Evaluation of Friesian Holstein Bulls Fertility in Lembang and Singosari Artificial Insemination Center using West Java ISIKHNAS Data

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Abstract. Friesian Holstein bull (FH) is one of dairy cattle in Indonesia. It is important to increase the production of dairy cattle to meet the need for milk consumption. The way to develop is through artificial insemination (AI). This study was aimed to evaluate the FH bull fertility by calculating the percentage of first service conception rate (%FSCR) of FH bulls in Lembang and Singosari AI Center using ISIKHNAS data in West Java for the year 2017 until 2018. The data included in this study after editing consisted of AI data (n=14176) and service records as well as pregnancy diagnosis information (n=98120). The study showed that the FH bull semen spread in West Java mostly from Lembang and Singosari AI Center. The fertility rate can be grouped into high fertile (HF), and low fertile (LF) level and also divided into two groups based on the number of AI services. The %FSCR of FH bulls semen that used for AI <1000 services in Singosari 64.29% as HF level; 22.22% as LF level, while in Lembang had 74.03% as HF level; 21.15% as LF level. Then, the AI> 1000 services in Lembang had %FSCR is 61.61% as HF level; 35.28% as LF level. While Singosari had 63.11% as HF level; 33.78% as LF level. In conclusion, the FH bulls in Lembang and Singosari AI center had the HF of the %FSCR is about 53.13 until 74.03%. It is needed the more accurate assessment through genomic analysis to get the biomarker of HF bulls as a suggestion to improve the FH breeding cattle.

1. Introduction
FH dairy cattle or the offspring is the cattle which are only kept and raised in highlands. Dairy cattle have existed and domesticated in Indonesia since 1786. In 1891 until 1892, several breeds of dairy cattle were imported from Australia (Hereford, Shorthorn, Ayrshire, and Jersey) and from the Netherlands (Holstein Friesians) to Indonesia [1]. FH dairy cattle are tremendously bred on Java Island. The number of FH dairy cattle population in Java reaches more than 99% of the total population of FH dairy cattle in Indonesia. However, in decade, the growth of the dairy cattle population in Indonesia, especially in Java for the period 2012-2016 decreased by 1.14% per year [2]. The application of reproductive technology of AI is one of solution methods used to increase productivity and develop the FH cattle population faster. The success of AI is determined by semen quality. It said that genetically, AI also supports the dissemination of high genetic quality of selected bull and in economic view, its increase milk production capability [3]. So, the main goal of dairy cattle producers is to achieve high pregnancy rates with semen from genetically superior sires and could
produce milk excessive. Then the principal goal of every AI Center is to provide customers with a product that allows them to meet these goals [4].

West Java is one of province in Java island in Indonesia Country which has big number of FH dairy cattle population about 116,400 heads. It has a mild climate, and mountainous region with a height of more than 1,500 m above sea level, ambient temperature 19-23°C and the humidity intensity 74% [5] therefore suitable for FH dairy cattle rearing. For years ago, a mating system in this area has relied on AI which performed by skilled and certified local inseminators according to the government policy. In the other side semen used for AI is mostly provided by the Lembang and Singosari AI Center. It is widely known that reproduction is a key component in enhancing population as well as milk production. However, the efficiency must be measure time to time for evaluation purpose. For that, this paper aims to evaluate to the FH bull reproductive efficiency and fertility in Lembang and Singosari AI Center by the percentage of first service conception rate (%FSCR) using ISIKHNAS data in West Java province for the year 2017 until 2018, following the explanation in the related factor in West Java. The result could be beneficial for strategic planning to enhance dairy cattle fertility.

2. Materials and methods

2.1. Data collection

Data of artificial insemination and pregnancy diagnosis information of FH bulls were collected from Isian Sistem Informasi Kesehatan Hewan Nasional (iSIKHNAS) Provinsi Jawa Barat/ National Animal Health Information System of West Java province two years from 2017 to 2018. The semen producers came from Lembang AI Center, Bandung and Singosari AI Center, Malang, Indonesia. Artificial insemination was done in 18 regencies (Bandung, Bandung Barat, Bogor Bekasi, Cianjur, Ciamis, Cirebon, Depok, Sumedang, Sukabumi, Garut, Indramayu, Kuningan, Majalengka, Pangandaran, Purwakarta, Subang, Tasikmalaya) and 9 cities (Kota Bandung, Kota Banjar, Kota Bekasi, Kota Bogor, Kota Cimahi, Kota Cirebon, Kota Depok, Kota Sukabumi and Kota Tasik) in West Java province. The data included in this study after editing consisted of AI data 141,176 records that occurred between January 31, 2017 and September 21, 2018. While service records as well as pregnancy diagnosis information 98,120 records. Each insemination event had 2 possible outcomes: a positive pregnancy diagnosis (i.e., Success), a negative pregnancy diagnosis (i.e., failure). Obvious data errors, e.g., There is not exactly date of pregnancy diagnosis information because the services more than four services, also the data with the services earlier than date of pregnancy diagnoses were discarded. The bulls with the services record data < 100 times services were removed to avoid the any bias. The total number of inseminations per bull (a minimum of 100 inseminations per bull) and the number of conceiving cows was calculated for estimation of conception rate of all the bulls that included in this study.

Then the bull fertility was classifying with calculated the percentage of first service conception rate (FSCR) according to the following formula Siddiqui et al. (2013); Singh et al. 2016; Aslam et al. 2018 [6]–[8]. The following formula used for evaluation of FH bull fertility using the %FSCR data described below:

\[
\text{FSCR} (\%) = \frac{\sum \text{Cows conceived after first insemination of bull (X)}}{\sum \text{Total of First Insemination of bull (X)}} \times 100\%
\]

The %FSCR of individual bulls were calculated and plotted according to the mean and the standard deviation (STDEV). The determination of high and low fertile of bulls is according to Aslam et al. [8] that those bulls which have %FSCR less than ‘mean - 1SD’ were considered as low fertile while those bulls which have FSCR above ‘mean + 1SD’ were considered as high fertile.

The range of service sire’s ages is about 2 until 9 years old, respectively, and two different seasons (dry season: from April to September, and wet season: from October to March). The data of climate were recorded every month based on Indonesian Meteorological, Climatological, and Geophysical Agency including the temperature and humidity. Bulls were fed and maintained under similar
management and feeding system according each Artificial Insemination Center management system. Bulls were housed in a barn individually.

3. Result and Discussion
The Friesian Holstein bulls used in this study can be classified into two levels of fertility. They were high fertile (HF) and low fertile (LF) based on the calculation of % FSCR using data of iSiKHNAS from year 2017-2018. Moreover, the iSiKHNAS data that were used in this study have been tabulated and selected according to their validities as well as the method to avoid any bias and it also selected based on the inseminator ability. The inseminator ability that is chosen based on their AI service, technical abilities that showed by more than 100 cows were conceived in the first artificial insemination service using the same ID of FH bulls. The inseminator ability should be considered to get the best result of AI program. Therefore, the selected inseminator that used in this study have been educated and receive certificate as inseminators from the government in this case the livestock service which has a license to do the insemination. The results of this study supported by Hoesni [9] who concluded that the inseminate expertise in implementing of this AI was one of the five critical success factors of AI. According to Ismanto [10], the expertise and inseminator skills in the recognition accuracy of lust, sanitary appliance, handling of the frozen semen, the right thawing, and the ability to implement the AI would determine AI success. It was added by Rivera [11], the inseminator skill in AI implementation on cattle highly influenced the pregnancy rate such as the estrus detection period. AI services were very critical to get a high conception rate. In this present work, it was known that the FH bull in both of AI Centre has been selected based on breeding soundness examination (BSE) and the frozen semen production was standardized by Indonesia national standard (SNI 4869-1:2017).

Although most evidence suggests the decline in FH dairy herd reproductive efficiency is primarily related changes in the management of the female, it is logical to question the portion of this decline that can be attributed to the male. This question is particularly relevant to the genetic components of fertility that may also be expressed in measures of bull reproductive efficiency that it become a main issue [12]. One of the ways to measure the male reproductive efficiency can be estimated using the first service conception rate (FSCR). First-service conception rate is the percentage of heifers that became pregnant after the first AI service [13]. Moreover, fertility is highly influenced by management and environmental factors [14]. The following result of %FSCR was shown in Table 1.

Table 1. Percentage of first service conception rate of FH Bulls in Lembang and Singosari AI Center from year 2017- 2018

| Group | Bulls ID | %FSCR | Fertility rate | Producers |
|-------|----------|-------|----------------|-----------|
| IB<1000 | 316121 | 21.15 | Low Fertile | Lembang |
|        | 30158 | 22.22 | Low Fertile | Singosari |
|        | 30775 | 64.29 | High Fertile | Singosari |
|        | 312110 | 74.03 | High Fertile | Lembang* |
| IB>1000 | 31084 | 33.78 | Low Fertile | Singosari |
|        | 30697 | 35.28 | Low Fertile | Lembang* |
|        | 313111 | 61.61 | High Fertile | Lembang |
|        | 31088 | 63.11 | High Fertile | Singosari |

(resources: iSiKHNAS data of West Java year 2017-2018 processed)

According to Saha, [15] in which the normal conception value of the FH dairy cattle is about 50% to 77%. The low fertile of bulls with the low percentage of FSCR could be influenced by some factors. The age of the bulls could be the one of the factors that influence the spermatozoa fertilities. The ID bulls that are given in the Table 1 shows a varying year of birth. The age of bull that used in this study as well as the method mentioned before by the range from 2 until 9 years old. The ID bulls have a meaning that the first number from the ID referring to FH breed. The next two digit number refers to the year of bull’s birth and then the following number is stand for the series number of the
bulls. According to [16] that all semen traits were significantly affected by the age. In addition, age had a significant interaction effect with the season on the volume of the ejaculate and on the percentage of motile spermatozoa. Volume and the concentration of spermatozoa tended to increase with the age of the bull, regardless of the season or the interval between collections.

Based on this study, the bulls that used is coming from Lembang and Simgosari AI Center. Both AI Center has their own environmental condition and management system. It could be influenced to the bull reproductive or fertility. It was observed that some bulls in the HF group exhibited better performance in situations of a greater challenge. Therefore, bulls that present semen with higher fertility in certain types of AI could be utilized on a larger scale to increase the reproductive rates in artificial insemination. The results of this study indicate that despite the tests indicating the semen that is submitted is adequate, there are still variations in quality and the reproductive efficiency of each bull. However, quality and quantity of semen that have a high potential of fertility depend on numerous genetic and environmental factors [17]. The effects of the successful artificial insemination are variable based on fertility and on different environmental and management situations [18]. The seasonal variation during year 2017 until 2018 also occurred. Rain and dry season gave an effect to the spermatozoa production. So, it could influence the spermatozoa quality. In recent, the some of the research told that seasonal variation could reduce the conception rate, because of the semen of the bull utilized or the female inseminated, which are exposed and susceptible to thermal stress and adverse environmental conditions [18].

The ability of individual bulls to produce large quantities of semen with good quality is essential for satisfactory breeding and economic results of artificial insemination. So that, it needs an attention towards the genetic factor of each bull. The genetics and environment (GxE) interactions must be understood if they are to be exploited to improve bulls production, particularly in production systems in this case semen production associated with large environments [19]. Each bull have the differentiating characteristic of fertility phenotypic. The difference of phenotypes is can be affected by epigenetic. The term epigenetics refers to changes in the phenotype caused by mechanisms other than changes in DNA sequences. Dada [20] reintroduced the term to explain that gene action and expression that give rise to the phenotype. Epigenetic changes encompass an array of molecular modifications of DNA, and it can influence to the bull fertility or specifically to the semen quality.

The ability to compare estimates of service bull fertility across different breeding AI center producers of frozen semen, having already adjusted for systematic environmental effects, will be valuable in making decisions, on which bulls to use. Achieving high pregnancy rates in the key to profitable dairy production systems, especially in seasonal calving (and breeding) production systems. This study clearly illustrates that the fertility rate of bulls on male fertility differ when systematic environmental, as well as genetic effects, are accounted for in a mixed model. The approach is also useful in evaluating technician performance, while simultaneously accounting for the impact of environmental and genetic effects on performance. Further, this study is really useful to get the biomarker of HF bulls using more accurate assessment through genomic analysis to improve the FH breeding cattle. Therefore, there is a more objective molecular approach is to look into problems related to fertility. Sufficient scientific evidence has been produced over the years for genetic and epigenetic regulation of spermatogenesis. Epigenetic modifications such as DNA methylation cause changes in gene of fertility expression without changes in DNA sequence [21]. DNA methylation is the addition of a stable covalent from a base group where cytosine can be methylated in CG-enriched regions of the genome, described as CpG island, which is a response to environmental cues or exposure so as to modify gene of fertility expression [22]. So that, the genomic analysis is needed to get more specific and accurate information about a specific marker of high fertile bulls. It could be used as a potential marker to selected the best superior sire and improve the breeding of FH dairy cattle.
4. Conclusion
The FH bull semen spread in West Java mostly from Lembang and Singosari AI Center. The fertility rate can be grouped into high fertile (HF), and low fertile (LF) level and also divided into two groups based on the number of AI services. The %FSCR of FH bulls semen that used for AI <1000 services in Singosari 64.29% as HF level; 22.22% as LF level, while in Lembang had 74.03% as HF; 21.15% as LF level. Then, the AI> 1000 services in Lembang had %FSCR is 61.61% as HF level; 35.28% as LF level. While Singosari had 63.11% as HF level; 33.78% as LF level. In conclusion, the FH bulls in Lembang and Singosari AI center had the HF of the %FSCR is about 53.13 until 74.03%. It is needed the more accurate assessment through genomic analysis to get the biomarker of HF bulls as a suggestion to improve the FH breeding cattle. The ability to compare estimates of service bull fertility across different breeding AI center producers of frozen semen, having already adjusted for systematic environmental effects, will be valuable in making decisions, on which bulls to use.

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