Genetic distance estimates and variable factors distinguishing between goat Kacang, Muara and Samosir

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Abstract. The purpose of this research was to look the genetic distance and factors distinguishing variable between types of goats in North Sumatera. This research have been conducted in PayaBakung, Hamparan Perak and Klambir Lima village, Deli Serdang district, Batu Binumbun, Aritonang, HutaGinjang village, Muarasubdi subdistrict, North Tapanuli district and ParbabaDolok, Siopat Sosor, Sinabulan village, Ronggur Nihuta Pangururan village, Sitonggi-tonggi village in the subdistrict RonggurNihuta, Samosir district of the month of July 2016. The data was analyzed using descriptive, discriminants, canonical, Principal Component Analysis, Distance genetic and Tree Phylogenetic. The result showed that the nearest genetic distance goat found in Kacang and Samosir (1.973), and the farthest genetic distance find in Saamosir and Muara (8.671). The variables made it difference was goat race Base Rim Horn (0.856) and Long Horn (0.878). Genetic distance values most far between Muaragoat with Samosir goat was (8.671). The conclude that the crossing superior result, must be cross between two goat types with value genetics most distance.It will have a better chance heterosis in cross result.

1. Introduction
Goats are the first animals to be domesticated by humans. Goats come from wild animals (Capra hircus aegagrus) that live in difficult areas and rocky areas. It is estimated that at the beginning the hunters bring back the goats from the prey. Goats are kept in the village as pets, then utilize for produce milk, meat and skin. In Indonesia, goat is found in rural areas.

Goat breeding has long been endeavored by farmers or the community as a side business or savings because the maintenance and marketing of their products (meat, dairy, dirt and leather) is relatively easy, although the traditional way of breeding is done.

Population of goats in Asia estimated about 225 million or 52% of the total population in the world. In Indonesia at 2014 have 19.2 million goats to be maintained. Livestock for small ruminants is mostly
in the hands of small farmers, with the main business is farming, and the others was used as side business.

Many types of goats exist in Indonesia is known to have different qualities and quantitative depends the nation. To be able to know the qualities and quantitative should know about nation of goats.

The desirable properties of a breeder are beneficial or beneficial properties, such as high production power, number and weight of good birth puppies, rapid growth, low mortality and high food use efficiency Fahmy and Bernard [1]. Livestock productivity is enhanced through genetic improvement by selection and marriage and through environmental improvement[2].

One method of phenotypic differences that can be used to determine genetic distance is diversity analysis Komenes [3]. Phenotypic diversity can be determined by measuring body parts or morphometrics. Measurement of body size is used to distinguish the diversity of both size and body shape. Diversity and correlation analysis is widely used in characterizing the relationship of phenotypic and genetic traits [4].

To increase the production of livestock one of which is considered genetic factors, livestock with close kinship may be expected to be less likely to increase heterosis in its crosses. Therefore, before the marriage need know about genetic distance between types. It aims to obtain superior or profitable properties.

To increase goat production is not enough just feed and environmental factors but also genetic factors. Close kinship or low genetic distances have little chance of acquiring superior traits in crosses.

Therefore, the author is interested in do a research related to genetic distance factors from some goats in North Sumatra. That is the estimation of genetic distance and distinguishing factor of difference between goats Beans, Estuary and Samosir through Cranometric analysis.

2. Materials and Research Methods
The location of this research are:
1. Kacang goat in PayaBakung village, Hamparan Perak village and KlambirLima village, Hamparan Perak district, Deli Serdang district.
2. Muara goat in BatuBinumbun village, Aritonang village and HutaGinjang village, Muara sub-district, North Tapanuli district.
3. Samosir goat in the village of ParbabaDolok, SiopatSosor village and Sinabulan village in Pangururan sub-district and RonggurNihuta village, Sitonggi-tonggi village in RongggurNihutasusubdistrict, Samosirdistrict.

This study was conducted in July 2016. The material used in this study was 100 head of Kacang goats with 34 males and 66 females, 100 head of Muara goats consists of 39 male and 50 female and 100 head Samosir goats with 37 males and 63 females who have adult genitals and adult body. The sample determination was done by census and the sample selection was done randomly.

The tool used in this study is the measuring tape or ruler in units (cm) and the sliding range in units (mm) as a gauge of the head part of the goat, the data book as a writing container of measurement results, the stationery to write the measurement results and the camera to document Measurement process, SAS (Statistical Analysis System) software, SPSS (Statistict Product and Service Solution) and MEGA are used to analyze data.

The research method used by census. The sampling technique was done randomly by taking the subject of goats Beans, Estuary and Samosir with age limit after adult body and adult sex. Parameters measured were skull length, skull width, horn length, horn circumference and inter-horn distance using unit gauge (cm) and unit slot (mm). Determination of the location of the research is selected in Hamparan Perak District, Muara District and Samosir District.

Parameters in this research are:
1. Skull length (PTe)
The length of the skull was measured from the base of the upper mouth to the upper part of the skull (X1).
2. Skull width (LTe)
The width of the skull was measured from the left cheekbone to the right cheek bone (X2).

3. Long Horn (PT)
The length of the goat's horn was measured from the base to the end of the horn (X3).

4. Boundary of the Horn (LPT)
The circumference of the goat horn was measured by encircling the meter at the base of the horn (X4).

5. Between the Horns (JAT)
The distance between the horns was measured horizontally from the base of the right horn to the base of the left horn (X5).

Measurements were made using a tape measure with units (cm) and with a unit sliding range (mm).

2.1. Data Analysis

2.1.1. Quantitative properties. Descriptive statistical analysis was shown to obtain characterization of body sizes in goats. This analysis was done by calculating the value of mean (X), standard deviation (s) and coefficient of diversity (KK) with the following statistical procedure according to Wiley [5].

\[
\bar{X} = \frac{\sum_{i=1}^{n} x^i}{n}, \quad S = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \bar{X})^2}{n-1}}
\]

\[
kk = (100 \%)\]

2.1.2. Genetic Distance. The genetic distance of Mahalanobis as the minimum quadratic square distance measure used according to Mahalanobis [6]:

\[
D^2_{(i,j)} = (\bar{X}_i - \bar{X}_j)^T C^{-1} (\bar{X}_i - \bar{X}_j)
\]

2.1.3. Canonical Analyzes. Canonical analysis was performed to determine dispersion maps and similarity and mix values within and between groups of livestock Herrera [7]. Canonical Discriminant Analysis were used to determine some variable to be used as discriminating variable or discriminator variable in the distribution of livestock based on the value of canonical structure or canonical correlation. This analysis was also used to estimate the genetic distance between livestock populations through the statistical distance of the mahalanobis and describes the relationship. Livestock in two dimensions based on the cumulative ratio of contributions from the canonical variables Gunawan and Sumantri [8].

2.1.4. Discriminant Analysis. When the test results of the two mean values of the properties used are different then the Fisher discriminant function was used to assess the differences in properties found among the goat groups. The discriminant function according to Wiley [9]:

\[
Y = a'X = (X1 - X2)' SG^{-1} X
\]

2.1.5. Main Component Analysis. The size and shape equations are derived from the covariance matrix. The Main Component Analysis (MCA) used is based on Simanjuntak et.al [10]. The model size equation is as follows:

\[
Y1 = a11X1 + a21X2 + a31X3 + \ldots + a101X10
\]

2.1.6. The Philogenetic Tree. A common method used to design phylogenetic tree is to use the genetic distance matrix and maximum parsimony methods. The construction of phylogenetic tree with the genetic distance method could be done more because the genetic distance can be obtained by
observation and some parameters. The maximum parsimony method is generally more limited in phylogenetic tree construction because it uses the amino acid or nucleotide sequence data Mirabella [11].

3. Results and Discussion

From Table 1 it can be seen that the highest average of the three goats is Muara goat with the length of the skull (15.80 ± 1.58) with the KK (2.50%) and the lowest is the average of goat Beans from the intermediate distance variables with the value (2.66 ± 0.59) And KK (0.35%). The differences in body composition among livestock are mainly due to differences in adult body size. Environmental and genetic factors have a close relationship to express the individual's genetic capacity and an ideal environmental condition is required Saparto [12].

3.1. Differentiator of Goat

From the results of the Main Component Analysis (Table 2) it can be seen the body size variables that have a strong influence that distinguish the goat, and the most distinguishing variables are the length of the horn (0.878) and the hollow circumference (0.856). The estimate is based on the high eigenvalues of the horns and circumference of the goat's horns. Prasetia [13] stated that the size of the phenotypic variables differ between types of cattle with one other.

3.2. Analysis nation clump of goat

The results of the analysis show (Figure 1) that the type of goat Beans spread on the X axis clustered with goats Samosir while goats grouping itself on the axis Y. Analysis above can be seen the closest relationships Nuts and Samosir while the most distant is Estuary with Samosir. The plot of discriminant analysis data can be used to describe the maximum possible separation between the tested groups Noor [14].

3.3. Discriminant Analysis

Based on the Table shows that the overall value of the observed variables has a comparison between goats species. The farthest value of comparison / variation is the value of Muara goat (-120.739) with Samosir goat (-94.387). The highest comparison value of the three types of goats was found in the Muara goat (11,814) from the skull length variant and the lowest was in Samosir goats (-2.091) from the skull length parameter. According to Saloko [15] size variations occur between different species, even in the same species. Several factors that limit the size and shape of animals, include genetic conditions, nutrient supply, toxicity, surface area to volume ratio, and structural limiting factors.

3.4. Determination of Estimation of Genetic Distance And Dendogram Between Goats

From the results in the Table 3 above can be seen that the highest or most distant genetic distance was Muara goat with Samosir goat with value (8.671), from this result can be stated that goat and goat gaosSamosir possible no crossing outside the goat. The lowest genetic distance was Kacang goats with Samosir goats that is (1.937) while the genetic distance value of Kacang goat with Muara goat was (7.417).

3.5. Dendogram Analysis

From the results of the Table 4 and the image of the dendogram analysis (Figure 2) above stated that the lowest distance value is in Kacang goat with Samosir goat that is (0.968) based on this value crossing between the two goats will not provide significant quantitative progress, if not accompanied by strict selection, it is possible Because of the small chance of heterosis (measured quantitative measurement of the superiority of children against the average parent) on the results of crossing between the two in the future. The goats that have the most distant kinship connections are Muara goats and Samosir goats and expected crossing between these two goats will provide significant
quantitative development, this is possible because the greater the chances of heterosis in the cross between the two future.

4. Conclusion and Recommendation

4.1. Conclusion
The highest or furthest genetic distance value from the three goats studied was Muara Goat with Samosir goat (8.671). From this result, it can be concluded that to get the superior crosses should be crossed between the two goats because the distance Themost distant genetic will have a greater chance of heterosis in the cross.

4.2. Recommendation
We recommend that the purity of these three goats (Peanut, Estuary and Samosir) should be improved and maintained in order to be a germplasm for the region of North Sumatra and In carrying out this research is expected to carefully and accurately sample measurements to obtain accurate and precise data.

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Table 1. Average, standard deviation and coefficient of variation among goats (adult body)

| Observed Variable | Kacang       | Muara       | Samosir       |
|-------------------|--------------|-------------|---------------|
| Skull length      | 14.45±1.06   | 15.80±1.58  | 13.40±0.78    |
| Average, SD, CD (%) | 1.12         | 2.50        | 0.61          |
| Skull Width       | 11.22±1.2    | 10.55±1.34  | 10.63±1.08    |
| Average, SD, CD (%) | 13.75      | 6.72        | 8.16          |
| Long Horn         | 10.82±3.7    | 8.36±2.59   | 8.09±2.85     |
| Average, SD, CD (%) | 10.69±2.30  | 8.00±1.80   | 9.33±1.79     |
| Ring of the Horn  | 0.432        | 0.588       | 0.642         |
| Average, SD, CD (%) | -1.899     | -2.030      | -2.091        |
| Distance Between Horns | 6.833    | 8.172       | 8.715         |
| Total (N)         | 100          | 100         | 100           |

Inf : SD : Standard Deviation  
CD : Coefficient Diversity

Table 2. Main Component Analysis  Body Size Variable

| Variable Body Size | Factor 1 | Factor 2 |
|--------------------|----------|----------|
| Skull length       | 0.492    | 0.720    |
| Skull Width        | 0.797    | 0.253    |
| Horn Length        | 0.878    | -0.002   |
| Outer Horn Circle  | 0.856    | -0.271   |
| Distance Between Horns | -0.403 | 0.798 |

Table 3. Discriminant Analysis

| Parameter          | Kacang  | Muara  | Samosir |
|--------------------|---------|--------|---------|
| Skull length       | 9.595   | 11.814 | 8.839   |
| Skull Width        | 4.970   | 4.556  | 5.038   |
| Long Horn          | -1.899  | -2.030 | -2.091  |
| Ring of the Horn   | 0.432   | -0.588 | 0.642   |
| Distance Between Horns | 6.833  | 8.172  | 8.715   |
| Y                  | -98.386 | -120.739 | -94.387 |
Figure 1. Goats Cariometric Analysis

Table 4. Matrix of goat’s genetic distance

| Goat     | Kacang | Muara | Samosir |
|----------|--------|-------|---------|
| Kacang   | .000   |       |         |
| Muara    | 7.417  | .000  |         |
| Samosir  | 1.937  | 8.671 | .000    |

Figure 2. Dendogram analysis of goat