Body weight and morphometrics of Bali cattle at people breeding station and non breeding station areas

S Garantjang¹, A Ako¹, S Syawal¹, F N Yuliati¹, M Hatta¹ and C Talib²

¹Faculty Of Animal Husbandry, Hasanuddin University, Makassar, Indonesia. 
²Research Institute Of Animal Production, Ciawi-Bogor, Indonesia.

E-mail: garantjang@ymail.com

Abstract. People Breeding Station is a Bali cattle breeding installation that was established by the Livestock Services of Bone Regency to maintain perform preservation breeding stock of Bali cattle. The research aims to analyze the differences body weight and morphometric of Bali cattle at different age groups in the area of People Breeding Station (PBS) and Non People Breeding Station (NPBS). The total number of measurable Bali cattle was 204 heads each consisted of 96 male and 108 females from PBS and NPBS. Mean and standard deviation of body weight Bali male cattle at PBS was significantly higher (p<0.01) than body weight of cattle at NPBS of the same age groups. Mean and standard deviation body weight male cattle mature (2.6-3.0) years in PBS is 246.58 ± 34.54 kg and in NPBS 187.17±21.67 kg. Mean and standard deviation body weight of Bali female cattle at PBS significantly (p<0.01) higher than in NPBS for age 0.1-1.0 and 1.1-2.0 years group but body weight for 2.1-3.0 and 3.1-4.0 years groups in PBS non significantly (p>0.05) than in NPBS. Mean and standard deviation body weight of Bali female cattle age 3.1-4.0 years in PBS is 216.46 ± 32.87 kg and in NPBS isw 198.85±5.32 kg. All of morphometrics data was found that such as body length (BL), shoulder height (SH) and chest circumference (CC) of Bali cattle increased with the age advancement. Morphometrics of Bali cattle for age less than 3 years in PBS significantly (p<0.01) higher than Bali cattle in NPBS. In conclusion, the body weight and morphometrics of Bali cattle at PBS was higher than those at NPBS.

1. Introduction
In the last decade a lot of research has been carried out on local cows that have not been well known but have bright economic potential in the future. Research on body weight and morphometric characteristics of local cattle has been reported [1] in Red Chittagong cattle, [2] in local cattle Syhlet districk, [3] in Tanzanian cattle Shorthorn Zebu, [4] in Deoni cattle cattle breed of India, [5] in Ongole Inbrreeding cattle in India and [6] in local Bangladesh cattle. Bali cattle are a breed of Indonesia cow that is not so well known in the world, their body weight is low, but they have high genetic potential in the future. Bali cattle can be integrated well with the areas of rice fields, plantation pasture and small farmer. The condition of the Indonesian territory that has a variety of forages in the form of grasses, legumes, shrubs and trees is a good source of feed and is compatible with Bali cattle because it is not a pure grazer (actual grazer) but rather browser that feeds diverse kinds of forage [7]. Bali cattle have a high reproductive capability, high percentage of carcass...
more than 50%, low fat content of meat, high positive heterosis [8-10]. Contributions of Bali beef to red meat consumption in Indonesia amounted to 26.92% [11] in comparison to other cattle breeds in Indonesia.

Growth rate under small holder farming with average daily weight gain is 0.50 kg/head/day [12]. In fattening by utilizing feed material of the palm oil industry wastes its daily weight gain can reach 0.8 kg/head/day [8, 13, 14]. Bone and Barru regency the purity level should be maintained because it is one of the preservation areas of Bali cattle outside of Bali Island. Therefore, the phenotype and genotype of Bali cattle needs to be pursued for maintaining its purity from cross breeding with taurine and zebu crossbred. The government's policy to preserve the germ plasma of indigenous livestock for example Bali cattle and also other local breeds should be supported, especially in the area of nature reserves and applied breeding plan for pure breed. One of the government's efforts to preserve and improve the purity of Bali cattle is by involving the community directly by establishing the People Breeding Station (PBS) at Lampoko District of Barebbo, Bone Regency in 2008. The cow in PBS at Lampoko has so far amounted to the heads with an average annual increase of cattle. This research is important as partial efforts to determine the extent of the changes in the body weight and morphometrics (shoulder height, body length and chest circumference) of Bali cattle at PBS in particular and Bali cattle in Bone regency in general by comparing the appearance of Bali cattle traditionally kept outside the breeding station (NPBS). While the dimensions of the body (shoulder height, body length and chest circumference) are very important because it is a standard criteria of breeding stock. The aim of the study is to determine the phenotypic diversity of Bali cattle in the region of People Breeding Station (PBS) and Bali cattle herds of the small farmers around it or non People Breeding Station (NPBS).

2. Materials and Methods
The study was conducted at the farmer group at People Breeding Station (PBS) of Bali cattle area at Lampoko and precisely at Non People Breeding Station (NPBS) of Bali cattle of farmer group at Mallari, Bone Regency, South Sulawesi, Indonesia. PBS is the center for Bali cattle breeding, where the farmers of this area get guidance and direction from the local government of the Animal Husbandry Office regularly with semi-intensive livestock system, while NPBS is a community farm that does not get guidance from the livestock service continuously (traditional farming).

The weight and morphological measurements were taken from Bali cattle farmer group of PBS 102 heads and the cattle of NPBS 102 heads. A total of 4 age groups at 0.5 year interval for male wherever 1.0-1.5, 1.6-2.0, 2.1-2.5 and 2.6-3.0 years, and 1 year interval for female wherever 0.6-1.0, 1.1-2.0, 2.1-3.0 and 3.1-4.0 years. The cattle studied consist of 96 males aged between 1.0 and 3.0 years, each in PBS 48 heads and 48 heads in NPBS divided in 4 different age group at 0.5 years were considered and females as many as 108 heads aged between 1 and 4 years each in 54 heads in PBS dan 54 heads in NPBS, a total of 4 different age group at 1.0 year were considered. Electronic scales were used to measure body weight and measuring stick and measuring tape were used to measure the morphometric characteristics or body dimensions.

Weighing of livestock was concentrated in two locations of People Breeding Station (PBS) and two sites outside of Non People Breeding Station (NPBS) and breeders chose a place adjacent to the cattle pen. Weighing body weight with electronic scale and measurement was done in the morning (07.30 a.m.), before the cattle were fed and at the same time measuring the body dimensions (morphometric) characteristic. The data obtained were tabulated and grouped according to age and sex then took the t-test and analyzed descriptively.
3. Results and Discussion

3.1. Phenotype diversities of male Bali cattle

The observation of purity of Bali cattle herds in two locations showed that the characteristic of pure Bali cattle is still dominant in all study sites. [15] of Bali cattle breeding stock mentioned characteristics of pure Bali cattle are white knee down half-moon white shaped at rump black tail tip and there was a line eel black on the back. Cows have red body color, short horns, head shape is long and slender neck. Bulls have black body color horn growth the leads into the middle literally and turn to the back wide head shape with a compact and powerful neck [15]. Added pure Bali cattle are small type of cattle, have white color on leaf edge, inner ear and the lower lip. Nevertheless, it was found that some Bali cattle herd in NPBS have color like tiger called tiger Bali cattle. Different features of tiger Bali cattle from pure Bali cattle are brick red-black body color, black stripes going down from the back to the abdomen in the whole body and white color on end of the tail. Other differences are tiger Bali cattle tend to be more violent and reproductive ability declined slightly. This shows that the possibility of the cow has a fairly high level of inbreeding that is marked with a white tip of tail hair and a drop in reproduction power. Another possibility is tiger Bali cattle inherited blood from crossbreeding with other breed such as Limousin in the previous generation characterized by the existed striped color like tiger. Tiger Bali cattle are not found at the location of PBS. With this discovery purity degree of Bali cattle in NPBS should be lower than those in the PBS. Tigers Bali cattle at Awangnipa (NPBS) were not included in the data analysis in this study. Coat color differences in Bali cows had no significant difference in body size, but effect the physiological status through increase in environmental temperature.

3.2. Body weight Bali bull Cattle

The average mean and standard deviation of body weight of male Bali cattle of farmer groups in PBS and NPBS area presented in Table 1.

| Age (year) | PBS (kg) | NPBS (kg) |
|------------|----------|-----------|
| 1.0 – 1.5  | 123.50±07.42ª | 105.04±11.24b |
| 1.6 – 2.0  | 164.55±17.22ª | 113.7±13.82b |
| 2.1 – 2.5  | 210.25±38.75ª | 157.42±27.35b |
| 2.6 – 3.0  | 246.58±34.54ª | 187.17±21.67b |

The average body weight of Bali male cattle in PBS aged that significantly (p<0.001) affected the weight Bali cattle in NPBS (Table 1). Average body weight of Bali male cattle aged 1.5 – 2.0 years 164.55 ±17.22 kg is lower than Sudanese Kenana cattle 1-2 years of age reaching 188.00 ± 10.56 kg [16]. The average body weight of male Bali cattle of PBS aged 2.6 – 3.0 years (mature weight) was 246.56 ± 34.54 kg significantly (p<0.01) higher than that weight Bali male cattle of NPBS was 187.17 ±21.67 kg. Body weight male Bali cattle in PBS and NPBS higher than the local native cattle of Sylhet with an average body weight of 141.99 kg ± 6.22 kg [2]. Generally. Bali bull cattle at the age of 2-3 years were sold with a weight of 200-250 kg. This is due to the demand for beef is high enough. [17] stated that the ideal age of Bali bull for sale ranging from 6 to 8 years and weighing 350-450 kg. The high sales of study has been uncontrolled in some areas resulted in a shortage of better bulls that females are mated by dwarf bulls. Stakeholders are concerned about the occurrence of adverse selection because better males are sold more quickly. Bali cattle show a low growth and reach adult body weight very slowly. and these cattle are still growing at the age of 4-5 years. Bali bull cattle could only be sold at the age of 3-5 years with average body weight 350 kg.
Otherwise, improvement of farming management practice should apply better quality of feed for cattle consumption to reach the target body weight in earlier age. The average body weight of native heifers cattle of Sylhet district is $96.04 \pm 2.71$ kg and native cow cattle weight of $186.88 \pm 2.52$ kg can be achieved [2].

### 3.3. Morphometric of Bali Bull Cattle

Morphometrics such as body length, shoulder height and chest circumference (Table 2) should be closely connected with production performance and can be used to measure cattle productivity. Body dimensions are often used to select cattle breeding stock. Know the nature of heredity and estimate the weight and appearance of livestock [18].

**Table 2.** Mean and standard deviation of body length, shoulder height, chest circumference in male Bali cattle in PBS and NPBS.

| Age (year) | Body Length (cm) | Shoulder Height (cm) | Chest Circumference (cm) |
|------------|------------------|----------------------|--------------------------|
|            | PBS NPBS         | PBS NPBS             | PBS NPBS                 |
| 1.0-1.5    | 95.43±0.03.08ª   | 86.71±02.20ª         | 100.43±03.34ª            | 95.79±01.42ª             | 122.71±03.85ª            | 118.21±03.19ª            |
| 1.6-2.0    | 104.06±04.06ª    | 91.00±04.08ª         | 101.07±03.02ª            | 96.06±01.51ª             | 133.05±02.88ª            | 119.04±01.71ª            |
| 2.1-2.5    | 113.83±06.57ª    | 102.09±06.87ª        | 109.92±02.23ª            | 100.75±05.24ª            | 145.05±09.36ª            | 125.08±09.59ª            |
| 2.6-3.0    | 117.58±04.01ª    | 108.50±03.58ª        | 122.33±03.27ª            | 109.05±04.01ª            | 155.00±10.88ª            | 146.25±06.25ª            |

### 3.3.1. Body length

Average body length of Bali bull cattle in PBS all of ages group significantly higher (p<0.001) than those in NPBS (Table 2). This difference is suspected as the average difference in body length influenced by better management and selection applied in PBS area. In line with this allegation, differences in dimensions of the body length are affected by the age and environment. The average body length bull in PBS age 2.6-3.0 years is 117.58±04.01 cm of this study higher than the body length of the native bulls of Sylhet 114.01 ± 1.51 cm [2] and Red Chittagong bull cattle age 31-36 months is 98.67±0.37 cm [1]. Body length bull Ongole Crossbreed cattle age 2-4 years is 126.68±8.52 cm higher than the present study [19].

### 3.3.2. Shoulder height

The average of shoulder height of Bali male cattle in PBS age 1.0-1.5 years is 100.43±03.34 cm, age 1.6-2.0 years is 101.07±3.02 cm and age 2.1-2.5 years is 109.92±02.23 cm significantly (p<0.001) higher than shoulder height of Bali male cattle in NPBS the same ages group. Shoulder height of Gangatiri cattle for age 1-3 years 102.95±1.24 cm [19] lower than Bali male cattle age 2.6-3.0 years in PBS is 112.33 ± 03.27 cm. Shoulder of Native bull cattle at district Sylhet was 85.26±0.94 cm [2] and Chittagong cattle age 25-30 mouth is 94.89±0.34 cm [1] lower than the present study. Shoulder height of male Ongole Crossbred cattle age 2-4 years is 124.93±4.98 higher than this present study [20].

### 3.3.3. Chest circumference

The average of chest circumference of Bali cattle in PBS at the age of 1.0-1.5 years is 122.71±03.85 cm, age least 1.6–2.0 year of 133.05±02.88 cm and age at least 2.1-2.5 years is 145.05±09.36 cm and age 2.6-3.0 years is 155.00±10.88 cm higher than Bali bull cattle in NPBS the same age group (Table2). Chest circumference of native bull of Sylhet 106.66±1.6 cm [2] and chest circumference of Red Chittagong cattle age 25-30 months is 126.29±0.38 cm [1] lower than in the present study. North Bengal Grey cattle chest circumference is 126.95±1.53 [21] was smaller than Bali male cattle in PBS.
3.3.4. Body Weight of Female Cattle. Mean and standard deviation of body weight Bali female cattle body in PBR areas was higher than that of Bali female cattle in the NPBR area (Table 3). This may be due to the more intensive management of Bali female cattle in PBS compared to the NPBS maintenance system.

Table 3. Mean and standard deviation of body weight of Bali female cattle in PBS and NPBS.

| Age (year) | PBS (kg) | NPBS (kg) |
|-----------|----------|-----------|
| 0.0 - 1.0 | 111.27±11.88ª | 95.87±10.21b |
| 1.1 - 2.0 | 146.23±15.13ª | 120.77±14.42b |
| 2.1 - 3.0 | 214.00±38.56ª | 183.92±26.44ª |
| 3.1 - 4.0 | 216.46±32.87ª | 198.85±05.32ª |

Mean and standard deviation body weight Bali female cattle in PBS aged 1.1-2.0 years was 146.23 ± 15.13 kg significantly higher (p<0.01) than Bali female cattle in NPBS (120.77±14.42 kg) and lower than Sudanese Kenana female cattle aged 1-2 years was 184.24 ± 16.29 kg [16]. Body weight of Bali female cattle in PBS (mature weight) of 3.1-4.0 years was 216.46 ± 32.87 kg higher than in NPBS was 198.85 ± 5.32 kg. Bali female cattle weight in PBS aged 3.1-4.0 years (mature weight) was lower than Sudanese Kenana female cattle aged 3-4 years was 284.22 ± 16.29 kg [16]. This difference maybe Bali cattle due to slow and longer growth to reach mature weight. [2] The minimum body weight of native cowm Sylhet was 89.7 kg and maximum 279.58 kg.

3.4. Morphometric of Bali female cattle

Morphometric characteristics (body length, shoulder height and chest circumference) are presented in Table 4. Morphometric very important and relevant body parameters to be examined because: a) it can be used to estimate the body weight. b) it is a measure of the quality of cattle seeds that is the minimum requirement of quantitative Bali female cattle Breeding Stock [15] and c) it is a barometer of Bali cattle quality by comparing the previous data.

Table 4. Mean and standard deviation of body length, shoulder height, chest circumference in female Bali cattle.

| Age (year) | Body Length (cm) | Shoulder Height (cm) | Chest Circumference (cm) |
|-----------|------------------|----------------------|-------------------------|
|           | PBS |
| 0.0 - 1.0 | 95.80±03.78ª | 99.00±03.00ª | 122.73±07.68ª |
| 1.1 - 2.0 | 108.92±07.87ª | 104.92±05.76ª | 148.92±11.10ª |
| 2.1 - 3.0 | 112.00±04.77ª | 111.46±02.26ª | 138.54±05.22ª |
| 3.1 – 4.0 | 115.69±03.79ª | 112.23±03.06ª | 149.46±05.27ª |

3.4.1. Body Length. The body length of the Bali female cattle at the same age tends to be longer in PBS than in NPBS. The body length of the Bali female cattle in PBS age 1.1-2.0 years was 108.92 ± 7.87 cm is within the range of [15] standard body length of Bali female cattle breeding stock are 101-112 cm age 18-24 months. [2] reported the body length of the local heifer cattle at Sylhet district was on the average 102.10 ± 1.99 cm lower than the body length of the Bali female cattle in PBS aged 1.1-2.0 years. [16] reported body length of Sudanese Kenana cattle of age 1-2 years was 75.66 ± 1.06 cm lower than the present
study of PBS and NPBS. The body length of Bali female cattle aged 3-4 years was $216.46 \pm 32.87$ cm higher than the average body length of local cow cattle Sylhet was $126.41 \pm 0.72$ cm [2].

3.4.2 Shoulder Height. Mean and standard deviation of shoulder height of Bali female cattle in PBS at all age levels was almost higher than the Bali female cattle in NPBS area (Table 4). Environmental conditions especially the management of Bali female cattle in PBS area was more conducive compared to the NPBS area. In NPBS the cattle tend to be bred extensively whereas in PBS it was bred semi-intensively. Shoulder height of Bali female cattle (heifer) in PBS aged 1.1–2.0 years was $104.92 \pm 7.13$ cm. The value was in range of Bali cattle shoulder height according to [15] of Bali cattle aged 18 – 24 months ranging from 100 to 107 cm. [2] reported shoulder height of local heifer cattle of Sylhet district ranges from 58.80 to 100.45 cm lower than the shoulder height of Bali cattle in PBS and NPBS area. Shoulder height of Gangatiri cattle for age 1-3 years was $102.95 \pm 1.24$ cm [20]. Shoulder height of Chittagong cattle age of 25-30 month was $94.89 \pm 0.34$ cm [1].

3.4.3 Chest Circumference. Mean and standard deviation chest circumference of Bali female cattle in PBS areas at all age levels is also higher than in the NPBS region (Table 4). Bali cattle heifer (1.1-2.0) years mean chest circumference in the area of PBS was $132.96 \pm 11$ cm is in the range of standard deviation chest circumference of breeding cattle of [15] age 18-24 months ranging from 124 to 139 cm and the circumference of Bali female cattle age 3.1-4.0 years was on the average $149.46 \pm 0.5$ cm. [16] reported the chest circumference of Sudanese Kenana cattle age 1-2 years was $128.11 \pm 1.38$ cm lower than Bali female cattle (1.1-2.0) years in PBS $132.96 \pm 11.10$ cm. [2] State that the chest circumference of a local female heifer of Sylhet district ranges from 58.80 to 120.05 cm and cow cattle in range was 88.20 to 134.75 cm. The results of [22] show that the chest circumference of Taro cow was lower than the present study, which is on average $121.17 \pm 15.139$ cm. [21] reported chest circumference forth North Bengal Grey Cattle is $126.95 \pm 1.53$ smaller than this study. Pabna cows chest diametr $147.56\pm170$ cm [6]. Chest girth of Doni cow cattle $151.82\pm1.92$ cm [4] higher than chest circumference of Bali female cattle in PBS aged 3.1-4.0 years.

4. Conclusions
1. The average body weight of Bali cattle in People Breeding Station higher than Bali cattle in People Breeding Station (PBS) than in Non People Breeding Station.
2. The average body length, shoulder height and chest circumference of Bali cattle in People Breeding Station are higher than in Non People Breeding Station.

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