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# Short Communication: The population number of Pelung chickens in West Java, Indonesia

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**Abstract.** *Asmara IY, Garnida D, Indrijani H. 2022. Short Communication: The population number of Pelung chickens in West Java, Indonesia. Biodiversitas 23: 3373-3378.* Domestic farm animals or, Animal Genetic Resources (AnGR), are part of the global biodiversity. The existence of AnGR, mainly local breeds, is threatened, and their population data is still far from complete. This study provides information about Pelung chickens (*Gallus gallus domesticus*), a local chicken breed in Indonesia. The purpose of this study was to offer an overview of the population, effective population size, and inbreeding rate of Pelung chickens in four districts in West Java, Indonesia. The method used in this study was a survey of fanciers and breeders of Pelung. Interviews were conducted to reveal the production system and population data. The data were analyzed descriptively and then calculated to estimate the effective population size (Ne) as well as the rate of inbreeding (ΔF). This preliminary survey indicated that there was a change in the distribution of the Pelung chicken, in which Garut District has the largest population number of Pelung, with 5664 birds of all ages. In this study, Pelung chickens in different areas had high Ne (267-569), and the ΔF can be considered fairly low (0.09-0.19). The results of the study are probably the first documentation of the population number of Pelung chickens in at least ten years. This research is the initial study that forms the basis for conducting a comprehensive survey on the Pelung chicken. This study offers an upper limit result of Ne, so that accurate diversity parameter such as using genomic information is required.

**Keywords:** Animal genetic resources, biodiversity, conservation, documentation, local breeds

## INTRODUCTION

Domestic farm animals or so-called animal genetic resources (AnGR) are part of biodiversity. They play important roles in food production, socio-culture, and ecological services. Millions of people depend on farm animals for their livelihoods (FAO 2015). The genetic diversity of AnGR in the world is a future food asset (Paiva et al. 2016). The sustained existence of AnGR ensures the capacity to counter unpredictable future events such as the emergence of new diseases or climatic changes.

The number of AnGR is reported to be in decline. A total of 17 percent of the livestock breeds reported to the Food and Agriculture Organization (FAO) are classified as being at risk of extinction. Furthermore, 58 percent of breeds are categorized as being of unknown risk status due to no current population numbers (FAO 2015). Chickens (*Gallus gallus domesticus*) have the highest number of breeds at risk among avian species. Among chicken breeds, local chicken breeds are most at risk of extinction (FAO 2007).

Local chickens have multifaceted values and are kept in diverse socioeconomic and physical production conditions (Bettridge et al. 2018). These conditions have formed local breeds based on farmers' preferences, i.e., for hobby or leisure purposes (Komiyama et al. 2016; Bortoluzzi et al. 2018). In Indonesia, some chickens are developed for entertaining purposes due to their unique characteristics, such as distinctive vocalization (Ulfah et al. 2015). Pelung chickens are among the local chickens developed for their unique crowing characteristics. A rooster of Pelung chickens can be identified by their long and rhythmical vocalization. Like other local chickens, the population data of Pelung chickens is unavailable. Pelung chickens are presumed to be endangered if not managed sustainably (Asmara 2014).

The absence of population data remains the main limitation of the farm animal monitoring system. The FAO risk classification relies on a combination of relatively few criteria focusing primarily on numerical factors, such as the number of productive males and females. The ratio of adult males and females in the population affects the effective population size (Waples et al. 2013). The effective population size (Ne) predicts the loss of genetic variation and the existence of small breeding populations (Kristensen et al. 2015). Genetic drift and inbreeding caused by low effective population sizes can cause populations to suffer from decreased reproductive fitness and, thus the risk of extinction (Okeno et al. 2012). Conventionally, genetic diversity parameters are estimated by pedigree and demographic data (Eusebi et al. 2020).

Genetic diversity and population structure affect the effective conservation and utilization of domestic chicken (Liu et al. 2021). Many researchers have studied effective population size and the inbreeding rate of local chickens (Lariviere et al. 2011; Rusfidra et al. 2015; Szalay et al. 2016). This current study investigates the population number, the effective population size (Ne), and the

inbreeding rate (ΔF) of Pelung chickens. It would be the first attempt to publish the population data on Pelung chickens, at least since 2014. The results are greatly important to provide general information about population data and the risk of extinction of Pelung chickens. The result would fill the gap of the lack of population data for the AnGR monitoring system, particularly for local chickens.

## MATERIALS AND METHODS

The object of this study was the Pelung chickens (Figure 1). They were originally kept and developed by people in Cianjur District, West Java Province, Indonesia. The chickens are among other local chickens in Indonesia, such as Kokok balenggek and Gaga or Ketawa chickens, developed for their unique crowing characteristics (Rusfidra and Arlina 2014). The chickens can crow for more than 10 seconds. Besides their distinctive crowing, Pelung chickens have bigger body sizes compared to other local chickens. The weight of a rooster is 3500 g on average, whereas a female is 3000 g on average (Mustofa et al. 2021). Red and black were the primary plumage colors for male Pelung chickens (Asmara et al. 2019b), while black and yellow-brown were commonly found in female chickens (Asmara et al. 2019a). The Minister of Agriculture formally acknowledged that Pelung is an indigenous chicken breed in Indonesia that needs safeguarding and conservation by issuing Decree No. 2918/2011.

### Study area

The research areas were Cianjur, Sukabumi, Bandung, and Garut Districts, West Java Province, Indonesia (Figure 2). Based on information from the key informants, the areas were selected due to the high population number of Pelung chickens. The key informants were the administrators of the Pelung chicken fancier and breeder association in each district. The association is Himpunan Peternak dan Penggemar Ayam Pelung (HIPPAPI). Cianjur is the place of origin of Pelung chickens. Cianjur and Sukabumi districts are bordered, and both districts are in the southwest of Java Island. The two districts have a high range of altitudes: between 7-2962 m for the Cianjur District and 0-2960 m for the Sukabumi District. Cianjur has an annual rainfall of 2610 mm with an annual temperature of 24.4°C (Cianjur District Information Communication and Statistics Agency 2017). Sukabumi District has an annual rainfall of 2000-4000 mm and it has an annual temperature of 18-30°C (Sukabumi District 2016). Like other research areas, Bandung and Garut Districts are in the highland regions. Bandung District has an altitude of more than 800 m, while Garut District is between 100-1500 m. Bandung District has an annual rainfall of 1500-4000 mm with a temperature between 12-24°C per year (Bandung District Government 2017). The annual rainfall in Garut District is 2589 mm with a temperature of 24-27°C (Garut District Communication and Information Office 2017).

### Procedures

The research used a survey method. A total of 207 respondents were involved in the survey. Respondents were HIPPAPI members in each research location. The key informants provided information about Pelung fanciers and breeders (respondents) in study areas. Data were retrieved from respondents by interview technique through a questionnaire using a semi-structured questionnaire. Information about the production system and population number was gathered during the survey. The unit analysis in this study was the population of Pelung chickens, which included the number of adult Pelung chickens (male and female) and the number of Pelung chickens less than six months old. The observed parameters were population structure, effective population size, and inbreeding rate.

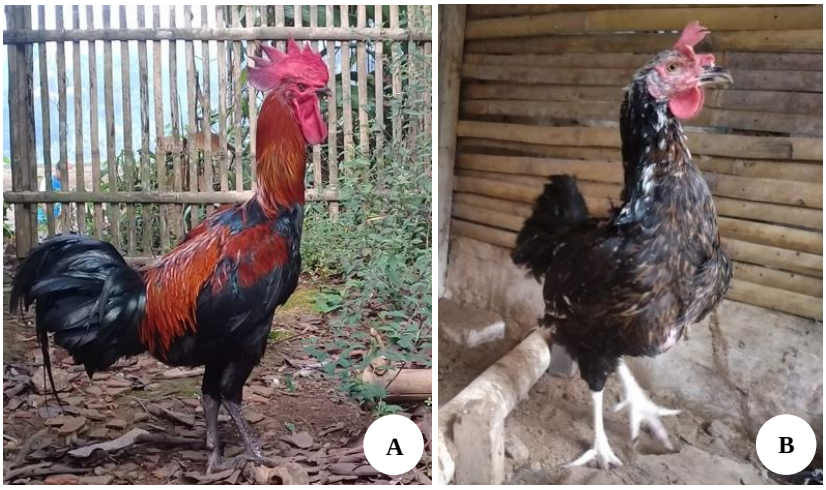


**Figure 1.** A. Male Pelung Chicken; B. Female Pelung Chicken

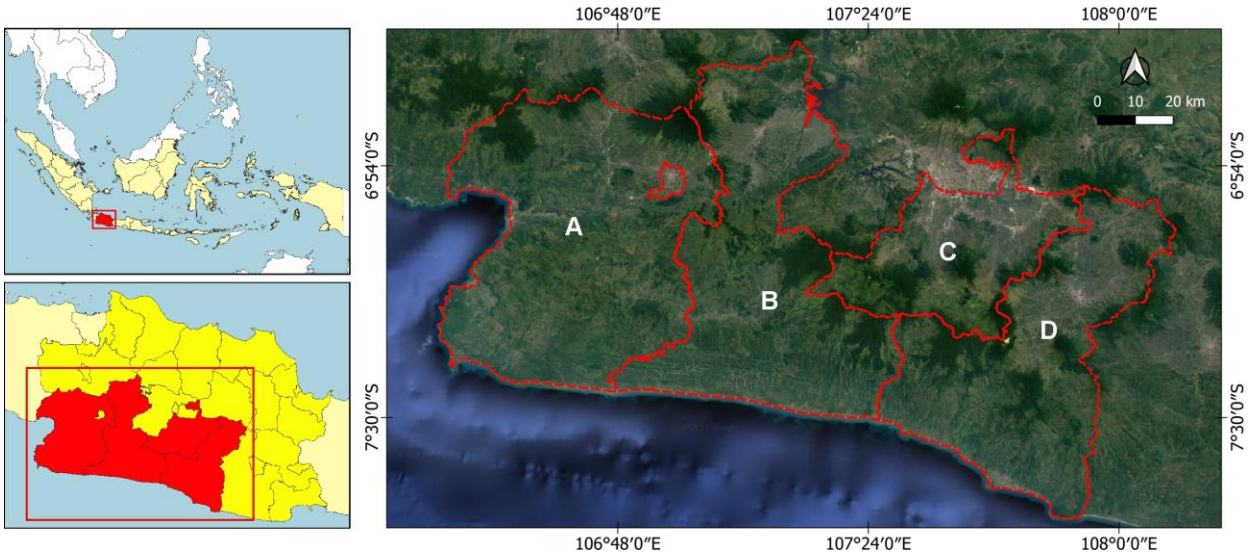


**Figure 2.** Research Area. A.Sukabumi District; B.Cianjur District; C. Bandung District; D. Garut District

**Data analysis**

Data were analyzed descriptively and included the mean, standard deviation, and coefficient of variation. The descriptive method is used to describe the characteristics of a population, or the phenomenon studied in this case is the population of Pelung chickens. The data were analyzed with the help of Microsoft Excel.

Population data was then used to calculate the effective population size (Ne) and inbreeding rate (ΔF). The number of individuals from a population randomly selected and randomly mated is defined as the effective population size (Ne). Ne was estimated using the formula given by Wright (1931):

$$Ne = \frac{4NmNf}{Nm + Nf}$$

Where, $N_e$: effective population size; $N_m$: the number of breeding males; $N_f$: the number of breeding females

The rate of inbreeding is an appropriate parameter of procedure in defining inbreeding in small populations (Lariviere et al. 2011). The difference in $\Delta F$ is inversely proportionate to the total of individuals evenly contributing to the gene pool (Lariviere et al. 2011).

$$\Delta F = \frac{1}{2Ne}$$

$\Delta F$ = inbreeding rate

## RESULTS AND DISCUSSION

**Results**

Table 1 shows that the purpose of raising Pelung chickens in three research locations (Sukabumi, Garut, and Bandung Districts) is dominated by hobbies, while a total of 94% of respondents in Cianjur District stated that the purpose of raising Pelung chickens is for commercial purposes. All respondents (100%) in Cianjur and Sukabumi obtain breeding stocks from their local areas. Semi-intensive system is the common rearing system found in research areas, in which the feed resources are derived from non-commercial stuff. All respondents (100%) in Cianjur District do not practice vaccination as part of the health management system for their chickens.

Table 2 displays that the total population of Pelung Chickens in study areas was 5664 birds. A total of 45% population (2566 chickens) was derived from Garut District. Both male and female chickens aged 0-3% contributed more than 20% of the population structure, while adult male and female chickens contributed more than 15%.

Table 3 shows the estimated Ne, Nm/Nf, and Ne/N Pelung chickens in research areas. The Nm/Nf ratios were from 0.67 to 1.35, and Ne/N ratios were from 0.96 to 0.99. Also, Table 3 displays estimates of inbreeding rates of Pelung in different locations from 0.09% to 0.19% per generation. Ne was diverse, was highest in Garut District (Ne: 569) and lowest in Bandung (Ne: 267). Populations with a smaller Ne had higher inbreeding rates.

**Discussion**

The main objective of keeping Pelung in research locations is as a hobby. In general, the chickens were reared under a semi-intensive system in which chickens moved easily and explored their feed in bounded areas. The keepers provided shelters to keep chickens from disturbances such as bad weather and predators. In terms of feeding, the keepers provided the chickens with agricultural products such as rice bran and household waste products. Vaccination was a common practice in research areas except for Cianjur District. Respondents usually provide vaccinations for Newcastle disease (ND). The rearing management system was a common system found for other local chickens in developing countries, as reported among others by Nwogwugwu et al. (2018) and Mpenda et al. (2019).

Based on the author's knowledge, the results of the study are the first documentation of the population distribution of Pelung chickens in West Java. The results showed that there was a change in the distribution of the Pelung chicken population, which was originally developed in the Cianjur area. This initial survey showed that Garut District is the largest population number of Pelung. This finding supported Asmara (2014), who reported that the Pelung chicken contest caused the existence of the Pelung chicken to be maintained and its distribution not only in the Cianjur area. Pelung chicken contest held from sub-district to national level is considered a promotional media for Pelung chicken. In the contest, a male bird participates to win both singing and performance categories. Fanciers and farmers recognized contests as a marketplace where they would find good breeds (Asmara et al. 2018). It has been reported that many of the winners of Pelung contests are from the Garut District.

In terms of flock structure, the composition between males and females is relatively equal. However, in Bandung District, the number of males is greater than that of females. The purpose of rearing Pelung chickens is to have chickens with a good crowing sound. Thus, the keepers tend to rear male birds by purchasing from other keepers. As the flock structure indicates the breeding objective of the farmers, it may suggest that Bandung and Sukabumi District are not breeding centers for Pelung chickens. The quality of Pelung chickens is influenced by the combination of genetics and environmental aspects (Daryono et al. 2020). The singing characteristic is inherited from their parents. A highly competing Pelung rooster is produced by the mating of a contest winner rooster with a female that had the closest bloodline to the male winner (Daryono et al. 2021). The mating ratio of one male mating with more than one female is probably not common for Pelung chickens.

**Table 1.** Rearing system characteristics of pelung chickens

| | District | | | |
|---|---|---|---|---|
| | **Garut** | **Bandung** | **Cianjur** | **Sukabumi** |
| | (%) | | | |
| Rearing Objectives | | | | |
| Hobby | 76 | 66 | 6 | 96 |
| Commercial* | 24 | 34 | 94 | 4 |
| Breeding Stock Source | | | | |
| Same area | 18 | 28 | 100 | 100 |
| Different area | 82 | 72 | 0 | 0 |
| Raring Management | | | | |
| Extensive | 0 | 2 | 20 | 5 |
| Semi-intensive | 100 | 62 | 78 | 91 |
| Intensive | 0 | 36 | 2 | 4 |
| Feed source | | | | |
| Commercial | 2 | 8 | 0 | 5 |
| Non-commercial | 98 | 92 | 100 | 95 |
| Vaccination | | | | |
| Yes | 61 | 52 | 0 | 36 |
| No | 39 | 48 | 100 | 64 |

Note: *****Selling chickens of various ages

**Tabel 2.** Population structure of Pelung chickens in research areas

| Sex | Age (Month) | District | | | | Total | Percentage |
|---|---|---|---|---|---|---|---|
| | | **Garut** | **Bandung** | **Cianjur** | **Sukabumi** | | |
| Male | 0-3 | 889 | 139 | 41 | 336 | 1404 | 25 |
| | >3-6 | 295 | 82 | 22 | 184 | 631 | 11 |
| | > 6 | 265 | 157 | 221 | 303 | 847 | 15 |
| Female | 0-3 | 598 | 149 | 149 | 335 | 1232 | 22 |
| | >3-6 | 212 | 79 | 57 | 232 | 532 | 9 |
| | > 6 | 307 | 116 | 292 | 204 | 1018 | 18 |
| Total | | 2566 | 722 | 782 | 1594 | 5664 | 100 |
| Percentage | | 45 | 13 | 14 | 28 | 100 | |

**Table 3.** Number of breeding males (Nm) and females (Nf), male: female ratio (Nm/Nf), total breeding population (N), effective population sizes (Ne), Ne/N ratio, and inbreeding rates (Δ*F*) of Pelung Chickens

| District | Nm | Nf | Nm/Nf | N | Ne | Ne/N | Δ*F* (%) |
|---|---|---|---|---|---|---|---|
| Garut | 265 | 307 | 0.86 | 572 | 569 | 0.99 | 0.09 |
| Bandung | 157 | 116 | 1.35 | 273 | 267 | 0.98 | 0.19 |
| Cianjur | 221 | 292 | 0.76 | 513 | 503 | 0.98 | 0.10 |
| Sukabumi | 204 | 303 | 0.67 | 507 | 488 | 0.96 | 0.10 |
| All Districts | 1694 | 2036 | 0.83 | 3730 | 3699 | 0.99 | 0.01 |

In this study, Pelung chickens in different areas had high Ne (from 267-569). The result is much higher than that reported by Rusfidra et al. (2015) for Kokok Balenggek Chickens, an indigenous local chicken in West Sumatra, Indonesia, with Ne 75-206. A minimum Ne of 50 would ensure a short or medium-term existence, while over 50 individuals would assure the long-term survival of a population (FAO 2013). As crucial in conservation genetics, effective population size is a criterion commonly used for defining the level of endangerment in domestic animals (Kristensen et al. 2015). If the total number of breeding females is less or equal to 100 or the total number of breeding males is less or equal to 5, a breed can be classified as critical. If the total number of breeding females is less or equal to 1000 or the total number of breeding males is less or equal to 20, a breed can be classified as endangered (FAO 2015). It could be stated that Pelung chickens had a safe, effective population size due to their large Ne. The genetic variety of livestock is commonly focused on the maintenance of an adequate number of populations (Biscarini et al. 2015). A very large Ne would maintain most of the genetic variability of the next generations. A small effective population size would have reduced heterozygosity and, eventually, reduced adaptive capability (Kristensen et al. 2015).

The rate of inbreeding of Pelung chickens found in all study areas was lower compared to Kokok Balenggek Chickens, as reported by Rusfidra et al. (2015), had an inbreeding rate of 0.24-0.66. The Ne correlates negatively with rates of inbreeding (Biscarini et al. 2015; Szalay et al. 2016). The current study showed that Ne and inbreeding rates tend to have an inverse relationship. For example, the Ne Pelung in Bandung district, which had Ne lower than other areas, had a higher inbreeding rate. To maintain its viability, the inbreeding rate for livestock should be less than 1% per generation (Mwangi et al. 2020). Based on the total population number, the inbreeding rate of Pelung chickens was 0.01%. It means that 0.01% of heterozygosity is lost in one generation. Thus, Pelung chickens have a low risk of extinction.

From this research, it can be concluded that the extinction threat of Pelung chicken is very low based on Ne and $\Delta F$ calculations.

However, this paper only provides an upper limit estimation of Ne. The assumptions in calculating Ne using demography data might not fit the farm animals' situation. For example, random mating is not common for fanciers, and chicken selection based on crowing duration has commonly occurred for Pelung chickens. In particular, the selection is an important factor in reducing farm animals' effective size (Makanjuola et al. 2020). Selection in livestock is generally used to develop animals for particular production traits or traits with high market value (Gandini et al. 2014). Thus, even though the Ne is high and the inbreeding rate is low, it might not indicate the real situation of Pelung chickens. A survey about production characteristics, mainly in egg production of Pelung chickens, showed that egg weight in Garut District is significantly low compared to that in Sukabumi District (Asmara et al. 2021). This finding might indicate the loss of genetic capacity of Pelung in research areas. Accurate diversity parameters can be observed if genomic information is available (Eusebi et al. 2020). Studies to find out the population structure and genetic diversity of Pelung chickens using genetic data are required in the future. In addition, regular monitoring of population data is needed as the population is a dynamic condition.

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