Estimation Repeatability of Milk Production in Fries Holland Cows (Case on BBPTU– HPT Baturraden)

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ABSTRACT

This study aims to estimate the repeatability of milk production in Fries Holland dairy cows. The object of this study was 474 milk production records from 237 first and second lactation dairy cows collected from 2022 to 2025 at the Center for Superior Livestock Breeding - Animal Feed (BBPTU - HPT) Baturraden. The dairy cow data used were total milk production records, which were then standardized to 305 days, 2 milking frequencies, and adult-equivalent age. The analysis results showed that the repeatability was 0,36 ± 0,048. The repeatability values obtained were included in the mid category.

Keywords: Fries Holland, repeatability, standardized

INTRODUCTION

Milk production in Indonesia has fluctuated over the past few years. According to the Central Statistics Agency (2025), domestic fresh milk production (SSDN) decreased by 3.45% from 2023 to 2024. The National Research and Innovation Agency (2025) stated at a National Seminar that milk consumption in Indonesia is approximately 16.6 kg per capita per year. This figure remains relatively low compared to neighboring countries, such as Malaysia at 29 kg per capita per year and Thailand at 40 kg per capita per year, while the FAO standard is around 30 kg per capita per year. National milk demand reached 4.7 million tons in 2024, while domestic production stood at only 1 million tons. Domestic milk supply can only meet 21% of demand, while the remaining 79% comes from imports.

Milk consumption in Indonesia is projected to continue increasing in line with population growth, rising public awareness of the importance of nutrition, and support from various government policies in the food and health sectors. One factor driving the rise in milk demand is the implementation of the Makan Bergizi Gratis (MBG) program, which positions milk as an important source of animal protein in meeting the nutritional needs of the population, particularly for target groups. The Directorate General of Social Protection (2025) states that by 2029, milk demand is projected to reach 8.5 million tons. This increased demand cannot yet be fully met by domestic milk production, so milk imports remain an option to address the national supply shortfall.

Efforts to increase national milk production cannot be achieved overnight and require a sustainable strategy. Milk production in dairy cows is influenced by interrelated genetic and environmental factors; therefore, productivity improvements depend not only on improved husbandry management but also on the genetic quality of the livestock. Understanding genetic parameters such as heritability and repeatability is crucial as a foundation for developing breeding programs. Genetic parameters such as repeatability serve as an indicator of the consistency or repeatability of an animal's performance from one lactation period to the next, which is useful for predicting its future productivity. A higher repeatability value indicates that past milk production records can be used as a basis for predicting future lactation performance, thereby accelerating the selection process.

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The National Center for Superior Livestock Breeding and Forage (BBPTU-HPT) Baturraden is a government agency with a vital role in dairy cattle genetic development programs in Indonesia. With robust production record data, BBPTU-HPT Baturraden is an ideal location for conducting studies on the estimation of genetic parameters related to milk production. This research aims to examine the reliability (repeatability) of milk production traits in the livestock population at BBPTU-HPT Baturraden. By estimating the reliability of milk production in FH cows at BBPTU–HPT Baturraden, it is hoped that this will provide a scientific basis for the selection of superior breeding stock to be developed. By knowing these parameters, the genetic potential of FH cows at BBPTU–HPT Baturraden can be evaluated more objectively, and the results can serve as a basis for selection programs and the breeding of superior dairy cattle in Indonesia.

METHODOLOGY

The method used in this study was a case study. The data used consisted of milk production data from 2022 to 2025, which had been standardized to a 305-day lactation period, two milkings per day, and adult equivalence using correction factors. Data on livestock identification, dry-off dates, and pedigrees were obtained from the BBPTU-HPT Baturraden. Milk production records show 474 liters from 237 dairy cows per lactation.

Research procedures

The data collected consists of all data in both softcopy and hardcopy formats obtained directly from the BBPTU – HPT Baturraden Data and Information Center; the data was then screened to eliminate outliers or data that did not represent the population. Records exceeding ± 2 standard deviations from the mean were considered outliers and excluded from the analysis.

Observed Variables

1. Daily Milk Production Data

The data used consists of data on cows in lactation periods 1 and 2 from 2021 to 2025, which has been standardized to a lactation period of 305 days, two milkings, and adult equivalence using correction factors. Milk production was standardized using the correction factor from the Hoerl formula $y = ab^x x^c$ which was subsequently modified by Indrijani (2008) as follows:

a. Regression equation for the correction factor for lactation duration of less than 305 days to a lactation duration of 305 days, for dairy cows aged 36 months or younger (≤36 months):

Hoerl Model :

$$y = (280{,}97692)(1{,}001079^x)(x^{(-1{,}0442258)})$$

Notes:

$x =$ Duration of lactation

$y =$ Correction factor

b. Regression equation for adjusting lactation duration of less than 305 days to 305 days, for dairy cows older than 36 months (>36 months)Regression equation for adjusting lactation duration of less than 305 days to 305 days, for dairy cows older than 36 months (>36 months)

Hoerl Model :

$$y = (257{,}85161)(1{,}0015769^x)(x^{(-1{,}0569318)})$$

Notes:

$x =$ Duration of lactation

$y =$ Correction factor

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c. The regression equation for the correction factor for lactation duration exceeding 305 days to a lactation duration of 305 days:

Hoerl Model :

$$y = (0{,}00835972)(0{,}99381142^{x})(x^{(1{,}1678976)})$$

Notes:

$x =$ Duration of lactation

$y =$ Correction factor

d. Regression equation for the age correction factor for cattle toward adult equivalent age:

4^{th}Degree Polynomial Model:

$y = (1{,}8181749) + (-0{,}02794495)x\ (0{,}000337177)x^2 + (0{,}0000017241288)x^3 + (0{,}000000003373)x^4$

Notes:

$x =$ Age of the cow

$y =$ Correction factor

2. Informasi Individu Sapi

a. Cow ID: Each cow has a unique ID number to facilitate the identification of each individual

b. Date of Birth: The date of birth is required because it is used to calculate the start date of record-keeping

c. Dry-off Date: This data is required to determine the duration of the lactation period

3. Repeatability Coefficient

The repeatability coefficient can be estimated by accounting for the genetic variance and permanent environmental variance of each cow/livestock animal. This data is derived from daily milk production records and analyzed using SPSS software

Statistical Analysis

Data analysis was first performed by standardizing the data for a lactation duration correction factor of 305 days and adult-equivalent age; the data were then used for genetic parameter analysis. The genetic parameter analyzed was the repeatability of milk production.

Estimation of Repeatability

Estimation of the reliability of milk production; the estimation method uses analysis of variance as an intraclass correlation coefficient. The statistical model is;

$$r = \frac{MS_s - MS_E}{MS_s + (k-1)MS_E}$$

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Notes :

MS_S = Mean Square for Subjects (between-subject variance)

MS_E = Mean Square Error (residual variance)

k = Number of measurements per subject

The standard error in the estimation of repeatability is calculated using the formula:

$$S.E(r) = \sqrt{\frac{2(1-r)^2(1+(k-1)r)}{k(k-1)(n-1)}}$$

RESULTS

Based on the results of the study, milk production increased from the first lactation to the second lactation. This is consistent with the findings of Siregar (1995), who noted that milk production in dairy cows increases continuously through the fourth lactation, as well as those of Snou et al. (2008), who stated that, physiologically, milk production increases through the fourth month of lactation.

Tabel 1. Milk Production Data for Lactation Periods 1 and 2 at BBPTU-HPT Baturraden for the years 2022–2025

Variable	Sum	Mean	Min	Max	SD	CV
		.....kg.....				...%...
Produksi susu laktasi 1	237	3678,71	2063,43	5845,43	787,76	21,41
Produksi susu laktasi 2	237	4954,79	2200,52	8018,19	1278,91	25,81

In this study, the estimated repeatability value was 0,36 with a standard error of 0,048. Based on this study, the repeatability value at BBPTU-HPT falls into the mid category. In accordance with Noor (2010), repeatability values are divided into three categories: 0,0–0.2 (low); 0,2–0,4 (mid); and greater than 0.4 (high).

Tabel 2. Estimation of Repeatability

Production Trait	Total Lactations	Total Records	$r \pm SE$	95% CI	Category
Milk Production	2	237	0,36 ± 0,048	0,244-0,466	Mid

DISCUSSION

Milk Production Repeatability

When compared with previous research findings from various locations, the repeatability values in this study show a consistent trend. Kubangun et al. (2018) reported milk production repeatability values at BBPTU–HPT Baturraden that fell into the high category, with values of 0.507 ± 0.323 for morning milking, 0.501 ± 0.324 for afternoon milking, and 0.490 ± 0.325 for total milk production. These estimates were obtained through analysis of variance using an intraclass correlation approach. Furthermore, Indrijani et al. (2018) reported a repeatability value of 0.44 for the first through third lactations, indicating that variations in milk production in subsequent lactations can be predicted based on previous production. Conversely, Lande et al. (2019) obtained a lower repeatability value of 0.18 ± 0.04 using an analysis of variance method.

The differences in milk production repeatability values obtained in this study compared to results reported in various studies at other locations cannot be separated from variations in dairy farming systems. Factors such as differences in farm environmental conditions, the amount of production data recorded, the analytical methods

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used, the implementation of management practices, and differences in the timing of the studies influence the observed milk production performance, resulting in inconsistent estimates across studies.

According to Johansson and Rendell (1968), estimated repeatability values for milk production are dynamic, tend to be unstable, and can fluctuate both over time and across dairy farms. This indicates that individual animal performance is not only influenced by genetic factors but is also significantly affected by fluctuating environmental conditions. This perspective aligns with the findings of Aditya et al. (2015), who stated that high genetic variation within a population, combined with the influence of permanent environmental factors, can increase the complexity of performance evaluation. These permanent environmental factors may even mask the effects of temporary environmental factors, making it difficult to identify the factors that directly influence milk productivity.

Repeatability values are useful for estimating future productivity of these animals (Indrijani et al., 2018). This indicates that genetic factors and permanent environmental factors play a dominant role, allowing individuals within the herd to serve as a basis for more accurate selection. Thus, dairy herds with high repeatability values have greater potential for development in breeding programs, as the predictability of their production performance is better compared to herds with low repeatability values.

CONCLUSION

The repeatability coefficient for FH dairy cow milk production at BBPTU-HPT Baturraden is 0,36 ± 0,048, which falls into the mid category. The moderate repeatability estimate indicates that milk production records from early lactations may provide useful information for predicting future performance. Therefore, repeatability can be utilized as a supporting parameter in dairy cattle selection programs.. These findings can be further utilized in EBV and MPPA evaluations as a basis for selection at BBPTU-HPT Baturraden.

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