Morfometric Portrait of Swamp Buffalo in Bombana

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ABSTRACT

The aim of this study was to find a portrait of body weight and body size of swamp buffalo in mainland and islands of Bombana region. The parameters observed were: body weight, shoulder and hip height, body length, chest circumference and width of hips. Based on the results of the study concluded: (1) the average body weight of buffalo in the islands was 416.9±117 kg, significantly higher ($P<0.05$) compared with the mainland area which averaged only 377.3±100 kg, as well as the average hips width of swamp buffalo in island area was significantly higher ($P<0.05$) than in the mainland, (2) portrait of body measurement of swamp buffalo generally not significantly different ($P> 0.05$) between the mainland and island regions, except the size of the hips width in the island was significantly higher ($P<0.05$) than the mainland, (3) the main component identifier of the total diversity of buffalo body measurements in mainland area was body length (69.30%), while the island areas was chest circumference (73.50%).

Key Words: Buffalo, Body Weight, Body Measurement, Principal Component Analysis

INTRODUCTION

The ability of domestic meat production has not been able to meet the needs of meat for the national community recently. As a result, the government must import frozen meat and calves from abroad. Based on the BPS report (2014) cited by detik Finance (2015) informed that imported meat during last few years has increased. Imports of frozen meat and calves in 2008 amounted to 91.6 thousand tons with a value of $ 198.8 million US, in 2009 reached 110.2 thousand tons with a value of $ 266.6 million US, and in 2010 jumped to 140 thousand tons with value reached $ 395 million. Although since 2011 the volume of imports tends to be reduced, but the value of these imports are still high, which in 2011 amounted to US$ 321.4 million and 2012 reached US$ 156.1 million. Imports of beef cattle in 2014 as many as 760,000 head (consist of 3,794 head of cattle seed and cattle ready for slaughter as many as 693,756 head or the equivalent of 115.510 tons meat. Total imports of beef meat in 2014 were 200,794 tons (or 26.52 % of total demand).

The Government through the Ministry of Agriculture continues to strive to reduce or even stop the dependence on imported the meat through improving meat production capacity in the country, by launched a program "Indonesia Self-sufficiency in meat premises in 2014". Buffalo is one commodity that is expected to play an important role in supporting the achievement of self-sufficiency in meat. The Performance of buffalo production which is not much different from beef cattle and its existence that has been fused with the social, economic and cultural community is the reason why the buffaloes play an important role in improving the national meat production.

However, statistical data livestock last few years indicated a population fluctuations buffaloes in Indonesia. The population of buffaloes nationally in 2008 was 1,930,716 head, in 2009 was 1,932,927 head, and in 2010 was 1,999,604 head. In Year 2010 was the peak population of buffaloes in Indonesia, due in 2011 dropped dramatically to 1,305,078 head, and in 2012 as many as 1,378,153 head, with an average reduction of 7.2% per year (Direktortat General of Livestock and Animal Health, 2013).

Reduction of Buffaloes population also occurred in the Southeast Sulawesi. In 2008 the population of buffalo in the region totaled 7,078 in the tail, but in 2012 dropped to 2,677 head or an

average reduction of 15.5% per year (Directorate General of Livestock and Animal Health, 2013). While on the other hand, in rural buffaloes contribute a lot, both as a source of revenue and labor to cultivate agricultural land (Prawirodigdo and Utomo, 2010), as well as the savings that can be sold at any time to meet the needs of families.

Bombana is an area that has the largest buffalo populations in the Southeast Sulawesi. In 2011 the population numbered 709 head or covering 34.8% of the total population of 2,610 head of buffalo in the Southeast Sulawesi (Southeast Sulawesi BPS, 2012). Compared to 2010, the population of buffalo in this region experienced a decline of as much as 765 tails or 51.9% of the population in 2010 (BPS Bombana, 2013).

As a development area of buffalo, Bombana has specific characteristics. Development of buffaloes in the mainland area is in Poleang, especially in the District of South Poleang and Central Poleang. This area is located on a dry land savanna, but in which there are some spots that serve as the swamp buffaloes wallowing area. Bombana also has Kabaena Island which is one of the regions of buffalo development in this region. In 2010 buffalo in this region amounted to 225 individuals (Bombana BPS, 2011). The specific characteristics of Bombana region may be associated with the morphometric variability buffaloes in this region.

Morphometric character of buffaloes is basic information that is important and necessary not only in order to develop but also to preserve and maintain the genetic diversity of this animal. In addition, analysis of the total diversity of the primary identifier morphometric help rejuvenate fix all the characters, based on the character of the most widely drawing morphometric variability buffalo. The aim of this study was to record the variability of morphometric characteristics, and analyzed the main character identifier of buffaloes morphometric variability in the mainland and islands of Bombana region.

MATERIAL AND METHOD

This study was conducted in Bombana, which includes four districts, that is: 2 districts represent the land area (Poleang subdistrict South and Central Poleang) and 2 districts represent of the islands (Central Kabaena and North Kabaena). The location was determined by purposive research, ie the one that has the highest buffalo population in each region (mainland and islands of Bombana). Equipment used include: (1) digital scales for weighing the buffalo body weight, (2) a measuring stick to measure the height of the shoulder, hip height, hip width, and (3) measuring tape to measure the circumference of the chest and body length.

Observed Variables

Variables measured and how to measure the dimensions of the body to record the character's body size dimensions are as follows:

1. High shoulder (TP), the highest distance behind the shoulder through the scapula perpendicular to the ground was measured using a measuring stick, units in cm.
2. Chest Circumference (LID), measured just behind the scapula circular, using the measuring tape, the unit is in cm.
3. The length of the body (PB), straight-line distance from the edge of the spinous processus bone to bone bump layers (Os ischium), measured using a measuring stick, the unit cm.
4. High hip (TPI), the highest distance hips are perpendicular to the ground, measured using a measuring stick, units in cm.
5. Hip width (LPi), the distance between the hip joint widths, measured using a measuring tape, units in cm.

Data analysis

Morphometric character data such as body dimensions sizes are grouped by age and region development. Furthermore, the data were analyzed to obtain the mean, standard deviation, and

coefficient of variability based Walpole (1982), ie:

$$\overline{X} = \frac{\sum_{i=1}^{n} Xi}{n} \qquad s = \sqrt{\frac{\sum_{n-1}^{n} (Xi - \overline{X})^2}{n-1}} \qquad KK = \frac{s}{\overline{X}} \times 100\%$$

Remarks: $\bar{X}$ = mean of sample in group to-1
s = Standard deviation
$\bar{X}_i$ = volue to-i of x variable
n = number samples
CC = Variation Coeficient

To compare the inter-regional group of buffalo t-test is done by using the formula Walpole (1982) as follows:

$$t_h = \frac{(\overline{X}_1 - \overline{X}_2)}{\sqrt{\frac{\sum (X_{1j} - \overline{X_1})^2}{n_1(n_1-1)} + \frac{\sum (X_{2j} - \overline{X_{21}})^2}{n_2(n_2-2)}}}$$

Remarks: t_h = value of t
$\bar{X}_1$ = mean of sample in group to-1
$\bar{X}_2$ = mean of sample in group to-2
$\bar{X}_{1j}$= observation value to-j in first group
$\bar{X}_{2j}$ = observation value to-j in second group
n_1 = number of samples in group to-1
n_2 = number of samples in group to-2

Discriminant analysis performed in the variable: shoulder hight (TP), hip height (TPI), hip width (Lpi), body length (PB), and chest circumference (LingD). Furthermore, to provide discrimination to the body size and shape, will be Principal Component Analysis (PCA). PCA used to get the size and shape equations derived from the covariance matrix, with the model equations:
$Yp = a_{1p}X_1+a_{2p}X_2+....+a_{pp}X_p$

Remarks: Yp = principal components to-p
a_{1p} - a_{pp} = *Eigen*vector to-p, (p = 1,2,3, ...,n)
X_p = variable to-p, (p = 1,2,3…..n)

RESULTS AND DISCUSSION

The mean and standard deviation of body weight, body length, shoulder height, chest circumference, hip height and chest width according to age, sex and area of research can be seen in Table 1.

Body Weight

Quantitative trait that has important economic value in buffaloes is body weight, so it is always used as the main criterion in the selection. Portrait buffalo body weight according to age and sex on the mainland and island of Bombana region can be seen in Table 1 and Figure 1. Mean body weight of the buffalo of the islands was 421.9±117 (P <0.05) higher than the land area which averaged only 377.3±100 kg, with a coefficient of variability respectively were 27.77% for the land area (Poleang) and 26.54% for buffalo in Kabaena Island. While the male buffalo body weight was

generally lower than females, although not statistically significantly different (P> 0.05). Overall mean body weight of male buffalo in this experiment was 406.3 ± 96.9 kg and female was 391.9 ± 123.7 kg.

Table 1. Mean and standard deviation of body weight and body size dimensions of buffalo by age, gender and regional research in Bombana

Age	**Sex**	**Place**	**Body Weight (kg)**	**Body length (cm)**	Shoulder Height **(cm)**	Hip Height **(cm)**	Circum-ference **(cm)**	chest width **(cm)**
< 2	♂	Poleang	237±80	117±70	109±1	105±6	146±10	35±7
		Kabaena	257±36	132±17	112±9	109±8	145±27	37±7
	♀	Poleang	180±105	114 ±21	104±14	104±12	131±30	27.0±5
		Kabaena	226±55	121±5	107±11	108±11	140±8	33±11
	♂+ ♀	Poleang	191±97	121±44	107±14	105±15	145±35	28±6
		Kabaena	249±42	115±15	108±9	109±8	141±28	35±8
2 – 3	♂	Poleang	323±28	125±18	113±4	109±27	170±24	41±7
		Kabaena	335±80	140±18	119±6	114±10	180±23	43±03
	♀	Poleang	341±73	117±15	108±6	117±70	174±22	37±1
		Kabaena	344±91	130±21	112±13	119±12	180±19	46±8
	♂+ ♀	Poleang	354±62	126±20	101±5	117±18	176±23	39±7
		Kabaena	434±87	132±21	116±12	117±12	176±20	45±9
4 – 5	♂	Poleang	414±45	131±19	120±4	120±24	183±16	41±8
		Kabaena	473±66	144±21	129±8	126±10	194±28	47±3
	♀	Poleang	403±43	130±19	120±4	121±12	179±10	39± 4
		Kabaena	467±121	134±21	129±13	128±11	198±34	45±10
	♂+ ♀	Poleang	443±42	134±19	120±11	120±15	197±10	39±05
		Kabaena	450±103	132±21	128±11	129±11	181±31	46±6
> 5	♂	Poleang	470±29	156±23	128±5	126±6	202±9	46±4
		Kabaena	504±35	165±5	130±6	128±6	210±8	53±9
	♀	Poleang	445±39	145±10	128±3	126±4	188±12	44±5
		Kabaena	495±34	160±13	129±6	131±7	207±9	50±8
	♂+ ♀	Poleang	457±36	161±13	128±4	126.6	195±13	39±4
		Kabaena	501±34	156±12	131±6	130.6	208±9	54±8
Total	♂	Poleang	389±68	135±32	123±6	122±23	190±21	40±6
		Kabaena	424±121	149±22	117±10	116±11	176±31	44±9
	♀	Poleang	365±111	130±21	120±10	121±12	178±27	36±7
		Kabaena	418±110	142±21	125±12	124±12	187±29	48±10
	♂+ ♀	Poleang	377±100	133±31	121±9	121±16	182±25	38±9
		Kabaena	416±117	145±22	122±12	121±12	183±30	47±10

Remarks: Data processed

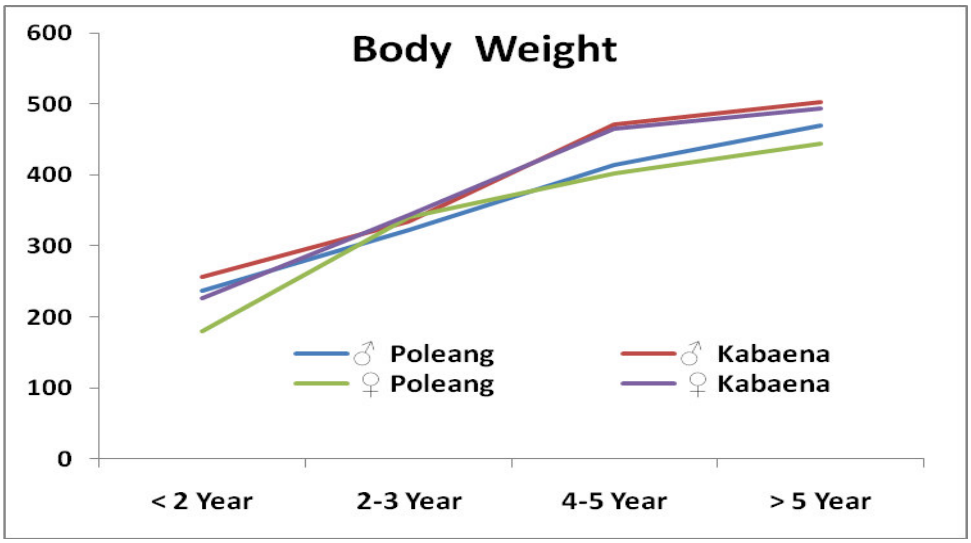


Figure 1. Buffalo body weight by different age and sex in the mainland and island of Bombana.

Based on the information breeders in this region of high male buffalo weighing generally preferred buyers and they are willing to pay a high price. The higher body weight and better body condition male buffalo, the higher of resale value. As a result, male animals with high performance will sold quickly, while having less performance maintained and produce offspring.

The high sales figures in the male buffalo Bombana supposed to influence the decrease in the average weight of the male animals. Male buffalo experiencing negative selection, thereby decreasing the genetic quality. Robbani et al. (2010) reported a similar situation in the swamp buffalo in Bogor Regency, and concluded that in general female buffalo in District Cibungbulang, Pamijahan, Nanggung and Sukajaya have a greater tendency than male buffalo.

Buffalo body weight over 2 years of age in this study (421±42 kg for males and 405±103 for females) was relatively not much different from Chantalakhana and Skunmum (2002) that buffalo swamp adults aged 4-5 years on average is 450 to 650 kg for male buffalo and 350 to 450 kg for female buffalo, the adult age range from 4 to 5 years. Similarly, when compared with the buffalo in Thailand that have adult body weight 350 to 650 kg (Chantalakhana and Skunmum, 2002), it was not much different from buffalo in Bombana, even has a higher weight than the swamp buffalo in China ie 250 kg, and Mianmar about 300 kg (Shackleton and Harestad, 2003).

Body Length

Research in the field of livestock breeding, especially in characterizing ruminants always include body length to the quantitative trait group. These characters include the traits of high economic value. Portrait of buffalo body length based on age and sex in Bombana mainland and island regions can be seen in Table 1 and Figure 2.

Male buffalo has body length which is relatively higher than females, especially after the age of adulthood, although it was not statistically significantly different (P> 0.05). Under 2 years of age, female buffalo in Poleang has average body length 113±70 cm and 132±17 cm at Kabaena, while female was 114±21cm in Poleang and 121±51 cm in Kabaena Island. At the age of 2-3 years of age, male buffalo has a body length 125±18 cm in Poleang and 140±18 cm in Kabaena, whereas females 117±15 cm in Poleang and 130±21 cm in Kabaena. In 4-5 years of age, male buffalo has a body length 131±19 cm in Poleang and 144±21cm in Kabaena, whereas females 130±19 cm in Poleang and 134±21 cm in Kabaena, buffalo aged over 5 years have a body length in males, 156±23 cm in Poleang and 165±5 cm in Kabaena, whereas females 145±10 cm in Poleang and 160±13 cm in Kabaena. In general, male buffalo has body length 144.61±31.14 cm with Variance Coefficient (VC) is 21.72%, longer than the female buffalo that only 130.45±23.37 cm with VC is 17.91%.

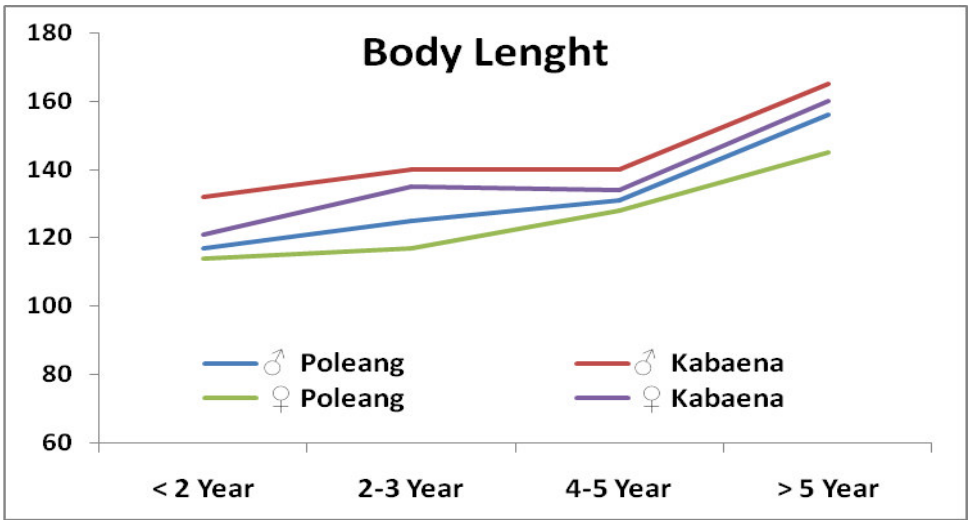


Figure 2. Buffalo body length by different age and sex in the mainland and island of Bombana.

In general, buffalo in mainland has body length 133.15±31.01 cm with VC 23.29%, shorter than in Kabaena islands that is 137.51±21.97 cm by VC 15.98%, but statistically not significantly different (P> 0, 05). Body length of Bombana swamp buffalo in this study was 134.00±27.39 cm, higher than the adult swamp buffalo in Bogor Regency, which is between 121.90 to 130.3 cm (Robbani et al., 2010), local buffalo in Brebes, ie 106.00±13.07 cm (Muhammad and Kusumaningrum, 2006), and the swamp buffalo of Sumbawa that has a mean value and standard deviation of 103.6±6.1 cm (Anggraeni and Triwulanningsih, 2007).

Shoulders High and Hips High

High shoulder and hip height is a measure of body dimensions that frequently used as selection criteria in large livestock such as beef cattle and buffalo. Together with other body dimensions sizes (chest circumference and body length), both parameters can be used to predict body weight, especially in rural areas that do not allow direct weighing. Livestock body dimensions are very important to know because it directly weighing often not possible because the animal/livestock scales are not available (Siregar et al., 1996).

Shoulders Hight

According to Santosa (1983), data chest circumference, body length and shoulder height can be used to estimate the live weight of the buffalo. The mean and standard deviation of buffalo shoulder height according to age and sex on the mainland and islands Bombana Region can be seen in Table 1, while the body length portrait of a buffalo by sex, age and Bombana Region development of buffalo can be seen in Figure 3.

Mean and standard deviation of the shoulder height of Bombana buffalo was 121±10 cm. Buffalo in mainland and the islands have relatively high at the shoulder that is 121±9 and 122±12 cm. By sex, male buffalo relatively has higher shoulder than females, ie 122±11 cm for males with VC is 7.40% and 120±9 cm in females with VC is 9.42%.

The mean hip height of Bombana swamp buffalo relatively similar to the height of swamp buffalo in Bogor, which is between 113-126 cm (Robbani et al., 2010), and tend to be higher than the swamp buffalo in Bradford as reported by Muhammad and Kusumaningrum (2006) with an average of shoulder height were 113.2±28.20 cm. The results of this study also relatively similar to the result reported by Triwulanningsih et al. (2004) that the average height of adult buffalo shoulder in West Java is 122 cm and 123 cm from Central Java, and Banten Province is 120 cm. However, the results of this study is lower than the results of research Chantalakhana (1981) that found that adult swamp buffalo in Indonesia have an average height of 127-130 cm for males and 124-125 cm buffalo buffalo females. However, body height and shoulder height buffalo Bombana lower compared with

salvation Borneo swamp buffalo, ie male is 135 cm and 130 cm in females, and also lower than the swamp buffalo Banten province to the male sex in 3 districts ie Serang samples 129.67 cm, 129.79 cm Pandeglang and Lebak regency 130.59 cm (Dude et al., 2011). Furthermore, it is stated that the female shoulder height row is 118.88 cm; 119.20 cm and 118.90 cm.

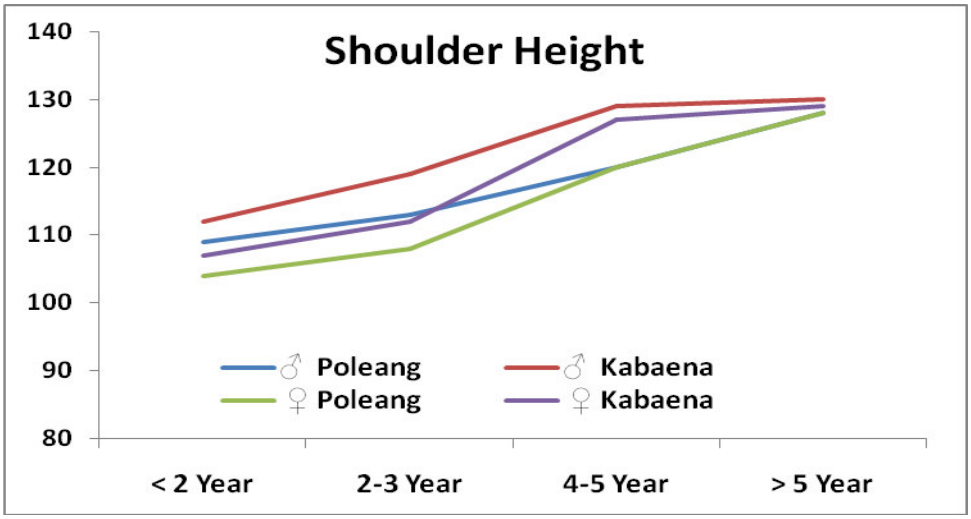


Figure 3. Buffalo shoulder height by different age and sex in the mainland and island of Bombana region.

Hips Height

Portrait of buffalo hip height based on age and sex on the mainland and island regions Bombana can be seen in Table 1 and Figure 4.

Increasing age was followed by an increase in the size of cattle hip height, especially before adulthood. At the age of less than 2 years, the average hip height in Bombana buffaloes was 109±15 cm for males with VC is 13.89% and 108±8 cm for females with variability coefficient is 7.33%. Age 2-3 years increased to 117±18 cm for males with VC is 15.38% and 117±12 cm for females with VC is 10.26%. Age 3-4 years have hip height 125±15 cm for males with VC 12.00% and 120±11 cm for females with variability coefficient 9.17%. While the above 5 years of age, respectively 126 ± 6 cm for males with variability coefficient 4.76% and 130 ± 6 cm for females with VC is 4.62%. Buffalo males tend to have size hips average height 122 cm with VC is 15,37% higher than females 118 cm with VC is 9.85%.

Buffaloes in Bombana mainland area have relatively high hip which is equal to the islands (Kabaena Island), those are 120.9±16.42 cm with VC is 13.58% and 120.98±12.03 cm with a coefficient of variability is 9.94%. When compared with the hip high swamp buffalo in South Tapanuli which range from 119.07-135.82 cm for males to 117.42-135.82 cm for males (Kampas, 2008), then both are relatively not much different, except with that buffalo is on site Sibuhuan (135.82 cm), the results of this study were lower. However Bombana buffalo shoulder height is slightly lower than the swamp buffalo in North Sumatra, ie 125.56 cm (Sitorus, 2008), and swamp buffalo Dompu in West Nusa Tenggara, i.e. an average of 123.03 cm (Erdiansyah, 2008).

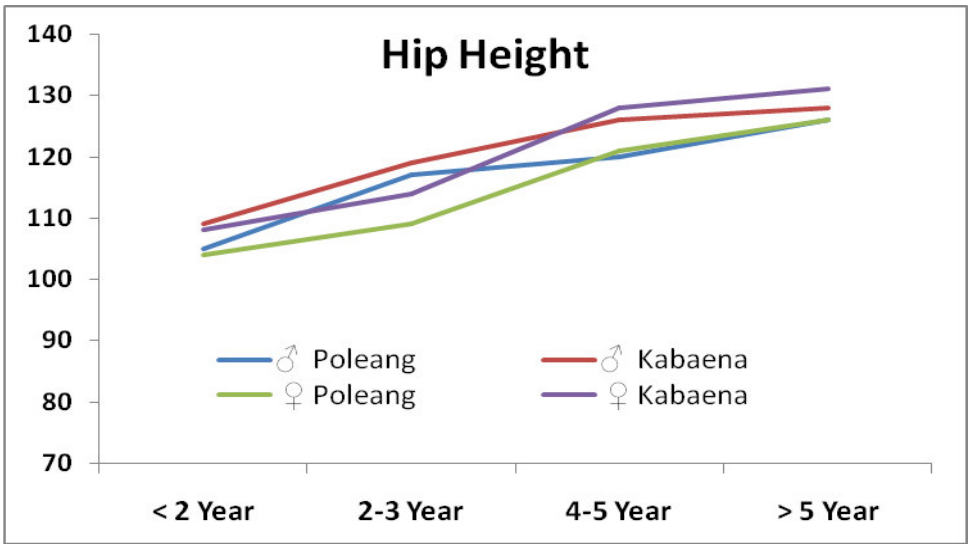


Figure 4. Buffalo Hip height by different age and sex in the mainland and island Bombana.

Chest Circumference

In most ruminants, chest circumference size is the best method to predict the body weight, so it is often used as one of the selection criteria. Anggraeni and Triwulanningsih (2007) found that chest circumference is a predictor of body weight on buffalo Sumbawa highest determination coefficient of 68.7% and the regression equation is Body Weight = -390 + 4.112 chest circumference. Portrait buffalo chest circumference based on age and sex on the mainland and island of Bombana region presented in Table 1 and Figure 5.

The average chest circumference of swamp buffalo Bombana was 183±28 cm with a coefficient of variability of 15.30%. Buffalo chest circumference at the Kabaena islands was 183 ± 30 cm that likely to be higher than in Poleang that only 182 ± 25 cm. In addition, seen of sex, male buffalo have an average chest circumference of 183±27 cm with VC was 14.66%, higher compared with females only 182±28 cm with VC was 15.51%, but a statistically significant difference in the development region and sex were not significantly affected (P> 0.05) to swamp buffalo chest circumference (Table 1).

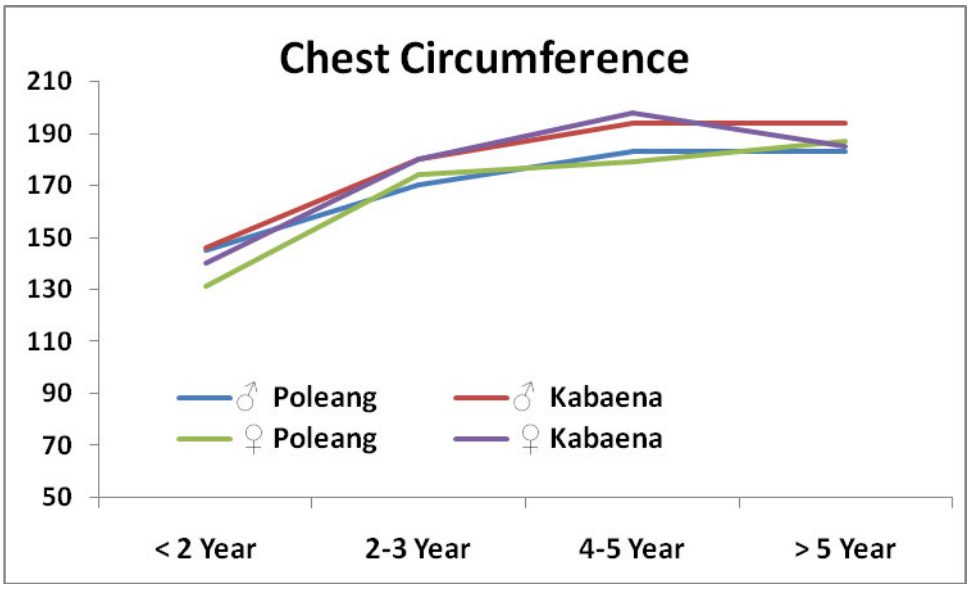


Figure 5. Buffalo chest circumference by different age and sex in the mainland and islands Bombana

Buffalo chest circumference at Bombana was increase with increasing of age. Buffalo over 2 years of age has the average chest circumference that is 182.89±26.82 cm for males with VC is 14.66% and 182.33±28.28 cm for famales with VC is 15.51%. The results obtained in this study was higher than the swamp buffalo Brebes reported by Anggraeni and Triwulanningsih (2007) ie only 171.7±8.8 cm, and male swamp buffalo in Banten Province ie 172.81±5.36 cm to Serang, 170.31±4.47 cm to Pandegrlang and 172.81±5.36 cm for the district of Lebak (Dudi et al., 2011).

Hips Width

Growing age the greater the size in width hips. The mean width of the hips of Bombana swamp buffalo was 37.65±6.86 cm for the mainland (Poleang) were significantly (P<0.05) lower than the buffalo in Kabaena island 47.10±10.00 cm. Age increasing age was followed by increasing in size of buffalo hip width (Figure 6).

The mean of width hips on Bombana swamp buffalo obtained in this study was 42.10±9.69 cm, which is higher than the swamp buffalo in South Tapanuli that only about 27.16 to 33.13 cm in males and from 26.84 to 33.13 cm in females (Rampas, 2008). Similarly, when compared with the results of the research by Erdiansyah (2008) on swamp buffalo in Dompu West Nusa Tenggara that is 35.86 cm, but lower than the results of the research Sitorus (2008) on swamp buffalo in North Sumatra with an average width of hips is 48.59 cm.

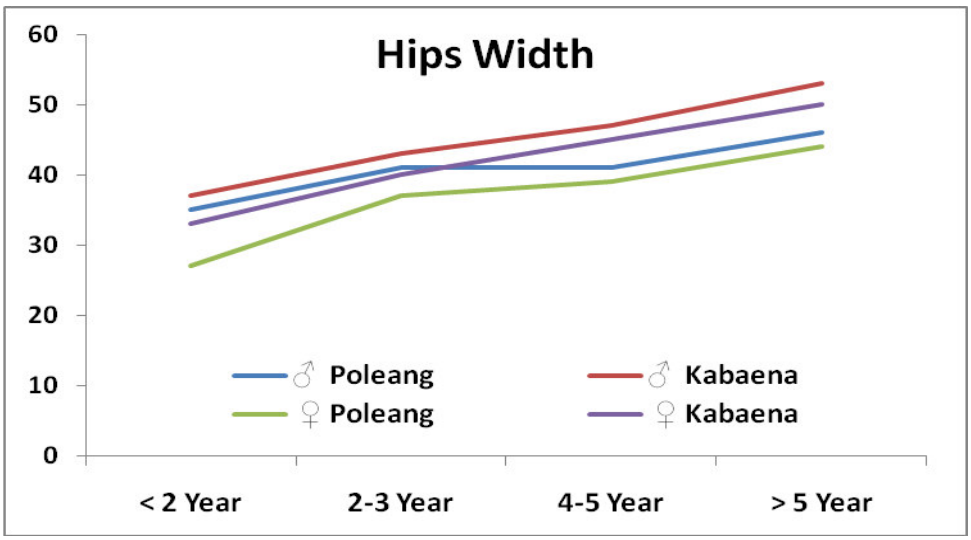


Figure 6. Buffalo Width Hips by different age and sex in the mainland and island Bombana

Principal Component Analysis

Principal Component Analysis (PCA) is used as a determinant of discrimination between cattle populations. In morphometric application of PCA, Principal Component I is an eigenvector size, while the second main component is an eigenvector form (Pangestu and Mulyono 1996). Body size variable that has the highest value in the equation Eigenvector body size variable identifier used as body size, body size as well as variables that have the highest Eigen vector values in equation form used as variable identifier body shape.

CA results in the form of equation size and shape of the body, the total diversity (KT), and Eigen value (λ) buffalo (mixed sex) in the mainland and islands Bombana presented in Table 2.

Body Size

Results of principal component analysis (Table 2) showed that the value of the highest Eigenvector in equation buffalo body size in Bombana mainland area present in body length (0,768X4). While the value of the highest eigenvectors in equation of buffalo body size in Bombana island areas found on the circumference of the chest (0,739X3).

Table 2. Equation body size and shape, and the total diversity Eigen values of buffalo (mixed sex) in the mainland and islands of Bombana

Place	PC	Equation	TV (%)	Λ
Mainland Area	Body size	$0,182X_1 + 0,045X_2 + 0,554X_3 + \mathbf{0,768X_4} + 0,212X_5 + 0,095X_6 + 0,102X_7 + 0,057X_8$	69,30	1.380,60
	Body shape	$0,161X_1 + 0,078X_2 + \mathbf{0,686X_3} - 0,632X_4 + 0,307X_5 + 0,041X_6 + 0,042X_7 - 0,001X_8$	16,10	320,10
Kabaena Island	Body size	$0,257X_1 + 0,197X_2 + \mathbf{0,739X_3} + 0,462X_4 + 0,251X_5 + 0,210X_6 + 0,165X_7 + 0,036X_8$	73,50	1.532,30
	Body shape	$-0,167X_1 + 0,166X_2 + 0,236X_3 - 0,544X_4 - 0,219X_5 + 0,091X_6 + \mathbf{0,730X_7} + 0,059X_8$	12,70	264,80

Remarks*:* PC= Principal Component, TV = Total Variability, X_1 = Shoulders height, X_2 = chest width, X_3 = chest circumference, X_4 = body length, X_5 = Hip height, X_6 = Hop width, X_7 = Head lenght, X_8 = head height.

Based on the highest Eigen vectors value on equality body size, then the variable identifier buffalo body size in Bombana mainland area was body length (X4), while the variable identifier buffalo body size in Bombana island areas was chest circumference (X3). The existence of differences in body size identifier in both populations indicate that these buffalo that living and growing in the land area was genetically different from the buffalo in Bombana island areas. Such differences may also be influenced by differences in environmental conditions. Tzeng et al. (2000) stated that the presence of morphometric variation of a population at different geographical conditions may be caused by differences in the structure of genetic and environmental conditions.

Identifier the size of the body of a buffalo in the mainland and in the islands of Bombana region contrast to Sembiring et al. (2013) report which states that the identifier body size swamp buffalo in Karo is hip hight for the District Munte shoulder, hip height for the District Kabanjahe is and chest width for the District Mardingding. However identifier body size buffalo in Bombana island areas was the same to report by Saroji et al. (2010) which states that the body size variable identifier Sajira and buffaloes in the district and Padeglang Cibadak Lebak district of Banten Province is chest circument.

Eigen value of the first main component (vector size) buffalo in Bombana mainland area was 1380.60 with total value of diversity vector size by 69.30%. It was mean that the total diversity of all the variables body size buffalo in this area, amounting to 69.30% could be explained by the first main component (body length) which is a variable identifier buffalo body size in mainland area Bombana. While the eigenvalues of the first main component (vector size) of buffalo at Bombana island areas was 1532.30 with a total value of diversity vector size was 73.50%. It was mean that the total diversity of all the variables body size buffalo in this area, amounting to 73.50% could be explained by the main component I (chest circumference) which is an identifier variable body size buffalo in Bombana island areas.

Body shape

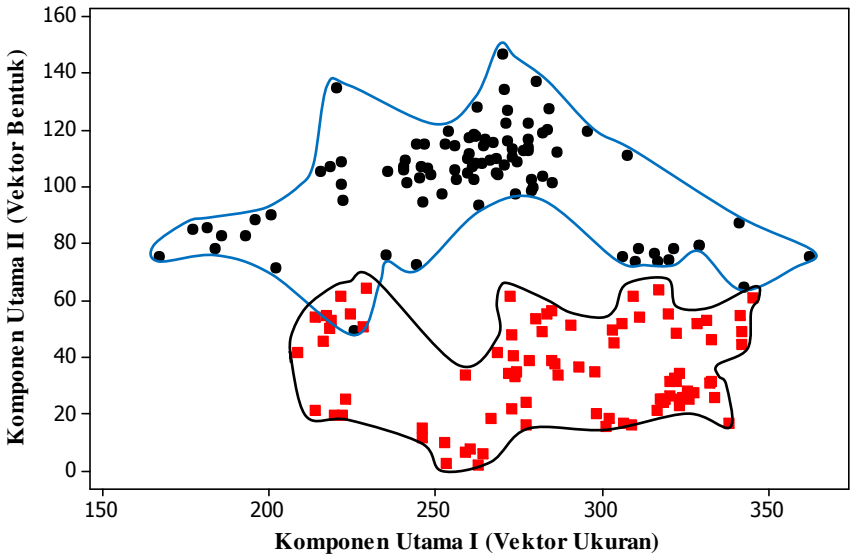
Results of principal component analysis (Table 24) showed that the value of the highest eigenvectors in equation buffalo body shape in Bombana mainland area found on chest circumference (0,686X3). While the value of the highest eigenvectors in equation buffalo body shape in Bombana island areas found on the long head (0,730X7). Based on the highest Eigen value equation vector shape, then the variable identifier in the shape of buffalo body in Bombana mainland area was chest circumference (X3) and the variable identifier buffalo body shape in the islands was head length (X7).

Identifier buffalo body shape in the mainland and in the islands region Bombana in this study was different from the report by Sembiring. al., (2013) which states that the shape identifier of buffalo in Karo is high hip for the District Mardingding, wide chest for the District Kabanjahe and in

the chest for the District Munte. Identifier buffalo body shape (mixed sex) in mainland area equal to the identifier Bombana body shape female buffalo in District Cibadak and District Lebak and Pandeglang of Banten province (Saroji at al., 2010), while the buffalo body shape identifier (mixed sex) in the Bombana islands region (body length) equal to the identifier body shape male buffalo in District Sajira Lebak district of Banten province and Pandeglang (Saroji at. al., 2010).

The main component II Eigen values (vector shapes) in the mainland buffalo Bombana at 320.10 with a total value of diversity vector size was 16.10%. It was mean that the total diversity of all the variables body size buffalo in this area, only amounted to 16.10% could be explained by the major component II (chest circumference) which is an identifier variable shape buffalo in Bombana land area. While the eigenvalues of the second main component (vector shapes) buffalo at island areas of Bombana was 264.80 with a total value of diversity vector size was 12.70%. This means that the total diversity of all the variables body size buffalo in this area, only amounted to 12.70% could be explained by the principal component II (long head) which is a variable identifier in the form of body size buffalo Bombana island region.

The cumulative value of the diversity of the main components I (vector size) and the main component II (vector shape) body buffalo in mainland area reached 85.30% Bombana. It was mean that the total diversity of all variable- ukuran tubuh size buffalo male body size in land area Bombana of 85.30% could be explained by two main components. While the diversity of the cumulative values of the main component I (vector size) and the main component II (vector shapes) at island areas, body of Bombana value reached 86.20%. It was mean that the total diversity of all variable-size buffalo body size in island areas Bombana was 86.20% could be explained by two main components. The size and shape of the body diagram buffalo (mixed sex) in the mainland and islands of Bombana presented in Figure 4. It could be seen that the score data vector crowd buffalo body size in island areas tend to be on the score value greater than the buffalo in Bombana land area. The difference in the value of the score vector body size between the two populations of buffalo is also reflected by differences in body weight. The average weight of buffalo (mixed sex) at island areas reached 456.58 ± 113.64 kg (n = 86), whereas in the mainland only reached 378.18 ± 97.70 kg (n = 95). However, in Figure 6 showed that the distribution of score data vector shape buffalo in land area explicitly different from Bombana island areas. Buffalo in land area had a score vector form using large body more than in Bombana island areas.



Remarks: ● = Mainland area; ■ = Island area

Figure 6. Diagram of body size and shape of buffalo in Bombana district.

Based on the results of principal component analysis concluded that the dimensions of the body (morphometric) buffaloes in land area explicitly different from Kabaena island areas, which is indicated by the size of the identifier and the identifier of different body shapes including mean different body weights. Morphometric character differences in the two populations of buffalo in Bombana allegedly attributed to differences in environmental conditions and maintenance management between mainland and island regions. The survey results indicate that the buffalo in land area Bombana maintained by means of detachable continuously on pasture with arid soil conditions (Figure 5), so availability is limited and forage in the dry season farmers were having trouble finding a source of water. Supplementary feeding to the buffalo in this area was also not done. At certain times such as when there were vaccination services from local farm workers, the buffalo were herded by motorcycle to the paddock which is not far from the location of pastureland. Buffalo grazing in this area conducted jointly with the cattle, so that there was competition between buffalo and cattle to obtain forage, while pasture forage conditions are very limited. In addition, access to the location of pasture land in the area is very open because it is located on the edge of the highway, thereby disrupting buffaloes.

Breeding of buffalo in the island area was not much different from the mainland area by means of continuously released, but the environmental conditions of both areas were very different. The pasture soil condition in the island area was quite fertile that enough forage available (Figure 6). Similarly, water resources were available even in the dry season. In addition, the location of buffalo grazing in the island areas was quite far from the highway so it did not interfere with vehicle traffic noise.

(a) (b)

Figure 7. Pasture conditions in Bombana (a) mainland and (b) island areas

CONCLUSION

Based on the results and discussion, it can be concluded as follows: (1) portrait of body weight of swamp buffalo in mainland region significantly lower than the island areas (Kabaena island) with a high variation, which is 23.73% in males and 29.60% in female buffalo, (2) portrait of body measurement in the Bombana swamp buffalo generally not significantly different ($P>0.05$) between the mainland and island regions, except the hip width, (3) the main component identifier of buffalo body measurements diversity in mainland area was body length, which is 69.30% and the island areas was chest circumference in the amount of 73.50%.

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REFERENCES

Anggraeni, A. dan E. Triwulanningsih. 2007. Keragaan bobot badan dan morfometrik tubuh kerbau Sumbawa terpilih untuk penggemukan. Seminar dan Lokakarya Nasional Usahaternak Kerbau. hlm. 124-131.

BPS Kabupaten Bombana. 2013. Kabupaten Bombana Dalam Angka Tahun 2012. Biro Pusat Statistik Kabupaten Bombana, Kasipute.

BPS Sulawesi Tenggara. 2012. Sulawesi Tenggara Dalam Angka Tahun 2011. BPS Sultra Kendari

Chantalakhana, C . 1981. A Scope on buffalo breeding. Buffalo Buletin. 4(4): 224-242.

Chantalakana, C, and P. Skunmun. 2002. Sustainable smallhoder animal systems in the tropics. 1 Edition, Kasetsart University Press. Bangkok.

Direktorat Jenderal Peternakan dan Kesehatan Hewan. 2014. Statistik Peternakan. Direktorat Jenderal Peternakan dan Kesehatan Hewan, Kementerian Pertanian Republik Indonesia, Jakarta.

Dude, C. Sumantri, H. Martojo, dan A. Anang. 2011. Keragaan sifat kualitatif dan kuantitatif kerbau lokal di Propinsi Banten. Jurnal Ilmu Ternak. 11(2): 61-67.

Erdiansyah, E. 2008. Studi Keragaman Fenotipe dan Pendugaan Jarak Genetik antar Kerbau Lokal di Kabupaten Dompu Nusa Tengggara Barat. Skripsi. Fakultas Peternakan. IPB, bogor.

Kampas, R. 2008. Keragaman fenotipik morfometrik tubuh dan pendugaan jarak genetik kerbau rawa di Kabupaten Tapanuli Selatan Propinsi Sumatera Utara. Skripsi. Program Studi Teknologi Produksi Ternak Fakultas peternakan Institut Pertanian Bogor

Muhammad, Z. dan D.A. Kusumaningrum. 2006. Penampilan produkti ternak kerbau lumpur (Bubalus bubalus) di Kabupaten Brebes Jawa Tengah. Seminar Nasional Teknologi Peternakan dan Veteriner. Bogor, 12–13 September 2005. Puslitbang Peternakan. Bogor.

Prawirodigdo, S. and B. Utomo. 2010. Profile of the agriculture and plantation industries byproducts potential for livestock feed on the high beef cattle population area in Central Java. Pros. Seminar Nasional Ruminansia 2010. Semarang, 6 Oktober 2010. Fakultas Peternakan Universitas Diponegoro, Semarang.

Robbani, A. R., Jakaria, dan C. Sumantri. 2010. Karakteristik fenotipik kerbau rawa di Kabupaten Bogor (Phenotypic Characteristic of Swamp Buffalo in Bogor District). Seminar dan Lokakarya Nasional Kerbau 2010. hlm. 49-56.

Santosa, D. 1983. Korelasi antara lingkar dada, panjang badan dan tinggi gumba dengan berat hidup kerbau di pasar ternak Banjarnegara. Ringkasan Hasil Penelitian DP3M Dirjen Pendidikan Tinggi Departemen Pendidikan dan Kebudayaan. Jakarta.

Sariubang, M. D. Pasambe dan A. Ella. 2003. Kajian Reproduksi dan Produksi Kerbau Lumpur di Kabupaten Tana Toraja Sulawesi Selatan. Prosiding Seminar Nasional Teknologi Peternakan dan Veteriner, Pusat Penelitian dan Pengembangan Peternakan. hlm. 60-63.

Saroji, R.E. Sitompul, Jakaria dan C. Sumantri. 2010. Karakteristik ukuran tubuh kerbau rawa di Kabupaten Lebak dan Pandeglang Provinsi Banten. Pros. Seminar dan Lokakarya Nasional Kerbau. Lebak, 2-4 November 2010. Puslitbang Peternakan, Bogor. hlm. 36-48.

Sembiring, F., Hamdan dan E. Mirwandhono. 2013. Analisis morfometrik kerbau lumpur (*bubalus bubalis*) Kabupaten Karo Sumatera Utara *(morphometric analysis of swamp buffalo (Bubalus bubalis*) *Karo District North Sumatra.* J. Peternakan Integratif. 1(2): 134-145.

Shackleton D, Harestad A. 2003. Bovids, Buffaloes and Bison. Di dalam: M. Hutchins, editor. Grzimek's Animal Encyclopedia. Ed ke-2. Farmington Hills: Gale groups.

Siregar, A. R, K. Diwyanto, E. Basuno, A. Thalib, T. Sartita, R.H. Matondang, J. Bestari, M. Zulbadri, M. Sitorus, T. Panggabean, E. Handriwirawan, Y. Widiawati dan N. Supriyatna. 1996. Karakteristik dan konservasi keunggulan genetik kerbau di Pulau Jawa. Buku 1: Penelitian Ternak Ruminansia Besar. Balai Penelitian, Ciawi. Bogor.

Triwulanningsih, E., Subandriyo, P.Situmorang, T.Sugiarti, R.G. Sianturi, D.A., Kusumaningrum, I Gede Putu, P. Sitepu, T. Panggabean, P. Mahyudin, Zulbardi, S.B. Siregar, U.Kusnadi, C. Thalib dan A. R. Siregar. 2004. Data base kerbau di Indonesia. Laporan Penelitian.Balitnak, Ciawi. Bogor

Walpole, R. 1982. Pengantar Statistika. Terjemahan: B. Sumantri. P.T.Gramedia, Jakarta.

Tzeng, T.D., Chiu, C. S,. Yeh, S. Y., 2000. Morphometric Variation in Redspot Prawn (*Metapenaeopsis barbata*) in Defferent Geographick Waters of Taiwan. Institute of Oceanography, National Taiwan University. Taypei 106, Taiwan ROC.