Research Article

Valuation of Massive Artificial Insemination Programs and the Economic Impact for Indonesia

ACHMAD FIRMAN[1*], SONDI KUSWARYAN[1], LILIS NURLINA[1], MUHAMAD HASAN HADIANA[1], MARINA SULISTYATI[1], UNANG YUNASAF[1], DWI CIPTO BUDINURYANTO[2], IMAN TRISMAN[3]

[1]*Department of Social Economic Livestock Development, Faculty of Animal Husbandry, Universitas Padjadjaran, Indonesia, Jl. Raya Bandung–Sumedang Km 21, Jatinangor, Sumedang 45363, West Java, Indonesia;* [2]*Department of Livestock Production, Faculty of Animal Husbandry, Universitas Padjadjaran, Indonesia, Jl. Raya Bandung–Sumedang Km 21, Jatinangor, Sumedang 45363, West Java, Indonesia;* [3]*Directorate General Livestock and Health, Ministry of Agriculture, Jl. Harsono RM. No. 3, Ragunan, Jakarta 12550, Indonesia.*

Abstract | Indonesian Ministry of Agriculture has made a breakthrough in increasing the cattle population to reduce supply inequality through a massive artificial insemination program (SIWAB/SIKOMANDAN). Previously, the artificial insemination program was carried out partially and not with the feed, health, and community services programs. However, feed, animal health, veterinary public health, and community services are a part of the SIWAB/SIKOMANDAN program. The purpose of the study was to assess the program performance through several aspects, such as the number of frozen semen distribution, the number of cow acceptors, the number of cow pregnancies, the service per conception rate, the number of calf's birth, and the economic impact. Data collected by Directorate General of Livestock and Health (DGLH) was for five years. The Key Performance Indicators utilized to analyze the program performance. The incremental capital-output ratio (ICOR) model was used to determine the economic valuation. The results determine that the analysis of Key Performance Indicators (KPIs) for the SIWAB/SIKOMANDAN program shows that the performance category was good and excellent. The proves that the five aspects assessed by KPI's analysis, namely frozen semen distribution, cow acceptors, cow pregnancy, S/C rate, and calf's birth are in accordance with the targets set. Meanwhile, the economic impact arising from this program could increase economic value added and development efficiency, the ICOR value < 1.

Keywords | Artificial insemination, Frozen semen, Acceptor cow, Pregnancy cow, Economic impact

INTRODUCTION

Indonesia is a big country with a number human population of almost reach 270 million people (Central Bureau of Statistics, 2020). The challenge with densely populated countries is food preparation, especially animal protein supplies. Food supplies do not only focus on

meeting calorie or carbohydrate requirements but also meeting animal protein needs (Anisa *et al.*, 2017; Kim *et al.*, 2019). Protein is essential for humans because it can build and repair muscles, bones, hormones, and enzymes (Rismayanthi, 2006). Therefore, it must be a protein component of every food consumption, like beef.

Beef has become an inseparable part of food consumption in Indonesia. Almost all Indonesian people have ever consumed beef, at least on Eid al-Adha. The development of beef consumption will continue to grow along with population growth. According to International Fund for Agriculture Development (IFAD, 2015), Estimated, the world's population can reach 9 billion people in 2050, and food productivity of 50% to 70% is for food fulfillment. In addition, ruminants provide 26% of human protein consumption and 13% of total calories. It means that the consumption of ruminant livestock products, such as beef, is positively correlated with an increase in a number of human populations. According to FAO (2019), the challenges ahead are population growth that continues to increase and dietary changes can encourage food needs by up to 60 percent. Agricultural production and livelihoods will face the challenge of providing adequate food for the population and healthy food and be able to preserve a depleting natural resource base.
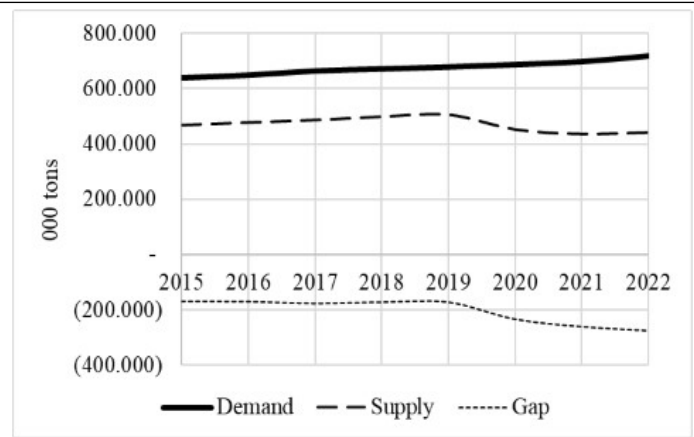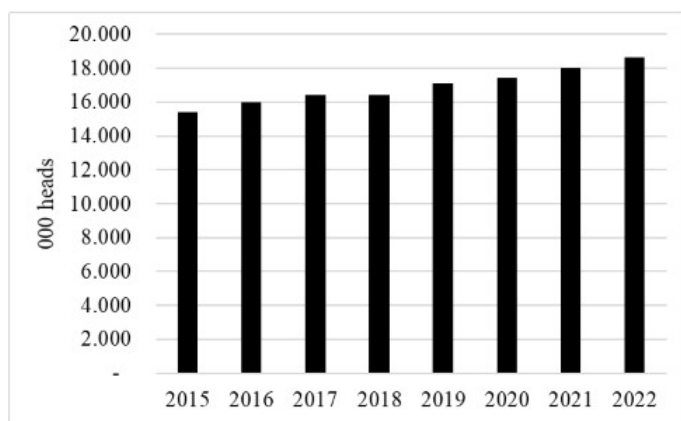

Figure 1: Total population of Beef Cattle in Indonesia (head).
Source: Ministry of Agriculture, 2015-2022.

Directorate General of Livestock and Animal Health Services (DGLVS, 2020) reported that the total population of beef cattle in Indonesia has slightly increased since 2015 (Figure 1). The entire population is only 6.75% of the total human population in Indonesia. The number of human populations can reflect the amount of beef meat demand in Indonesia. The average beef meat demand is approximately 675.11 thousand tons per annum, while beef meat production is about 471.30 thousand tons per annum. The gap between beef meat demand and production reaches 203.81 (30.19%) thousand tons per annum. It determines that the rate of beef meat demand is higher than the beef meat supply (Firman et al., 2018; Ariningsih, 2014). Figure 2 illustrates that the beef meat demand has continued to increase from 2015-2022, however, beef production has decreased since the Covid-19 outbreak in 2020. It has created an imbalance in the supply and demand for beef which is quite large compared to before the occurrence of Covid-19.

Figure 2: The balance of beef supply and demand in Indonesia from 2015-2022.
Source: Ministry of Agriculture, 2015-2022.

Shortage of beef meat demand was imported by out of Indonesia, for instance Australia. The imports are in order to balance in and out of cattle in aggregate. To reduce the demand gap, the government implemented a breakthrough program to increase the cattle population in Indonesia. Therefore, the government has issued a national program of insemination to accelerate the increasing of cattle population through the implementation of massive artificial insemination at the end of 2016. The name of the program is SIWAB/SIKOMANDAN. The program has a set to produce the local cattle population by facilitating and optimizing massive artificial insemination, improving feed and nutrition, animal health, and information systems integration. Increasing cattle population is the main target of this program. Before the program, several government programs were setted to achieve the cattle population from 2005-2010, namely the beef self-sufficiency program, the partnership program, and the cow import program (Atmakusuma et al., 2015; Ashari et al., 2012). However, programs were not running well because there was no program integration with one management, no information system and reports that are connected from the local government to the center on a daily, weekly, or monthly basis (Atmakusuma et al., 2015; Ashari et al., 2012; Widiati, 2014).

The Ministry of Agriculture allocates a budget to support programs from the national to the district level. Traditionally, the government will be said to be successful if budget absorption is close to 100% (Hidayat, 2017; Klimaitienė et al., 2020). Currently, the government's budget should be able to achieve the targets set, such as output, benefits, or outcomes that can be felt by the community (Hidayat, 2017). To ensure target achievement and monitoring activity, there are several models to measure the performance organization or institution, such as key performance indicators (KPIs), Balanced Scorecard (BSC), Integrated Performance Measurement System

(IPMS), and Performa Prism (Simbolon, 2015). Balanced Scorecard (BSC), Integrated Performance Measurement System (IPMS), and Performa Prism have developed to measure the company's performance from the financial and non-financial side (Simbolon, 2015), while the KPIs determine the key indicators that are the target of the organization (Klimaitienė et al., 2020). However, these models have in common to be used by organizations, government institutions, and companies according to their respective goals.

Key performance indicators (KPIs) are targets that help you measure improvement against your most strategic purposes. While institutions can have many types of metrics, KPIs are targets that are "key" to the success of your business. Based on the definitions exploring of KPI from various authors, word "key" of KPI is similar with the essential or most important criteria which objectives of enterprises or organizations (Klimaitienė et al., 2020). KPIs can be assessed and provide information on the extent to which the government and company strategic objectives have successfully achieved (Gusnadi and Hermawan, 2020; Adianto et al., 2014). In another persfective, KPIs support the management system to improve company performance in achievement of targets, such as labour, management, and financial (Ante et al., 2018; Zelga, 2018).

Various studies in the livestock sector have used the KPIs model to measure key indicators, both within and outside Indonesia, as shown in Table 1. According to Table 1, the KPIs model in the livestock sector is relatively limited in Indonesia compared to European and American countries. It means that in developed countries, used the KPIs model is often used to measure company performance, especially in monitoring and evaluation aspects.

The SIWAB/SIKOMANDAN program has aimed to increase the cattle population as the success the program through the number of frozen semen distribution, the number of cow acceptors, the number of cow pregnancies, service per conception rate, and the number of birth of calves. Unfortunately, the annual report submitted by the Directorate General for Livestock and Animal Health Services (DGLAHS) on the performance of the SIWAB/SIKOMANDAN program has not used the KPIs model to measure performance indicators and measure the economic impact of government investment on this program yet. Therefore, this study aimed to assess the program performance through the number of frozen semen distribution, the number of cow acceptors, the number of cow pregnancies, service per conception rate, the number of birth of calves, and the economic impact.

MATERIALS AND METHODS

STUDY AREA AND COLLETING DATA

The research was held in Indonesia, and data collected by Directorate General of Livestock and Health (DGLH) was for five years from 2017 to 2021. DGLVS collected data from all provinces (34 provinces) to analyze the program's achievements nationally. The data collected includes the number of frozen semen distribution, the number of the acceptor (productive cows), the number of cow pregnancies, service per conception value, and the number of birth calves. Previously, there had never been any data collection related to this matter. DGLVS has established a reporting system through the iSIKHNAS system from the district to the national level. Besides, it and can be monitored and controlled on a weekly, monthly, and yearly basis. iSIKHNAS system is an Indonesian animal health information system which compiles all reports on artificial insemination, pregnancy, calf births, and animal health reported by Livestock Services at the district/city, provincial to central government levels every day.

Table 1: Studies in the livestock sector using the KPIs model.

Author	Research focus	Location
Purnami (2021)	Milk supply chain performance at the Mojosongo Cooperative, Central Java Province	Indonesia
Rayesa (2018)	Analyze the performance of dairy cooperatives in Yogyakarta	Indonesia
Kusmawan (2022)	Performance measurement of layer husbandry Dafa farm banjaran	Indonesia
Hewit et al. (2018)	Evaluation of key performance indicators to monitor performance in beef herds	Nottingham
Kelly et al. (2011)	Identification of key performance indicators for on-farm animal welfare incidents: Possible tools for early warning and prevention	Europe
Armengol et al. (2022)	Key performance indicators used by dairy consultants during the evaluation of reproductive performance in a first visit	Europe, America, Asia, Africa, and Oceania
Hansen (2005)	Key Performance Indicators on Dairy Farms	Norway

PROCEDURES AND ANALYSIS

The research analysis used key performance indicators (KPIs) and incremental capital output ratio (ICOR). Valuation of the massive artificial insemination programs focused on performance indicators achievement. The aspects assessed were the number of frozen semen distribution, the number of cow acceptors, the number of cow pregnancies, the service per conception rate, and the number of birth of calves. The analysis used to assess these indicators was the key performance indicators (KPIs). The KPIs are financial and non-financial indicators that institution/organization/ government uses to testify how the success organization in long-lasting aims (Velimirović *et al.*, 2011; Febrinata et al., 2014). The KPIs are static and stable indicators that convey more meaning when comparing information, especially compared with the target and the realization of indicators (Velimirović *et al.*, 2011; Hidayat, 2017). In addition, the KPIs help to focus on the job and object of the business, and get profit (Velimirović *et al.*, 2011). The KPIs analysis used the following formulas:

$$Y_1 = \frac{X_1}{X_{t1}} \times 100\% \quad ...(1)$$

$$Y_2 = \frac{X_2}{X_{t2}} \times 100\% \quad ...(2)$$

$$Y_3 = \frac{X_3}{X_{t3}} \times 100\% \quad ...(3)$$

$$S/C = \frac{X_1}{X_{t3}} \quad ...(4)$$

$$Y_4 = \frac{X_4}{X_{t4}} \times 100\% \quad ...(5)$$

Where Y_1 is the achievement of the number of frozen semen distribution (%), X_1 is the realization of the number of the semen distribution in doses, and X_{t1} is the target of semen distribution. Y_1 is a determining factor for the success of frozen semen distribution. Y_2 is the achievement of the number of acceptors (%), X_2 is the realization of the number of acceptors (heads), and X_{t2} is the target of acceptors. Y_3 is the number of cow pregnancies, X_3 is the realization of the number of cow pregnancies, and X_{t3} is the target of cow pregnancy. Meanwhile, the formula of the S/C value was X_1/X_{t3} (in Equation 4). And Y_4 is the achievement of the number of birth of calves, X_4 is the realization of the number of birth of calves and X_{t4} is the target of the birth of calves.

Table 2: The success measure of KPIs.

Indicators	Performance categories
Y ≥ 100%	Excellent
75% ≤ Y < 100%	Good
50% ≤ Y < 75%	Sufficient
25% ≤ Y < 50%	Acceptable
Y < 25%	Fail

Based on Rahardja *et al.* (2012), the success measure of KPIs can be seen in the Table 2. The Table 2 show that the aspect (Y_n) reaches excellent performance if the aspect (Y_n) achieves equal or more than 100 percent. In contrast, the aspect (Y_n) get less than 25%, the performance is in fail performance. Y_n means Y_1 to Y_4.

Meanwile, service per conception is the frequency of matting, both natural mating and artificial insemination, to produce pregnant cattle, or frequently used as a sign of fertility (Siatka *et al.*, 2017). In this study, service perception was the frequency of matting measured by the artificial insemination services (doses) and used for mating acceptors. The optimal range of S/C values was under 1.6 in good category, between 1.6 and 1.8 in normal category, and S/C around 2 was acceptable, but S/C more than 3 indicates that it has reproductive problems (Siatka *et al.*, 2017; Haryanto *et al.*, 2015).

The economic valuation to measure the economic impact used the ICOR (Incremental Capital Output Ratio) analysis. The ICOR value shows the level of economic efficiency in using capital goods as a factor of production (Setiyanto, 2016). The formula used to calculate the ICOR value is as follows:

$$ICOR = \frac{\Delta K_t}{\Delta Y_t} \quad ...(6)$$

Where ΔK_t is the financial investment in year t and ΔY_t is the value-added output in year t. In this study, the Government supported the financial investment for the UPSUS SIWAB/SIKOMANDAN program. The added value output was the value of all birth of calves in a year. The ICOR value is lower than 1, which means that the investment is efficient (Setiyanto, 2016; Mahmud, 2008). ICOR value is more than 1 (ICOR > 1), which means that the investment is not efficient (Susilowati *et al.*, 2012).

RESULTS AND DISCUSSION

PROGRAM SIWAB/SIKOMANDAN OVERVIEW

The program beginned in 2017, namely SIWAB, but the name of the program changed to the SIKOMANDAN program in 2020. However, there is no significant change in the program system has been established since 2017. The goals are to increase the beef cattle population, especially at the small-scale farmer's level. The typical smallholder livestock producers in Indonesia have one to five cows, limited land, semi-permanent pens, traditional management, family-based labor, taking various economic activities, and inadequate money and assets to raise cattle (Asmara *et al.*, 2017; Daud *et al.*, 2015; Rapsomanikis, 2015). Small-scale farmers dominate the cattle farming business in Indonesia (Hastang and Asnawi, 2014). Beef

cattle play an important role in the daily life of smallholder farmers, i.e., to generate cash income, savings, and a very liquid asset; to develop social relationships, such as for a signal social status; to fulfill the nutritional need, and to be for religious purposes, such as sacrificial animals on Eid al Adha for Muslim countries, or as symbols for Hinduism in India country (Firman and Obed, 2021; Doğan *et al.*, 2013; Uba *et al.*, 2015; Moyo and Mlilo, 2019; Winarso, 2014; Tuncel and Cevger, 2015; Kennedy *et al.*, 2018).

The Government of Indonesia defrayed funds for the program from 2017 to 2021. The budget was used to support improved feed quality, massive artificial insemination services, purchasing and distribution of frozen semen, purchasing and distribution of liquid nitrogen, animal health services, veterinary public health services, pregnancy examination, and birth management, and monitoring and reporting systems (Figure 3).
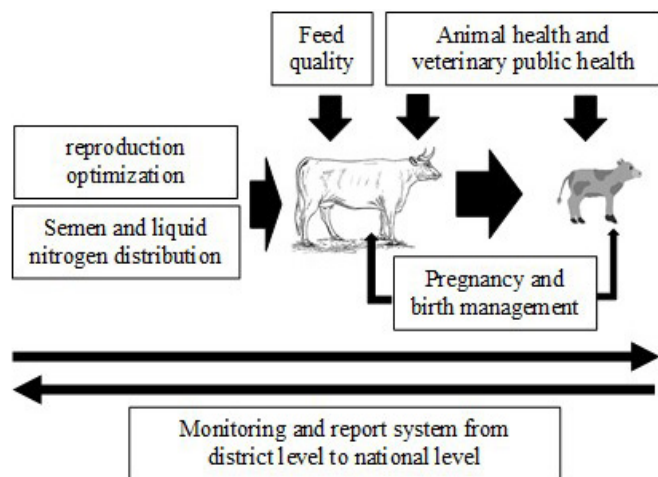

Figure 3: SIWAB/ SIKOMANDAN program.

Beef cattle farms require new approach, such as sustainable, modern, and professional, to increase utilizing technological innovations to improve business efficiency (Mayulu and Sutrisno, 2014). The approach will face constrains because the business actors are dominated by small-scale farmers who have limited cattle, capital, land, traditional management, family labour, and limited funds to operate farms. The number of smallholder cattle farmers in Indonesia was 5 million farmers with 2-3 heads ownership (Rusdiana and Praharani, 2019). Family cattle farm contribute to the beef cattle population in Indonesia and contributes 6.8% of the total income of livestock farmers (Harsita and Amam, 2019). Raising cattle is a side source of family income. Therefore, the most farmers pay more attention to their main livelihood (as rice/horticulture farmers). Hence, this program can assist farmers to increase the cattle population on the farm.

PROGRAM PERFORMANCE
The main objective of the program is to increase the beef

cattle population in Indonesia. It is needed to reduce the gap between the demand and supply of beef in Indonesia. To analyze the program performance, a comparison of targets and realization of each indicator, such as the distribution of frozen semen, cow acceptors, cow pregnancy, service perceptions, and the birth of calves, is used as program performance.

FROZEN SEMEN DISTRIBUTION
Frozen semen is a method of preserving sperms in the straw through the freezing system and stored in liquid nitrogen at a temperature of -196ºC in cryogenic containers (Indonesian National Standard (SNI) No. 4869-1:2017, 2017). The frozen semen used in this program is the frozen semen of cattle from various breeds, such as local cattle and others. Figure 4 illustrates the target and realization of the semen distribution. The frozen semen distribution means the amount of frozen semen used for insemination services. Based on research data, the target of the distribution of frozen semen from 2017-2021 was above three million doses. In 2017, the semen distribution target was four million doses, and the highest was 5, 5 million doses in 2021 compared to 2017–2020. However, the achievement of the frozen semen distribution in 2017 was lower compared to the distribution achievement from 2018 to 2021 because the program was socialized in November 2016 by the Minister of Agriculture, then started in January 2017. Therefore, some activities have not been prepared properly at that time.
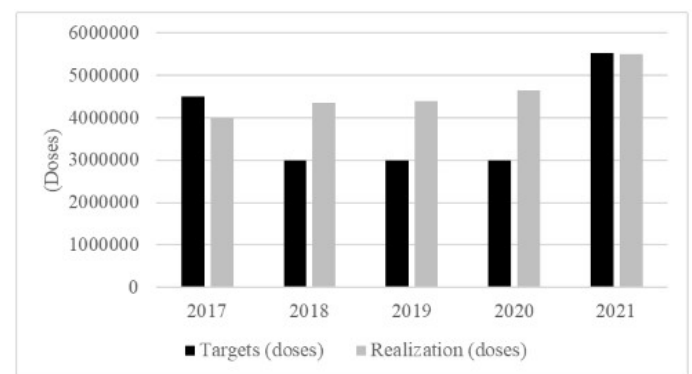

Figure 4: The performance indicator of frozen semen distribution.
Source: Indonesia Ministry of Agriculture, 2017-2022.

THE NUMBER OF COW ACCEPTORS
Cow acceptors are cows that will be artificially inseminated and have met the requirements, such as reproductive health (Yohana *et al.*, 2018). Figure 5 is the target and realization of the number of cow acceptors. The cow acceptors established the potential of productive cows from all provinces and the stipulated budget. Based on Figure 4, the target of acceptors was between 3 million to 4 million heads. The result showed the achievement of cow acceptors exceeded the set target.
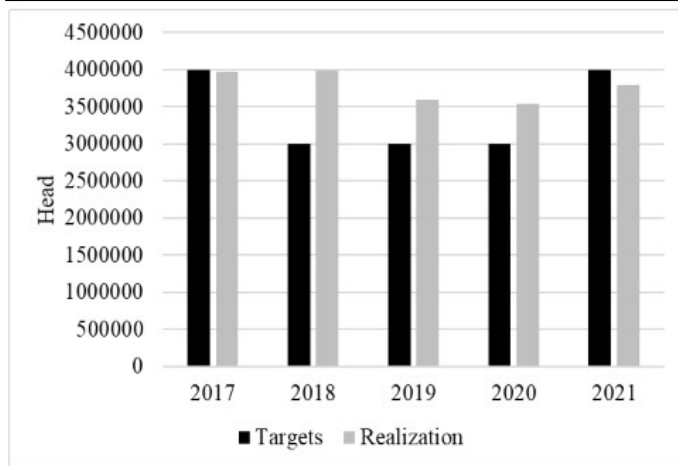
Figure 5: The performance indicator of cow acceptors.
Source: Indonesia Ministry of Agriculture, 2017-2022.

According to the data from DGLAHS (2022), 26 provinces have achieved more than the target number of cow acceptors receiving insemination services, especially East Java, Central Java, Yogyakarta, and Lampung. The regions had a target of acceptor cattle between 100,000 to 1,300,000 heads compared to others. However, six regions only reached less than 100%.

NUMBER OF COW PREGNANCY

In this context, productive cow acceptors should be a positive response to the services provided in the program because they have received reproductive health checks and feed assistance to improve the body condition of the female cow. The positive response that emerged from artificial insemination services was pregnancy. The pregnancy rate can indicate the success rate of marriage, either artificially or naturally. However, the incidences of non-cow pregnancy at the farmer level are reproductive disorders. Reported several occurrences that often occur due to reproductive disorders are ovarian hypofunction, repeat breeding, silent heat, corpus luteum persistent, delayed puberty, cystic ovaries, abnormal uterus, luteal cyst, follicular cyst, endometritis, atrophy, delayed puberty, vaginal inflammation, retained placenta, dystocia, and hypoplasia (Ratnani *et al.*, 2020; Sutiyono *et al.*, 2017; DGLAHS, 2020). Generally, reproductive disorders were ovarian hypo-function at 41.18% and endometritis at 11.16%. DGLVS also reported that the examination for reproductive disorders in January-December 2019 found 61,859 heads (91.263%). The number of cows that recovered from reproductive disorders reached 45,615 cows (73.74%), and 26,036 (57.08%) heads have artificially inseminated, and 8,561 (32.88%) cows got pregnant. The problems often arise in small-scale farms because the farmers cannot recognize the symptoms and signs of lust in cows. The intensity of lust is less apparent, it ultimately results in artificial insemination being less precise and pregnancy failure (Anisa *et al.*, 2017).
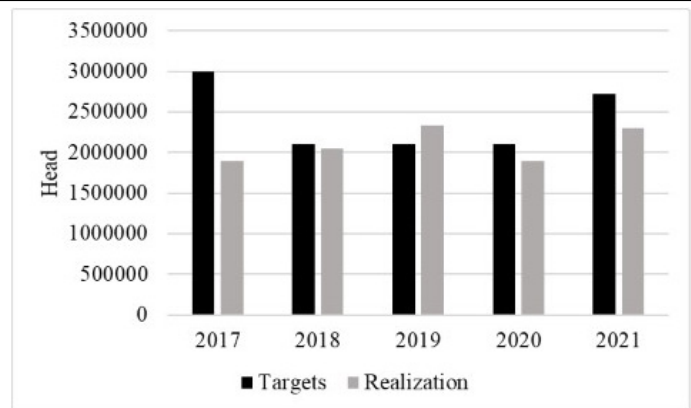

Figure 6: The performance indicator of cow pregnancy.
Source: Indonesia Ministry of Agriculture, 2017-2022.

Figure 6 shows the target and realization of cow pregnancy in four years. The general picture shows that the average number of cows had pregnant was 87.84%. The number of pregnant cows increased in 2017-2021, while the realization exceeded the target in 2019. It indicates that it is a positive signal to be a potential for calves to be born from several pregnant cows and a positive signal to born many calves. The program's success is still very early in closing the faucet on imported cattle. An increasing number of pregnant cows was due to the government conducting an estrus synchronization activity in several regions. Estrus synchronization was determined to triggers simultaneous estrus in a herd of cows (Hermadi, 2015). According to DGLAHS (2020), 25 provinces achieve a success rate of cow pregnancy above 100% from the results of artificial insemination. Two regions can reach more than 180%, namely Maluku (187.43%) and North Maluku (181.71%). Many factors influence to successful cows' pregnancy, one of which is the ideal body condition of the cow (BCS > 2) and the timeliness of artificial insemination with estrus (Anisa *et al.*, 2017; Yakubu *et al.*, 2013). According to Mansur (2021), the BCS score consists of 1-5 based on Canadian categories, such as BCS= 1: very thin, BCS= 2: thin, BCS= 3: moderate, BCS= 4: fat, and BCS= 5: very fat.

SERVICE PER CONCEPTION

Figures 4 and 6 represented a measure of the service per conception (S/C). Table 3 shows that the average S/C value was 1.82, which means it required twice the services for a productive cow to get pregnant. The value of 1.82 was in the normal range (Siatka *et al.*, 2017; Ghiasi *et al.*, 2016). In the context of insemination, 1.82 determines that it needs two straws of frozen semen for services, time and energy consumption, long calving intervals, and additional operational costs.

Several factors that most influence the high S/C rate, such as delays in detecting estrus and body condition score (BCS) values below 3 (Anisa *et al.*, 2017). Lack of feed, both in quality and quantity, reinforced the problems of

livestock reproduction at the farm level (Saili *et al.*, 2016; Hermadi, 2015). This condition often occurs in the dry season because of a lack of forage. Cows often feed with rice straw without being given additional feed. Energy reserves were closely related to nutrition where nutrition and nutritional status of cattle could affect the intensity of lust because it is associated with reproductive hormones (Winugroho, 2000).

Table 3: The performamce indicator of service per conception.

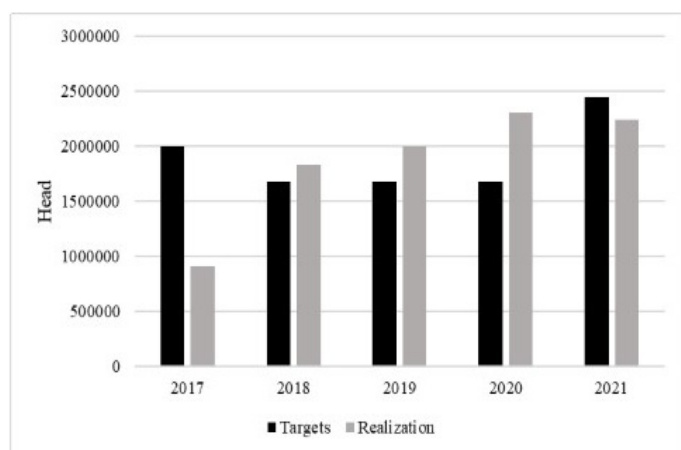| Years	Insemination services (doses)	Cow pregnancy (head)	S/C rate
2017	3976470	1892462	2.10
2018	3987661	2051108	1.94
2019	3586374	2334474	1.54
2020	3545199	1891426	1.87
2021	3791140	2295346	1.65
		Average	1.82

Figure 7: The performance indicator of calves born.
Source: Indonesia Ministry of Agriculture, 2017-2022.

THE NUMBER OF CALVES BORN
The number of birth of calves is the number of cows that have successfully given birth. Calves had an economic value for farmers because the calves are a liquid asset (Hastuti *et al.*, 2008; Prasetyo *et al.*, 2020). The proceeds from the sale of calves can contribute to the farmer's income from 32% to 54% (Rahayu *et al.*, 2014; Michaličková *et al.*, 2015). Therefore, the number of birth of calves indicates an increasing cattle population nationally. Based on Figure 7, the number of birth of calves continued to increase from 2017 to 2021. The number of birth of calves from 2017 to 2021 was more than 9.23 million heads. It can prove that the SIWAB/SIKOMANDAN program can provide additional cattle population and provide a balance for domestic cattle slaughter. The success of the number of birth of calves was inseparable from the role of field officers, such as insemination officers, veterinary officers, extension agents, and local government. DGLAHS reported that 28 provinces achieved calf birth rates of more than 100% of the target, and Banten and Kepulauan Riau provinces achieved a birth rate of more than 200%.

Based on the description above, the program performance can be seen in Table 4. The achievements of each aspect of the program show an average result between 89% - 127%. It means that the program performance category ranges from good to very good. The performance category for S/C is under normal conditions. Therefore, the overall performance can be said to be good and excellent.

ECONOMIC VALUATION
Economic valuation is a measuring instrument to determine the effect of government investment. Economic valuation means the economic change in income or expenditure generated in an area due to investment (Warnick and Bojanic, 2012). ICOR analysis is a measuring tool for calculating the economic valuation. Table 5 shows that the investment spent by the government for the program was able to produce an ICOR value < 1 and a very efficient investment (Susilowati, 2012). It can prove that the program could increase the number of cattle in Indonesia with an additional close to 2 million heads per year. The government expenditure for this program was US$ 388.12 million for five years. The added value was able to generate US$ 2.83 billion. This economic value-added was obtained from the number of birth of calves each year and multiplied by the value of calf sales equal to US$ 310.35 per head.

Table 4: Key performance indicators.

Aspects	Years					Average	Performance category
	2017	2018	2019	2020	2021		
Frozen semen distribution (%)	88.89	145.01	146.41	154.95	99.52	126.96	Excellent
Cow acceptors (%)	99.41	132.9	119.5	118.2	94.78	112.96	Excellent
Cow pregnancy (%)	63.08	97.67	111.17	90.07	84.57	89.31	Good
S/C rate	2.10	1.94	1.54	1.87	1.65	1.82	Normal
Birth of calves (%)	45.56	109.09	118.78	136.95	91.61	100.40	Excellent

Table 5: The economic impact on the program.

Years	Govern investment	Value added	ICOR
	US$	US$	
2017	75,862,069	230,936,276	0.33
2018	82,758,621	568,789,759	0.15
2019	82,758,621	619,301,793	0.13
2020	76,972,323	714,031,556	0.11
2021	69.766.381	694.528.230	0,10
Total	388.118.015	2.827.587.614	0.14

Overall, the Government of Indonesia has made a breakthrough increasing the cattle population in Indonesia. The program could reduce inequality in the demand and supply of beef. The program is very effective and efficient in proving the achievement of program performance and the economic value. In addition, the integration of reproduction, animal health, feed, veterinary public health, and information system could make programs more transparent and accountable. The program is carried out simultaneously by the central government to regional governments with coordinated directly by the Ministry of Agriculture. An integrated reporting system was the mainstay of the program to monitor and evaluate obstacles that occur in the field.

However, there are still some obstacles that have not been able to overcome by the program, such as the delay in farmers reporting the presence of estrus in their cows, data on the performance conditions of cow acceptors (BCS values), evaluation of the quality of frozen semen, service quality evaluation of inseminators, and tracking of calves that are born. The calve tracking is needed to get some information about calves that are born can be collected, such as how many male and female calves, how many calves died or slaughtered, and how many calves grow into heifers. Program improvements should focus on early detection of estrus by farmers, improving semen quality, and tracking systems for calf births. However, the SIWAB/SIKOMANDAN program can produce program effectiveness because it can achieve and or exceed the set targets.

CONCLUSIONS AND RECOMMENDATIONS

Based on the description above, the analysis of Key Performance Indicators (KPIs) for the SIWAB/SIKOMANDAN program was between good and excellent performance. Five aspects assessed, namely frozen semen distribution (excellent), Cow acceptors (excellent), Cow pregnancy (good), S/C rate (normal), and Birth of calves (excellent). Meanwhile, the economic impact arising from this program could increase economic value added as

well as development efficiency, the ICOR value < 1.

ACKNOWLEDGMENT

NOVELTY STATEMENT

This study is the first study using KPIs and ICOR to measure the performance of the SIWAB/SIKOMANDAN program.

AUTHOR'S CONTRIBUTION

The manuscript has been compiled and written by author and co-authors. Achmad Firman as author has contributed to the writing framework, writing, and Key Performance Indicators analysis, Sondi Kuswaryan as co-author has contributed to the ICOR analysis and writing, Lilis Nurlina as co-author has contributed to the data compilation and writing, Muhamad Hasan Hadiana as co-author has contributed to the data compilation and writing, Marina Sulistyati as co-author has contributed to writing, Unang Yunasaf as co-author has contributed to writing, and Iman Trisman as co-author has contributed to the data compilation.

CONFLICT OF INTEREST

The manuscript was written by the team and there is no conflict of interest with any party related to the materials discussed in the paper.

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