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ESTIMATED MODEL OF CORRELATION ENVIRONMENTAL FACTOR WITH CROWING CHARACTERISTICS OF PELUNG CHICKENS

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Abstract
Indonesia has high biodiversity, including local chickens like the Pelung, known for their distinctive crowing. The characteristics of the Pelung chicken's crowing sound are believed to be influenced by genetic and environmental factors. This study aims to determine the relationship between environmental factors and the characteristics of the crowing sound. This research was conducted using a survey method with purposive sampling in Bandung, Cianjur and Sukabumi Regencies. The samples used were 32 Pelung chickens aged at least 1 year. The data observed were the duration, number, and crowing volume of Pelung chicken, alongside measurement of temperature, humidity, and light intensity. The data were analyzed using multiple linear regression tests. The results of the research show that the regression equation for Duration and environment is $Y=-0.547+0.142\chi_1+0.02\chi_2+0.066\chi_3$, crowing number with environment: $Y=-47.48+1.17\chi_1+0.007\chi_2+0.423\chi_3$, and volume with environment: $Y=62.563-0.336\chi_1+0.01\chi_2+0.031\chi_3$ with coefficients of determination (R2) of 0.179, 0.096, and 0.023 respectively. These findings indicate that environmental factors such as temperature, light intensity, and humidity influence the duration and number of Pelung chickens' crowing but do not affect the volume of the crowing sound. It is suspected that other unidentified factors and genetic factors are more dominant in influencing Pelung chicken's crowing characteristics.
Keywords: Pelung chicken, crowing duration, crowing number, crowing volume, environment.

MODEL PENDUGA HUBUNGAN FAKTOR LINGKUNGAN DENGAN KARAKTERISTIK SUARA KOKOK AYAM PELUNG

Abstrak
Indonesia memiliki keanekaragaman hayati yang tinggi, salah satunya adalah keragaman ayam lokal Pelung yang termasuk ke dalam kategori ayam penyanyi. Karakteristik suara kokok ayam Pelung diduga dipengaruhi oleh beberapa faktor, termasuk faktor genetik dan lingkungan. Penelitian ini dilakukan untuk mengetahui bagaimana model hubungan faktor-faktor lingkungan dengan karakteristik suara kokok yang dihasilkan. Penelitian dilakukan dengan metode survey dengan teknik pengambilan sampel secara purposive di Kabupaten Bandung, Cianjur dan Sukabumi. Sample yang digunakan sebanyak 32 ekor ayam Pelung dengan umur minimal 1 tahun. Data yang diamati adalah durasi, jumlah kokok dan volume kokok ayam Pelung. Pada saat mengukur karakteristik suara diukur juga suhu, kelembaban, dan intensitas cahaya. Data yang diperoleh dianalisis dengan menggunakan uji regresi linear berganda. Hasil penelitian menunjukkan persamaan regresi durasi dengan lingkungan, yaitu : $Y = -0,547+0,142\chi_1+0,02\chi_2 +0,066\chi_3$, sedangkan jumlah kokok dengan lingkungan yaitu : $Y = -47,48+1,17\chi_1+0,007\chi_2 +0,423\chi_3$, serta Volume dengan lingkungan : $Y = 62,563- 0,336\chi_1+0,01\chi_2 +0,031\chi_3$, dengan koefisien determinasi (R^2) masing-masing sebesar 0,179, 0,096, dan 0,023. Penelitian ini menemukan bahwa faktor lingkungan suhu, intensitas cahaya, dan kelembaban berpengaruh terhadap durasi dan jumlah kokok ayam Pelung, namun tidak berpengaruh terhadap volume suara kokok. Faktor lingkungan lain dan genetik diduga lebih dominan dalam mempengaruhi karakteritik suara berkokok pada ayam Pelung.
Kata Kunci: ayam Pelung, durasi kokok, jumlah kokok, volume kokok, lingkungan

INTRODUCTION

Indonesia is well known for its rich biodiversity, which includes a variety of local chicken breeds. These chickens are vital animal genetic resources with the potential for developing pure and superior chicken lines. Local chickens in Indonesia are also a part of the culture society (Sidalodog, 2007) and are distributed in all regions of Indonesia. More than 30 local chicken breeds are found in Indonesia which can be differentiated based on their unique characteristics. They are reared for many purposes such as for broilers,

entertainment, or for social culture purposes (Nataamijaya, 2000).

Pelung chickens are local chickens known as crowing chickens with relatively large body sizes, making them chickens that were developed for entertainment purposes (Ulfah et. al., 2015; Asmara et. al., 2023). This chicken, which was originally developed in Cianjur area, West Java, has long and rhythmic crowing vocalizations, often associated with the tune of the Cianjuran song (Iskandar and Susanti, 2007). Pelung chickens are now spread in different regions in Indonesia. Pelung chicken contests, held regularly at local and national levels, help promote the Pelung chicken's unique crowing sound. These contests are also a place for enthusiasts and breeders to exchange information and market their Pelung chickens (Asmara et al. 2018). The categories in this contest are divided into performance and crowing sound categories.

The crowing characteristics of Pelung chickens are influenced by several factors, including genetic and environmental factors. Stimulation from temperature, light intensity and humidity can respond to chicken physiological processes, including hormone production (Zhang et al, 2014). The intensity of light will stimulate a group of nerves in the hypothalamus called the Suprachiasmatic Nucleus (SCN) which uses photoperiod information (light duration) to synchronize the body's internal physiological processes with the animal's external conditions (Welsh et al, 2010). Butler et. al. (2009) stated that SCN can regulate the secretion of several hormones through neural connections with hormone-producing neurons in the hypothalamus, including the testosterone hormone, which influences crowing (Shimmura et. al., 2019).

Factors such as age, body weight, and training also influence the crowing sound characteristics (Asmara, et. al., 2020a, b). This research aims to determine the relationship between environmental factors and the crowing characteristics of Pelung chickens. This research is expected to provide a deeper understanding of the influence mechanisms between environmental factors and the crowing characteristics and to enrich the knowledge of the rearing system and conservation of Pelung chickens.

MATERIALS AND METHODS

The research was conducted with surveys on Pelung chickens owned by the members of the Association of Pelung Chicken Breeders and Enthusiasts (HIPPAPI) in three different regencies: Bandung, Cianjur and Sukabumi. The total samples were 32 adult males with a minimum of 1 year of age of Pelung chickens that had crowed well.

Research Procedure

The crowing sounds were recorded using a Sony LCD-PX 470 Digital Voice Recorder. Ambient temperature, light intensity, and humidity data were measured while collecting the sound data. Thermometer, hygrometer, and HS1010A Light Meter were used to measure temperature, humidity, and light intensity, respectively. All data were collected during three time periods: morning (07:00-10:00 WIB), afternoon (10:00-14:00 WIB), and evening (14:00-17:00 WIB).

Observed Variables

The variables observed in this study included duration, number of crows, and volume of crows. Cocking duration is measured based on the full length of crowing (per seconds). The number of crowing (times) is the number of times a cock crows in each specified period. The crowing volume is the strength of Pelung chicken’s crowing sound in decibels (dB).

Data Analysis

Sound data processing used Audacity 2.1.0 which produces sound duration and cuts the sounds. Raven Lite 2.0 software was used to measure the crowing volumes. The processed data were analyzed with SPSS version 25 program. The normality test on the data used Kolgomorov Smirnov and the Multiple Linear Regression test by Steel and Torrie, (1993) as applied by Sarwono et. Al. (2019):

$$Y = a + b\chi_1 + b\chi_2 + b\chi_3$$

Information:
Y: Sound Characteristics (duration, number of crowing, volume)
a : Constant
b : regression coefficient
X_1 : Temperature
X_2 : Light Intensity
X_3 : Humidity

The correlation coefficient for each variable was calculated using the formula used by Steel and Torrie (1993) in Sarwono et al (2019), as follows:

$$r = \frac{(n\sum_{i=1}^{n} x_i y_i) - (\sum_{i=1}^{n} x_i)(\sum_{i=1}^{n} y_i)}{\sqrt{(n\sum_{i=1}^{n} x^2 - (\sum_{i=1}^{n} x)^2)}(n\sum_{i=1}^{n} y^2 - (\sum_{i=1}^{n} y)^2)}$$

Information:
r : Correlation Coefficient
n : Number of Data
x_i : Independent variable
y_i : Dependent variable

The coefficient of determination value was calculated by squaring the computed correlation coefficient.

RESULT AND DISCUSSION

The results of average sound characteristics (duration, number, and volume of crowing) and environmental factors (temperature, light intensity, and humidity) are presented in Table 1. The average crowing duration, number, and volume were 8.97 seconds, 19 times, and 50.87 dB, respectively. The average temperature, humidity, and light intensity were 28.69 ºC, 72%, and 313 lux, respectively.

The Pelung chicken crowing duration in this study showed a higher range compared to those reported by Jatmiko (2001), with 3.0 – 8.9 seconds. However, the average crowing duration is still lower compared to the standard used by HIPPAPI (2012), of 11 seconds. The number of crowing in this study had a higher range compared to Jatmiko (2001), who reported a crowing range of 16-30 times, depending on the time of observation. The chicken crowing volume range was also below the standards from the Ministry of Agriculture (2011), which states that the volume range for Pelung chicken crowing is 60-63.89 dB.

The average temperature and humidity in the study tended to be higher than the birds' comfort zone. According to Gunawan and Sihombing (2004) and Ajakiye et. al. (2011), the ideal and comfortable temperature for chickens in tropical areas is 18 – 25ºC, while the optimal humidity is below 70%. There is a lack of information about the ideal light intensity for local chickens, however, the result shows that the maximum light intensity measured in the research is near the light intensity on a sunny day reported by Mendes et al. (2013). Mendes et al. (2013) stated that the light intensity on a sunny day may be as high as 100,000 lx. The natural light spectrum provides a uniform energy distribution with wavelengths between 350 and 700 nm, not too far from the chickens; vision range of 315–750 nm.

Table 1. Descriptive Data of Sound Characteristics and Environmental Factors

Description	Average	Standard Deviation	Minimum	Maximum
Duration (second)	8.97	1.69	1.43	13.87
Crowing number (times)	19	12	1	56
Volume (decibel)	50.87	3.77	42.50	60.90
Temperature (Celsius)	28.69	2.31	21.67	34.73
Light Intensity (Lux)	313	273	19	1437
Humidity (%)	72	10	51	96

Table 2. Correlation of characteristics of the crowing sound of Pelung chickens and environmental factors

Correlation	Coefficient of Correlation (R)
Duration and environmental factors	0.423
Crowing number and environmental factors	0.31
Volume and environmental factors	0.151

Environmental factors such as light intensity may influence the crowing behavior of roosters. The light intensity affects cells in the hypothalamus to stimulate the hormone testosterone formation. As this hormone production increases, so does the crowing activity of chickens (Zhang et al, 2014). This is in line with the findings by Shimmura and Yoshimura (2013), that the number of crows in chickens is related to external stimuli such as light and the sound of other chickens' crowing. However, the current study shows slightly different results. Based on the results presented in Table 2, there is a moderate relationship between duration and environmental factors, and a low relationship between the number of crowing and the environment. The relationship between volume and environment shows an even weaker relationship. The weak correlation (number of crowing) and very weak correlation (crowing volume) with environmental factors indicate that other factors besides temperature, humidity, and light correlate more with these two sound characteristics. The Pelung breeders believe that sound characteristics are more influenced by genetic and other factors, such as age and health status. Another study by Asmara et. al., (2020a) has indicated that age and body weight may influence the crowing volume of Pelung chickens.

Table 3 shows that the regression coefficient value of environmental variables has a positive effect on duration, which indicates that the recorded environmental factors significantly influence the crowing duration characteristics of Pelung chickens. Temperature has a greater regression coefficient (0.142) than light intensity (0.02) and humidity (0.066), showing that temperature is the most dominant environmental factor in influencing crowing duration. High temperatures are thought to increase the duration and vice versa.

The coefficient of determination result was 0.179, which means that the influence exerted by environmental variables was 17.9%. The majority of 82.1% was influenced by other variables, such as genetics and other unidentified environmental factors. A combination of genetic and environmental factors can influence the duration of crowing in Pelung chickens (Daryono et. al., 2020). Asmara et. al. (2020a) stated that older chicken has longer crowing durations due to its more optimally developed lungs and air sacs, and a heavier Pelung chicken has a shorter crowing duration due to its heavier respiration process. Additionally, the management system and health conditions influence the crowing duration of Pelung chickens (Jarmani and Nataamijaya, 1995).

The environmental factors significantly influence the number of Pelung chickens crowing in this study. Among the environmental factors, temperature was the greater influence on the number of crowing. Several studies showed that the number of crowing is higher in the morning compared to the day and the afternoon (Rusfidra, 2004; Safitra et. al., 2022), because the morning temperature is the lowest among the three time periods.

The coefficient of determination value for the number of crowing was 0.096. This indicates that temperature, humidity, and light intensity may not be the main factors inducing chickens to crow. Age and social behavior may be those other factors, as age might affect the status formation in roosters (Ligon et. al., 1990). An older rooster will crow more often than a younger rooster (Asmara et. al., 2020b), and a dominant rooster crows more frequently than its subordinates (Leonard and Horn, 1995). In the morning, the dominant rooster crows first (Shimmura et. al., 2015).

Table 3. Model for estimating the relationship between the characteristics of the crowing sound of Pelung chickens and environmental factors

Parameter	Regression Equations	R^2	p values
Duration	$Y= -0.547+0.142\chi_1+0.02\chi_2+0.066\chi_3$	0.179	0.000
Crowing number	$Y= -47.48+1.17\chi_1+0.007\chi_2+0.423\chi_3$	0.096	0.022
Volume	$Y= 62.563- 0.336\chi_1+0.01\chi_2+0.031\chi_3$	0.023	0.534

Note: χ_1 temperature; χ_2 light intensity; $\chi_3$humidity

Table 3 shows that environmental factors did not influence the crowing volume of Pelung chickens, implying that some other factors are involved in determining crowing volume. The crow is produced during expiration, and the thoracic muscles are involved in this process (Suthers and Zollanger 2004). Respiratory and syringeal muscles control crowing intensity by modulating the degree of airflow in the syrinx (Goller and Shutters, 1996). Similar to other sound characteristics, age, body weight, and chest size also influence the crowing volume (Asmara et al. 2020a). Body weight increases with age, therefore, it was expected that the older and bigger chickens would have stronger muscles in controlling crowing volume.

Genetic factors should be assumed to have contributed to crowing characteristics in chickens. A study shows that crowing capacity is controlled by the gene *FoxP*2, a crucial gene in gender development. This gene possibly also regulates rooster crow, as the mRNA and protein expression of *FoxP*2 is sexually dimorphic (Wang et. al., 2012). There is a differentiation in the Dopamine receptor 4 gene in Shamo and Naganakidori chickens, a crowing chicken in Japan (Komiyama et. al., 2014). The study by Shimmura et. al. (2019) reveals that cholecystokinin B receptor (CCKBR) is a regulatory gene involved in inducing the crowing sound in roosters. This is indicated by the increased expression of the CCKBR gene in testosterone-induced chicks, which can crow, and high expression in roosters.

CONCLUSION

Environmental factors such as temperature, light intensity, and humidity influence the duration and number of Pelung chickens' crowing but do not affect the volume of the crowing sound. A comfortable temperature dominantly influences the duration and number of crowing in Pelung chickens. The results of this study indicate that there are factors other than environmental factors that contribute more in influencing the duration and number of Pelung chickens' crowing.

REFERENCES

Ajakaiye, J., Perez, B. A., & Mollineda, T. A. (2011). Effect of high temperature on production in layer chicken supplemented with vitamin C and E. *Revista MVZ Cordoba*, 16(1), 2283-2291.

Asmara I. Y, Garnida, D., Sulistyati, M., Tejaningsih. S, & Partasasmita, R. (2018). Knowledge and perception of Pelung keepers's toward chicken contests in West Java, Indonesia. *Biodiversitas*, 19(6), 2232-2237.

Asmara, I.Y., Garnida, D., & Partasasmita, R. (2020a). Crowing characteristics of Pelung chickens at different age and body weight. *Biodiversitas*, 21(9), 4339-4344.

Asmara, I. Y., Garnida, D., Partasasmita, R. (2020b). Duration and volume of crowing of Pelung chickens of West Java, Indonesia. *Biodiversitas*, 21(2), 748-752. DOI: 10.13057/biodiv/d210242.

Asmara, I.Y., Hilmia, N., & Garnida, D. (2023). The long-crowing chickens in Indonesia: A review. *Open Agriculture.* 8, 1-14.

Daryono, B.S., Mushlih, M., & Perdamaian, A.B.I. (2020). Vocalization characters and forkhead box P2 (FoxP2) polymorphism in Indonesian crowing-type chicken (Gallus gallus domesticus). *Iranian J App Anim Sci*, 10(1), 131-140.

Goller, F., & Suthers RA. (1996). Role of Syringeal muscles in controlling the phonology of bird song. *J Neurophysiol*, 76(1), 287-300.

Gunawan & Sihombing, D.T.H. (2004). Pengaruh suhu lingkungan tinggi terhadap kondisi fisiologis dan produktivitas ayam buras. *Wartozoa*, 14(1), 31-38.

HIPPAPI. 2012. *Pengkaderan dan Pelatihan Juri Ayam Pelung*. Bandung: Pangalengan.

Iskandar, S., & Susanti, T. (2007). Karakter dan Manfaat Ayam Pelung di Indonesia. *Wartazoa.* 17(3), 128-136.

Jarmani, S.N., & Nataamijaya, A.G. (1995). *Characteristics of the sound of a chicken Pelung. Proceedings of the National Seminar on Animal Husbandry and Veterinary*. Bogor: Center for Animal Husbandry Development. Agricultural Research and Development Agency.

Jatmiko. (2001). *Studi Fenotipe Ayam Pelung untuk Seleksi Tipe Ayam Penyanyi* (Thesis). Program Pascasarjana Institut Pertanian Bogor.

Komiyama, T., Iwama, H., Osada, N., Nakamura, Y., Kobayashi, H., Tateno, Y.,

& Gojobori, T. (2014). Dopamine receptor genes and evolutionary differentiation in the domestication of fighting cocks and long-crowing chickens. *PLoS One*, 9(7), e101778.

Kementerian Pertanian. 2011. *Surat Keputusan No. 2918/2011: Penetapan Ayam Pelung sebagai Sumber Daya Genetik Ternak di Indonesia.* Jakarta: Kementerian Pertanian.

Mendes, A. S., Paixão, S. J., Restelatto, R., Morello, G. M., de Moura, D. J., & Possenti, J. C. (2013). Performance and preference of broiler chickens exposed to different lighting sources. *Journal of Applied Poultry Research*, 22(1), 62-70.

Nataamijaya, A.G. (2000) The native chicken of Indonesia. *Bul. Plasma Nutfah*, 6, 1–6.

Rusfidra. (2004). *Karakterisasi Sifat-sifat Fenotipik Sebagai Strategi Awal Konservasi Ayam Kokok Balenggek di Sumatera Barat* (Dissertation) (Unpublished). Bogor: Sekolah Pascasarjana Institut Pertanian Bogor.

Safitra, M. I., Putranto, H., & Brata, B. (2022). Karakteristik Suara kokok Ayam Burgo Jantan Kota Bengkulu. *Jurnal Peternakan*, 19(1), 64-70.

Sarwono, P.A.T., Sulastri., Hamdani, M.D.I., & Dakhlan, A. (2019). Korelasi Antara Ukuran-ukuran Tubuh dan Bobot Badan Sapi Peranakan Ongole Betina pada Umur Pascasapih di Kecamatan Tanjungsari Kabupaten Lampung Selatan. *Jurnal Riset dan Inovasi Peternakan*, 3(3), 14-19.

Shimmura, T., Ohashi, S., & Yoshimura, T. (2015). The Highest-Ranking Rooster Has Priority to Announce the Break of Dawn. *Sci Rep*, 5: 11683. DOI: 10.1038/srep11683.

Shimmura, T., Tamura, M., Ohashi, S., Sasaki, A., Yamanaka, T., Nakao, N., Ihara, K., Okamura, S., & Yoshimura, T. (2019). Cholecystokinin induces crowing in chickens. *Sci. Rep*, 9(1): 1-7. DOI:10.1038/s41598-019-40746-9.

Suthers, R.A., & Zollinger, S.A. (2004). Producing sound: the vocal apparatus. *Ann NY Acad Sci*, 1016, 109-129.

Sidadolog, J.H.P. (2007). *Pemanfaatan dan kegunaan ayam lokal Indonesia (Utilisation of local chickens in Indonesia)*. In: Diwyanto K, Prijono SN (eds.). *Diversity of Indonesian Local Chicken Liver Resources: Benefits and Potential*. Jakarta: LIPI Press.

Ulfah, M., Perwitasari, D., Jakaria, J., Muladno, M., & Farajallah, A. (2015). Multiple maternal origins of Indonesian crowing chickens revealed by mitochondrial DNA analysis. *Mitochondrial DNA A DNA Mapp Seq Anal* 28 (2), 254-262. DOI: 10.3109/19401736.2015.1118069.

Wang, X., Li, H., Hamid, M. A., & Zhao, X. (2012). Differential expression of forkhead box protein 2 between genders in chickens. *African J. Biotechnol*, 11(58), 12153-12157.

Zhang, L., Wu, S., Wang, J., Qiao, X., Yue, H., Yao. J., Zhang, H., & Qi, G. (2014). Changes of Plasma Growth Hormone, Insulin-Like Growth Factors-I, Thyroid Hormones, and Testosterone Concentrations in Embryos and Broiler Chickens Incubated under Monochromatic Green Light. *Italian Journal of Animal Science*, 13(1), 14-19.