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Morphometrics and carcass production of Kalimantan swamp buffalo under extensive production system (*kalang*)

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Abstract

Swamp buffaloes in Kalimantan Island are commonly kept in extensive production systems in wetland areas (*Kalang*). The changes in the wetland environment and social condition of wetland communities affect the ecosystem and the buffalo. This research aimed to obtain the body measurements of swamp buffalo in Kalimantan as indicators of meat producer and to compare the current with the preceding data. Surveys were conducted at slaughter houses to record heart girth (HG), whither height (WH), body length (BL), live weight (LW) and carcass percentage (CP). Results showed the average values of body measurements for males and females were as follows: HG 202 and 174 cm; WH 125 and 124 cm; BL 131 and 117 cm respectively. The LW for males and females were 380 and 312 kg; whereas their CP were 46 and 44% respectively. Compared to previous studies, the current body measurements are considerably similar; however, their LW and CP were lower. These results indicated that there was a decrease in the productivity of swamp buffaloes in lowland Kalimantan. Hence, an improvement of the existing production system is required that might involve conservation, maintenance and improvement of swamp environment, and introducing rotational mating system, feed supplement, and health care.

Keywords: *body measurement, buffalo meat, sustainable production system, swamp ecology*

Introduction

Swamp type buffalo (*Bubalus bubalis carabanensis*) constitutes 25% of the world's buffalo population and especially favored in South east Asia. Their main purpose is for agricultural labor, meat source and also kept as additional income for farmers (Pineda et al 2021). Kalimantan buffalo is a type of swamp buffalo which are kept in extensive or semi-extensive manners in wetland and also mountainous areas of South, East and Central Kalimantan, Indonesia. Referring to their habitat, 64% of these buffaloes were kept extensively in swamp areas while local communities regard them as *kalang* (Sumantri 2021). *Kalang* rearing system (a wooden structure in the middle of the swamp) is regarded as local wisdom of native people whom live in lowland Kalimantan in utilizing their environment for their livelihood (Rochgiyanti and Susanto 2017).

Other than as meat producer, Kalimantan buffalo has important roles in social aspect related to the human community and also biological importance related to the ecosystem (Rakhman 2009). Regardless of these facts, Indonesian buffalo population kept on decreasing within the decade. In South Kalimantan the buffalo population declines 63%; from 44,603 heads in 2009 to only 16,556 in 2019 (DGLS 2021). This decline is suspected due to diseases, reproductive issues and also due to the decrease in feed resources and their grazing areas (Hilmawan et al 2020). This remarkable decrease in buffalo population size is not only happening in Indonesia; but has become a common occurrence in South-East Asian region (Deb et al 2016).

Despite the phenomenon occurred in buffalo population, however, the demand for buffalo meat is increasing. This increase can be seen by the value of the Indian buffalo meat (IBM) importation; from 58 thousand tons in 2016 to 94 thousand tons in 2019 with main consumers were restaurants, catering services and meatball producers (Chang et al 2020). In South Kalimantan, IBM importation had decreased inter-island cattle trading, local beef production, and beef demand in wet market (Sumantri and Chang 2021). Regardless, buffalo meat has shown a great market potential; hence, attempts to improve Indonesian cattle productivity is needed. To date, the contribution of buffalo to the total national red meat production only account for around 3.7% (DGLS 2021).

Extensive buffalo rearing system is commonly occurred when there is enough land for pasture; such is in coastal or hilly areas; in marsh land, however, the rearing systems are more towards semi-intensive due to the limited feed resources (Momin et al 2016). Buffaloes are commonly kept in harsh environment and only given low quality feed such as natural plants in the pastures or agricultural by products in semi-intensive rearing system (Minervino et al 2020). Even though buffalo has more efficient ruminal fermentation system and nitrogen utilization compared to cattle (Wanapat et al 2000), the sub-optimum environmental conditions in extensive rearing systems had costed low productivity.

This research was conducted to observe the body measurements and carcass production of Kalimantan buffalo in wetland extensive rearing system. The results shall describe the productivity of Kalimantan buffalo in *kalang* rearing system (Photos 1,2,3). It will serve as a stepping ground for the improvements of production systems as an attempt to increase the productivity of Kalimantan buffalo.

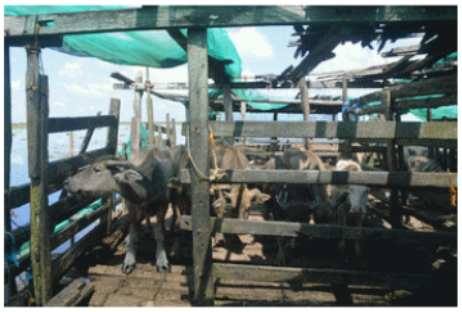

Photo 1. The buffalo calves are left in the shed when the adult reared in swamp

Photo 2. TA farmer opens the gate to release the buffalo in the morning

Photo 3. Buffaloes climb to the shed in the afternoon after grazing in swamp area

Materials and methods

Data collection

Kalimantan buffalo is still showing feral behavior; hence, the researchers were not able to conduct the morphometric measurements and weighing procedures on site (at the *kalang*). The data collection was then conducted at three slaughterhouses which located in the Province of South Kalimantan (Hulu Sungai Utara, Banjar and Banjarmasin regions). The observation time was spanned from January to July 2020. Information regarding the origin of the buffaloes were obtained from the owners and only data of buffaloes from *kalang* rearing systems (wetland area) are included in this research. The live weight (LW) and body measurements including wither height (WH), body length (BL) and heart girth (HG) were recorded prior to slaughter. The procedures for body measuring were as follows:

a. BL: was measured from the protruding part of shoulder bones (humerus) to the pelvic bones (tuber ischi) using cattle measuring stick (unit in cm).

b. HG: was measured using measuring tape encircling chest right behind the elbow joint (or the 3rd to 4th ribs), front legs have to be perpendicular to the axis (unit in cm).

c. WH: was measured from the highest point of the shoulder bone perpendicular to the ground; using cattle measuring stick (unit in cm).

In the cases where weighing scales were absent; LW was estimated using multiple linear regression equation as proposed by Sumantri et al (2021) as follows:

$$Y = -553.116 + 1.545HG + 3.295BL + 1.701WH$$

Where Y was the estimated live weight (in Kg), HG was the heart girth (in cm), BL was the body length (in cm) and WH was the wither height (in cm).

After slaughtered, the buffalo carcasses were weighed. The carcass was defined as all body parts after slaughter excluding blood, head, internal organs and legs (from tarsal-metatarsal and carpus-metacarpus). The carcass data was presented as percentage (CP).

Data analysis

The collected data from the observed variables were presented as summary statistics inclusive number of observations, means and standard deviations.

Results and discussions

Morphometric characteristics

The morphometric characteristics of Kalimantan buffalo (*Kalang* buffalo) is presented in Table 1.

Table 1. Morphometric characteristics of Kalimantan buffaloes under extensive farming system (*Kalang*)

Sex	n[1]	Age (years)	Morphometric characteristics		
			HG[2] (cm)	WH[3] (cm)	BL[4] (cm)
Male	44	2-5	202.2±31	124.9±9	130.5±12
Female	11	2-4	173.5±21	124.0±19	117.3±23

[1] n = number of samples; [2]HG: Heart Girth; [3]WH: Wither Height; [4]BL: Body Length

Referring to the release of the Department of Agriculture of Indonesia (SK Kementan no. 2844/Kpts/LB.430/8/2012), male buffaloes from South Kalimantan have a standard LW of 415.5±53 kg; whereas HG, BL and WH were 170.3±15, 94.0±7 and 117.0±7 cm respectively. Table 1 shows the body measurements in this research were higher compared to the national standard of South Kalimantan buffalo. However, the average of live weight of the male buffaloes (LW) in this research were considerably lower (380.2±110 kg) (Table 2). As reference, male buffaloes of East

Kalimantan were reported to have average LW of 372.2 Kg; whereas the average HG was 175.5 and BL was 125.6 cm (Komariah et al 2014). Anggraeni et al (2011) reported that South Kalimantan male buffaloes aged 2 – 8 years had HG and WH of 169 and 128 cm respectively; whereas the female buffaloes were 164 and 120 cm respectively. Other research found that the weight of buffaloes in *kalang* farming systems were between 500 – 600 Kg (Rohaeni et al 2005).

In general, these results indicated that the LW of buffaloes reared in extensive *kalang* farming systems decreased over time. Kalimantan buffalo rearing in wetland areas carried the characteristics of low input farming system where there are minimum investments made by the farmers in term of feed, labor, effort, health and reproduction. The occurrence of wetland to land conversion for plantations and urban development reduced the amount of area for buffalo to roam and graze (Hilmawan et al 2020). This also affected the availability of forage plants especially *Hymenache amplexicaulis* Haes., *Paspalum sp*, *Oryza sativa forma spontanea* L., and *Cynodon dactylon* L Pars. These plants were highly palatable for the buffaloes and naturally grown on the swamps surface (Agusliani and Dharmaji 2017).

High slaughtering rate of adult male buffaloes with high economical values was suspected to be among the causes of lower body size and weight of the current buffalo population when compared to their predecessors. The non-existence superior genetic resources as male buffalo breeding stock brought negative selection to the buffalo population; hence, their performance declining over time. Further, uncontrolled mating among individuals within the herds in *kalang* farming systems had generated inbreeding (Windusari et al 2017) and caused inbreeding depression which in turn affecting their fitness and productivity. Swamp buffaloes had considerably low genetic diversity of around 0.387 – 0.613; hence, mating strategies are needed to reduce inbreeding rate; such as through rotational mating and bull selection (Berthouly et al 2010).

Carcass Production

Carcass productivity variables of Kalimantan buffaloes in *kalang* farming system of Kalimantan wetland are presented in Table 2.

Table 2. The buffaloes live weight and carcass traits

Sex	n[1]	LW[2] (kg)	CW[3] (kg)	CP[4] (%)
Male	44	380.2±110	180.3±44	46.3±4
Female	11	312.4±116	114.3±24	43.6±7

[1] n = number of samples; [2]LW: live weight; [3]CW: Carcass Weight; [4]CP: Carcass Percentage

The results showed that the male buffaloes in this research had higher carcass percentage (46.3%) that their female counterpart (43.6%). These results however were higher that the report from Siregar and Diwyanto (1996) which mentioned that the carcass percentage of male Kalimantan buffalo was 44%, whereas for female was 33%; but in agreement with the findings from Miskiyah and Usmiyati (2005) and Siamtiningrum et al (2016) which mentioned that the carcass percentage of Kalimantan buffalo was 46-47%. However, Rohaeni et al (2005) reported that carcass yield of Kalimantan buffaloes reached a value of 50%.

Farming system affecting the physiological and behavioral states of the buffaloes; which in turn shall affect the productivity as well as the quality of the carcass (De La Cruz-Cruz et al 2019). Swamp buffaloes in Indonesia are commonly kept in extensive farming system; especially outside the island of Java. This was due to some restrictions in investments, technology and development of farming systems in the *kalang* system of wetland of Kalimantan Island (Rochgiyanti and Susanto 2017) or *lutur* system in dryland of Moa Island (Tatipikalawan et al 2019). These extensive production systems are suspected to be the causal variables for swamp buffalo productivity in Indonesia as shown by the results of this research. Previous study to Kalimantan swamp buffalo indicated the extensive production system of *kalang* affected on delaying of female buffalo first mating and calving (Widi et al 2021).

Intensively reared swamp buffalo shall have better productivity due to the improvement of feed by the addition of legume and concentrate. The research of Lambertz et al (2014) showed that free-ranged buffaloes yielded Average Daily Gain (ADG) of 316 g/day with carcass percentage of 42.9%; whereas the swamp buffaloes reared with the addition of concentrate were able to yield ADG of 570 g/day with carcass percentage of 44.8%. River buffaloes which were reared in intensive farming system could yield 51% of carcass with no distinctions between the groups with and without additional fresh rye grass (Marrone et al 2020).

Conclusions

This research showed that buffaloes reared in extensive farming system with *kalang* in wetland areas of Kalimantan had lower live weight and carcass percentage compare to previous reports. The body measurements of the current buffaloes, however, did not show any sign decline overtime. In this type of farming system, the insufficient amount of feed, the absence of superior male genetic resources along with poor management and health services made the buffaloes less productive. Hence, further research and government policies covering improvement of lowland buffalo farming system and ecosystem support are required.

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