Selection of cow buffalo and its effect on reproductive characteristic of swamp buffalo

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Abstract. This study aimed to understand the effect of cow buffalo selection on the characteristic of the reproduction of swamp buffalo. It was conducted in the center of buffalo development in District Bombana, South-east Sulawesi Indonesia. In this research, 65 heads of cow buffalo were used (aged 3 - 9 years), divided into two groups including (1) selected cow buffalo as many as 28 heads, and (2) unselected cow buffalo as many as 37 heads. Selected cow buffaloes had a higher body condition score (BCS), shoulder height, and body weight (fulfilling minimum requirements). The mating system was conducted through artificial insemination (AI). Before holding AI, all the cow buffaloes accepted the estrus synchronization by using the single dose of PGF2α (Capriglandin®Inj) hormone as much 5 ml/head. The result of the study demonstrated that the selection of cow buffalo could improve the reproductive characteristic of buffalo such as increasing estrus response and pregnant rate and shortening calving interval. Finally, the researcher recommends that farmers could utilize BCS, shoulder height and body weight as the criteria of selection to grow the animal production.

Keywords: swamp buffalo, selection, pregnant rate, birth rate.

1. Introduction

Buffalo (Bubalus bubalis) is the ruminant animal that has important roles in the social life of people in Bombana District, South-east Sulawesi Indonesia. It produces meat and commonly being used in the traditional ceremony. In several places in Indonesia and another country such as India, buffaloes are raised for milk and meat production, electricity, transportation, organic fertilizer [1]. Moreover, buffalo meat is desirable and there is no prohibition in certain religions to consume it.

Nowadays, buffalo meat is more popular in several countries in South-east Asia, Middle-east, and Africa because of the low content of fat, cholesterol, and other health problems. Also, for the last few years, the importance of buffaloes in tropical and sub-tropical countries was increased because of the ecological and economical advantages including the ability to reproduce in a bad environment and under pressure, transforming the low quality of feedstuff to meat and milk, and the performance [2]. Besides, buffalo milk contains a higher amount of total solid substrate (protein, fat, and mineral) compared to dairy cow milk.

Buffalo is estimated as the priority livestock in fulfilling the world meat needs and plays substantial roles in continuous agricultural production, even though it is the lack of government attention compared to other livestock [3].

South-east Sulawesi Province Indonesia had the population of swamp buffalo as many as 7,926 of heads in the year 2005 [4], and in 2011 the population of buffalo in this area was drastically decreased to 2,492 heads [5], although it significantly increased in 2017 to 2,873 heads [6].
Bombana has the highest population of buffalo as many as 757 heads in 2017 or 26.3% of the total of buffalo population in South-east Sulawesi Province.

Buffaloes in District Bombana is commonly raised extensively. Farmers neither select the animal nor arrange the breeding system of the animal [7,8]. Conversely, all the best male buffalo are sold because the buyers (generally come from other provinces) are capable of paying to the high price [9]. If this condition happened continuously, then there will be a long time decrease in the genetic quality and production performance of swamp buffalo in this region.

One of the efforts to improve genetic quality is selection. The selection of either cattle or buffalo can be conducted on both female and male animals [10]. The criteria of selection depend on the purpose of selection, for example, for improving meat production then phenotypic characteristics (body weight, size and body score condition) can be utilized as the criteria of selection. The result of the selection would be expressed in the increasing of potential genetic through the elevation of buffalo productivity. Applying of reproductive biotechnology and selection program at the same time can accelerate the increase of productivity of dairy buffalo[3]. A study on the application of a selection of buffalo in Indonesia is limited. This research aimed to understand the effect of the selection of cow buffalo on the reproductive characteristic of swamp buffalo.

2. Material and methods
This study was conducted in the center of development of buffalo in District Bombana, South-east Sulawesi Province Indonesia. Numbers of cow buffalo (aged >3 – 9 years and had given birth) used are 65 heads, divided into 2 groups including (1) selected cow buffalo as many 28 heads, and (2) unselected cow buffalo as many 37 heads. Selected cow buffaloes had a higher BCS, shoulder height, and body weight (fulfilling minimum requirements). Data for selected and unselected cow buffalo performances were presented in Table 1.

| Buffalo | Number of buffalo | Average of Body Condition Score | Average of Shoulder Height (cm) | Average of Body Weight (kg) |
|---------|------------------|---------------------------------|---------------------------------|----------------------------|
| Selected | 28               | 3.4                             | 125                             | 402                        |
| Unselected | 37             | 2.4                             | 121                             | 380                        |

The mating system was conducted through artificial insemination (AI). Before holding AI, all the cow buffaloes accepted the estrus synchronization by using the single dose of PGF2α (Capriglandin®Inj) hormone as much 5 ml/head. Estrus synchronization by using a single dose was injected because the buffaloes were raised extensively. Buffaloes were caged for AI needs only for a maximum of 7 days. After accepting AI, the buffaloes then were released to pasture and being caged again for the next estrus cycle (more or less 21 days). Observed variables were (1) estrus response, (2) pregnant rate, (3) calving rate, (4) pregnant duration, and (5) calving interval. Observation on pregnant rate was conducted twice: (1) investigating the anestrus return in the next estrus cycle, and (2) investigating a 5-month pregnancy after AI application.

3. Result and discussion
Numbers of synchronized cow buffalo, numbers of pregnant cow buffalo and accepting AI, numbers of non-return estrus (pregnant), and numbers of cow buffalo that calved are presented in Table 2.
Reproductive characteristics of cow buffaloes (estrus response, pregnant rate, calving rate, pregnant duration, and calving interval) are presented in Table 3.

**Table 3. Reproductive Characteristic of Cow Buffalo**

| No | Parameter of Reproduction | Cow Buffalo | |
|----|---------------------------|-------------|---|
|    |                           | Selected    | Unselected | Average |
| 1  | Estrus response           | 64.29       | 62.12      | 63.08   |
| 2  | Pregnant Rate             | 55.56       | 47.83      | 51.22   |
| 3  | a. Calving rate (% toward mating cow buffalo) | 44.44 | 39.13 | 41.46 |
|    | b. Calving rate (% toward pregnant cow buffalo) | 80.00 | 81.82 | 80.95 |
| 4  | Pregnant duration (day)   | 10.40       | 10.40      | 10.40   |
| 5  | Calving interval (month)  | 14.30       | 15.30      | 14.85   |

**Estrus Response.** Cow buffaloes giving estrus response after accepting synchronization through injection of Capriglandin®inj were 41 heads (63.1%) of 65 heads that were synchronized. Estrus rate of Kundhi - Pakistan buffalo after application of the Ovsynch+CIDR hormone was 76.47% with the pregnant 52.94% [11]. This result was relatively lower than the estrus response of Nili-Ravi Pakistan buffalo gave protocol eCG as much 90% and protocol CIDR 80% [12]. Meanwhile, cow buffalo of swamp buffaloes in District Kampar North Sumatra that accepting AI after application of GnRH and PGF2α (double dose) result estrus cow buffaloes as much 100% [13,14]. Estrus synchronization with the single-dose was hypothesized as a factor causing the low value of estrus response. Moreover, it is due to the extensively raising system of buffalo that leads to the silent heat caused by stress.

**Pregnant Rate.** Estrus cow buffaloes were then given AI treatment by using straws of striped buffalo Tana Toraja from Local Technical Holding Unit of Breeding of South Sulawesi Province. From a total of 65 heads of synchronized cow buffalo, 41 heads were pregnant or 51.22% on average. The pregnant rate of this study was higher than Murrah buffalo of India ranged 30 - 50%) [15], relatively similar to the pregnant rate of buffalo in India which was various depending on weather, ranged 36.11 - 60.00% [16]. Moreover, Nili-Ravi buffalo of Pakistan injected 3000 IU hCG intramuscularly on AI treatment resulted in the pregnant rate as much 48% on the first application, 22% on the second application, and 20% on third application. The pregnant rate was drastically dropped by decreasing the dose of the hCG hormone [17]. The pregnant rate of Nili-Ravi Pakistan buffalo given protocol eCG was 50%, whereas the application of RIDR was 60% [12]. The use of the Ovsynch protocol supplemented with progesterone produced conception rates of 74.43 ± 9.16% in buffalo in Hayana India [18]. Cow buffalo of swamp buffalo in District Kampar North Sumatra receiving AI after the addition of GnRH and PGF2α (double dose) resulted in estrus of cow buffalo as much 100%, and the pregnancy rate was 100% of each [14]. The low pregnant rate of this study
was due to the addition of single-dose PGF2α. Moreover, buffaloes used were commonly grazed freely therefore, when they were guided to the cage, they were stressful causing estrus failure or silent head.

Selected cow buffaloes resulted in the pregnant rate as much as 55.56% which was higher than unselected cow buffaloes (47.83%) (Table 3) which is related to the BCS before mating. Buffaloes which were raised in the limited quantity of feed were reflecting the BCS condition. Cow buffaloes with 2.5 BSC (in 1 – 5 scale) reflecting the late of ovulation and service per conception value were higher than buffaloes with a 3 – 4 BSC score [19]. Estrus response of river buffalo in Australia with BCS less than 2.5 was 57.2%, BCS 3.0 - 3.5 was 84.6%, and BCS more than 3.5 was 96.3%, while pregnant rate from AI application were 38.1%, 74.3%, and 82.3% respectively [20]. BCS is significantly related to milk production and reproductive disruption on Nili-Ravi buffalo [21] which meant that BCS around 3 results in the high milk production and the low reproductive disruption. Application of prostaglandin using different brand resulted in the variation of the pregnant rate as follows: brand Enzoprost® 53%, Estrumate® 65%, Lutalyle® 56% Prosolvin® 70%, and brand Prolan® 68% [20]. Furthermore, dairy buffalo of Egypt accepted progesterone + PGf2α (Prontogeste® +3 ml Estrumate) resulted in the pregnant rate of 80.00%, higher than without application of progesterone (57.14%) [22].

**Calving Rate.** In this study, the calving rate was estimated by using two methods including: (1) calving rate based on numbers of cow buffalo accepted AI, and (2) calving rate based on numbers of pregnant cow buffalo.

Based on the numbers of cow buffalo accepted AI, the calving rate was 41.46%. The group of selected cow buffaloes resulted in a higher pregnant rate (44.44%) compared to unselected cow buffaloes (39.13%). Result of the study was similar to calving rate of Sabah buffalo of Malaysia fluctuated from year to year ranged 36.1 – 77.4% [23], however, it was lower than calving rate of swamp buffaloes in District Kampar Riau Province Indonesia reaching the pregnant rate 75-100% on the different dose of GnRH [13]. The low number of calving rate in this research was related to the lower estrus response and pregnant rate. Moreover, it was affected by the low feed quantity and quality that was extremely dependent on forage production on grassland [8]. The calving rate of swamp buffalo in Sub-district Muara Muntai District Kutai Kartanegara South Kalimantan Indonesia was 75% [24].

The calving rate of buffalo in the ICAR-National Dairy Research Institute, Karnal–132 001, India, was varied depending on the weather. The highest calving rate was achieved in winter as much 60.00% whereas in summer it resulted in the lowest calving rate as much 36.11% [16], which meant that weather variation affected the calving rate value due to the different stress level, reflecting the variety of nutrition. In the dry season, buffaloes have more feed stress and lack of nutrition.

The calving rate based on the numbers of pregnant cow buffalo was 80.95% on average. It indicated that mortality of embryo during the pregnant period (from five months of pregnancy to birthday) was high as much 9.05%. The extensively raising system can lead to the lack of feed quantity and quality causing the nutrition needs of the embryo will be lack. Besides, the dry season was not proper for buffalo mating [25]. The calving season preferred to be conducted when the feed condition was provided properly because it affected the reproductive system.

**Pregnant Duration.** The average of the pregnant duration of buffalo in this study was 10.4 months or 312 days ranged from 308 to 319 days. This result was similar to the pregnant rate of buffalo in Bangladesh as long 319 days on average [26,27] or was only need more or less 10 months [28]. Also, the pregnant duration of swamp buffalo in District Malang was 10.94±2.29 months [29]. Selected and unselected cow buffalo have different pregnant duration as presented in Figure 1.
The pregnant rate of swamp buffalo in District Kutai Kertanegara was 365 days [24], much higher than the result of this study, while the average of pregnant duration of buffalo in Armenia was 328 days, ranged from 302 to 361 days [30]. Based on the study and previous research, it seemed that there was variation in the pregnant duration of buffalo, which can be caused by genetic factors, environment, and maintenance management.

Calving Interval. In this research, the average calving interval of buffalo was 14.85 months or around 444 days ranged 433 - 450 days which was higher than the calving interval of swamp buffalo in Sub-district Muara Muntai District Kutai Kartanegara East Kalimantan as long 13 months or 390 days [24].

One of the factors affecting the reproductive characteristics of buffalo was BCS when mating. The average of BCS selected buffalo was 3.4, resulted in calving interval 14.30 months, shorter than BCS of an unselected cow (BCS 2.4) with calving interval 15.30 months. The higher of BCS would lead to the shorter calving interval [20]. Meanwhile, local Murrah buffalo had a calving interval of 17.4±1.01 months, longer than crossbreeding Murrah buffalo that had 14.6±0.52 months of calving interval [31].

Selection is one way to increase the productivity of buffalo. Phenotypic traits of cow buffalo (body weight, size, and BCS) can be utilized as selection criteria. Selection of cow-based on those criteria can grow the productivity of cow buffalo through the improvement of reproductive characteristics including increasing the estrus response, pregnant rate, and shortening of calving interval. The criteria of selection used in this study were easy to be applied by the farmer to select the cow buffalo to be developed because the method was practical and expected to be implied on increasing income and prosperity of farmers.

4. Conclusion and recommendation
Based on results and discussion, it could be concluded that selection on cow buffalo can improve reproductive characteristics of buffalo including increasing estrus response, increasing of pregnant rate, and shortening of calving interval. Therefore, this study recommends that farmers can use the BCS, body height, and bodyweight of cow buffalo as the selection criteria to improve calf production.

5. Significant statement
The result of this study is important to be continued as the selection of the cow buffalo is difficult to be applied in improving the genetic quality of buffalo in District Bombana. This is because the best quality of bull in this area is easy to be traded at a high price. Traders from another province, for example from Tana Toraja South Sulawesi, come to explore the location to buy the best male buffalo to be used in the traditional ceremony even though its price is expensive, causing the negative
selection. The selection of cows based on BCS, size, and body weight criteria is one of the alternatives to increase the population and productivity of buffalo in this area.

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