198,937 by Year 5. In contrast, maintaining a counterfactual non-intervention status quo incurred steady losses of IDR -5,612,158,852 annually, accumulating a severe five-year deficit of IDR -33,672,953,111 (Table 7).

Table 7: Comparative economic trajectories between the programmatic intervention and the non-intervention counterfactual

Period/Year	Strategic Intervention Scenario (IDR)	Non-Intervention Counterfactual Scenario (IDR)
T ₀ 2024	0	- 5,612,158,852
T ₁ 2025	0	- 5,612,158,852
T ₂ 2026	3,741,439,235	- 5,612,158,852
T ₃ 2027	4,988,585,646	- 5,612,158,852
T ₄ 2028	5,404,301,117	- 5,612,158,852
T ₅ 2029	5,542,872,940	- 5,612,158,852
Total	19,677,198,937	- 33,672,953,111

3.4. Sensitivity analysis

Deterministic sensitivity analysis was executed to evaluate the economic stability of the model against variations in two primary input parameters: baseline RB prevalence and calf market prices. Substituting the baseline RB prevalence with a minimum bound of 5.5% reduced the NPV to IDR 559,490,858 (a 15% reduction relative to the mean model baseline) based on a recalculated PVB of IDR 1,395,274,144 and a PVC of IDR 835,783,286. The corresponding BCR decreased by 36% to 1.67. Conversely, utilizing the maximum epidemiological bound of 33.3% expanded the NPV by 53% to IDR 7,223,080,536 (PVB: IDR 8,447,750,726; PVC: IDR 1,224,670,189) and escalated the BCR by 67% to 6.90. With respect to commodity pricing, modeling the minimum calf price of IDR 4,000,000 dropped the projected NPV by

51% to IDR 1,959,092,473, contracting the BCR by 62% to 2.83. In contrast, incorporating the maximum reported calf market price of IDR 13,000,000 drove a substantial 228% surge in NPV, reaching IDR 8,780,289,267, while the BCR amplified by 200% to a value of 9.19.

4. Discussion

Quantifying the precise economic impacts of reproductive disorders in livestock production systems presents a notorious methodological challenge due to the multi-layered nature of direct and indirect financial variables. In the present study, the estimated baseline economic loss due to repeat breeding (RB) in Bali cattle within Bangli Regency was determined to be IDR 5,612,158,852 annually. Given that this evaluation was structurally confined to a single regency, the aggregate

macroeconomic drain at the provincial or national tier is arguably far more severe. For context, reproductive failures in production herds globally incur staggering financial penalties. Deka *et al.* (2021) ^[3] projected that reproductive disorders in the Assam region of India generated an annual economic deficit of USD 59 million, driven primarily by declines in milk yields, cumulative veterinary therapeutic costs, and the absolute loss of aborted calves. While the primary loss commodity in dairy systems centers on milk production, the economic threat in beef-oriented Bali cattle systems rests heavily on the elongation of the calving interval, which directly compromises the annual output of weaned calves.

The five-year programmatic investment simulated in this study yielded a highly positive Net Present Value (NPV) of IDR 3,848,961,888. This robust financial return within a relatively tight analytical horizon demonstrates that structured veterinary interventions can reverse substantial baseline losses into profitable liquidation. Comparable economic resilience was elucidated by Deka *et al.* (2021) ^[3], where the evaluation of three distinct reproductive healthcare strategies yielded positive NPV values ranging from USD 3.1 million to USD 41.9 million. In their model, the inflation of the Present Value of Benefits (PVB) relative to the Present Value of Costs (PVC) was heavily predicated on expanding dairy performance and mitigating abortion rates. In our intervention model for Bali cattle, the driving force behind the positive PVB (IDR 4,921,512,435) was exclusively the successful restoration of cyclical fertility in 854 cows, leading to live calf births.

Deterministic financial models are inherently sensitive to market price fluctuations. Sensitivity analysis indicated that the market valuation of weaned calves exerted the most profound leverage over the elasticity of both NPV and BCR. The baseline mean price utilized (IDR 6,493,525 per head) represents the standard commercial value for calves immediately post-weaning, which is operationally the earliest viable trading window reported by local smallholders. However, the wide market range (IDR 4,000,000 to IDR 13,000,000) underscores the vulnerability of smallholder profit margins to seasonal volatility, supply-demand shifts at

the Kayuumbua animal market, and the phenotypic quality of the stock.

Conversely, the projected program cost (PVC: IDR 1,072,550,547) appeared highly conservative relative to the high epidemiological recovery rate achieved. This expenditure effectively capitalized not only direct clinical input, such as Gonadotropin-Releasing Hormone (GnRH) regimens, veterinary field allowances, and sanitary consumables, but also critical institutional capacity building. Funding decentralized educational extensions and information-education-communication (IEC) campaigns for smallholder communities at the sub-district level is vital. This educational bridge optimizes early disorder detection, thereby minimizing the latent period before professional veterinary notification.

The resulting Benefit-Cost Ratio (BCR) of 4.59 implies that every unit of monetary capital invested in the RB control program returns more than a fourfold dividend. This efficiency compares favorably with long-term veterinary economic frameworks. For instance, Singh *et al.* (2018) ^[12] reported a BCR range of 3.2 to 10.6 across a 20-year multi-treatment reproductive management project in dairy cattle. Although our five-year evaluation window limits the maximum compounding of long-term financial benefits as established by Ascott and Elizabeth (2006) ^[2], who noted that shorter project lifespans systematically truncate the cumulative curve of positive cash flows, the program still demonstrated undeniable financial self-sufficiency within 60 months.

Beyond immediate monetary liquidity, the implementation of this fertility program drives critical indirect demographic benefits for the regional herd structure. The clinical resolution of chronic repeat breeders acts as a direct counter-measure against the premature culling and subsequent slaughter of productive female cows. By successfully restoring optimal conception rates, the model demonstrated that the slaughter of 1,295 productive female Bali cattle could be actively prevented over five years, significantly expanding the localized breeding nucleus (Figure 1).

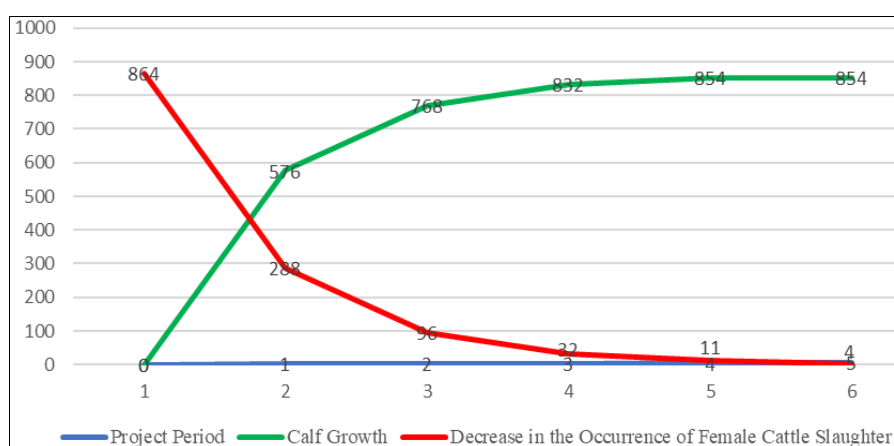


Fig 1: Predicted total number of calves being produced and anticipated repeat breeding female Bali cattle being slaughtered due to the implementation of repeat breeding control program in five years.

If the status quo of non-intervention remains unaddressed, the regional cattle population faces an artificial contraction. The systemic failure to treat RB ensures an annual opportunity loss of IDR 5,612,158,852, culminating in a cumulative five-year macroeconomic deficit of IDR 33,672,953,111. Over time, the unmitigated compounding of repeat breeding cases will cause a downward spiral in local herd dynamics due to low reproductive replacement rates. Consequently, treating

repeat breeding is not merely a localized animal welfare or farm-level profitability concern; it is a critical epidemiological and economic requirement. Without structured veterinary interventions, Indonesia's broader strategic mandate for national beef self-sufficiency and sustainable food security will remain structurally unachievable.

5. Conclusion

This study demonstrates that repeat breeding (RB) poses a severe economic threat to Bali cattle production in Bangli Regency, incurring an annual baseline loss of IDR 5.61 billion and projecting a cumulative five-year counterfactual deficit of IDR 33.67 billion. However, the deployment of a structured five-year reproductive control program centered on hormonal therapy offers a highly viable solution. Financial modeling confirms the program's robust economic feasibility, yielding a Net Present Value (NPV) of IDR 3.85 billion, a Benefit-Cost Ratio (BCR) of 4.59, and generating a total economic dividend of IDR 19.68 billion.

Beyond direct monetary returns, the clinical resolution of RB cases significantly stabilizes regional herd dynamics by increasing cumulative calf births and preventing the premature culling of productive females. Ultimately, these findings underscore that transitioning from a passive non-intervention status quo to an active veterinary handling framework is highly justified. To optimize these economic and demographic rewards, it is recommended that local livestock authorities implement decentralized institutional policies, specifically by expanding smallholder access to hormonal therapeutic interventions and intensifying technical capacity building for field inseminators. Structured reproductive management at the regional level is a critical prerequisite to accelerating regional livestock growth and supporting Indonesia's broader strategic mandate for national beef self-sufficiency.

Acknowledgment

This research was conducted as a collaborative initiative between the Faculty of Veterinary Medicine, Udayana University, and the Department of Agriculture, Food Security, and Fisheries of Bangli Regency, Bali, Indonesia. The study was designed to support local community development and aligns with the United Nations Sustainable Development Goals (SDGs), specifically contributing to SDG 1 (No Poverty), SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-being), SDG 4 (Quality Education), and SDG 17 (Partnerships for the Goals).

Authors' Contributions

PJW: Conceptualization, Methodology, Data Curation, Formal Analysis, Writing – Original Draft. IMK, IBKS.: Methodology, Investigation, Formal Analysis, Writing – Review & Editing. IGNT, DIL, TGOP, JLN: Project Administration, Software, Formal Analysis, Writing – Review & Editing. All authors have read, critically reviewed, and approved the final version of the manuscript for submission in accordance with global academic integrity standards.

Competing Interests

The authors declare that they have no competing financial, personal, or professional interests that could have appeared to influence the work reported in this paper.

Conflict of Interest

Not available

Financial Support

Not available

References

1. Ariningsih E. Performance of national beef self-sufficiency policy. *Forum Penelitian Agro Ekonomi*. 2014;32(2):137-156.
2. Ascott E. A benefit-cost analysis of the San Marcos Conference Center in San Marcos, Texas. San Marcos

(TX): Texas State University-San Marcos, Department of Political Science; 2006.

3. Deka RP, Magnusson U, Grace D, Randolph TF, Shome R, Lindahl JF. Estimates of the economic cost caused by five major reproductive problems in dairy animals in Assam and Bihar, India. *Animals*. 2021;11(11):1-20.
4. Diro S, Mamo T, Getahun W, Mebratu T, Musemma R. The economic loss of dairy cattle poor reproductive performance in central highlands of Ethiopia. *Advances in Dairy Research*. 2021;9(2):248.
5. Gustafsson H, Emanuelsson U. Characterisation of the repeat breeding syndrome in Swedish dairy cattle. *Acta Veterinaria Scandinavica*. 2002;43(2):115-125.
6. Juliana A, Hartono M, Suharyati S. Repeat breeding of Bali cattle in Pringsewu Regency. *Jurnal Ilmiah Peternakan Terpadu*. 2015;3(2):42-47.
7. Marhendra AVH, Zainul A, Yusri A. Analysis of the impacts of the cattle import quota restriction policy on company performance (case study on PT. Great Giant Livestock, Central Lampung, Lampung). *Jurnal Administrasi Bisnis*. 2014;13(1):1-8.
8. Pemayun TGO, Putra S, Puger W. Reproductive performance of Bali cattle in a three-strata system. *Jurnal Kedokteran Hewan*. 2014;8(1):61-63.
9. Pemayun TGO, Budiasa MK, Trilaksana IGNT, Kendran AAS, Dharmayudha AAGO, Gunawan IWNF. Calf birth weight, onset of estrus and postpartum estrogen levels of Bali cows raised in the highlands and lowlands of Gianyar Regency, Bali. *Journal of Animal Health and Production*. 2020;8(2):71-74.
10. Sari DAP, Muladno, Said S. The potential and reproductive performance of Bali cattle breeders in supporting breeding efforts at the field of Peternakan Rakyat School. *Jurnal Ilmu Produksi dan Teknologi Hasil Peternakan*. 2020;8(2):80-85.
11. Sawo K. Evaluation of reproductive efficiency of Bali cattle in Makimi District. *Jurnal Fapertanak*. 2017;2(1):10-19.
12. Singh BB, Kostoulas P, Gill JPS, Dhand NK. Cost-benefit analysis of intervention policies for prevention and control of brucellosis in India. *PLOS Neglected Tropical Diseases*. 2018;12(5):1-16.
13. Suputra GWK, Trilaksana IGNT, Pemayun TGO, Sukernayasa IW, Widiarta INO. Effect of gonadorelin injection during estrus on follicle development, ovulation, and non-return rate in Bali cattle undergoing repeated mating. *Buletin Veteriner Udayana*. 2023;15(2):256-263.
14. Yusuf M, Rahardja DP, Toleng AL, Haryani R, Asja MA, Zulkarnaim, Sahiruddin. Body condition score of Bali cows: its effect on reproductive status. In: *Proceedings of the International Conference on Improving Tropical Animal Production for Food Security*. 2015;1(1):115-121.

How to Cite This Article

Tangkas PJW, Kardana IM, Suardana IBK, Trilaksana IGNT, Laksmi DNDI, Pemayun TGO, *et al.* Economic assessment of a five-year reproductive control strategy for repeat breeding in Bali cattle. *International Journal of Veterinary Sciences and Animal Husbandry*. 2026;11(6):191-196.

Creative Commons (CC) License

This is an open-access journal, and articles are distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 International (CC BY-NC-SA 4.0) License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.