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Milk Production and Reproductive Performance of Holstein Friesian Dairy Cattle in the Working Area of South Bandung Pangalengan Animal Husbandry Cooperative (KPBS) Bandung Regency

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ABSTRACT

Increasing the population and productivity of dairy cows is one of the way to boost national milk production capacity. This study was aimed to determine and investigate the performance of milk production and reproduction of Friesian Holstein (FH) dairy cows in the Working Area of KPBS Pangalengan, Bandung Regency. This research used FH dairy cows with a complete milk production and reproduction record. In total, there were 90 heads of cows in the Pangalengan District and 178 heads of cows in the Kertasari District. This study used the survey method to collect the data. A Multistage Random Sampling Method was used in this research. Sampling was carried out in two stages, the first stage was sampling from two sub-district locations in Pangalengan and Kertasari Districts. In the second stage, two villages were selected from each district: Pangalengan and Margamukti Villages in Pangalengan District, and Santosa and Tarumajaya Villages in Kertasari District. Farmers and their cows were chosen by simple random sampling. Data on milk production and reproduction records were obtained from farmers and their cows through direct observation and interviews related to the identity of the cattle they owned. The results showed that the average performance of the milk production characteristics of FH dairy cows was: an average milk production of 3779.2 ± 497.48 liters/head/day, an average length of lactation of 307.8 ± 31.30 days, and an average dry period of 72.14 ± 21.43 days. The lactation period had a significant effect ($P < 0.05$) on milk production. The peak of milk production was reached in the fourth lactation period. The mean of reproductive traits consisting of the first postpartum mating was 77 ± 20.5 days, the average length of days open was 96 ± 26.4 days, the average number of services per conception was 1.8 ± 0.85 times, and the average calving interval was 381.05 ± 24.5 days. In conclusion, FH dairy cows raised in Pangalengan and Margamukti Villages, Pangalengan District, Santosa and Tarumajaya Village, Kertasari District, in the working area of Pangalengan KPBS during the Covid-19 pandemic indicated a fairly good performance of milk production and reproduction characteristics.

Keywords: Characteristics of milk production, FH dairy cows, Reproductive characteristics

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Introduction

The continuously increasing milk consumption in Indonesia country was not followed by the performance of fresh milk production by the farmers. To meet the demand for milk, Indonesia still needs to import milk. In 2018, the availability of domestic milk was 77.47% supplied from imported milk, while domestic cow's milk only contributed 22.53% (Kementerian Pertanian, 2019). One of the efforts to increase domestic milk production capacity was done by increasing dairy cows' population and productivity.

The production performance of a female dairy cow is influenced by its genetic, and environmental factors, and the interaction between the two (Anggraeni, 2003). The synergy between

genetic and environmental factors, including reproduction, feed, and good management will result in a better performance. The reproductive characteristics of dairy cows are directly related to the amount of milk production. For this reason, it is essential to acknowledge this characteristics as it can define the reproductive management level that shall be carried out, which indirectly will affect the farmers' income (Makin, 1990). Environmental factors such as climate, feeding, maintenance management, lactation period, dry period, service periods, and calving intervals are estimated to contribute around 70% to milk production (Anggraeni, 2003). Reproductive performance includes service per conception, days open, service period, gestation period, and calving interval. One way to calculate reproductive

efficiency is by calculating the number of mating to gain pregnancy (Makin and Suharwanto, 2012).

Pangalengan district is one of the centers for dairy cattle development in Bandung Regency that is significantly contributed to West Java Province. In addition to its climatic, geographical, and topographical conditions, this location is suitable for raising dairy cattle and has a potential for development. Friesian Holstein (FH) dairy cattle in Pangalengan are mostly raised by smallholder farmers who are members of the Pangalengan South Bandung Dairy Cooperative (KPBS). They faced various common problems like productivity, maintenance management, feeding, and reproduction. There was little information regarding the performance of the production and reproductive characteristics of FH dairy cattle in various lactation periods in the Pangalengan KPBS Working Area during the Covid-19 pandemic. Based on this reason, this research aimed to determine and study the milk production and reproduction performance of dairy cows in the South Bandung Dairy Cooperative Pangalengan Working Area, Bandung Regency.

Materials and Methods

This research was conducted in the working area of the Pangalengan South Bandung Dairy Cooperative (KPBS), Bandung Regency. Several years earlier, the KPBS working area covered three districts, but currently, there are only two districts, Pangalengan and Kertasari District. The research was carried out from November to December 2021. FH dairy cows that had already complete records of milk production and reproduction, starting from the 1st to 5th lactation period were used in this study. All dairy cows used in this study were owned by farmers who were members of the Pangalengan KPBS. In total, there were 90 cows in Pangalengan District and 178 cows in Kertasari District.

This research was conducted using a survey method. A Multistage Random Sampling Method was used as the sampling technique. Sampling was carried out in two stages, the first stage was the sampling of two district locations that had the largest dairy cows population: Pangalengan and Kertasari Districts. In the second stage, two villages were selected from each district, Pangalengan and Margamukti Villages in Pangalengan District, and Santosa and Tarumajaya Villages in Kertasari District. Farmers and their cows were chosen by simple random sampling. Data on milk production and reproduction records were obtained from farmers and their cows' samples through direct observation and interviews related to their cow's information. While data on climatic and physical conditions were obtained from KPBS Pangalengan, District's Offices, and related agencies.

Some variables observed were as follows:

- 1) milk production: obtained from daily milk production record (liters), and also milk production record in one period of lactation (within 305 days),
- 2) lactation period was determined as the interval

from parturition up to dry off (days), 3) dry period is the length of the day starting from the cow is not milked until the cow is calving (days), 4) postpartum mating or the first insemination after calving was the time interval calculated from date of the first calving to the first insemination after calving (days), 5) days open period or interval from calving period to the service (re-mating) and the conception period (days), 6) Service per conception was calculated by the number of inseminations after the first calving that is carried out up to the results of the second pregnancy, 7) calving interval was the time interval from the date of the first calving to the date of the second calving (days).

A comparison between average cow's milk production at different lactation periods (1st to 5th) and reproductive traits was analyzed using the student T-test. All data were processed using SPSS 16.

Results and Discussion

General conditions of the study locations

Pangalengan South Bandung Dairy Cooperative (KPBS) is located in Pangalengan District, Bandung Regency, West Java Province. The Pangalengan KPBS working area is surrounded by mountains and is located at an altitude of 1,000-1,420 meters above sea level (asl), air temperatures are ranging from 12-28°C, and relative humidity is 60-70% (BPS, 2019). Besides being suitable for the development of dairy cattle, these natural conditions are also suitable for plantations and vegetable crops. Most of the Pangalengan people's livelihoods are crop and livestock farmers.

The working area of the Pangalengan KPBS includes 2 (two) districts: Pangalengan District which consists of 12 villages and Kertasari District which has 5 villages. Since the working area is very broad, to serve all members, 24 regional commissariats (komda) and 34 cooperative service points (TPK) are formed.

Dairy cows' milk production performance

The study on the FH dairy cattle productivity was conducted to get an overview of the potential of dairy cows raised by farmers who are members of the Pangalengan KPBS. The complete data of the production traits performance that include daily milk production, milk production for each lactation, length of lactation, and dry period are presented in Table 2.

Milk production characteristics of FH dairy cows raised by members of the Pangalengan KPBS (Table 2) that include daily milk production, milk production per lactation, length of lactation, and dry period indicated a fairly good average score.

Daily milk production

The results of the study marked that the average daily milk production of FH dairy cows was 12.93±1.91 liters/head/day with a range between 9.11-17.53 liters. The results of this study (12.93

Table 1. The number of dairy farmers and cattle in the research location

No.	Location of dairy cattle farmers (Persons)	Farmer (household)	Dairy cow (heads)
1.	Pangalengan District Pangalengan and Margamukti Villages	40	90
2.	Kertasari District Santosa and Tarumajaya Villages	48	178
		88	268

Table 2. FH dairy cattle milk production performance in the study locations

Lactation period	Daily milk production (kg)	Milk production per lactation (kg)	Length of lactation (days)	Dry period (days)
1 st	11.39±1.93 ^a	3475.43±589.12 ^a	303.39±25.93 ^a	66.43±12.25 ^a
2 nd	12.45±1.91 ^b	3794.42±579.35 ^b	303.79±24.21 ^a	67.40±12.53 ^a
3 rd	12.78±2.14 ^b	3898.74±652.49 ^b	308.63±23.58 ^a	71.25±14.97 ^a
4 th	13.39±2.15 ^{b,c}	4083.41±654.47 ^{b,c}	308.75±24.17 ^a	71.59±14.78 ^a
5 th	11.95±1.41 ^a	3643.76±431.36 ^a	314.46±58.60 ^a	84.05±52.62 ^a
Average	12.39±1.91	3779.15±497.48	307.80±31.30	72.14±21.43

^{a,b,c} Different superscripts in the same row show significant differences ($P < 0.05$).

liters) indicated an increase in the average daily milk production per head when compared to that of Kusmayadi *et al.* (2020) report, which confirmed that FH dairy cows raised in the Rainfed Dry Land Agroecosystem, Agroecosystem Dryland Irrigated Paddy Fields, and Dryland Agroecosystems bordering forests in Garut Regency produced 10.6 liters/head/day, 10.1 liters/head/day, and 11.4 liters/head/day, respectively, and 8.62-9.83 kg/head/day in KPBS (Sudrajat *et al.*, 2021). On the other hand, it is lower than the average daily production of cows raised at BPPT-SP Cikole Lembang, 14.3±3.9 kg/head/day (Anggraeni *et al.*, 2008), lower than West Java Province, which was 14.93±3.23 kg/head/day (Makin and Suharwanto, 2012), and also lower than national production 13.8 liters/head/day (Toharmat, 2013). According to Sudono (1999), the factors that affect the level of milk production are as follows: breed, gestation period, lactation period, cow size, estrus, age, calving interval, dry period, milking frequency, feed, and management. According to Sari *et al.* (2016), the provision of forage and concentrate feed will affect the amount of milk production. It means that feed is a very essential factor for livestock production. According to Anggraeni *et al.* (2008), differences in milk production are due to differences in maintenance and feeding management between locations. The results in this study and the previous studies by those researchers were still in the average milk production range of FH dairy cows raised in the tropics, including in Indonesia. The occurrence of a range of average milk production both in various regions in West Java and various tropical countries indicates that there are differences in production performance that is possibly due to environmental differences where FH dairy cows live (Warwick and Legates, 1979).

Milk production per lactation

The results presented that the average milk production per lactation was 3779.2±497.48 liters/head/day, with a milk production ranging from 2779-5348 liters. The highest milk production was gained in the 4th lactation period at 4083.4±654.5 liters, while the lowest milk production was in the 1st lactation period at 3475±589.12 liters. Statistically, milk production at the 1st and 5th

lactation periods are significantly different ($P < 0.05$) from the 2nd, 3rd, and 4th lactation periods. While milk production during the 2nd lactation period was significantly different ($P < 0.05$) from the 4th lactation period. According to Sandhu *et al.* (2011), differences in milk production in each lactation period were due to the level of feed provision and quality, maintenance management, and some seasonal influences, such as rainfall, humidity, and temperature. Beyene *et al.* (2018) reveal that the production performance was low because of poor management. Season variations were the main reasons for low milk production caused by feed shortage. Keeping records also has a big impact on lactation length and calving interval. Some previous researches report the average production per lactation. At the Kaa Alboon Station, Imuran Governorate, Yemen was 3919.66±42.99 kg (Samarai *et al.*, 2015); at BPPT-SP Cikole Lembang was 4558±1326 kg (Anggraeni *et al.*, 2008); in West Java was 4185.89±990.43 kg (Makin and Suharwanto, 2012); at the Government Dairy Farm Quetta, in Balochistan province, Pakistan was 3977.75±37.20 (Sandhu *et al.*, 2011). By comparing these results, it can be assumed that the average value of milk production is categorized as medium milk production capability. The milk production performance is quite good in tropical environments like Indonesia, so it is quite profitable to raise dairy cattle in the Pangalengan KPBS working area. According to Anggraeni *et al.* (2008), instead of the genetic quality of dairy cows, maintenance management and better feed quality can increase the milk production capacity of FH dairy cows. A more complete description of the genetic quality of FH dairy cattle raised in the working area of Pangalengan KPBS can be seen from the lactation curve during the dairy cows' life and production.

By observing the lactation curve in Figure 1, it seemed that milk production begins to increase in the 2nd lactation and reaches its peak in the 3rd to 4th lactation period and then decreases again in the 5th lactation period. Milk production from the 2nd, 3rd, and 4th lactation were significantly higher ($P < 0.05$) than the 1st and 5th lactation periods. This lactation curve suggests that along with increasing age and the body weight of dairy cows, farmers had carried out feeding management and maintenance

properly. According to Warwick and Legates (1979), the more increase biological maturity of a lactating cow, the more milk is produced as the body weight, organs, and udder are growing. The research by Anggraeni *et al.* (2008) at BPPT-SP Cikole reports that at different lactation periods, milk production and lactation increase reach peak production in the 3rd lactation, and begin to decline in the 4th lactation. Whereas Makin and Suharwanto (2012) report that the peak of milk production is in the second lactation period and then decreases until the 5th lactation period. This situation reflects that there was a possibility of a decrease in the genetic quality of FH dairy cattle in Pangalengan as a result of frequent changes in feed management and quality. According to Warwick and Legates (1979), if reproductive management is well implemented, quality feed is provided, and the environment supports maintenance, milk production will continue to increase from the first lactation until a peak at around 5-6 lactation.

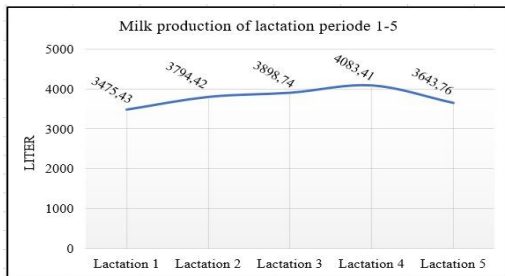


Figure 1. Lactation curve.

Length of lactation

The average lactation length of the cows at the research sites was 307.8±31.30 days, with a range between 250-380 days. Statistically, the length of lactation in the 1st to 5th lactation period (Table 2) was not significantly different. However, the range of lactation length of FH dairy cattle raised in the Pangalengan KPBS working area is quite varied than several other areas, such as at BPPT-SP Cikole Lembang between 276-329 days (Anggraeni *et al.*, 2008); in West Java Province between 263-380 days (Makin and Suharwanto, 2012); and the average length of lactation of FH dairy cattle in Ethiopia is 314.11±4.24 days (Worku *et al.*, 2016). Variations in the length of lactation, apart from temporary climatic and environmental factors, also depend on reproductive efficiency. According to Sudono (1999), the duration of lactation depends on 'persistence', while this persistence is heavily influenced by several factors that are not hereditary, such as the age of the cow, the condition of the cow during calving, the length of the previous dry period, the amount of food given to the lactating cow. Meanwhile, the length of lactation of more than 10 months is due to reproductive disorders, in which the cows are late in being pregnant again as a result of poor management. The occurrence of variations in milk production in this study was influenced by

variations in the length of lactation. Milk production is low because the lactation is shorter and on the opposite, milk production is high because the lactation period is also longer.

Dry period

Table 2 suggests that the average dry period for FH dairy cows raised at Pangalengan KPBS was 72.14±21.43 days, with a range of dry times between 30-120 days. The average dry period of the 1st and 2nd lactation periods was almost the same (66.43±12.25 and 67.40±12.53). Whereas in the 3rd, 4th, and 5th lactations, the average dry period became longer (71.25±14.59); (71.59±14.78); (84.05±52.6), but statistically, the dry period of the 1st, 2nd, 3rd, 4th and 5th lactation periods were not significantly different ($P>0.05$). The average dry period of FH dairy cattle at KPBS was shorter than that of FH cattle raised at BPPT-SP Cikole Lembang, which was 94±47 days (Anggraeni *et al.*, 2008), and longer than that of FH dairy cows in West Java Province, which was 65.93±14.79 days (Makin and Suharwanto, 2012). The average dry period of FH dairy cows in KPBS indicated an ideal dry period (60-80 days). According to Makin (1990), a good or ideal dry period is between 60-90 days before parturition. If shorter than 60 or longer than 90 days, the next milk production will decrease. Variations in the dry period in FH dairy cattle in the KPBS working area, in West Java, or other tropical countries are caused by not only local climate influence but also due to poor management, especially feeding management. As a result, the period becomes longer and milk production reduces.

Performance of reproductive traits of FH Dairy Cattle

Performance of the reproductive characteristics of FH dairy cows that includes the first postpartum mating, days open, service per conception, and calving intervals are presented in Table 3.

Based on Table 3, in terms of the aspect of reproductive characteristics, FH dairy cattle raised in the Pangalengan KPBS working area demonstrated quite good performance and in turn, can support production characteristics in an even better direction.

First postpartum mating

Table 3 describes that the average first post-partum mating in FH dairy cattle in the Pangalengan KPBS working area was 77±20.5 days with a range between 40-170 days. Statistically, the first postpartum mating in the 1st, 2nd, and 3rd lactation periods was significantly different ($P<0.05$) from the 5th lactation period. While the first postpartum mating in the 4th and 5th lactation periods was not significantly different ($P>0.05$). The average value of this study is fairly good because according to Sudono (1999), the first mating of FH dairy cows should be done two months after calving, while according to Makin (1990), a good period after calving is 60-90 days.

Table 3. Performance of the reproductive traits of FH dairy cattle at the research sites

Lactation period	First postpartum mating (days)	Days open (day)	Service per conception (days)	Calving interval (days)
1 th	71.80±17.69 ^a	90.80±23.73 ^a	1.76±0.66 ^a	373.52±20.25 ^a
2 nd	71.53±19.04 ^a	89.03±23.27 ^a	1.76±0.78 ^a	374.18±21.66 ^a
3 rd	76.57±19.66 ^a	93.81±26.24 ^a	1.81±0.89 ^a	379.09±23.54 ^a
4 th	78.26±18.09 ^{ab}	95.35±28.92 ^a	1.86±0.97 ^a	381.26±26.28 ^a
5 th	86.32±27.92 ^b	111.82±29.83 ^b	2.05±0.93 ^a	397.18±31.01 ^a
Average	76.90 ±20.48	96.16±26.40	1.85±0.85	381.05±24.55

^{a,b} Different superscripts in the same row show significant differences ($P < 0.05$).

The reproductive aspect of the first mating after calving in FH dairy cows raised by the members of Pangalengan KPBS was considered efficient because it had an optimal range of first postpartum mating.

Days open

The average length of days open (Table 3) was 96±26.4 days with a range between 50-170 days. The length of the days open in the 1st, 2nd, 3rd, and 4th lactation periods were significantly different ($P < 0.05$) from the 5th lactation period. The long-vacant period is caused by delays in performing AI, reproductive disorders, and silent heat, in which the symptoms of heat are difficult to detect (Anggraeni *et al.*, 2008). The average length of vacancy was shorter than that of FH dairy cows raised at BPPT-SP Cikole Lembang, which was 141±74 days (Anggraeni *et al.*, 2008), FH dairy cows in West Java was 119.10±31.33 days (Makin and Suharwanto, 2012) and the tropical highlands of Central Ethiopia was 179.9±6.8 days (Wondossen *et al.*, 2018). The average day's open length was longer than the ideal or optimum range for FH dairy cows which is 60-80 days after calving. It means, the average day's open score for FH dairy cows in Pangalengan KPBS Working Area is fairly good and will not influence the total milk production. According to Wondossen *et al.* (2018), calving season does not affect the length of vacancy, but parity and male parents are a significant source of variation for day's open.

Number of services per conception

The average number of services per conception in KPBS Pangalengan (Table 3) is 1.8±0.85 mating times with a range between 1.0-4.0 times. Statistically, the S/C scores during the 1st to 5th lactation periods were not significantly different ($P > 0.05$). This S/C score was not much different from FH dairy cows reared in West Java, 1.88±0.88 times (Makin and Suharwanto, 2012) and in the tropical highlands of Central Ethiopia, 1.98±0.05 times (Wondossen *et al.*, 2018). The results indicated that the number of matings per pregnancy is normal or good and follows Toelihere (1981) who states that the normal number of matings until pregnancy in FH dairy cows is between 1.6-2.0 times. Variations of maintenance management, environment, heat detection, and the fertility level of dairy cows will affect the number of matings per pregnancy (Sandhu *et al.*, 2011). It is also possible that the high number of matings per pregnancy (S/C) in the tropics, including Indonesia, is due to poor management and poor quality of

feed, as well as the influence of the tropical climate, especially in the high-altitude area environment.

Calving interval

One of the most important reproductive efficiency indicators is the length of calving interval as it can be used as an indicator of success in a dairy farming business. The mean of the calving interval in the 1st, 2nd, 3rd, and 4th lactation periods were significantly different ($P < 0.05$) from the 5th lactation period. The long calving interval in the 5th lactation was due to the long empty period and the first service per conception (Table 3). As stated in Table 3, the average calving interval for FH cattle was 381.05±24.5 days, with a range between 330-470 days. The calving interval of FH dairy cows in the study area was longer than the recommendation, 365 days. However, the calving interval was still shorter than that of at BPPT-SP Cikole, which was 418±74 days (Anggraeni *et al.*, 2008), FH dairy cattle in West Java was 389.60±25.40 (Makin and Suharwanto, 2012), in Ireland was 379±58 days (Coffey *et al.*, 2016) and in the tropical highlands of Central Ethiopia was 469.2±7.9 days (Wondossen *et al.*, 2018). The average score of the calving interval in KPBS was considered ideal and normal, which was between 360-420 days or 12-13 months (Sudono, 1999). It means FH dairy cows raised in the Pangalengan KPBS working area are classified as cows with high productivity in producing calves during their productive life, and in turn, more milk production will be obtained. If the calving interval is longer than the range between 12-14 months, there will be a decrease in the total milk production.

Conclusions

FH dairy cows in Pangalengan and Margamukti Villages, Pangalengan District, Santosa, and Tarumajaya Village, Kertasari District in Pangalengan KPBS working area during the Covid-19 pandemic showed a fairly good performance of milk production and reproduction characteristics. The performance of milk production nature includes the average milk production at 3779.2±497.48 liters/head/lactation; lactation length at 307.8±31.30 days, and dry period at 72.14±21.43 days. The performance of reproductive traits includes the average first postpartum mating at 77±20.5 days; days open at 96±26.4 days; the number of services per conception was 1.8±0.85 times, and the calving interval at 381.05±24.5 days.

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