

External Genetic Characteristics of Swamp Buffalo Based on Sex and Age in South Konawe District

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ABSTRACT

This research aims to analyze the external genetic characteristics of swamp buffalo in South Konawe Regency based on sex and age. Variables observed included: skin color, stocking color, horn shape/direction, whorls and chevron lines in different sexes and ages. Based on the results of the research and discussion, it can be concluded as follows: (1) The skin color of swamp buffalo in South Konawe Regency is predominantly dark (black and dark grey) in both males and females (83.31%). The older the buffalo, the darker its skin color. Apart from that, there is an albino skin color which shows that inbreeding occurs in buffalo in this area, (2) the dominant sock color is dark gray (85.3%), (3) the dominant shape/direction of the horns is upwards (77.3%), (4) the dominant whorls are at the waist (73.33%), and (5) the dominant chevron is single (53.68%). To overcome the occurrence of inbreeding, it is necessary to procure males from outside the population and use them for a maximum of 3 years.

Keywords : Swamp Buffalo, External Genetics, Sex and Age of Buffalo.

I. INTRODUCTION

Until 2022, beef production will not meet the needs of the Indonesian people. From the target demand of 703,650 tons, national beef production capacity only reached 438,585 tons, so that imports of frozen meat and feeder cattle from abroad in 2022 amounted to 265,065 tons or 37.67% of the total need (Livestock and Animal Health Statistics, 2022).

One of the government's efforts to overcome dependence on meat imports includes increasing the

capacity for meat production from livestock, including swamp buffalo. Buffalo livestock plays an important role in increasing national meat production, considering that its performance is not much different from beef cattle and its existence has been integrated with the social, economic and cultural life of the community (Nafiu *et al.*, 2015).

Swamp buffalo have many advantages, such as the ability to adapt to poor environments, can utilize low quality feed, provide a positive response to feed improvement programs (Nafiu *et al.*, 2017 and 2018),

and the buffalo breeding business is financially viable (Nafiu *et al.*, 2020a). Apart from that, swamp buffalo can also be used as a source of labor and food diversity (Dude *et al.*, 2011 and Sembiring *et al.*, 2013). Genetically, swamp buffalo, especially in Bombana Regency, have found the GH/MspI and GHRH/HaeIII genes which can be used as selection criteria to increase meat production. However, swamp buffalo also have several limitations, including low reproductive performance (Nafiu *et al.*, 2013), very little public and government attention to increasing buffalo production (Nafiu *et al.*, 2020b and Karabu *et al.* 2021).

The development of the buffalo population in Indonesia has fluctuated. In 2020 the buffalo population in Indonesia was 1,154,226, decreasing to 1,143,189 in 2021, then increasing to 1,170,209 in 2022 (Livestock and Animal Health Statistics, 2022). In recent years, the development of the buffalo population in Southeast Sulawesi Province has been quite encouraging. In 2019, the buffalo population in Southeast Sulawesi was only 2,162, growing to 2,668 in 2022 (BPS Southeast Sulawesi, 2023) with an average increase rate of 7.80% per year.

South Konawe Regency is one of the swamp buffalo development areas in Southeast Sulawesi Province. In the last four years the development of the buffalo population in this area has been quite rapid. In 2019 the buffalo population in South Konawe numbered 191 heads, growing to 351 heads in 2022 (BPS Southeast Sulawesi 2020 and 2023) with an average increase rate of 27.95% per year. Most of the buffalo population in South Konawe Regency is concentrated in Mowila and Angata Districts with a total of 291 head in 2022 or covering 82.91% (BPS South Konawe, 2023). Mowila and Angata sub-districts can be used as buffalo development centers in South Konawe Regency.

External genetic characteristics (skin color and stocking color, shape/direction of horns, whorls and

chevrons) are important to study, because they are related to phylogenicity and describe the characteristics of authenticity. Information on the external genetic characteristics of swamp buffalo in South Konawe Regency is not yet available. In connection with this, it is necessary to carry out research aimed at analyzing the external genetic characteristics of swamp buffalo in South Konawe Regency.

II. METHODS AND MATERIALS

Time dan Location

This research was carried out for 3 months, taking place from August to October 2023. The research was carried out in South Konawe Regency and focused on two sub-districts, namely: Mowila District and Angata District. The research location was determined using purposive sampling with the consideration that the two sub-districts have the largest buffalo population in South Konawe Regency.

The material used was 225 swamp buffalo at all age levels, namely calf, young and adult buffalo, consisting of 60 male buffalo and 165 female buffalo. Other materials used are a list of questions and writing tools. The equipment used includes: (1) clamp cage measuring 1 m X 2 m, (2) cameras, and (3) GPS device.

Research variable

Observed research variables include:

1. Skin color: black, dark gray, light gray and albino.
2. Stocking colors: dark gray, light gray and albino
3. whorls: located on the head, stomach, chest and waist
4. chevron: none, single and double
5. Shape the horns circular to the side, circular downward, circular upward, straight to the side, circular to the back.

The age of the buffalo is determined based on

information from the breeder/livestock worker and based on the condition of the teeth and condition of the horns.

Data analysis

The external genetic characteristics data obtained were analyzed using relative frequencies with the following formula:

$$\text{Relative Frequency of Trait A(\%)} = \frac{\sum \text{Trait A}}{n} \times 100\%$$

Where:

A = Observed traits

n = Number of samples

Based on the results of relative frequency calculations, a descriptive analysis was carried out to describe the external genetic characteristics of the swamp buffalo population in South Konawe Regency.

III. RESULTS AND DISCUSSION

External genetic characteristics of buffalo include skin color, stocking color, whors, chevron lines, and horn shape/direction. External genetic characteristics are the qualitative characteristics of local buffalo which still vary in skin color, stocking color and horn shape, whorls and chevrons (Nur *et al.*, 2018). The external genetic characteristics of swamp buffalo based on sex and age structure in South Konawe Regency can be seen in Table 1.

Table 1. External genetic characteristics of swamp buffalo based on sex and age structure in South Konawe Regency

External Genetic Characteristics	Sex						Age Structure								
	Male		Female		Total		Calf		Young		Adult		Total		
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
skin color	Black	32	53,3	118	71,5	150	66,7	12	26,1	37	63,8	101	83,5	150	66,7
	Dark Gray	17	28,3	20	12,1	37	16,4	13	28,3	16	27,6	8	6,6	37	16,4
	Light Gray	9	15,0	21	12,7	30	13,3	19	41,3	3	5,2	8	6,6	30	13,3
	Albino	2	3,3	6	3,6	8	3,6	2	4,3	2	3,4	4	3,3	8	3,6
	Total	60	100,0	165	100,0	225	100,0	46	100,0	58	100,0	121	100,0	225	100,0
Stoc-king Color	Dark Gray	47	78,3	145	87,9	192	85,3	41	89,1	45	77,6	106	87,6	192	85,3
	Light Gray	11	18,3	14	8,5	25	11,1	3	6,5	11	19,0	11	9,1	25	11,1
	Albino	2	3,3	6	3,6	8	3,6	2	4,3	2	3,4	4	3,3	8	3,6
	Total	60	100,0	165	100,0	225	100,0	46	100,0	58	100,0	121	100,0	225	100,0
Horn Direction/ Shape	Side	2	3,3	5	3,0	7	3,1	0	0,0	1	1,7	6	5,0	7	3,1
	inward	4	6,7	40	24,2	44	19,6	3	6,5	5	8,6	36	29,8	44	19,6
	upward	54	90,0	120	72,7	174	77,3	43	93,5	52	89,7	79	65,3	174	77,3
	downward	0	0,0	0	0,0	0	0,0	0	0,0	0	0,0	0	0,0	0	0,0
	Total	60	100,0	165	100,0	225	100,0	46	100,0	58	100,0	121	100,0	225	100,0
Whorls	Head	2	3,3	0	0,0	2	0,9	1	2,2	0	0,00	0	0,0	1	0,4
	Stomach	6	10,0	3	1,8	9	4,0	3	6,5	1	1,72	3	2,5	7	3,1
	Chest	26	43,3	35	21,2	61	27,1	22	47,8	10	17,24	20	16,5	52	23,1
	Waist	38	63,3	127	77,0	165	73,3	20	43,5	47	81,03	98	81,0	165	73,3
	Total	60	100,0	165	100,0	225	100,0	46	100,0	58	100,00	121	100,0	225	100,0
Chevron	None	5	8,3	16	9,7	21	9,3	2	4,3	5	8,62	14	11,6	21	9,3
	Single	30	50,0	92	55,8	122	54,2	27	58,7	35	60,34	60	49,6	122	54,2
	Double	25	41,7	57	34,5	82	36,4	17	37,0	18	31,03	47	38,8	82	36,4
	Total	60	100,0	165	100,0	225	100,0	46	100,0	58	100,00	121	100,0	225	100,0

Characteristics of Skin Color

Skin color is a manifestation of one or several pairs of genes. As a qualitative trait, skin color can be used as a selection criterion (Dudi *et al.*, 2011). The research results show that the majority of swamp buffalo in South Konawe Regency are black, around 66.7%, respectively 53.3% for male and 71.5% for female buffalo (Table 1). Dark gray and light gray skin colors and albinos only account for 16.4%, 13.3% and 3.6% respectively. The results of this study are different from swamp buffalo in Serang, Pandeglang and Lebak districts, Banten Province, where the dominant skin color is dark gray, covering 61% -67% (Dudi *et al.*, 2011). This situation is likely caused by differences in the composition of their genes. Dudi *et al.*, (2011) stated that the dark gray color variations most commonly found in Banten Province are influenced by different gene arrangements. Ibrahim *et al.* (2021) reported that buffalo in North Musi Rawas Regency generally have a dark gray color of 85.71%. This is in line with Krisnandi *et al.* (2015) stated that local buffalo have gray skin, Karabu *et al.* (2021) in swamp buffalo in Konawe Regency, the dominant skin color was 56.52% dark gray. Swamp buffalo in Muara Rupit, Karang Dapo, Karang Jaya, Ulu Rawas, Rawas Ulu, Rawas Ilir and Nibung Districts in North Musi Rawas District have a dark gray color of 85.71% and light gray 14.29% (Ibrahim *et al.*, 2022) . Olson (1999) stated that variation in coat color is the result of the cooperation of several loci A, B, C, D and E, where the dominant allele at locus D is responsible for the dilution effect (fading) of an individual's original color to dark gray.

Apart from black and gray (dark and light) skin, swamp buffalo in South Konawe Regency also have a small proportion of albino skin (only around 3.6%), both male and female buffalo. The albino color is also found in calf, young and adult buffalo (Table 1 and Figure 1). The same results were reported by (Dudi *et al.*, 2011) that swamp buffalo in Banten Province were found to be albino with a percentage of 2% in Serang Regency, 1% in Pandeglang (1%) and 4% in Lebak Regency. Koesmara *et al.*, 2023) also reported that albino colored Gayo buffalo were found in a limited percentage,

namely 4%. However, albino buffalo have never been found in Kampar District (Yendraliza, 2007).

Buffaloes in rural areas are generally kept extensively. They are released freely in pastures with a limited number of males. Such conditions can increase the chances of marriage between males and females who have a close family relationship (inbreeding), for example the marriage of a male with his female offspring, a parent with his male offspring and the marriage of siblings and/or half-siblings. Muhakka *et al.* (2013) stated that buffalo that are grazed freely can cause inbreeding, resulting in an increase in the population of albino buffalo.

Based on sex, black skin color is more common in female buffalo than in male buffalo (71.5% vs 53.3%), whereas dark gray skin color is more common in male buffalo than female buffalo (28.3% vs 12.1%) (Figure 1: left-1a).

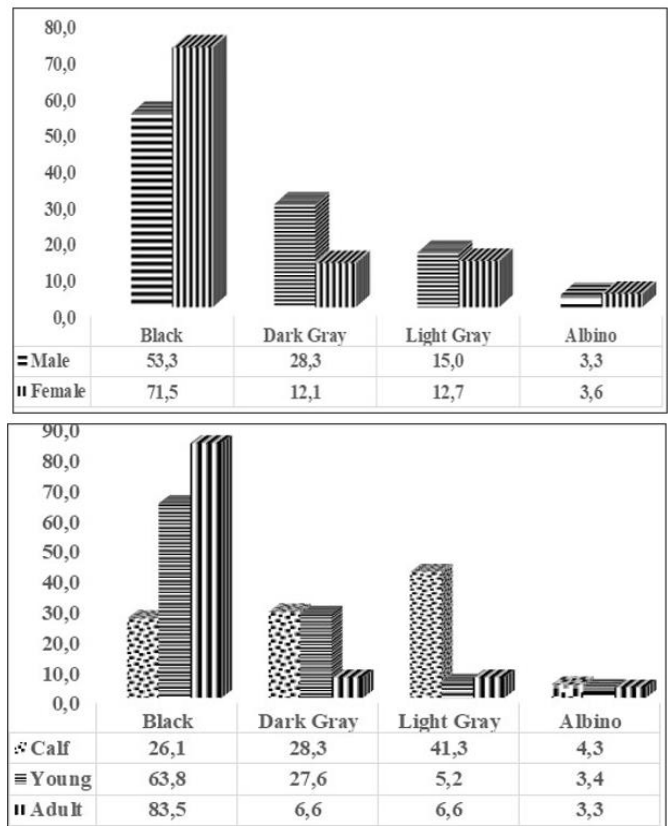


Figure 1. Swamp buffalo skin color according to sex (left-1a) and age structure (right-1b) in South Konawe Regency

Swamp buffalo in adults and young generally have a darker color (black), respectively 83% in adult buffalo and 63.8% in young buffalo. The high proportion of black skin in swamp buffalo in South Konawe Regency is probably due to the fact that many of the buffalo are old (>6 years old). Erdiansyah (2008) stated that the older the buffalo, the darker the skin color (black).

Stocking Characteristics

The stocking color of swamp buffalo is grouped into 2, namely having stockings if the color of the legs is not the same as the body color, and not having stockings if the color of the legs is the same as the overall body color.

The color characteristics of swamp buffalo stockings in South Konawe Regency can be seen in Table 1 and Figure 2. Based on Table 2, it can be seen that generally the color of buffalo stockings in this area is dark gray with a percentage of 78.3% for males and 87.9% for females. The remaining sock color is light gray, respectively 18.3% of males and 8.5% of females, and albino with a proportion of 3.3% in males and 3.6% in females. Dudi et al. (2011) reported that the highest stocking color of local buffalo in Banten Province was dark gray (44.67%) and the lowest was light gray (23.33%), while white legs were found at 32.00 percent.

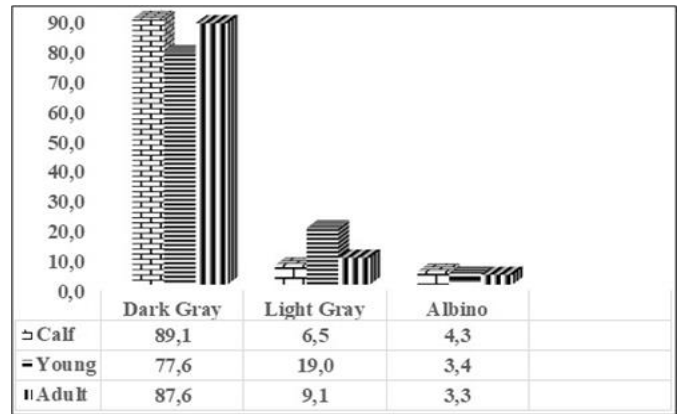
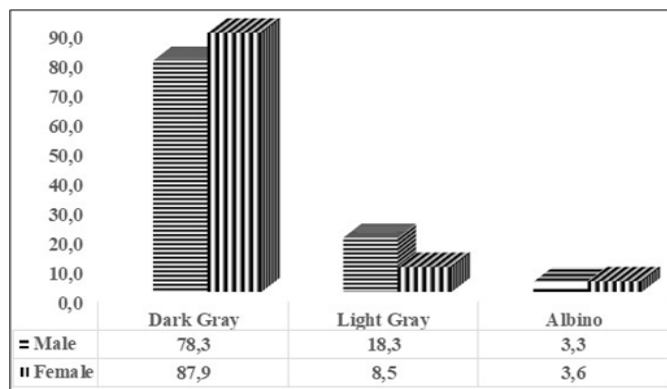


Figure 2. Swamp buffalo stocking colors in South Konawe Regency according to gender (left) and age structure (right)

The results of this study are not much different from Karabu *et al.* (2021) on swamp buffalo in Konawe Regency that all or 100% had stockings. Likewise, research results from Erdiansyah (2008) show that 96% of buffalo with stockings were found in Dompu Regency, West Nusa Tenggara Province. Generally, swamp buffalo have legs that are lighter in color than their body color. Meanwhile Afista *et al.* (2021) reported that swamp buffalo in Puriala District, Konawe Regency are all white or light gray. Sock color expression is thought to be controlled by the white marking gene (Praharani and Triwulaningsih, 2008).

Characteristics of Horn Shape/Direction

The presence of horns in both male and female buffalo is normal, but there are variations in the shape/direction of the horns such as pointing backwards, sideways and upwards. The horns of swamp buffalo are used to scavenge mud in wallows and ward off insects on their backs, as well as for scratching. For male buffalo, the horns can also be used to fight with other males.

Characteristics of the shape/direction of the swamp buffalo's horns based on sex and age structure in South Konawe Regency can be seen in Table 1 and Figure 3.

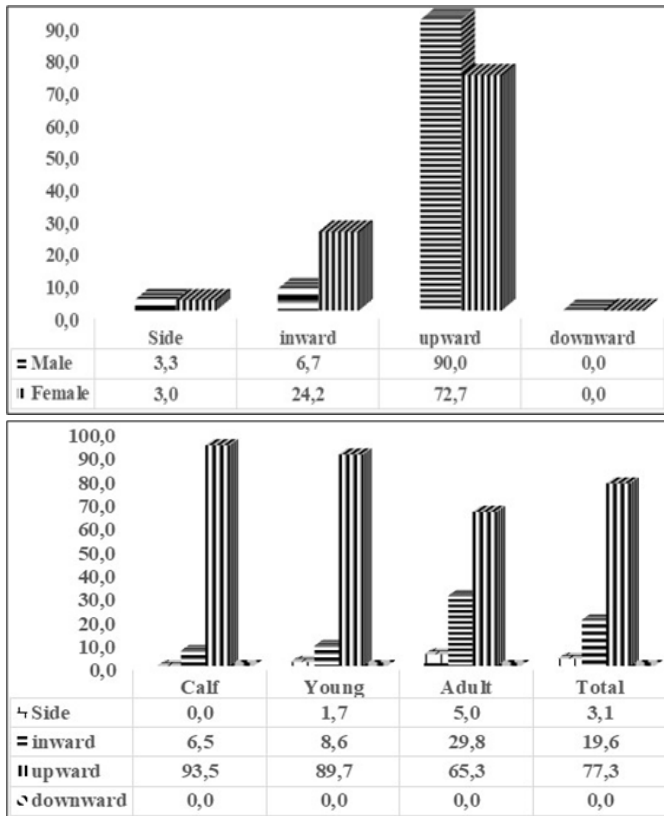


Figure 3. Shape/Direction of swamp buffalo horns in South Konawe Regency according to sex (left) and age structure (right)

The horns of the swamp buffalo obtained in this study predominantly point upwards with a percentage of 90.0% in males, 72.7% in females, the remaining horns point inward (back) with a percentage of 6.7% and 24.2% and point to the side. 3.3% and 3.0%. The results of this research are in line with the shape of the Lebak buffalo's horns pointing upwards at 78.00%, Pandeglang and Serang buffalo at 73.00% and 65.00% respectively. The shape of the horns curling backwards in Serang buffalo is 35.00%, Pandeglang 27.00% and Lebak buffalo 22.00% (Dudi et al., 2011). Yendraliza (2007) reported that the shape of buffalo horns in Kampar District was generally wide by 83.3% and semi-circular only 16.7%). The research results of Afista et al. (2021) found that the shape of the horns of swamp buffalo in Puriala District, Konawes Regency is predominantly circular to the back, namely 61.76%, the remainder is circular upwards with a small proportion.

Characteristics of Whorls

The number of whorls is the most prominent qualitative characteristic in buffalo. Generally, mud buffalo have unyeng-unyeng, but the number and location varies. Whorls, also known as hair whorls, are also a preference factor for selecting racing buffalo. The characteristics of hair vortices vary both from the location and direction of the vortices (Dudi *et al.*, 2011; Rombe 2010). Characteristics of whorls in swamp buffalo in South Konawe Regency according to gender and age can be seen in Table 1. Based on Table 1, it can be seen that the dominant whorls are located at the waist, reaching 73.3% (63.3% in males and 77.0% in females). Furthermore, the whorls found on the chest are around 27.1% (43.3% in males and 21.2% in females). The distribution of whorls based on age is relatively the same for young buffalo, young buffalo and adult buffalo. Karabu *et al.* (2021) reported that swamp buffalo in Puriala District had whorls on the head, back and waist as much as 38.89%), found on the back and waist 27.78%), found on the head and back as much as 22.22. %, and on the back it is 11.11%.

Furthermore, Karabu et al. (2021) that the location of whorls in swamp buffalo in Anggaberi District is mostly located on the head, back and waist as much as 56.25%, the rest is on the back and waist 12.50%, found on the head and back as much as 25%, and on the back only 6.25%. Meanwhile, the majority of buffalo whorls in Sampara District are found on the head and back of the buffalo, namely 66.67%, the remaining 16.67% are found on the back and waist and 16.67% are found on the head, back and waist.

Characteristics of Chevron

Chevron is a white stripe on the neck with a black base that resembles a ribbon. The collar line is one of the distinctive characteristics of swamp buffalo which is usually a character that is considered when selecting mud buffalo (Chantalakana and Skumun, 2002). There

are two forms of white necklace lines on the neck, namely single and double white necklace lines.

The presence of chevrons on swamp buffalo in South Konawe Regency based on gender and age can be seen in Table 1. Based on Table 1, it is known that the majority or 54.2% of buffalo in this area have single chevrons and 36.4% have double chevrons and only 9, The 3% that don't have a chevron. The chevrons on males and females are relatively no different. Dudi *et al.* (2011) reported that the highest frequency of double chevrons was in Lebak buffalo which reached 92.00%, while in Serang buffalo it was 85.00% and Pandeglang buffalo 88.00%. The frequency of single chevrons in Serang swamp buffalo is 15.0%, Pandeglang 12.00% and only 8.00% in Lebak swamp buffalo. The frequency of double chevrons in the overall subpopulation was (88.33%) while single chevrons were 11.67%.

The results of this study are not much different from Karabu et al. (2021) that 61.11% of swamp buffalo in Puriala District have double collar stripes, while only 27.78% of swamp buffalo have chevrons and 11.11% of swamp buffalo do not have chevrons. Swamp buffalo in Anggaber District have 75% double chevrons, while 25% have single chevrons, and there are no buffalo that don't have chevrons. Sampara District has 75% double chevrons and the remaining 25% has single chevrons.

IV. CONCLUSION

Based on the results of the research and discussion, it can be concluded as follows: (1) the skin color of swamp buffalo in South Konawe Regency is predominantly dark (black and dark grey) in both males and females (83.31%). The older the buffalo, the darker its skin color. Apart from that, there are albino buffalo, which indicates the existence of inbreeding in this population, (2) the stocking color is dominantly dark gray (85.3%), (3) the dominant shape/direction of

the horns is pointing upwards (77.3%), (4) the dominant whorls are found at the waist (73.33%), and (5) the dominant chevrons are single (53.68%). To overcome inbreeding, it is necessary to bring in bulls from outside the population and use them for a maximum of 3 years.

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