



Characteristic of Swamp Buffalo (*Bubalus Bubalis*) Pampangan at Distric of Banyuasin, South Sumatera, Indonesia

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Abstract

The research objective was to study the character and analyze the phenotypic diversity among variants swamp buffalo (*Bubalus bubalis*) found in the area Pampangan, Banyuasin, South Sematera. The observed data is quantitative and qualitative. Quantitative data is determined by the circumference of the chest (Li Da), body length (Pa Ba), tail length (Pa Ek), the length of the head (Pa Ke), head width (Le Ke) and hip height (Ti Pi). Qualitative data is determined based on the character of each variant shown through the hair color, the shape and direction of growth of the horn. Characteristics that indicate of genetic relationship between the variant found swamp buffalo. Methods of observations carried out directly on the morphology and methods NTSYS Ver. 2.1 to the analysis of kinship and then presented in the form of a dendrogram. Results showed that there are four variants of buffalo in the area Pampangan namely red buffalo, black buffalo, buffalo striped and Lampung buffalo. morphology of four buffalo such as body size, hair color, shape and direction of growth of the horns are different Genetic relationship correlation coefficient value of 0.57 was found in group A (OTU-1) and group B (OTU-2, OTU-3 and OTU-4), and correlation coefficient value of 0.612 found in group A (OTU-2 and OTU-4) and group B (OTU-3). The correlation value of more than 0.57 kinship between the variance explained that the swamp buffalo in areas relatively close Pampangan and suspected level of inbreeding among the variants tend to be high. The analysis also showed that the closest genetic relationships found in OTU-2 (black buffalo) and OTU-4 (buffalo Lampung) with a correlation coefficient of 0.85. This condition is believed that the OTU-2 and OTU-4 derived from the same lineage.

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Keywords: Swamp buffalo (*Bubalus bubalis*) Pampangan, Phenotypic diversity.

Contribution/ Originality

This study is one of very few studied which have investigated about the characteristics of local endemic animals that have the potential to be developed or preserved. Swamp buffalo in South Sumatra is the local animal with the potential to be cultivated and become a major food source.

1. Introduction

Swamp buffalo found in Indonesian is expected to come from mainland China (Murti, 2002). Swamp buffalo (*Bubalus bubalis*) in District Rambutan, Banyuasin regency of South Sumatra Province is one of the varieties of buffalo native South Sumatra. Spread covering Sub Rambutan Pampangan Banyuasin district and sub-district, so it is often referred to as a buffalo buffalo Pampangan, characteristics of buffalo Pampangan located in District Rambutan or residing in District Pampangan or other areas surrounding that has a body shape tall and big, black leather, head and ears with long hair, short horns circular toward the back down, then towards the circular shape spirals, elbow-shaped body, a slim lead as the type of dairy cows, the udder well developed and symmetrical, and calm temperament. Swamp buffalo Pampangan located in District Rambutan spend their lives and live in swamps in the area of indigenous land area of ± 1,200 hectares (Windusari et al., 2014).

Storer *et al.* (1971 in [Kampas \(2008\)](#)) classifies the swamp buffalo as the family of Bovidae, genus *Bubalus* and including the species *Bubalus bubalis*. [Windusari *et al.* \(2014\)](#) stated that the swamp buffalo potential as workers and the animals can be developed as a source of food for human needs. [Kampas \(2008\)](#) explains that the buffaloes has three functions as dairy cattle, meat and labor.

Information Directorate General of Livestock South Sumatra (2010 in [Windusari *et al.* \(2014\)](#)) states buffalo population in South Sumatra decreased approximately 50% in a period of 6 years, or approximately 3.97% per year (\pm totaled 2,403,298 head in 2004 to \pm 1,932,927 head in 2010) Decrease in swamp buffalo populations associated with low reproductive rate ([Anggraeni *et al.*, 2007](#)). The existence of swamp buffalo is very important for people, especially people in Sub Rambahan where the majority of the population worked as farmers buffalo. Reproduction low and high inbreeding among species of buffalo in the area Pambangan decrease the quality of the puppies and potential. Environmental conditions also affect reproductive rate swamp buffalo ([Windusari *et al.*, 2014](#)). Therefore, this study was conducted to look at the genetic diversity of the swamp buffalo (*Bubalus bubalis*) found in South Sumatra, especially in Banyuasin as a basis for conservation.

2. Methods

The research method is through direct observation of the morphology of each variant were found to swamp buffalo and then calculate kinship use NTSYS software ver. 2.1.

2.1. Data Collection

a. Quantitative

According to [Abdullah *et al.* \(2006\)](#) to determine the morphology of the buffalo fourth variation is to measure several variables of limbs buffalo. Measured variables are: (1) Bust, (2) High-shoulder, (3) The length of the body, (4) Long tail, (5) The length of the head, (6) The width of the head and (7) High hips.

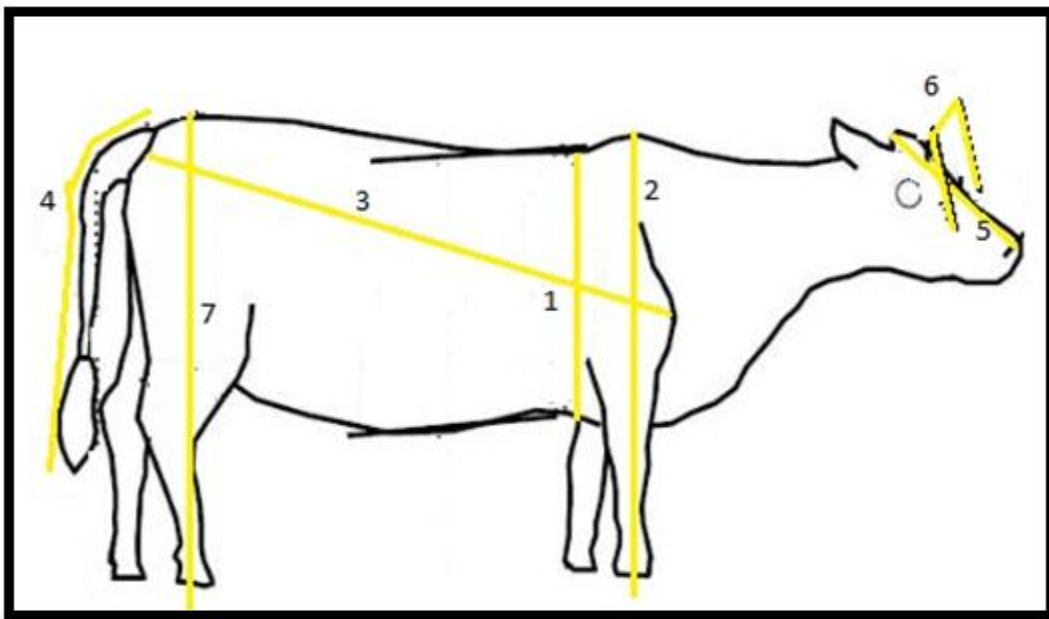


Figure-1. Sketch Body Buffalo Swamp to see quantitative data ([Abdullah *et al.*, 2006](#)).

The size of the body calculating by average value (\bar{x}), standard deviation (s) and the coefficient of variance (KK). The formulas is :

$$\bar{x}_i = \frac{\sum_{i=1}^n x_i}{n} ; s = \frac{\sqrt{\sum_{i=1}^n (x_i - \bar{x})^2}}{n-1} ; \text{ dan KK (\%)} = \frac{s}{\bar{x}} (100\%)$$

Description:

- \bar{x} : the average value
- S : Standard Deviation
- KK : coefficient Diversity
- x_i : The size of the i-th of nature x
- N : Number of Samples obtained from Population

b. Qualitative

Qualitative data were obtained in the form of a fourth color variant swamp buffalo hair and the shape and direction of growth of the four variants of buffalo horn is presented in tabular form.

2.2. Relationship

Observations conducted descriptive morphological characters that include the characters starting at the head, neck, body, tail and legs. Furthermore, the character gained will be given scale comparison of the numbers 0, 1, 2 and 3 in accordance with the character possessed of individual variants swamp buffalo. Then the morphological characters of each buffalo variation is presented in the tables for kinship analysis.

Data obtained from morphological characters of each buffalo analyzed using NTSYS ver. 2.1 and presented in the dendrogram. Cluster analysis is done by using the Unweighted Pair-Group Method with Arithmetic Averaging (UPGMA) with similarity coefficient. Morphological characters on the table to strengthen dendrogram grouping patterns and characters that play a role in the separation OTU.

3. Results and Discussion

3.1. Morphology

Morphology each swamp buffalo (red buffalo, black buffalo, striped buffalo and Lampung buffalo) were observed in the form Circumference Chest (Li Da), Long Board (Pa Ba), Long Tail (Pa Ek), Long Head (Pa Ke), Width Head (Le Ke) and High Hips (Ti Pi). Results morphology of swamp buffalo can be seen in Table 1.

Table-1. The average value (\bar{x}) and a diversity coefficient (KK) fourth morphological variation Swamp Buffalo

No.	variable observation	Variations Swamp Buffalo							
		Red	KK	Black	KK	mottle	KK	Lampun g	KK
1.	Chest size (Li Da)	183±11	6,0 1	181±11	6,08	173±1	0,58	176±0	0
2.	Body length (Pa Ba)	117,5±8,5	7,2 3	129±7	5,43	121±0	0	118±0	0
3.	Tail length (Pa Ek)	72±4	5,6	85±4	4,70	79±3	7,8	69±0	0
4.	Head length (Pa Ke)	48±1	2,0 3	51,5±2,5	4,85	45,5±0,5	1,01	42±0	0
5.	Head width (Le Ke)	25,5±0,5	197	25±1	4,0	25,5±0,5	1,17	24±0	0
6.	high Hips (Ti Pi)	125±5	4,0	126,5±1,5	1,19	130±2	1,54	125±0	0

Chest circumference of each buffalo is different and has variations. Chest circumference mean value (Li Da) contained in the Red Ox is 183 cm, to Black Buffalo is 181 cm, at Striped Buffalo is 173 cm, while the Lampung Buffalo is 176 cm. The chest circumference shown in Red Buffaloes while the value shown on the chest circumference Striped Buffalo. In Figure 1 shows that the red and black buffalo buffalo have large flats chest circumference is nearly equal and the spotted buffalo and buffalo Lampung also has a chest circumference values were nearly equal as well. Factors that can affect the body size of the buffalo that age, gender and heredity or genetic factors.

The buffalo body length varies even there is one variation of buffalo which was far above the other three variations. Red Buffalo has a body length of 117.5 cm, the Black buffalo body length of 129 cm and for Striped buffalo body length of 121 cm, while the Lampung buffalo has a body length of 118 cm. The results ranged from 117.5 to 129 cm, based on research results [Dudi et al. \(2011\)](#) Pandegelang male buffalo, Serang and Lebak has a body length range of between 121.86 to 122.25. As for the female buffalo Pandegelang, Serang and Lebak ranged from 119.59 to 120.22 cm. Comparison between chest circumference and body length in red buffalo, has a big difference. Red buffalo has a chest circumference greatest variation compared with the three other buffalo. As for the length of the body, red buffalo has a body length shorter than the black buffalo, striped buffalo and Lampung buffalo. The most influential factor in the growth of that genetic factors and environmental factors.

Long tail between the average value of dairy buffalo, black buffalo, striped buffalo and Lampung buffalo. Based on the results in can length red buffaloes which is 72 cm, while the black buffalo is 85 cm and for buffalo stripes have panjang tail is 79 cm while the lampung buffalo tail length is 69 cm. When viewed from the long tail of the fourth variation of buffalo can be seen that the black buffalo tails are longer than the other buffalo variations. while buffalo lampung which has a shorter tail length.

Red buffalo head length is 48 cm, while for black buffalo is 51.5 cm, for striped buffalo is 45.5 and for Lampung buffalo has a length of 42 cm head. These results are almost the same possibility in the long head of research [Dudi et al. \(2011\)](#) namely buffalo lampung. Based on his research buffalo head length contained in Serang, namely 42.21 cm to 41.63 cm in Pandegelang namely in the Valley and for the length of his head reaches 42.14 cm long while for the measurement results for buffalo head lampung is 42 cm. while the others are variations buffalo head that much different length da tone is also nearing similarities with studies in Serang, Pandegelang and Lebak.

The width of the head of the dairy buffalo, black buffalo, striped buffalo and Lampung buffalo. Where the value of the average width of the head between the four variations of the water buffalo that for red buffalo is 25.5 cm, for black buffalo head width of 25 cm and a width

which is owned by a buffalo head stripe is 25.5 cm while the width of the head of a buffalo owned by lampung ie 24 cm. Research [Dudi et al. \(2011\)](#) show different figures with the results obtained. Penelitiannya where the head width is 19.41 cm Serang buffalo, Pandegelang buffalo is 20.53 cm and 20.68 cm Lebak buffalo namely, so buffalo that have a superior head width ranging number 20.68 cm whereas the results obtained indicate the width buffalo head is superior numbers ranging from 25.5 cm.

High hips highest buffalo found in streaks, reaching 130 cm, while the most hip height indicated on the red buffalo and lampung buffalo which has a hip height is 125 cm. black buffalo hip height is 126.5 cm. The results obtained in this study is smaller than the research of [Kanpas \(2008\)](#) in Sibuhuan is to have a male buffalo 135.82 cm whereas for females the same as male buffalo hip height is 135.82 cm.

The content of the feed given to cattle have a close relationship with the decrease and increase the size of the animal's body. The content of the feed which has a high nutritional will impact both on animal and vice versa. According [Ariko et al. \(2015\)](#) the content of Volatile Fatty Acids (VFA) which can increase the body size of the animal and at the lower VFA in the rumen can reduce the size of the animal's body.

3.2. Characteristics

Hair color characteristics of dairy buffalo, black buffalo, buffalo and striped buffalo float shows in Table 2.

Table-2. Characteristics of Dairy Buffalo hair color, Black Buffalo, Striped Buffalo and Buffalo Lampung

No.	Buffalo variations	Hair color			
		Black	Red	Mottle	Gray
1.	Dairy Buffalo	-	+	-	-
2.	Black Buffalo	+	-	-	-
3.	Striped Buffalo	-	-	+	-
4.	Lampung Buffalo	+	-	-	-

Table 2 shows that red buffalo has a hair color that corresponds to the name that is red, black buffalo also has a hair color that corresponds to the name that is black. As for the buffalo striped hair consisting of two colors, black and red colors and for buffalo lampung have the same hair color hair color possessed by the black buffalo is black.

According to [Azmi and Suharnas \(2007\)](#) is generally white buffalo coat color red and black with sparse and coarse body hair. One cause of this hair color diversity that genetic factors are derived by the parent buffalo earlier. Research [Ssitorus \(2008\)](#) explains that the frequency of cross pollination shows color variations of Murrah buffaloes and swamp buffalo.









According to [O'Rahilly \(1995\)](#) among other hair function to protect the body, regulate body temperature and facilitate evaporation of sweat. Hair can also serve as a tool flavorings. Colored hair contain pigment in the cortex and medulla, but the sheath surrounding there is no pigment. Hair color depends mainly on the pattern and the amount of pigment in the cortex, and sometimes on the air cavity inside the hair. White pigment in the hair that is not there, and putihnya caused by air content in the hair (as well as the water foaming); "Gray" (canities) is usually a mixture of white hair and colored hair. Oxidation of melanin causing compounds that are colorless, so the hair is dark to be white because of the presence of hydrogen peroxide.

3.3. The Shape and Direction of Growth Horn

Bred buffalo horn shape that is like a crescent moon. Shape black buffalo and striped buffalo also has the same shape with a red buffalo is like a crescent moon. While the shape of buffalo horn lampung buffalo different from the other three, which is like a half circle. According to research [Erdiansyah and Anggraeni \(2008\)](#) the type of normal buffalo horn is mowing backward. In his research gained 98% back shape, circular shape down 1%, 0.5% and 0.5% laterally straight circular backward. The direction of growth of buffalo horn red, black buffalo, striped buffalo and lampung buffalo have similarities and differences. Red buffalo have horns growing direction is directed perpendicular and curved inward. Black buffalo have horns backward direction and edges curved inward. The direction of growth together with a buffalo horn striped red buffalo is upright and curved edges to the inside. As for the lampung buffalo growth is downward and curved edges to the inside. According [Kanpas \(2008\)](#) the swamp buffalo in general have this kind of horns curved upwards, straight to the side, and curved down and very rarely have any kind of swamp buffalo Tandung with arched back.

Comparison of the shape and direction of growth of the buffalo horn dairy, black buffalo, striped buffalo and lampung buffalo, can be seen in Table 3 below:

Table-3. The shape and direction of growth of dairy buffalo horn, Black Buffalo, Striped Belang Lampung Buffalo and Buffalo

No.	Variation Buffalo	Horn Shape	
		Front look	Side view
1.	Dairy Buffalo		
2.	Black Buffalo		
3.	Striped Buffalo		
4.	Lampung Buffalo		

Dairy buffalo, black buffalo and lampung buffalo horn have a more flattened surface and has a pointed end and sharp. As for the stripes buffalo have a more rounded surface and the horns are more tumpul. Perbedaan form of four variaasi buffalo horn can be caused by factors as sex, age and status factors or position of the buffalo in their environment.

3.4. Relationship Analysis of Swamp Buffalo

Relationship analysis of dairy buffalo, black buffalo, striped buffalo and lampung buffalo based on morphological characters possessed of the four variants of the buffalo. In correlation coefficient of 0.57, there are two groupings uatam namely group A and group B. In a correlation coefficient of 0.57, the group A which comprises only one OTU OTU-1 (Red Buffalo) and in group B, which consists of three OTU, OTU -2 (black buffalo), OTU-3 (striped buffalo) and OTU-4 (lampung buffalo) .At koefisien correlation of 0.612, in group B again divided into two groups, namely group a and group b. a group that is composed of two OTU OTU-2 (black buffalo) and OTU-4 (lampung buffalo). Whereas in group B, which comprises only a single OTU OTU-3 (striped buffalo) .According Cabezas *et al.* (2010) the index value above 50% similarity (correlation coefficient 0.50) indicates that the animal is still in one species , So between the four variants of the swamp buffalo still belong to the species.

Fenetic kinship analysis results of the four variants of the buffalo is presented in the figure 2 below dendrogram.

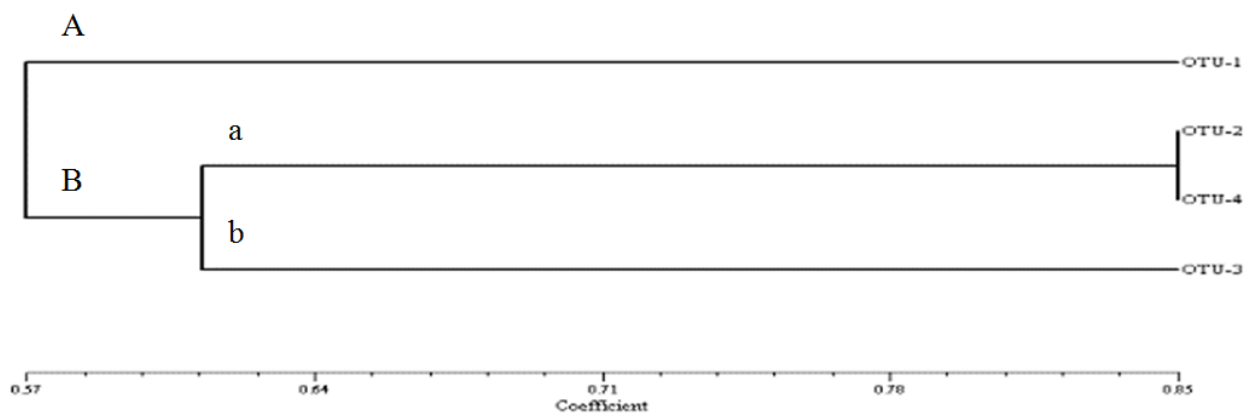


Figure-2. Dendrogram kinship swamp buffalo Pampangan (dairy buffalo , black buffalo, striped buffalo and buffalo Lampung).

Description: OTU-1: Red Buffalo, OTU2:Black Buffalo , ITU-3: striped Buffalo , OTU-4: Lampung Buffalo

The similarity of character possessed between group A and group B with 24 of the 54 characters that dimlikinya among others, the texture base of the horn, the texture of the fence, forms the base of the horn, ear shape, accessories on the nose, the shape of the sclera eyes, accessories on the eyelids, tip shape and the base of the eyelid, the shape of the eyelashes, the shape of the tip and base of the brow, accessories and forms of accessories, accessories on the neck, the direction of hair growth and shape umu body, arahpertumbuhan leg hair and accessories on foot, arahpertumbuhan tail hair, accessories tail, color cambukekor, shape common tail whip and whip tail tip shape. While distinguishing antarakelompok A and group B were 7 characters include the color and shape of the iris, pupil shape, the color of the eyelids, the eyelashes, the color of shoes and hair color on the tail.

Similarities in character between group A and group B contained 31 characters, among others, the texture of the base and the tip of the horn, forms the base of the horn, ear shape, accessories on the nose, the shape of the sclera, the shape and color of the iris, the shape of the pupil, colors and accessories on the eyelid, tip shape and the base of the eyelid, color and shape of the eyelashes, the shape of the tip and base of the brow, accessories and shape of accessories on the eyebrows, accessories on the neck, the direction of hair growth, a common form of the body, the color of the shoes, the direction of the growth of leg hair, accessories feet, hair color body tail, direction pertumbuhan rambut body tail, tail accessories, colors and textures whip tail, as well as the shape of the tip of the tail whip. While the difference between group A and group B contained 15 characters, among others colors horn, forms the tip of the horn, ring horn, the color of the base and the tip of the horn, the color of the ears, accessories ear, the color of the nose, the color of the sclera, color accessories brow, the color of the neck, where collar and color, the body color, and hair color foot.

Similarities and differences in the four variants swamp buffalo Pampangan can be seen in the figure below:

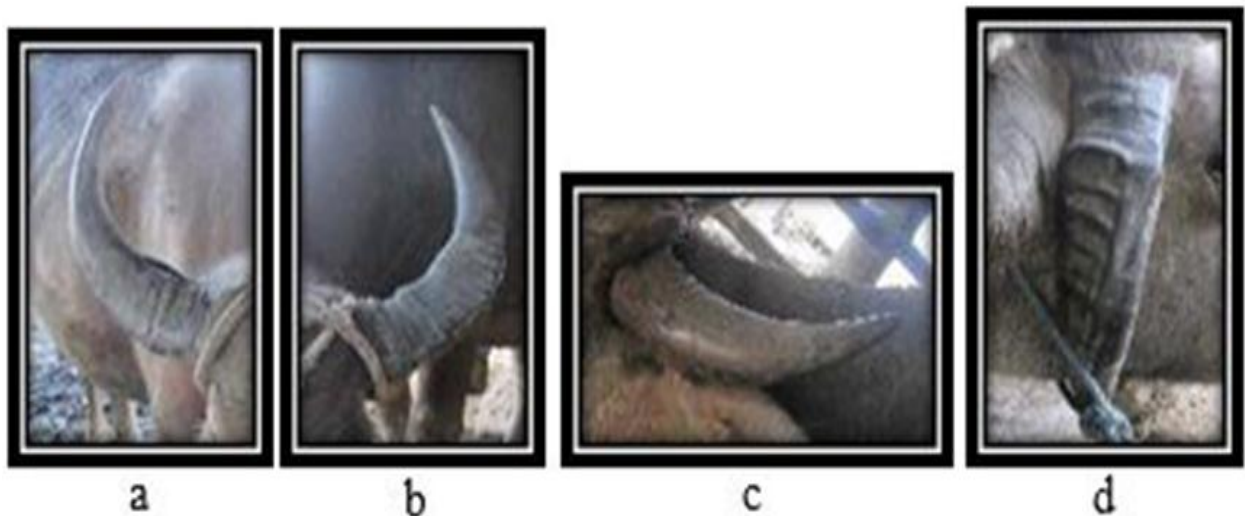


Figure-3. Variation of morphological variants swamp buffalo horn (*Bubalus bubalis*).

Description: a; Red buffalo horns, b; black buffalo horn, c; buffalo horn striped, d; lampung buffalo horn.

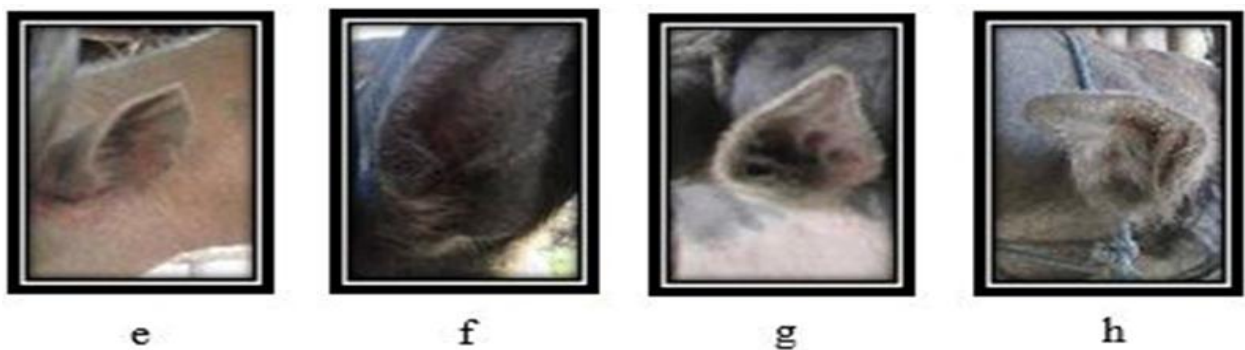


Figure-4. Variation ear morphology of variants swamp buffalo (*Bubalus bubalis*).

Description: e; buffalo ears red, f; black buffalo ears, g; buffalo ears striped, h; buffalo ears lampung



Figure-5. Variation of morphological variants nose of swamp buffalo (*Bubalus bubalis*).

Description: i; red bull nose, j; nose of black buffalo, k; buffalo nose stripe, l; lampung buffalo nose.

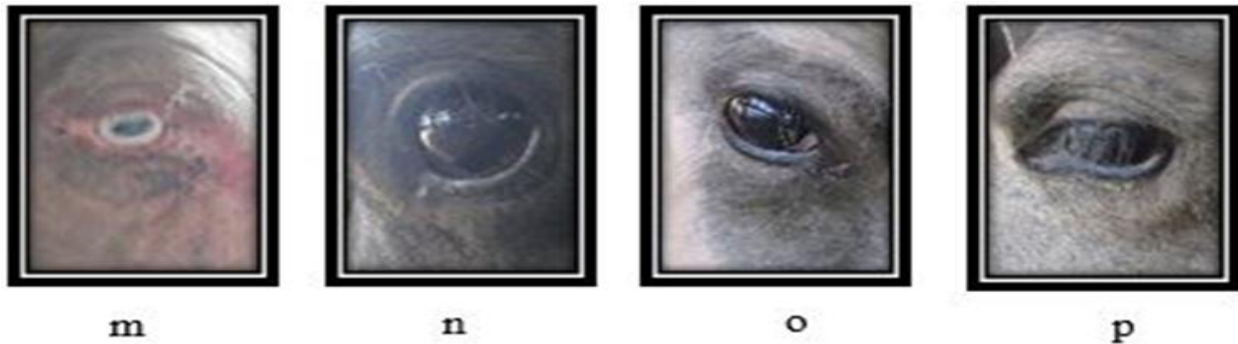


Figure-6. Variation of morphological variants eye of swamp buffalo (*Bubalus bubalis*).
Description: m; eyes red buffalo, n; eye black buffalo, o; buffalo eye stripe, p; lampung buffalo eye.



Figure-11e. General morphological variation (neck, body, legs and tail) of a variant of the swamp buffalo (*Bubalus bubalis*).

Description: (a) the general morphology of red buffalo, (b) general morphology of black buffalo, (c) the general morphology of striped buffalo, (d) the general morphology of Lampung buffalo.

Relationship between the fourth variation of the closest swamp buffalo found in a black buffalo and Lampung buffalo. Based on morphological character data obtained, the two variations are significant similarities in both the hair color of black, while red buffalo and buffalo different stripes.

The observed data showed that of 54 morphological characters were observed, there are 45 characters in common between the two variations of the water buffalo. The same fundamental morphological characters of black buffalo and lampung buffalo include: hair color, the color and shape of a horn. While the difference between the two most visible is in the direction of the growth of the horn.

Near and away kinship of the fourth variation swamp buffalo can be influenced by several factors, including internal factors are genetic factors and external factors which include the environment and lifestyle of the fourth variation of the swamp buffalo. According [Tarwinangsih et al. \(2011\)](#) states that an animal kinship pattern is thought to occur because of the deployment and migration (gene flow). One reason is also that inbreeding, according [Hastono \(2008\)](#) a male which has a small body and is young and marrying a female will produce smaller offspring as well. According to [Hart \(2012\)](#) nearby population geofrafis an individual basis can improve the process of interaction of the individual. So the higher the level of interaction both individuals can trigger more occurrence of inbreeding and the higher the degree of similarity in the behavior of each individual.

4. Conclusion

They are 4 variants found in the swamp buffalo Pampangan, South Sumatra. The fourth variant is the buffalo red, black, striped and Lampung. Morphological differences in the four variants are body size, hair color and the shape and direction of growth of the horn. The differences shown in the dendrogram with the range of the correlation coefficient is 0.57 to 0.85 and the highest correlation values found in Lampung variants buffalo and black variants. This suggests that the two variants is thought to originate from the same parent.

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