Influential Factors and Strategies to Improve Insemination Success Artificial in Cattle in Asahan District, North Sumatera

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ABSTRACT

The slow growth of the cattle population is generally caused by the suboptimal knowledge of reproductive management at the farmer level and the performance of livestock that is not in accordance with their growth period. Suboptimal reproductive management has implications for the number of repeated Artificial Insemination (AI) incidents or Service per Conception (S/C) which is still high so that the calving interval is longer than normal. Suboptimal cattle reproductive management will cause major losses for farmers both in material and immaterial terms. The purpose of this study was to determine the success of Artificial Insemination (AI) in Asahan Regency, to analyze what factors influence the Success of Artificial Insemination in Asahan Regency, and to formulate a Strategy to Increase the Success of Artificial Insemination in Asahan Regency. The data collected in this study were primary data and secondary data. The data obtained were then analyzed using multiple linear regression statistics. The AI program in Asahan Regency was quite successful, this was indicated by the average S/C value ranging from 1.69, CR ranging from 61.4%, and NRR ranging from 67.92%. Based on the results of the F test (simultaneous), the calculated F value is obtained > F table, so that the independent variables simultaneously affect the success of AI. The results obtained are the calculated F value (37.688) > F table (2.198) and the value (Sig) <0.001 is smaller than 0.05. Policies needed to increase the success of AI include utilizing government support and genetic improvement, implementing livestock health and nutrition improvement programs, improving ongoing education and training programs, utilizing opportunities for collaboration with academics and researchers.

Keywords: *Factor Analysis, Artificial Insemination, Asahan Regency, Cattle*

INTRODUCTION

Artificial insemination (AI) is one of the biotechnologies in the field of livestock reproduction that allows the process of mating female livestock without keeping males. This AI activity is a series of planned and programmed processes because it is related to the genetic distribution of livestock in the future. The advantages of AI in cattle in Indonesia include faster genetic quality improvements because they use semen from superior males, can save on the cost of maintaining males and can limit or prevent the transmission of reproductive diseases from inseminated livestock. The expertise and experience of the Inseminator are determining factors in the successful implementation of Artificial Insemination (AI). A common mistake often made by Inseminators is placing semen incorrectly in the reproductive tract, namely inserting it into the cervix not in the correct position, directly into the uterus. Technical knowledge about reproduction and cattle breeds must be truly understood by the Officer (Inseminator).

The success rate of Artificial Insemination technology in a region can be described by looking at S/C, CR and NRR data (Susilowati, 2011). Susilo (2005) and Rasad et al. (2008) argue that the evaluation of the efficiency of AI activities that are commonly carried out are the number of pregnancies per mating or *Service per Conception* (S/C), Pregnancy Rate or Conception Rate (CR), and the number of animals that do not show heat again after AI or *Non Return Rate* (NRR). Efforts to increase the success of Artificial Insemination (AI) need to pay attention to factors that influence the implementation of Artificial Insemination. Knowledge of farmers about reproductive management, Livestock performance that does not match their growth period, Expertise and Experience of AI Officers (Inseminators), AI Facilities and Infrastructure (Seed Quality, Liquid N2 and AI equipment) and livestock diseases. From the description above, the author is interested in conducting an Analysis of Influential Factors and Strategies to Increase the Success of Artificial Insemination in Cattle in Asahan Regency, North Sumatra.

MATERIALS AND METHODS

Location and Time of Research

This research was conducted in Asahan Regency. This research was conducted for three months starting from the field data survey, then continued with data analysis, until writing in the form of a thesis. Time allocation from July to September 2023.

Research methods

The respondents of the study were cattle breeders and inseminator officers located in 3 sub-districts. The research method used was a survey method with a respondent unit that raised livestock. The population of this study was all cattle breeders located in Teluk Dalam Sub-district (low population), Pulo Bandring (medium population) and Sei Kepayang (high population) in Asahan Regency and the determination was carried out using the Slovin formula. Factors that influenced the success rate of artificial insemination (AI) in this study included the age of the livestock, the knowledge of the breeder about estrus, skills, ib officers, availability of seeds, local government regulations, and distance of the location. The data obtained were then analyzed using multiple linear regression analysis statistics.

RESULTS AND DISCUSSION

Service Per Conception Rate (S/C)

Service per conception (S/C) is a number that indicates the number of matings that can result in a pregnancy. To obtain S/C from research results obtained by recording the implementation. The results of the average S/C value research can be seen in the table below.

Table 1. Average S/C Value in Asahan Regency

Population	Year				
	2018	2019	2020	2021	2022
Low (Sei Kepayang)	1.67	1.82	1.68	1.59	1.67
Medium (Pulo Bandring)	1.78	1.65	1.60	1.59	1.54
Height (Deep Bay)	1.75	1.96	1.84	1.68	1.56

Source: Asahan in figures (BPS Asahan Regency)

In general, lower S/C values are better, as they indicate higher reproductive efficiency. In the low population category, S/C values fluctuate but remain relatively stable, with the highest value in 2019 (1.82) and the lowest in 2021 (1.59). The medium population category shows a decrease from 1.78 in 2018 to 1.54 in 2022, indicating an increase in reproductive efficiency. Meanwhile, the high population category experienced a spike in 2019 (1.96), but then continued to decline to 1.56 in 2022, indicating an improvement in insemination efficiency. Overall, these data indicate that the reproductive system is increasingly efficient in the medium and high categories, while the low category tends to be stable with little fluctuation. This value is still quite good because the value is still below 2. According to Siaga *et al* ., (2014), the S/C number if it is below 2 means that the cow can still breed once a year, if the S/C number is above 2 it will cause the ideal calving interval not to be achieved and indicates that the cow's reproduction is less efficient which makes the calving interval long. So that it can harm farmers because they have to spend more AI costs.

The S/C value in the study has a good value and this is supported by the number of livestock populations in Asahan Regency which increases every year. The increase in the number of populations in Asahan Regency can be seen in the table below.

Table 2. Cattle Population in Three Sample Districts in Asahan Regency (Heads)

Subdistrict	Cow (Year)				
	2018	2019	2020	2021	2022
The Beautiful Sea	526	531	536	875	420
Bandring Island	8.568	8.654	8.740	8.543	10.237
Deep Bay	3.963	4.003	4.043	15.972	12.047

Source: Data from the Department of Animal Husbandry and Animal Health

The table above shows the cattle population in three sample sub-districts in Sei Kepayang (low population), Pulo Bandring (medium population), and Teluk Dalam (high population) from 2018 to 2022. Sei Kepayang sub-district, which has a low population, has a relatively stable cattle population from 2018 to 2020, with a small increase from 526 in 2018 to 536 in 2020. There was a sharp increase in 2021, reaching 875. However, in 2022 the number of cattle decreased drastically to 420.

Pulo Bandring District, which has a medium population, has a relatively stable cattle population from 2018 to 2020, with a slight increase from 8,568 in 2018 to 8,740 in 2020. In 2021, the population decreased slightly to 8,543. However, in 2022 there was a significant spike to 10,237.

Teluk Dalam District, which has a high population, from 2018 to 2020 the cattle population increased slowly, from 3,963 in 2018 to 4,043 in 2020. 2021 showed a very sharp increase, with a population reaching 15,972. In 2022, the cattle population dropped to 12,047, but this figure is still higher than previous years.

Sulaksono, *et al* ., (2010) stated that the high and low S/C values can be influenced by several factors including inseminator skills, time in performing artificial insemination and the knowledge of farmers in detecting estrus. The cause of the high S/C rate is generally due to farmers being late in detecting estrus or

late in reporting their cows' estrus to the inseminator, abnormalities in the reproductive organs of the mother cow, inseminators being less skilled, insemination service facilities that are still limited, and poor transportation to the livestock location (Iswoyo and Widiyaningrum, 2008).

Conception Rate (CR)

Conception Rate (CR) is the percentage of pregnant cows in The conception *rate* is one method to measure the high or low reproductive efficiency. *Conception rate* (CR) is the percentage of pregnant cows from the first insemination (Sakti, 2007). The results of the average CR value research can be seen in the table below.

Table 3. Results of the Average CR Value Assessment in Asahan Regency (Tail)

Population	Year				
	2018	2019	2020	2021	2022
Sei Kepayang (Low)	60.8%	66.70%	55.50%	63.30%	61%
Pulo Bandring (Medium)	51.6%	67.7%	54.3%	61.9%	64.2%
Deep Bay (High)	63.5%	62.7%	62.7%	63.1%	61.5%

Source: Data from the Department of Animal Husbandry and Animal Health

In general, higher CR values indicate better reproductive efficiency. In the low category, CR fluctuated, with a significant increase in 2019 (66.7%), a decrease in 2020 (55.5%), and then increased again in the following years to reach 61% in 2022. The medium category showed a fairly good increasing trend, from 51.6% in 2018 to 64.2% in 2022, indicating an increase in pregnancy efficiency. Meanwhile, the high category was relatively stable, ranging from 61.5% to 63.5%, with no drastic changes from year to year. Overall, these data indicate an increase in reproductive efficiency in the medium category, stability in the high category, and fluctuation in the low category, which may reflect variations in reproductive management or other external factors. Based on the results of the research calculations, the average CR value according to Toelihere (1993) is the best CR reaching 60-70%, while for Indonesia, taking into account natural conditions, management and distribution of livestock, it is considered good if the CR value reaches 45-50%.

Fanani *et al.*, (2013) stated that the CR value is determined by the fertility of the bull, the fertility of the female, and the insemination technique. One of the responsibilities of the Artificial Insemination Center (BIB) which produces frozen semen in addition to storage management at the inseminator level. The fertility of the female is the responsibility of the farmer assisted by a veterinarian who is tasked with monitoring the health of the mother cow. Meanwhile, the implementation of AI is the responsibility of the inseminator. Apriem *et al.*, (2012) explained that the high and low CR is influenced by the condition of the livestock, detection of estrus, detection of estrus and reproductive management which will affect the fertility of the livestock and the conception value.

***Non Return Rate* (NRR)**

Non Return Rate (NRR) is livestock that do not show any return of lust after mating/insemination within 28-

35, 60-90 and >90 days. The NRR assessment is based on the assumption that cattle that do not show signs of re-estrus are pregnant from the first mating. The results of the average NRR value study can be seen in the table below.

Table 4. Results of Calculation of Average NRR Value in Asahan Regency

Population	Year				
	2018	2019	2020	2021	2022
Sei Kepayang (Low)	66.70%	72%	66.70%	73.32%	68%
Pulo Bandring (Medium)	65.10%	53.40%	62.80%	78%	77.30%
Deep Bay (High)	63.50%	62.80%	64.30%	73.40%	71.50%

Source: Data from the Department of Animal Husbandry and Animal Health

This data shows *the Non-Return Rate* (NRR) or the percentage of cattle that do not show signs of heat again after insemination within a certain period (usually 21 or 60 days) in three population categories (low, medium, and high) from 2018 to 2022. In general, a higher NRR value indicates better reproductive success because it indicates a higher probability of pregnancy. In the low category, the NRR value tends to fluctuate, with a peak in 2021 (73.32%) and a decline back to 68% in 2022. The medium category shows a significant increasing trend, from 53.4% in 2019 to 78% in 2021, although it slightly decreased to 77.3% in 2022, indicating an improvement in reproductive efficiency. Meanwhile, the high category also experienced an increase, especially in 2021 (73.4%), but slightly decreased to 71.5% in 2022. Overall, these data show improvements in reproductive efficiency especially in the medium and high categories, while the low category experienced fluctuations that may be influenced by reproductive management factors or environmental conditions.

Assessment of NRR that every cow that does not show estrus again is not necessarily pregnant. According to Toelihere (1993) the NRR assessment is not very correct because females that do not show estrus again are likely to die, be sold, be lost, have quiet estrus, Corpus Luteum Persistence (CLP) and not be pregnant. The number of livestock is the number of livestock (heads) kept by farmers. The number of livestock is also influenced by the birth rate and mortality of Goat livestock. According to Ikun (2018) the livestock population includes the number of livestock, young, adults and calves that can be obtained from the research location by researchers, through interviews and direct counting in the field.

Evaluation of IB Success in Asahan Regency

The need for beef increases every year along with the increasing population, increasing income and welfare of the community, and increasing knowledge about the importance of animal protein. In addition, the provision of meat is still relatively low when compared to demand. This gap can be reduced by various efforts that can increase productivity, especially for smallholder beef cattle breeders (Nuryadi and Wahjuningsih, 2011). One of the efforts made by the local government is to try to increase the population and productivity as well as the genetic quality of livestock through the application of livestock reproductive technology, both artificial insemination (AI) and embryo transfer (Sibagariang *et al* ., 2010).

The results of the evaluation of the success of IB in the results of this study indicate that IB activities in Asahan Regency were successful, this is based on seeing the NRR value of (66.7%) to 98% greater than normal, which is a minimum of 70%. CR of (67.7% to 80.9%) is greater than normal, which is 70%. S / C of (1 to 1.5) is lower than normal (value below 2). The results above are in accordance with the opinion of Susilo (2005) that, the evaluation of the efficiency of IB activities that are commonly carried out, namely NRR, CR and S / C, the better the numbers of the three parameters, the better the goal of insemination biotechnology will be to achieve reproductive efficiency which can affect the development of the cattle population in an area. Likewise, conversely, if the results of the three parameters are getting worse or do not match the standard value, it will reduce the reproductive efficiency value, meaning that the goal of insemination biotechnology is unsuccessful.

The implementation of AI in North Sumatra Province was first carried out in 2007, involving nine districts and two cities, namely, Mandailing Natal Regency, Deli Serdang, Langkat, Simalungun, Karo, Asahan, Labuhan Batu, South Tapanuli, Serdang Bedagai and Binjai City and Medan. The cattle population in North Sumatra is very high and almost every district/city has cattle. North Sumatra Province is targeting beef self-sufficiency in 2010. The above target is based on the population of beef cattle and dairy cattle per district/city and also the livestock maintenance system in North Sumatra Province (Sibagariang *et al.*, 2010). One of the districts in North Sumatra that has a relatively good AI success rate is Asahan Regency, which is almost 70%. Information from data from the Directorate General of Animal Husbandry and Animal Health of the Ministry of Agriculture in 2017 stated that in Asahan Regency, out of 19,390 acceptors, the number of acceptors who successfully became pregnant reached 12,991. The success factor of IB is influenced by the knowledge of the farmer in the symptoms of estrus, the implementation of IB, the experience of the inseminator, and the quality of the sperm. According to Hoesni (2015), the factors that influence IB are fertility, inseminator skills, estrus detection, insemination time, number of sperm, insemination dose and semen composition and several things that can influence IB are the condition of the livestock, the level of education of the farmer, the experience of giving birth for cows, good sperm quality and experienced inseminators. One of the keys to the success of IB is that the cows are kept intensively by being penned. This will facilitate the detection of estrus and make it easier for officers to carry out IB (Ihsan, 2010).

Cattle farming in Asahan Regency is a community farm, most respondents own more than four cattle with an average ownership of 6-8 cattle, this is because farmers make livestock as a side business to get a source of income that meets the economic needs of farmers. Support from the local government through counseling and insemination services by inseminators also helps increase the success rate of AI in Asahan Regency. This collaborative effort between farmers and the government is expected to continue to increase cattle productivity in the area.

Breeder Profile

Farmers in Asahan Regency are generally local people who have long been involved in the livestock sector as their main livelihood. On average, farmers have quite large areas of land for grazing and planting animal feed. Many of them have received training and counseling from related agencies, so they are able to implement more efficient and sustainable livestock practices. In addition, farmers in Asahan also tend to collaborate in farmer groups or cooperatives to strengthen marketing networks and gain better access to supporting facilities such as quality feed, medicines, and animal health services. Support from the local government and the availability of abundant natural resources further encourage the productivity and quality of livestock products, making livestock a vital sector for the economy of Asahan Regency.

The profile of farmers as respondents in this study includes the characteristics of the age of the respondents , the main education of the respondents , and livestock farming experience, as presented in the table below based on three sub-districts that represent the population. The ability of farmers to detect estrus and the right

time for AI and to manage livestock to support success cannot be separated from several influencing factors, including the age of the farmer, the length of farming and the education of the farmer. This is also clarified by the opinion of Alim & Nurlina, (2014) who stated that farmers' acceptance of innovation is related to their perception of innovation, while the perception of the farmers themselves is related to their background. respectively, because the acceptance of innovation will be influenced by the perceptions and characteristics of the farmers themselves.

Breeder Age

The following are the results of descriptive analysis related to the age of the farmers who were included as respondents in this study.

Table 5. Results of Descriptive Analysis of Respondents' Age Characteristics

Respondent Age (years)	Subdistrict		
	The Beautiful Sea	Bandring Island	Deep Bay
20-30	0	3	6
31-40	1	6	16
41-50	1	7	23
51-60	1	16	11
>60	0	2	7
Amount	3	34	63

Source: Results of questionnaire data processing

Based on age group, farmers in the age range of 41-50 years are the group with the highest population in the high category, which is 23 people. This shows that this age group dominates the number of farmers quite a lot. In addition, the 31-40 year group also has a significant number of farmers in the high category, which is 16 people. Meanwhile, the 20-30 year age group has the fewest number of farmers in the Little category, showing that the younger generation still has low involvement in the livestock business.

In the Medium category, the 51-60 age group has the largest number of farmers, which is 16 people. This shows that at this age, there are still many active farmers, although the number is not as many as in the high category. Meanwhile, the age group over 60 years has a relatively smaller number of farmers, both in the medium (2 people) and high (7 people) categories, which may indicate that as age increases, involvement in livestock businesses begins to decrease.

Overall, these data show that the largest population of farmers are in the productive age range, namely in the range of 31-50 years. Meanwhile, the involvement of young farmers (20-30 years) and elderly farmers (> 60 years) is relatively less. This could be an indicator that farmer regeneration still needs to be encouraged so that livestock businesses remain sustainable in the long term. Empowerment programs for young farmers and support for older farmers can be strategies to maintain and increase the number of farmers in the future. The diversity of ages among farmers creates a rich dynamic, where experience and innovation complement each other to increase productivity and efficiency in the livestock sector in Asahan Regency.

Farmer Experience

The following are the results of descriptive analysis related to the experiences of farmers who were included as respondents in this study.

Table 6. Results of Descriptive Analysis of Respondents' Livestock Farming Experience

Long time farming	Subdistrict		
	The Beautiful Sea	Bandring Island	Deep Bay
1-5 years	0	2	12
6-10 years	3	10	29
11-15 years	0	12	13
>15 years	0	10	9
Amount	3	34	63

Source: Results of questionnaire data processing

When viewed based on the length of livestock farming experience, the group of farmers with 6-10 years of experience has the largest population in the high category, which is 29 people. This shows that the 6-10 year period is a time when many farmers develop and manage their businesses on a larger scale. Meanwhile, the group of farmers with 1-5 years of experience also has a fairly high number in the high category (12 people), which indicates that although still in the early stages, many farmers already have a fairly large business scale. Farmers with 11-15 years of experience have the largest number, which is 12 people, followed by the group >15 years with 10 people included in the medium category. This shows that despite having long experience in livestock farming, not all farmers remain on a large business scale. Some farmers may experience stagnation or choose to reduce the scale of their business as their experience and age increase.

The small category was only found in the group of farmers with 6-10 years of experience, which amounted to 3 people. This shows that although there are farmers in this category, the number is very small compared to other groups. Interestingly, there are no farmers with 1-5 years, 11-15 years, or more than 15 years of experience in this category, which could mean that those who are just starting out or are already experienced tend to be in the medium or large business scale. Overall, these data show that livestock experience affects the scale of the farmer's business. Farmers with 6-10 years of experience tend to have the largest number in the larger business scale, while those with longer experience (>15 years) are more in the Medium category. This could be an indication that the challenges in maintaining and developing a livestock business can increase with increasing experience. Therefore, mentoring programs and technological innovations in livestock farming can help farmers maintain and increase the scale of their businesses, both for those who are just starting out and those who are already experienced.

Farmers who have been operating for decades often have a good understanding of seasonal changes and local challenges, such as frequent livestock diseases or market price fluctuations. In addition, they are also more familiar with traditional practices that have proven effective in the local environment. However, long experience does not prevent them from continuing to learn and adapt to new developments in livestock technology and livestock management. Supported by the local government and various training programs

organized by related agencies, many farmers in Asahan are now increasingly skilled in combining traditional knowledge with modern innovations. This helps them improve the productivity and quality of livestock products, as well as maintaining the sustainability of their livestock businesses amidst ever- growing challenges.

Education Level of Farmers

The following are the results of descriptive analysis related to the level of education of the farmers who were included as respondents in this study.

Table 7. Results of Descriptive Analysis of Education of Research Respondents' Breeders

Breeder Education	Subdistrict		
	The Beautiful Sea	Bandring Island	Deep Bay
SD	1	1	5
JUNIOR HIGH SCHOOL	0	2	24
SENIOR HIGH SCHOOL	2	31	34
S1/PT	0	0	0
Amount	3	34	63

Source: Results of questionnaire data processing

Research based on education level, the majority of farmers have a high school education background, with the largest number in the High (34 people) and Medium (31 people) categories. This shows that farmers with high school education dominate the population and tend to run livestock businesses on a larger scale. Meanwhile, farmers with junior high school education also have a significant number in the High category (24 people), although fewer than farmers who are high school graduates. On the other hand, farmers with elementary school education have a much smaller number than higher education levels. In the High category, there are only 5 people, while in the Medium and Low categories, there is only 1 person each. This shows that farmers with low education tend to be fewer in number and may face more obstacles in developing their livestock businesses. What stands out in this data is the absence of farmers with a Bachelor's (S1) or College education background in all categories observed. This could indicate that the world of livestock is still less attractive to college graduates, or it could also indicate that those with higher education choose to work in other sectors that are considered more promising.

Overall, these data show that education has an influence on the number and scale of livestock farming businesses. Farmers with secondary education (junior high school and senior high school) dominate, while those with basic education (elementary school) are fewer. The absence of college-educated farmers in these data can be a concern for policy makers and stakeholders in the livestock sector, because increasing the interest of college graduates to enter the livestock world can bring innovation, better management, and increased productivity in this sector. Therefore, training programs, mentoring, or incentives are needed for college graduates to be interested in developing livestock businesses in a more modern and sustainable way. Although the level of formal education is relatively limited, many farmers gain knowledge and skills through practical experience and informal training. The local government and local livestock services actively conduct extension programs and technical training to increase the capacity of farmers. These programs cover various aspects of livestock management, such as animal health, nutrition, reproductive techniques, and the use of modern technology in livestock farming.

Farmers who participated in the training program showed significant improvements in managing their livestock businesses. They were more skilled in implementing best practices that support productivity and efficiency. In addition, the existence of farmer groups and cooperatives also played an important role in the transfer of knowledge between farmers, so that they could learn from each other and overcome various challenges collectively.

Simultaneous test (F test)

F test after conducting classical assumption testing and obtaining the conclusion that the model can be used to conduct multiple regression analysis testing. Then, the next step is to conduct simultaneous hypothesis testing with the F test and partial hypothesis testing with the t test.

Table 8. Simluhtan Test Output (F Test)

Model	Df	F_{count}	F_{table}	Sig.
Regression	6	37,688	2,198	0.00 b
Residual	93			
Total	99			

Source: primary processed data

Based on the table above, it is known that the calculated F value is 37.688 with an F table value of 2.198, meaning that the calculated F value (37.688) > F table (2.198) and the value (Sig) 0.00 is less than 0.05, so it can be concluded that the independent variables of livestock age, livestock farmers' knowledge of estrus, IB officer skills, availability of seeds, local government regulations, and location distance simultaneously affect the dependent variable, namely the success of artificial insemination. Theoretically, in multiple linear regression analysis, the F test is used to test whether all independent variables simultaneously affect the dependent variable (Gujarati & Porter, 2009).

Regression is a method to determine the causal relationship between one variable and another. After conducting the classical assumption test and obtaining normally distributed data, no multicollinearity, and no heteroscedasticity, the data can then be analyzed using multiple linear regression analysis. The purpose of multiple linear regression analysis is to determine the extent to which the independent variables influence the dependent variable. Based on the results of the multiple regression analysis, the following results were obtained.

Simultaneous testing above has been known, all independent variables have a significant influence on the dependent variable. Independent variables that have a more significant influence on the success of IB need to be known which is the most significant need to use partial testing (t-test). Based on the results of the partial test (t-test) it can be seen that the independent variable that has the most significant influence on the pregnancy rate is the age of the livestock. Where t count of livestock age (8.392)> t table (1.986) which states that there is an influence of location distance on the success of artificial insemination.

Table 9. Multiple Linear Regression Analysis

Variables	Coefficient	t-count	t-table	Significant
Constants	3,119	-8,392	1,986	<0.001
Age of livestock	-0.639	0.92		0.36

Breeders' knowledge of estrus	0.06	-1,651		0.102
IB officer skills	-0.138	-2,169		0.033
Availability of seeds	-0.157	-1,973		0.051
Local government regulations	-0.155	-6,331		<0.001
Location distance	-0.38			

Source: primary processed data

The multiple linear regression equation above can be described as follows:

Y=3.119 – 0.639 (X1) + 0.060 (X2) – 0.138 (X3) – 0.157 (X4) – 0.155 (X5) – 0.380 (X6)

Based on the results of the regression equation, it can be explained that:

1. The constant value obtained is 3.119, which means that if the constant value of the variable X is assumed to be 0, then the value of Y is 3.119.
2. The regression coefficient value of the Age variable (X1) is negative at 0.639, which means that if there is a unit increase in the Age variable (X1), it will cause a decrease in the success of IB in Asahan Regency (Y) of 0.639.
3. The regression coefficient value of the Farmer's Knowledge variable (X2) is positive at 0.060, which means that if there is a unit increase in the Farmer's Knowledge variable (X2), it will cause an increase in the success of AI in Asahan Regency (Y) of 0.060.
4. The regression coefficient value of the IB Officer Skills variable (X3) is negative at 0.138, meaning that if there is a unit increase in the IB Officer Skills variable (X3), it will cause a decrease in the success of IB in Asahan Regency (Y) by 0.138.
5. The regression coefficient value of the Seed Availability variable (X4) is negative at 0.157, meaning that if there is a unit increase in the Seed Availability variable (X4) it will cause a decrease in the success of IB in Asahan Regency (Y) by 0.157.
6. The regression coefficient value of the Regional Government Regulation variable (X5) is negative at 0.155, meaning that if there is a unit increase in the Regional Government Regulation variable (X5), it will cause a decrease in the success of IB in Asahan Regency (Y) by 0.155.
7. The regression coefficient value of the Location Distance variable (X6) is negative at 0.380, meaning that if there is a unit increase in the Location Distance variable (X6), it will cause a decrease in the success of IB in Asahan Regency (Y) by 0.380.

Based on the description above, it can be concluded that the higher the value of the location distance variable (the closer the location distance), the higher the success rate of artificial insemination in Asahan Regency.

Coefficient of Determination (R2)

The coefficient of determination is a regression test tool used to test the level of closeness of the relationship between dependent and independent variables. The results of the data from testing using the SPSS test tool, the coefficient of determination value can be seen as follows:

Table 10. Output Results of the Determination Coefficient Test (R2)

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.842a	0.709	0.69	0.17941

Source: primary processed data

Based on the table above, the value of the determination coefficient R2 is located in the R Square column. It is known that the determination coefficient value is 0.709, this means that all independent variables simultaneously affect the pregnancy rate variable 70.9% of the livestock age factor, farmer knowledge about estrus, IB officer skills, seed availability, local government regulations, and location distance. In other words, the factors included in the research model only have a small influence on the success of IB, while 29.1% of the other variations are caused by other factors not included in the model.

DATA ANALYSIS RESULTS

The Effect of Livestock Age on Pregnancy Rates

The calculation results obtained the age of livestock has a t value of -8.392 and t table 2.198 (? = 0.05). Because the t value is smaller than the t table (8.392 > 2.198). This means that the age of livestock has a significant influence or relationship with the success of artificial insemination. The results of this study indicate that the age of livestock has no influence on the success of artificial insemination in Asaham Regency. The age of livestock in Asahan Regency when carrying out AI is in the optimal range for carrying out AI. From the results of the questionnaire, the average age of cattle owned by farmers is above 2 years. Optimal female cattle for AI are usually 15-24 months old for heifers and no more than 6 years old for adult cattle. Good reproductive management, including accurate estrus detection and monitoring of cattle body condition, also contributes to the success of AI (Senger, 2003).

The results of the statistical analysis obtained, it can be concluded that although in theory age has a role in cattle fertility, empirical data in this study did not show a significant relationship. This could be caused by other factors that are more dominant in determining the success of AI. Therefore, a holistic approach in reproductive management is still needed to increase the pregnancy rate in cattle.

The Influence of Breeder Knowledge in Detecting Pregnancy on IB Success Rates

The results of the calculation of the knowledge of farmers have a t-value of 0.920 and a t-table of 2.198. Because the t-value is smaller than the t-table (0.920 <2.198), it can be said that the knowledge of farmers does not have a significant effect on the success of AI. Based on the results of the interview, farmers know the signs of heat, namely clear mucus coming out of the genitals, mounting and staying still when mounted by other livestock. Based on the results of the study, several farmers already understand when livestock are in heat, so that when livestock are in heat, farmers immediately contact the inseminator, this is in accordance with the opinion of Nella desiona (2023) who stated that the level of success is not only influenced by inseminator officers but also influenced by livestock zootechnics, namely the farmers themselves who are tasked with supervising when their livestock are in heat. This is because farmers are the ones who have the task of maintaining and being responsible for supervising their livestock if they show signs of heat.

The success of artificial insemination (AI) in cattle depends not only on the biological factors of the cattle, but also on the level of knowledge and skills of the farmer in detecting pregnancy and managing cattle reproduction optimally. The ability of farmers to recognize signs of pregnancy and estrus (heat) plays an important role in increasing the efficiency of the AI program and reducing the rate of pregnancy failure. According to research by Romano *et al* . (2016), cows that are not detected as pregnant for a long time are at risk of experiencing a delay in the reproductive cycle, which can cause an extension of the calving interval (birth distance) and reduce production efficiency. Therefore, the ability of farmers to detect pregnancy is very important to ensure that cows that are not pregnant can be treated immediately with re-AI or appropriate reproductive care. Perry & Smith (2010) found that the success rate of AI was higher on farms that implemented good heat detection methods, such as observing estrus behavior at least twice a day or

using aids such as pedometers and activity sensors. Farmers who do not understand the reproductive cycle tend to carry out AI at less than optimal times, which results in low pregnancy rates.

The Influence of IB Officer Skills on IB Success Rates

The calculation results obtained the skills of IB officers have a t count of -1.651 and a t table of 2.198. Because the t count value is smaller than the t table (1.651 <2.198). This means that the skills of IB officers do not have a significant effect on the success rate of IB. IB officers or inseminators in Asahan Regency on average have done a lot of training to hone their respective IB skills. Almost all IB officers in Asahan Regency have been given IB training and on average already have certificates on IB training. Research shows that IB officers who have undergone intensive training and have more experience tend to have a higher IB success rate. According to research by Silva *et al* . (2017), IB officers who have performed more than 500 procedures have a better success rate compared to officers who are still beginners. In addition, ongoing training in IB techniques and reproductive management can increase the efficiency of the IB program. Garcia-Paloma *et al.* (2011) emphasized that IB officers who routinely attend training and receive supervision from experts are able to significantly increase pregnancy rates in livestock.

The Influence of Seed Availability on IB Success Rates

The availability of seeds has a t count of -2.169 with a t table of 2.198. According to the Decision criteria, the H0 value is accepted because the t count is smaller than the t table. This means that the availability of seeds does not have a significant effect on the success rate of AI. The success of artificial insemination (AI) in cattle depends not only on the skills of officers and reproductive management, but also on the quality and availability of semen or superior seeds used in the AI process. High-quality and consistently available semen plays an important role in increasing the conception rate and success of the AI program.

Semen used in AI is generally stored in liquid nitrogen at a temperature of around -196°C to maintain sperm viability. Suboptimal storage and transportation processes can cause a decrease in semen quality before use (Vishwanath, 2003). If the availability of seeds is limited or there is a disruption in distribution, the semen used may have experienced a decrease in sperm motility due to exposure to unstable temperatures during the trip. The availability of seeds is also related to the selection of the right genetics to increase the success of AI. Bulls with a history of high fertility and quality offspring tend to have a higher success rate of AI compared to bulls with a history of low fertility (Walsh *et al.,* 2011). In some areas, limited superior seeds can hinder the increase in livestock productivity and cause a decrease in reproductive efficiency. Therefore, a system is needed to ensure the availability of superior seeds evenly, as well as good storage and transportation infrastructure to support the artificial insemination program.

The Influence of Local Government Regulations on IB Success Rates

The calculation results obtained government regulations have a t count of -1.973 and a t table of 2.198. Because the t count value is smaller than the t table (1.973 <2.198). This means that the skills of IB officers do not have a significant effect on the success rate of IB. Local government regulations play an important role in supporting the success of the artificial insemination (IB) program in cattle. Good policies can ensure the provision of adequate resources, increase the capacity of farmers and IB officers, and optimize the distribution of semen and supporting facilities. Conversely, less effective regulations can hinder the implementation of IB and reduce the success rate of the program.

One of the main roles of local governments is to provide facilities and infrastructure to support AI. Local governments that allocate budgets for the construction of insemination centers, provision of liquid nitrogen for semen storage, and training for AI officers will increase livestock farmers' access to these services (Ministry of Agriculture of the Republic of Indonesia, 2019). According to research by Hartono *et al*

. (2020), areas that have AI centers with complete facilities and sufficient inseminators experience higher AI success rates than areas that still rely on semen distribution from outside their area. This shows that investment in AI infrastructure contributes directly to the success of the program.

The Effect of Location Distance on Pregnancy Rates

The calculation results obtained the location distance has a t count of -6.331 with a t table of 2.198. Although the t count value is smaller than the t table (6.331 > 2.198), the location distance factor has a significance value of 0.00 < 0.05, so it can be concluded that the location distance has a significant effect on the success rate of IB. The location distance also determines the success of artificial insemination because the distance of the location will be suspected of damaged semen on the way. In this study for low populations the location distance ranges from 8-12 km, medium populations 4-15 km. For location distances in areas with high populations, the distance varies, ranging from 3 to 15 km.

Long distance conditions, inseminators have many obstacles in providing IB services because there are many areas that have up and down terrain or heavy terrain plus damaged road conditions, especially the rainy season greatly inhibits insemination activities. According to Wahyutae *et al* . (2014) the distance traveled by the inseminator to the work area greatly affects the quality of semen, this has an impact on the failure of IB. In addition, it also has an impact on the quality of semen. Long journeys with poor conditions such as high hot weather will reduce the quality of semen (Toelihere, 1985).

The distance between the AI service center and the farm can affect the delivery time of sperm, the condition of the sperm upon arrival at the location, and the frequency and quality of services received by farmers. Overall, the long distance and inadequate infrastructure can reduce the efficiency and effectiveness of the artificial insemination program, thus affecting the success rate of AI in Asahan Regency. Improving accessibility, infrastructure, and human resources in this area is essential to improve the success of the AI program.

CONCLUSION AND SUGGESTIONS

Conclusion

Based on the research results, several conclusions can be drawn as follows:

1. The IB program in Asahan Regency was quite successful, as indicated by the average S/C value of around 1.69, CR of around 61.4%, and NRR of around 67.92%.
2. Based on the results of the F test (simultaneous), the calculated F value is obtained > F table, so that the independent variables simultaneously affect the success of IB. The results obtained are the calculated F value (37.688) > F table (2.198) and the value (Sig) <0.001 is smaller than 0.05.
3. Policies needed to improve the success of AI include improving technology and innovation as the main factors in the success of AI. Providing superior seeds, implementing automatic estrus detection technology, and digitizing livestock management can improve reproductive efficiency. In addition, education and training for farmers are very important to improve their understanding and skills in implementing AI optimally.

Suggestion

The research data shows that the Artificial Insemination program in Asahan Regency is quite successful. However, from the population development data for the last 5 (five) years, it is relatively small and even tends to stagnate. For this reason, further research is needed to determine other factors that influence it.

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