Enhancing Cattle Reproductive Performance and Its Economic Impact on Farmers in Sorong, Southwest Papua through the Upsus Siwab and SIKOMANDAN Programs

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Abstract

The Special Efforts Program for Compulsory Pregnancy of Cattle and Buffalo (Upsus Siwab) and SIKOMANDAN (National Commodity Cattle and Buffalo) are strategic initiatives by the Indonesian Ministry of Agriculture aimed at boosting livestock populations through reproductive optimization. This study evaluates the impact of these programs on livestock reproductive performance and farmers' economic conditions in Sorong Regency, Southwest Papua, by comparing data from 2017 to 2025. The results show that both programs significantly improved pregnancy rates, births, and farmers' incomes compared to the national average. Projections to 2025 indicate a trend of sustained performance improvement and increasing cost efficiency. This article outlines the achievements, challenges, and strategies to enhance program success in the future.

Key words: Upsus Siwab, SIKOMANDAN, Livestock Reproduction, Farmers' Economy, Sorong Regency.

Introduction

Indonesia faces significant challenges in meeting the increasing domestic demand for beef and buffalo meat due to high dependence on imports (Sterzer & Azizah, 2021). The country's livestock sector has historically struggled with low reproductive efficiency, poor genetic quality, and suboptimal herd management practices (Demartini et al., 2015;). The reliance on imported meat not only affects national food security but also poses a risk to the stability of local livestock markets (Tona, 2021). To address these issues, the Indonesian government has implemented strategic initiatives aimed at enhancing local cattle and buffalo production through reproductive optimization and management improvements (Widyas et al., 2022).

The Ministry of Agriculture, through the Directorate General of Animal Husbandry and Animal Health (Ditjen PKH), launched

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the Upsus Siwab (Special Efforts Program for Compulsory Pregnancy of Cattle and Buffalo) in 2016 (Bappenas, 2023). This program aimed to boost livestock populations through targeted artificial insemination (AI) interventions, improved breeding management, and increased farmer participation. The program's core objectives include enhancing reproductive performance, increasing birth rates, and ultimately reducing the dependency on imported meat (Mayberry et al., 2016). The program was later succeeded by SIKOMANDAN (National Commodity Cattle and Buffalo), which began in 2020 with an expanded focus on optimizing the management of reproduction, genetic quality improvement, and strengthening the economic resilience of local farmers (Bappenas, 2023).

Upsus Siwab and SIKOMANDAN are designed to address critical factors affecting livestock reproduction, such as inadequate insemination techniques, low conception rates, and high mortality rates among calves (Firman et al., 2023). The implementation of these programs includes capacity-building initiatives for inseminators, farmers, and extension officers, along with substantial government investment in AI technology, semen quality control, and logistical support (Suyatno et al., 2024) Deb et al., 2020). Additionally, these programs aim to enhance farmers' knowledge and adoption of better reproductive practices, thereby ensuring sustainable improvements in cattle productivity.

Despite these efforts, the success of the Upsus Siwab and SIKOMANDAN programs varies significantly across different regions, influenced by factors such as local environmental conditions, farmer engagement, and the availability of resources. Sorong Regency in Southwest Papua is one such area where these programs have been actively implemented, offering a unique context to evaluate the effectiveness of these interventions. Sorong's distinct geographic and socio-economic characteristics pose specific challenges, including limited access to veterinary services, traditional farming practices, and logistical constraints.

This study focuses on Sorong Regency to assess the impact of the Upsus Siwab and SIKOMANDAN programs on reproductive performance and the economic outcomes for cattle farmers. By comparing local performance data with national averages and projecting trends up to 2025, this research aims to provide a comprehensive evaluation of the programs' effectiveness in enhancing reproductive efficiency and boosting farmers' income. The findings offer valuable insights into the achievements, challenges, and future optimization strategies that can be applied to strengthen these programs and expand their benefits across Indonesia.

Moreover, the study contributes to a broader understanding of how targeted reproductive interventions can transform the livestock sector in developing countries, enhancing food security, and promoting economic resilience among rural communities. By integrating advanced reproductive technologies, improving farmer education, and optimizing resource allocation, Indonesia's livestock development initiatives serve as a model for other nations seeking to address similar challenges in animal husbandry and sustainable agriculture.

Materials and Methods
This study employs a descriptive quantitative approach using data from the

Table 1: Comparison of Reproductive Performance in Sorong and National Average (2017-2021).

Year	Indicator	Sorong	National Average
	Service Per Conception (S/C)	3.0	3.5
2017	Conception Rate (C.R) (%)	65.5	60
	Calving Rate (C/R) (%)	60.0	55
	Service Per Conception (S/C)	2.9	3.4
2018	Conception Rate (C.R) (%)	67.8	61
	Calving Rate (C/R) (%)	62.3	56
	Service Per Conception (S/C)	2.8	3.3
2019	Conception Rate (C.R) (%)	69.5	62
	Calving Rate (C/R) (%)	64.0	57
	Service Per Conception (S/C)	2.75	3.2
2020	Conception Rate (C.R) (%)	70.5	63
	Calving Rate (C/R) (%)	66.0	58
	Service Per Conception (S/C)	2.77	3.5
2021	Conception Rate (C.R) (%)	72.16	60 - 65
	Calving Rate (C/R) (%)	68.04	55 - 60

implementation reports of Upsus Siwab and SIKOMANDAN in Sorong Regency and national data from Ditjen PKH. The analysis includes Service Per Conception (S/C), Conception Rate (C.R), Calving Rate (C/R), and the economic impact on farmers from 2017 to 2025. Statistical analysis involved descriptive statistics and polynomial regression models to identify trends in performance improvement and cost efficiency (Zhou & Ye, 2016).

Data Collection: Data were collected from the Ministry of Agriculture, provincial and district animal husbandry offices, and direct interviews with farmers and inseminators in Sorong Regency. Primary data were categorized into reproductive performance indicators, economic impacts, and cost efficiency metrics.

Data Analysis: Descriptive and statistical analyses were conducted using polynomial regression models to predict future performance and economic impact trends up to 2025. These models help project the

effects of continuous optimization of the programs (Румик et al., 2021).

Results and Discussion

Improvement in Reproductive Performance in Sorong

The implementation of Upsus Siwab and SIKOMANDAN in Sorong showed a significant improvement in livestock reproductive performance compared to the national average. The average Service Per Conception (S/C) in Sorong decreased from 3.0 times in 2017 to 2.77 times in 2021, better than the national average of 3.5 times. The Conception Rate (C.R) increased from 65.5% in 2017 to 72.16% in 2021, and the Calving Rate (C/R) improved from 60% to 68.04%.

Table 1 shows that Sorong's livestock reproductive performance consistently outperformed the national average from 2017 to 2021. The declining Service Per Conception (S/C) value in Sorong reflects higher efficiency in artificial insemination than the national average. Sorong's

Graph 1: Comparison of Reproductive Performance in Sorong vs. National Average (2017-2021).
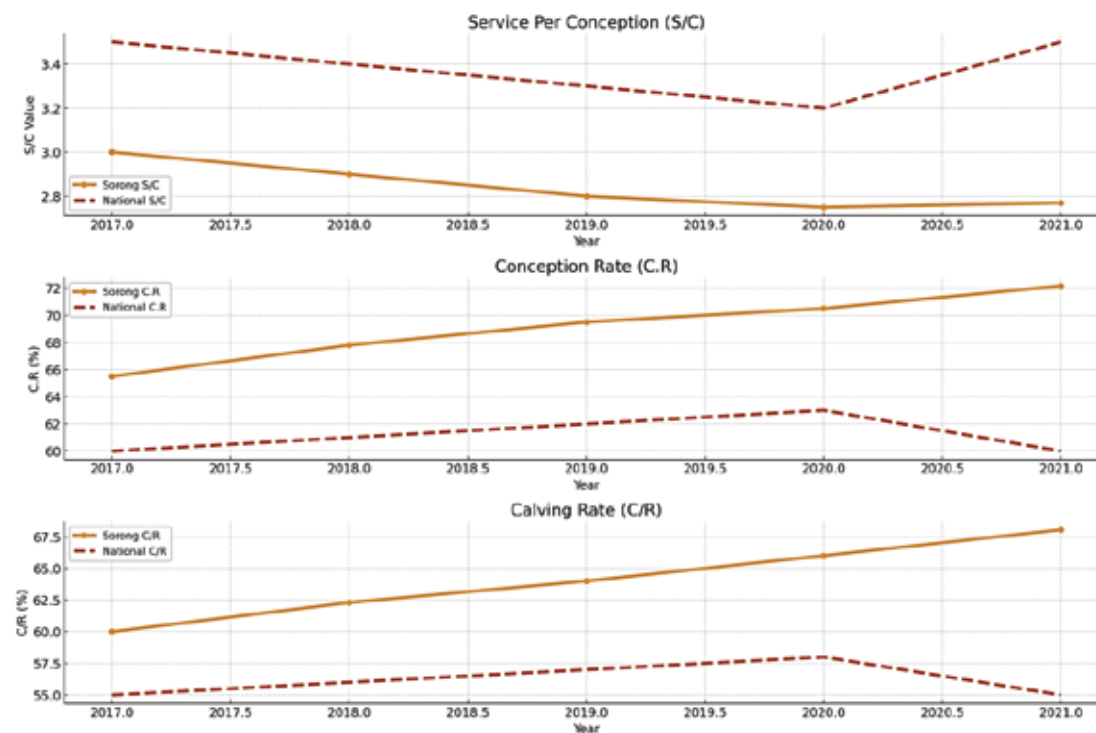
Conception Rate (C.R) increased from 65.5% in 2017 to 72.16% in 2021, exceeding the national standard of 60-65%. Similarly, the Calving Rate (C/R) in Sorong showed a steady increase from 60% in 2017 to 68.04% in 2021, significantly higher than the national average, which stagnated between 55-60%. These data indicate that the Upsus Siwab and SIKOMANDAN programs in Sorong have successfully improved livestock reproductive performance, attributed to better reproductive management, effective inseminator training, and adequate logistical support.

The graph above compares the reproductive performance of Sorong against the national average from 2017 to 2021, highlighting key differences:

1. Service Per Conception (S/C): Sorong consistently shows better efficiency (lower S/C values) compared to the national average, as indicated by the shaded blue area. This reflects improved insemination practices in Sorong.

2. Conception Rate (C.R): Sorong's conception rates are consistently higher than the national average, illustrated by the shaded green area, demonstrating better reproductive outcomes.

3. Calving Rate (C/R): The calving rate in Sorong surpasses the national average, shown by the shaded salmon area, indicating a higher success rate in maintaining pregnancies to full term.

Table 2: Predicted Increase in Farmers' Income in Sorong (2021-2025)

Year	Calf Births (Thousand)	Cost per Calf (IDR)	Calf Price (IDR Million)	Income per Calf (IDR Million)	Total Income (IDR Billion)
2021	3.1	64,516	7.0	6.935	21.5
2022	3.3	60,000	7.0	6.940	22.9
2023	3.5	55,000	7.0	6.945	24.3
2024	3.7	50,000	7.0	6.950	25.7
2025	3.9	45,000	7.0	6.955	27.1

These comparisons underscore Sorong's superior reproductive performance due to effective program implementation.

Impact of Programs on Farmers' Economy

Based on budget data and improvements in reproductive performance during the SIKOMANDAN program, predictions for increased income for farmers in Sorong can be made using assumptions and projections based on historical trends. These predictions consider increased calf births, cost efficiency per calf, and direct impact on farmers' income.

Basic Assumptions for Prediction:

1. Reproductive Efficiency Improvement: The SIKOMANDAN program has increased Conception Rate (C.R), Calving Rate (C/R), and decreased Service Per Conception (S/C), indicating continuous improvement in artificial insemination effectiveness.

2. Reduced Cost per Calf: Program efficiency is also reflected in the reduction of cost per calf from approximately IDR 249,000 in 2017 to IDR 64,516 in 2021. Continued optimization is expected to further reduce costs.

3. Increased Births: The increase in calf births directly boosts the livestock supply for farmers, which can be sold or raised to enhance meat production.

4. Market Price of Calves: The average market price of calves in Indonesia is around IDR 6-8 million per head. The projection assumes a stable price of IDR 7 million per head.

Table 2 shows that emphasizes the positive economic impact of the Upsus Siwab and SIKOMANDAN programs on farmers in Sorong, highlighting the importance of continued support and optimization to sustain and further enhance these benefits.

1. Increase in Number of Births: The number of cattle births is projected to increase from 3.1 million in 2021 to 3.9 million in 2025, driven by improved reproductive performance under the programs.

2. Reduction in Cost per Pedet: The cost per pedet is expected to decline from IDR 64,516 in 2021 to IDR 45,000 in 2025, reflecting increased efficiency in reproductive management and cost control.

3. Stable Market Price and Income per Pedet: With the market price per pedet assumed to be stable at IDR 7 million, the income per pedet increases slightly due to lower production costs, enhancing the overall profitability.

Graph 2: Influence of Upsus Siwab and SIKOMANDAN Programs on Reproductive Performance and Farmers' Income in Sorong (2017-2021).
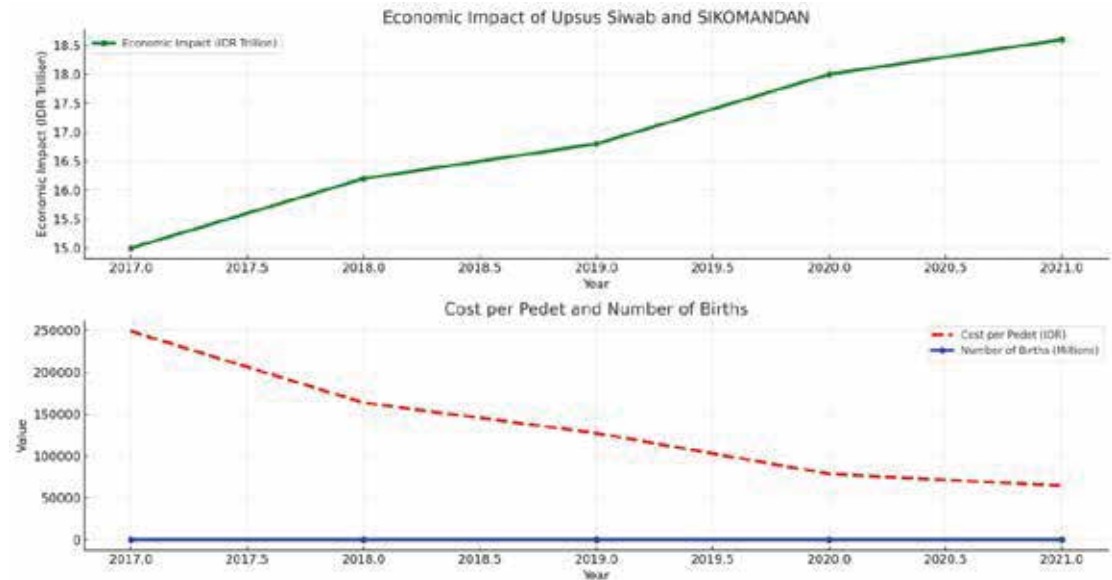
4. Significant Increase in Total Income:
The total income for farmers in Sorong is predicted to grow from IDR 21.5 trillion in 2021 to IDR 27.1 trillion in 2025, representing a substantial boost to farmers' economic well-being.

The graph above illustrates the influence of the Upsus Siwab and SIKOMANDAN programs on reproductive performance and farmers' income in Sorong from 2017 to 2021:

1. Economic Impact: The first graph shows a steady increase in economic impact, rising from IDR 15 trillion in 2017 to IDR 18.6 trillion in 2021. This growth reflects the significant economic benefits these programs bring to farmers through increased cattle births.

2. Cost per Pedet and Number of Births:
The second graph highlights a substantial decrease in the cost per pedet, from IDR 249,000 in 2017 to IDR 64,516 in 2021, indicating improved efficiency.

Simultaneously, the number of births increased from 2.5 million in 2017 to 3.1 million in 2021, underscoring the programs' effectiveness in enhancing reproductive performance.

These graphs emphasize the critical role of the Upsus Siwab and SIKOMANDAN programs in boosting both reproductive outcomes and the economic well-being of farmers in Sorong.

Cost Effectiveness Analysis
The program demonstrated high efficiency, with the cost per calf continuously decreasing over time. The cost per calf for Upsus Siwab decreased from IDR 249,000 in 2017 to IDR 127,321 in 2019. SIKOMANDAN showed even greater efficiency, with costs dropping from IDR 78,700 in 2020 to IDR 64,516 in 2021. This cost effectiveness significantly contributed to increasing farmers' profits alongside rising birth rates recorded annually.

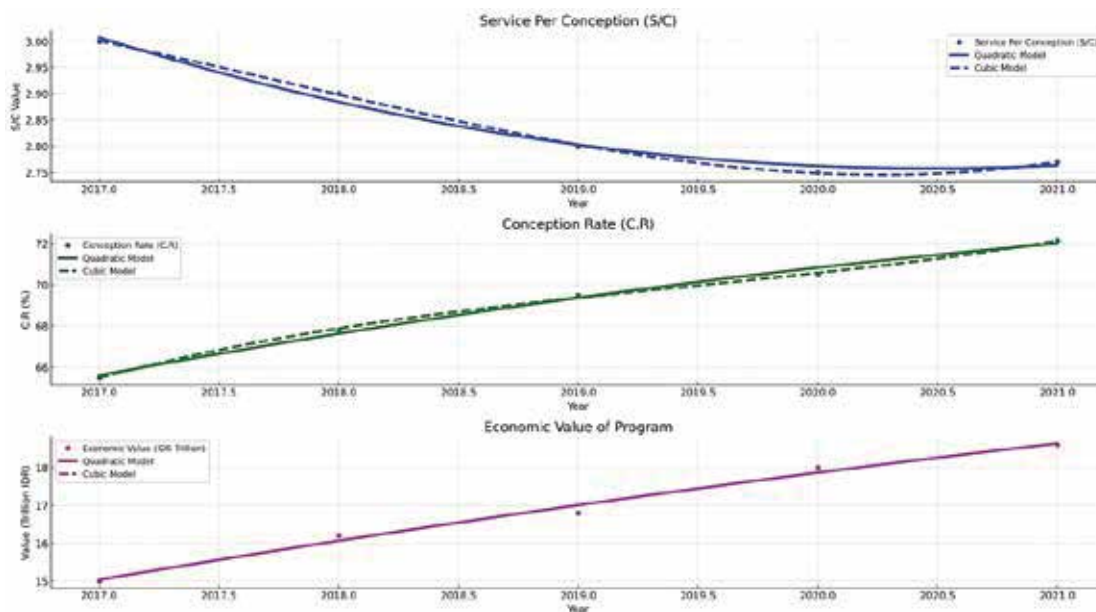**Graph 3:** Quadratic and Cubic Model Influence of Program on Performance and Farmers' Economy.

Table 3. Projected Reproductive Performance and Economic Impact of SIKOMANDAN Program to 2025.

Indicator	2021	2022	2023	2024 (Projected)	2025 (Projected)
Service Per Conception (S/C)	2.7	2.6	2.5	2.4	2.3
Conception Rate (C.R) (%)	72.16	74.0	75.5	77.0	78.5
Calving Rate (C/R) (%)	68.04	70.0	71.5	73.0	74.5
Cost per Calf (IDR)	64,516	60,000	55,000	50,000	45,000
Economic Value (IDR Billion)	18.6	20.0	21.5	23.0	25.0

Review of Cost Effectiveness: The data show that SIKOMANDAN is more efficient in resource utilization than Upsus Siwab. The declining cost per calf reflects improved operational efficiency achieved through better inseminator training, enhanced livestock health management, and advanced technology adoption. This demonstrates that government investment in the program yields significant results in terms of increased output at lower costs.

Program Analysis Models
Using quadratic and cubic polynomial regression models, it is evident that reproductive performance and economic impact have shown a significant upward trend with increased program efficiency.

The graph above illustrates the influence of the Upsus Siwab and SIKOMANDAN programs on performance and farmers' economy using quadratic and cubic models:

1. Service Per Conception (S/C): Both the quadratic and cubic models show a downward trend, indicating improved efficiency in insemination. The cubic model highlights a sharper decline, suggesting

Graph 4: Quadratic Projection of Performance and Economy to 2025
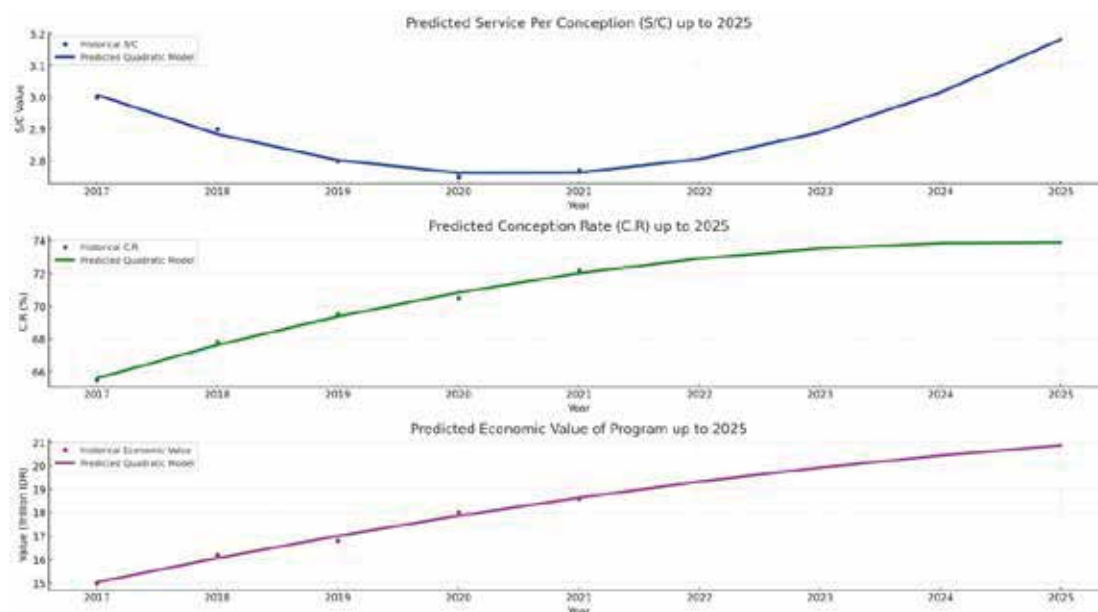
significant progress over the years.

2. Conception Rate (C.R): The models predict continued improvement, with the cubic model showing an accelerated increase compared to the quadratic model. This reflects the growing success of the programs in enhancing reproductive performance.

3. Economic Value: The economic impact has been rising, with both models predicting further growth. The cubic model shows a steeper increase, underscoring the substantial economic benefits that the programs have brought to farmers.

These models demonstrate the strong positive influence of the programs on cattle reproductive performance and economic outcomes for farmers, highlighting the potential for continued progress with ongoing program support and optimization

Performance Projections to 2025
Based on historical data and observed improvement trends, projections to 2025 indicate that reproductive performance and economic impact will continue to increase with ongoing optimization strategies.

The projections in Table 3 illustrate the substantial benefits of the SIKOMANDAN program, not only in terms of reproductive performance improvements but also in enhancing the economic resilience of cattle farmers. These projections provide a clear rationale for continued investment and strategic support to maximize the program's impact by 2025.

1. Improvement in Reproductive Performance:

-The **Service Per Conception (S/C)** is projected to decrease from 2.77 in 2021 to 2.3 by 2025, indicating enhanced efficiency in insemination practices.

-The **Conception Rate (C.R)** is expected to increase steadily from 72.16% to 78.5%, reflecting better reproductive outcomes under the program.

- The **Calving Rate (C/R)** is projected to rise from 68.04% to 74.5%, demonstrating improved success rates in maintaining pregnancies and healthy births.

2. Cost Efficiency:

- The **Cost per Pedet** continues to decrease from IDR 64,516 in 2021 to IDR 45,000 in 2025, highlighting ongoing improvements in operational efficiency and cost management.

3. Economic Impact:

- The **Economic Impact** of the SIKOMANDAN program is expected to grow significantly, from IDR 18.6 trillion in 2021 to IDR 25.0 trillion in 2025. This increase underscores the program's potential to boost farmers' income and strengthen the local and national economy.

The graph above shows the quadratic projections of cattle reproductive performance and economic impact of the Upsus Siwab and SIKOMANDAN programs up to 2025:

1. Service Per Conception (S/C): The projection indicates a continued decrease in S/C, highlighting ongoing improvements in insemination efficiency. By 2025, the S/C value is expected to be significantly lower, reflecting enhanced reproductive management.

2. Conception Rate (C.R): The predicted C.R shows a steady increase, with projections reaching around 78.5% by 2025. This trend underscores the growing success of the programs in achieving higher pregnancy rates among cattle.

3. Economic Value: The projected economic impact is expected to rise steadily, reaching approximately IDR 25 trillion by 2025. This growth reflects the programs' effectiveness in boosting farmers' income through improved reproductive performance and cost efficiency.

These projections demonstrate the potential for sustained and enhanced outcomes in cattle reproduction and economic benefits for farmers if the current programs continue to be optimized and supported.

Conclusion

The Upsus Siwab and SIKOMANDAN programs have significantly improved livestock reproductive performance and farmers' economies in Sorong. These successes are evident in the increased pregnancy rates, births, and ongoing cost efficiency improvements. Further optimization strategies, including advanced reproductive technologies, human resource capacity building, and more effective data utilization, are necessary to achieve even better results.

With continued government support and the implementation of the latest reproductive innovations, these programs have the potential to sustain national meat self-sufficiency and enhance the well-being of local farmers. Through a comprehensive approach, SIKOMANDAN can serve as a model for livestock reproductive management and economic development in Indonesia.

References

Deb, G.K., Dey, S., Alam, M., Sarker, N., Rahman, M., Nahar, T. and Miraz, M. 2020. Biometrical analysis of bovine female reproductive system. Bang. J. Lives. Res., 20(1–2), 1–7.

Demartini, E., Pirani, A., Bertocchi, M., Marescotti, M. E. and Gaviglio, A. 2015. The hidden costs of animal health in dairy cattle breeding:

evidences from a case study. Ital. J. Anim. Sci., 14(suppl. 1), 45.

Firman, A., Kuswaryan, S., Nurlina, L., Hadiana, M. H., Sulistyati, M., Yunasaf, U., Budinuryanto, D. C. and Trisman, I. 2023. Valuation of massive artificial insemination programs and the economic impact for Indonesia. Adv. Anim. Vet. Sci., 11(7): 1037–1046.

Kementerian Perencanaan Pembangunan Nasional/Badan Perencanaan Pembangunan Nasional. 2023. Metadata Indikator Pembangunan Rencana Kerja Pemerintah (Rkp) Tahun 2024. https://perpustakaan.bappenas.go.id/e-library/file_upload/koleksi/dokumenb appenas/konten/Upload Terbaru/Buku Metadata Indikator RKP 2024.pdf

Mayberry, D., Cowley, F., Cramb, R., Poppi, D., Quigley, S., McCosker, K. and Priyanti, A. 2016. Project Improving the reproductive performance of cows and performance of fattening cattle in low input systems of Indonesia and northern Australia. Australian Centre for International Agricultural Research.

Sterzer, S. and Azizah, S. 2021. Trade and cooperation opportunities for the MERCOSUR countries in the livestock sector and beef meat in Indonesia. Jurnal Ilmu-Ilmu Peternakan, 31(2), 175–185.

Suyatno, S., Alamsyah, M. T., & Novianto, D. (2024). Application of artificial insemination as an effort to increase beef cattle population in Bangka Belitung Islands, Indonesia. AIP Conference Proceedings, 2957(1).

Tona, G.O. 2021. Impact of beef and Milk sourced from cattle production on global food security. Bovine Science—Challenges and Advances. Bovine Science.

Widyas, N., Widi, T.S.M., Prastowo, S., Sumantri, I., Hayes, B.J. and Burrow, H.M. 2022. Promoting sustainable utilization and genetic improvement of Indonesian local beef cattle breeds: a review. Agriculture, 12(10): 1566.

Zhou, B. and Ye, H. 2016. A study of polynomial fit-based methods for qualitative trend analysis. J. Process Control, 37: 21–33.

Румик, І., Лаптєв, С., Сегеда, С., Акімова, Л., Акімов, О. and Карпа, М. 2021. Financial support and forecasting of food production using economic description modeling methods. Financial and Credit Activity Problems of Theory and Practice, 5(40): 248–262.