Conference Paper

The Gene Distribution, Population Equilibrium, Effective Population Size of Pasundan Cattle in Village Breeding Centre at the Southern Part of West Java, Indonesia

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Abstract

Basic on Pasundan's cattle population at the southern region of West Java, Indonesia contained in the Tegalbuleut sub-district Sukabumi district, Agrabinta sub-district Cianjur district, Cibalong sub-district Garut district, Sukaraja sub-district Tasikmalaya district, and Cijulang sub-district Pangandaran district. These zones can be used the breeding center of the village as an effort of animal genetic conservation in Indonesia. The aim of this research was to describe the gene distribution, population equilibrium, the effective population size' Pasundan cattle at Village Breeding Centre zone from February to August 2016. The research method is a descriptive method, sampling technique use stratified random sampling, and to estimate the genotype distribution based on the albumin protein pattern. While the population structures were measured on the based population in it's carrying capacity. The result of this research showed that the distribution of the blood albumin gene markers, there are three genes, namely Alb^A, Alb^B, and Alb^C, with the population equilibrium value has not been any deviation ($X^2 \leq X^2_{0.05}$). While the condition of effective population size, including safe towards to the risk status, except at Cibalong sub-district Garut Regency. So, this condition can be concluded that Pasundan cattle population in the VBC had the diversity of high qualitative but may occur degradation of livestock genetic and may result in deterioration in the status of the population of both quantitative and qualitative aspects due to the declining value of the EPS, the conservation efforts made to repair the carrying capacity and the introduction of bulls in the population.

Keywords: Albumin protein pattern, Effective population size, Gene, Land carrying capacity, Pasundan's cattle, Population equilibrium

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1. Introduction

Pasundan's cattle are a Sundanese icon of livestock genetics resource from West Java, set as clumps based on claimed the Minister of Agriculture Number. 1051 / Kpts / SR.120

/ 10/2014 concerning to the establishment of Pasundan's cattle population [1]. The distribution of Pasundan cattle spreads in two important areas, namely regions along the southern coast of West Java and buffer zone area of protected forest areas along the northern Priangan [2]. This livestock population is reported to reach 50 000 in 2013, and year by year it's population gradually declining until 2015 to 28 000 cattle's. This livestock has a qualitative characteristic as *Bibos sondaicus* (D'Alton, 1823) group cattle, which has a body color red or red brick, there is a dark red or black line, has a leg color white with not contrast limit on the Carpus until metacarpus and metatarsus until tarsus. In bull, it is going to can change color from red to black, because of the development of glands androgen production.

The coastal areas of West Java is extending from Pangandaran district to Sukabumi district. The population of Pasundan's cattle is in farm people, belonging to the cattle group and some are not incorporated in the group farmers. Results of field observations show going:

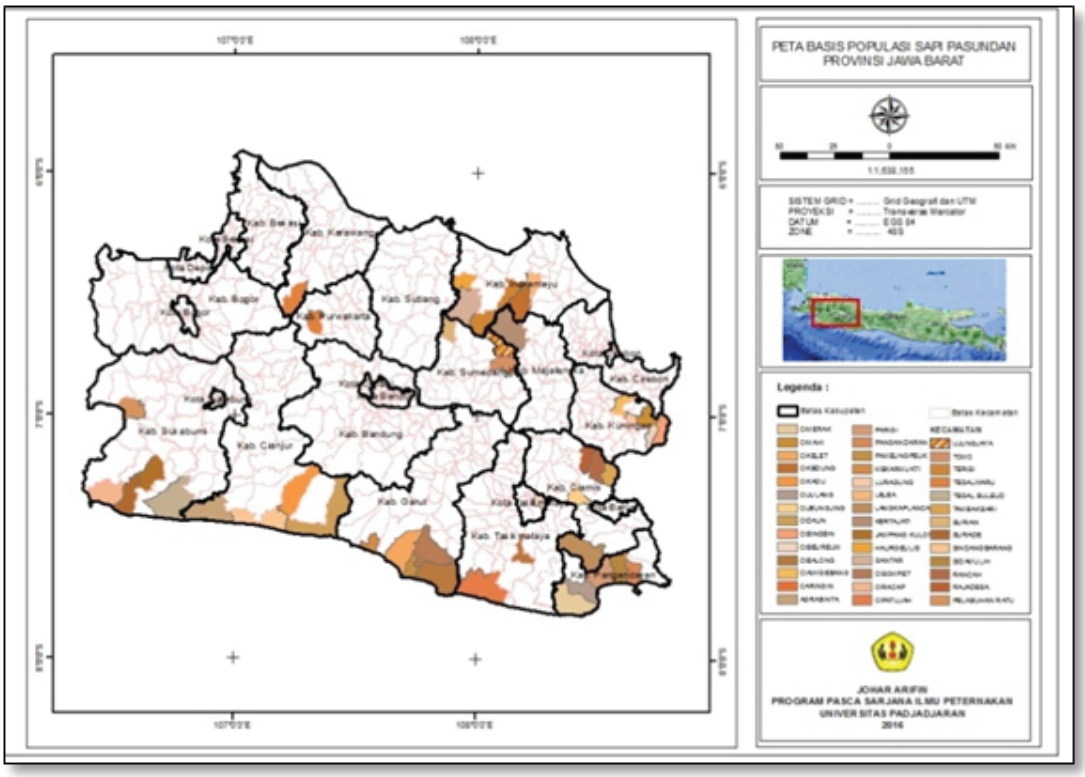

Figure 1: Distribution map of the cattle population base in West Java Pasundan 2016.

Impairment middle of the population (quantitative characters) and a decline in population from year to year. This condition may jeopardize the status of the population and even threaten the existence of indigenous livestock genetic resources which became an icon of the community in West Java. Since 2011 researchers are working with the

government of West Java Province in conservation work that starts from the inventory of the population to clump registration to the Ministry of Agriculture RI [1].

Results of previous studies have established a viable population base used as a breeding center of the people in the concept of conservation of genetic resources. These regions include Tegalbuleut sub-district Sukabumi district, Agrabinta subdistrict Cianjur district, Cibalong sub-district Garut district, Sukaraja sub-district Tasikmalaya district, and Cijulang sub-district Pangandaran district. Conservation areas (in situ) were selected if (i) the resource of genetic cattle have been acculturated and become part of the ecosystem forming system tilapia and aesthetics of human nature, (ii) the empowerment of group for introducing of a variety of conservation activities, (iii) the carrying capacity area (either standalone or integrated) to meet the needs of feed and (iv) social conditions with a low potential conflict [3]. Based on this illustration, these base areas are eligible as a conservation area.

Conservation activities starting from an inventory population of both the population structure and distribution of genetic that can describe the status of the population and regulations are required if there are problems in the population which can reduce the quality and quantity. Therefore, this study aims to explore the distribution of gene frequencies, value population equilibrium and changes in effective population size, Pasundan's cattle population in the southern region of West Java which has been a source of seed or village breeding center. Variables that have been measured can provide information about the identities and status of the population, so it is useful in determining the genetic quality improvement activities implemented on farm people.

2. Methods

This study is divided into two phases, among others:

2.1. Phase I: Analysis of protein patterns albumin

The materials and objects used in the first phase of research are that 20 Pasundan cattle and dry ice for securing blood serum, while the material for the analysis of patterns of protein blood albumin, among others: a blood sample, dry ice, liquid N2, and alcohol 70 %. For the purification of albumin, the required materials are matched with a kit of protein electrophoresis; they are aquabidest, 11.25 % sodium sulphate, sodium sulphate 30 %, sodium sulfate 22.5 %. Materials for electrophoresis are SDS PAGE, buffer sample and running buffer soluble.

As a tool for the analysis of blood albumin protein patterns includes syringes size 10 mL, cotton or tissue, a cool box for storage of blood samples in the field, label paper, the mine to help tie the cattle. As a tool for the separation of blood serum is a test tube or tube taper, centrifuges, and tube Eppendorf size 4 mL, whereas the tool for the purification of albumin, among others tube Eppendorf for storage of serum, tube cone, analytical balance (accuracy of 0.001 g), Becker glass, stirrer, bottle 1 L, incubators, water bath, centrifugation 300 rpm, filter paper, vacutainer, test tubes, and cooling box. Tools for the electrophoresis vertical system include a power supply 40 mA, Runner, glass clamp, comb where wells gel, micropipette, Eppendorf tube, test tubes, water bath, incubator, bowl, Becker glass, caliper, centrifuges, filter paper and a water bath swaying. Techniques for vertical electrophoresis system using the method to separate the protein albumin while using Deutcher Method [5].

The method used in Phase I using descriptive analysis (non-experimental design). Tools for measuring or comparing between and within populations used *koasi* experiment. The data analysis was based on the observed variables, a blood protein in the form of bands (band) formed in a polyacrylamide gel. Observations using blood albumin protein patterns based on distance migration, included in the tables gene frequencies and genotype, then to determine differences in gene frequencies and genotype using chi-square test. Gene frequency is calculated using the Formula (Equation) [5].

$$qA = \frac{\sum Locus A}{\sum Locus A + \sum Locus a} \tag{1}$$

explanation: q_A = frequence of gene A

q_a = frequence of gene a

the equilibrium genes (gene array): *(p + q) 2 = 1* (2)

equilibrium genotype (genotype arrays): *2PQ + p2 + q2 = 1* (3)

To test the difference in the genotype of a balance between population, the chi-square test was used with the Formula:

$$X^2 = \sum \frac{(O - E)^2}{E} \tag{4}$$

explanation:

X^2 = countchi-square

O = the results obtained from observations (Observed Value)

E = the expected results according to the Hardy-Weinberg equilibrium (Expected Value).

X^2 table calculated at α 0.05 with degrees of freedom n-1 so

$$db = n - 1. \tag{5}$$

n = number of loci that appear albumin

To test whether the two populations there are similarities or differences in the genotype compared to count table with the rules of the following decisions:

1. If the X^2 count < X^2 table, it can be concluded that the genotypes of the two populations are equal.
2. If the X^2 count > X^2 table, it can be concluded that the genotypes of the two different populations.

2.2. Phase II: Value analysis of effective population size

Value analysis of effective population size starts from the survey population structure in the base area. Researchers used the help of officers (Department of Animal Husbandry) lists of cattle by age and sex distribution. Value effective population size is measured only in females and males productive [6] in cattle with different numbers of female and male adult, then Ne can be calculated as:

$$N_e = \frac{4N_m \cdot N_f}{N_m + N_f}, \tag{6}$$

where: Nm = number of male animals

Nf = number of female animals

3. Results and Discussion

3.1. Population structure and value effective population size cow Pasundan

The results showed that the population base Pasundan cattle spread only in certain areas, not all districts in the southern coastal areas of West Java Pasundan cattle there. Livestock population is spread along with the carrying capacity of the grazing area. This grazing system using the integration between forests and plantations as well as through land use arise that are at the seashore. This patterns and farming systems rely heavily on land like other parties, these conditions always due because of farmers are a landless shepherd. On the other hand, the farmers who own land shepherd broad

decline (narrowing) due to land conversion and land derivative of the division of the inheritance.

Data on population structure starting from the Cijulang sub-district Pangandaran district, as follows:

Table 1: Structure of the cattle population in the district Pasundan Cijulang.

Village	Males	Females	Males Offspring	Females Offspring
Cijulang	98	245	89	134
Ciakar	105	1 324	312	487
Nusawiru	56	218	68	98
Pandansari	9	25	8	12
Jumlah	336	2 163	617	986

Pasundan's cattle population in this region has a carrying capacity of the land area that is entirely grass in the pasture integrate with coconut plantations, cocoa, and others. As for the use of agricultural by-products are also used, consisting of a byproduct of corn in the form of straw and corn, rice straw, nuts by utilizing the extensive wetland and upland narrow (64 231 ha). Based on the population structure of the value of the effective population size is 1 163 294, this condition is included in the category of safe towards vulnerable. These conditions can be bad for Pasundan cattle population, among other things increasing inbreeding or genetic degradation due to the use of stud cattle from other groups.

The next population structure is in the Sukaraja sub-district Tasikmalaya district; this region became the basis of Pasundan cattle with semi-intensive rearing. The data structure of the population in this district is only in the village Sirnajaya that is 42 males, 124 females, 120 offspring's herd. This population includes a little population because of the farmers in the south (coast) began to abandon their livestock due to damage incurred grazing land caused by iron sand mining. On the other hand, the central region such as Sukaraja, farmers do not have a high fanaticism against to Pasundan cattle. So, the population in this region has many group and clumps. Based on the population structure, the value of the effective population size is 124; this condition is included in the category of safe towards vulnerable. This can be bad for Pasundan cattle population, among other things increasing inbreeding or genetic degradation due to the use of stud cattle from other groups.

The next region is located in Cibalong sub-district Garut district, the structure of the population is 256 males, 358 females, 123 male offspring and 134 female offspring's. The population included the high category in one spot of the districts has a value of

effective population size is 701, these conditions included in the safe category. The number of the balance of adult males and females will decrease inbreeding and genetic degradation. In the district of Cianjur, located in sub-district Agrabinta. Livestock migration patterns come from Garut region through Mekarmukti and Cidaun [7]. The structure of the region's population is 78 males, 210 females, 102 male offspring and 111 female offspring's. Based on the population structure of the value of the effective population size is 227 this condition included in the category of safe towards vulnerable. This can be bad for the Pasundan cattle population, among other things increasing inbreeding or genetic degradation due to the use of stud cattle other groups. However, the high number of male calves can be used as a stud with a regular marriage pattern to avoid inbreeding.

The most region in the west of the south coast of West Java is Sukabumi district. The Pasundan cattle in Sukabumi area comes from the natural migration of cattle from Cianjur district [3]. The structure of the cattle population in Tegalbuleut sub-district is 210 males, 425 females, 321 male offspring and 223 female offspring's. Based on the population structure of the value of the effective population size is 562, this condition included in the safe category. However, the characteristics breeders are easy to sell the males make the population dynamics in this region is very high. Such conditions can create value EPZ became vulnerable.

Based on data from the value of effective population size above, it can be explained that the cattle breeding program at VBC needs to be done through the introduction of breeding technology and capacity building in the livestock group's ability to understand, respond to and capable of carrying out activities to improve the quality of genetic breeding of livestock. The introduction of knowledge among others the knowledge and application of recording individual in group, mating system of livestock and livestock sales patterns in synergism with efforts to avoid adverse selection.

3.2. Distribution frequency genes, genotype, and balance population

The diversity of proteins can be used to estimate the genetic diversity of an organism. Protein as primary products of gene expression can be said to be qualitatively not influenced by the diversity of the environment. Therefore, the protein may be a good predictor in the analysis of the genetic diversity of a population. A large number of differences that regulated genetically have been found in the globulin (transferrin), albumin, blood enzymes and hemoglobin [4].

Albumin is a type of protein in the blood plasma of between 3 % to 5 % of the total blood volume, or about 35 % to 50 % of total plasma proteins [8]. Albumin has an important role in transporting various kinds of amino acids to various tissues of the body and to defend the balance of osmotic pressure of blood. So, albumin has the smallest molecular plasma protein that is BM 69 000, because of molecular size is small, albumin more participates in osmotic pressure compared with other plasma proteins [9]. On the characteristics of blood enzyme or protein is commonly found genetic diversity within species, group or strains within a species, then the blood protein polymorphism genetically regulated by a pair of alleles or allele sequence.

Results of vertical gel electrophoresis system on samples selected Pasundan cattle to show that their migration distances varying albumin, migration distance value is then calculated for establishing the proportion of genotype of each individual sample. The analysis showed that the distribution of the blood albumin gene markers there are three genes, namely Alb^{A}, Alb^{B}, and Alb^{C}, gene frequencies for each allele of each area vary. Here show the gene frequency data of each region:

Table 2: The frequency of gene locus albumin of Pasundan's cattle population in southern coastal areas of West Java.

Gene/Region	Alb^{A},	Alb^{B}	Alb^{C}
Pangandaran	0.4	0.3	0.3
Tasikmalaya	0.2	0.3	0.5
Garut	0.4	0.3	0.3
Cianjur	0.2	0.4	0.4
Sukabumi	0.33	0.4	0.27

Research on the genotype frequencies using protein markers was made by Johari et al. [10] about the diversity of blood protein as a parameter biogenetic on Java cattle, controlled by five different genotype frequencies look like the following: Alb^{BB} (15 cattle); Alb^{AC} (6 Cattle); Alb^{BC} (five cattle); Alb^{AB} (three cattle) and Alb^{AA} (1 Ox) or it can be stated that the genes that control the Java cattle protein markers are also the same with the Pasundan cattle. The gene frequency number is similar to that examined by Johar Arifin et al. [11] on Pasundan cattle at Majalengka that value of Alb^{A}, Alb^{B} and Alb^{C} are 0.45, 0.35 dan 0.20.

It can serve as guidelines that are still in the category of Pasundan cattle *B. sondaicus*. In line with this stated by Sulasmi et al. [12] found Cow Pasundan has similarities high with *B. sondaicus* to some areas in southern West Java, that is the livestock population in the region Garut, Cianjur and Sukabumi but has a range of genetic close also to the livestock population in Pangandaran and Tasikmalaya based on cranio matric.

The analysis of the equilibrium population based on Hardy-Weinberg law indicates that the cow Pasundan cattle in five coastal areas of West Java has not deviated from the balance or equilibrium population ratio ($X^2 \leq X^2_{0.05}$). This condition assumes that the qualitative diversity of the population in the southern region is still relatively high. It is also a guideline that has not occurred in the southern region of genetic mutation and migration with mating occurs randomly. Likewise, farmers naturally have not selected. The condition is a potential for conservation practitioners and livestock breeders to make improvements genetic quality of cattle through the selection and mating systems are integrated into the conservation of genetic resources.

4. Conclusion

This condition can be concluded that the population Pasundan cattle in the VBC has a diversity of qualitative high, but may occur degradation of animal genetic that can lead to deterioration in the status of the population of both quantitative and qualitative aspects due to the declining value of the EPS, the conservation efforts made to repair the carrying capacity and the introduction of a study in the population.

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