Production and reproduction performances of Bali cattle in Southeast Sulawesi-Indonesia

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Abstract. Bali cattle is predominant cattle breed raised by smallholder farmer who lives in villages across Southeast Sulawesi region. Besides keeping Bali cattle, they also grow various crops for supporting their livelihood, so they are not really the livestock farmer. However, the existence of Bali cattle for farmers has been a main pillar of the family economy when they need a lot of cash either for the educational needs of children or ceremonial events of religion and culture. Cattle production management in Southeast Sulawesi is quite diverse because it depends on the habit of the farmer. In transmigration settlements, Bali cattle are generally kept by farmer in a semi-intensive system and some even kept intensively, especially for fattening purposes. Whereas in local community settlements (indigenous people), cattle are generally kept extensively or semi-intensively. The smallholder farmer kept cattle on a small scale (2 - 5 heads/household, on average). However, in areas with extensive management systems (natural ranch), they can even keep a hundred cattle per farmer. According to livestock statistical data, beef cattle population in Southeast Sulawesi increased about 15% per year during 2013-2017 but it decreased about 19% during 2017-2018. However, the preliminary data in 2019 cattle population in Southeast Sulawesi increased again about 41%. Bali cattle breed is about ±95% (90%-99%) of beef cattle population in Southeast Sulawesi. The other cattle breeds were crossbreed between Bali cattle and Limousine, Simmental, Brahman Cross or Ongole Cross. Based on cattle population data (December 2018), the cow population is more than bull population. The fertility of Bali cow are diverse with calving interval ranged between 1-3 years because of several factors such as bull availability, nutrition, poor understanding of estrus sign, disease etc. However, in the area where Bali bull is always available or in the area that artificial insemination applied well, the fertility of Bali cow is good, indicated by short period of anestrus post parturition (40-60 days) or calving interval about 12-13 months. Moreover, Bali cow has long reproductive periods, she still has fair fertility up to 13-15 years of age. Bali cattle are also kept for fattening purposes. Young bull of Bali cattle could have daily gain up to 0.7kg/day when they are fed by grass plus concentrate compared to pasture fattening in which daily gain only ranged between 0.2-0.4kg/day. Those production and reproduction performances of Bali cattle in Southeast Sulawesi will be elaborated in this article.

Keywords: Bali cattle, production, reproduction, population, fertility

1. Introduction
Southeast Sulawesi is located in the eastern part of Indonesia, establishing the south-eastern peninsula of Sulawesi, therewith a number of large offshore islands such as Buton island, Muna, Kabaena, Wawonii and Wanci, Kaledupa, Tomia, Binongko (Wakatobi) islands. It lies between 02°45’ and 06°15’ south latitude, and between 120°45’ and 124°45’ east longitude with total area 38.067.7 km² [1]. The main livelihoods of the people who settled in the mainland of Southeast
Sulawesi are farmers, including those who inhabit the islands of Muna and Buton, while the people who live in small island areas such as Wakatobi islands, the majority of the population earn a living as fishermen. The agricultural businesses they do include food crops, horticulture and plantations. Based on statistical data [1], paddy rice is a predominant production of food crop with 131,399 ha of harvesting area and 499,007 tonnes of production, while horticultural crops are as diverse as vegetables and fruits. Cocoa is the main production of plantations with 253,481 ha of planting area and 122,943 tonnes of production.

In addition to agriculture, poultry and livestock production also develops well in Southeast Sulawesi. Village chicken is the main commodity of poultry in Southeast Sulawesi that has annual meat production about 10,709 tonnes. While beef cattle is the main livestock commodity in this region with annual meat production reached 6,474 tonnes in 2018 [1]. The population of beef cattle is distributed widely across Southeast Sulawesi Province but the big five of beef cattle population are concentrated in Muna regency (76,274 heads), Konawe Selatan (72,004 heads), Konawe (65,817 heads), Bombana (58,102 heads), and Muna Barat regencies (44,300 heads).

Almost 100 percent of beef cattle production in Southeast Sulawesi is running by farmer who lives in villages where agricultural products such as rice plantation and various crops are the main production to support their livelihood. They keep various breeds of beef cattle such as Bali cattle, Ongole cross, Brahman cross, Limousine cross or Simmental cross but Bali cattle is a predominant one (95%). Bali cattle have been a main source of farmer income when they need a lot of cash either for the educational needs of children or ceremonial events of religion and culture. Moreover, Bali cattle is well suited to smallholder cow-calf systems in tropical areas because of their small mature size, low feed requirements, high fertility and heat tolerance [2].

In 2015, Southeast Sulawesi Province was established as one of the national beef cattle development areas based on the Ministry of Agriculture decree No.43 of 2015 in which Konawe Selatan and Muna regencies were designed as the intended area. Furthermore, Konawe Selatan regency was re-established as a national source area for Bali cattle breeds in 2016 under the Ministry of Agriculture decree No. 803 2016. The implication of this policy is that the government of Konawe Selatan regency should be able to manage its resources to make the maximum contribution to the national beef cattle development program.

Bali cattle production systems in Southeast Sulawesi are generally still in extensive or traditional system, but in transmigration settlement, Bali cattle are kept in semi-intensive system, even in intensive system especially for fattening purposes. Although the ownership of Bali cattle is still low (2-5 per household) and running as subsistent in their production system, in Bombana regency located in the mainland of Southeast Sulawesi where large savanna are available, the beef cattle ownership of some farmer can even reach a hundred beef cattle per household. In this area, the cattle are kept in free-range system so the cattle production and reproduction are dependent very much on quality and quantity of the grass in savanna. During rainy season where the grass is growing well indicated the animal will fed adequately but contrary during dry season, cattle condition are very poor indicated by low body condition (score <3). At present, there is a big company actually in Bombana regency commencing cattle production on a big scale under the integration system with sugar cane plantation. They used a large area of savanna that previously occupied by some farmers. The company has cultivated some productive grass such as elephant grass (cut and carry grass) and *Brachiaria decumbens* (as a shepherd grass) to fulfill the feed requirement of cattle in paddock.

Talib et al. [3] reported that Bali cattle are one of the important beef cattle breeds contributing to the development of livestock industries in Indonesia, and are the most predominant genotype within the Eastern Islands and some provinces in western Indonesia. This well-adapted genotype forms the basis for many smallholder enterprises in the region, but some considerable pressures placed on the Bali cattle population because of high demands for slaughter animals: large numbers of productive females have been slaughtered, no effective selection has been applied in the basic population and there has been a probable decline in the genetic resources of the genotype.
because the best bulls and heifers are exported from the population, while high calf mortalities occur in some areas.

2. Production Aspects of Bali Cattle

Beef cattle population in Southeast Sulawesi increased about 15% per year during 2013-2017 [4, 5, 6, 7, 8]. Interestingly, the population decreased about 19% in 2018 [1]. However, The Horticulture and Livestock Service Office of Southeast Sulawesi Province issued the temporary data in early 2020 in which beef cattle population in 2019 increased 41% (Table 1). This “uncommon” difference might be due to the different data collection methods applied by these two agencies.

Table 1. Population Dynamics of Beef Cattle in Southeast Sulawesi (2013-2019)

| No. | Year | Population (head) | Data Sources |
|-----|------|-------------------|--------------|
| 1.  | 2013 | 230,363           | BPS Sultra, 2014 [4] |
| 2.  | 2014 | 285,370           | BPS Sultra, 2015 [5] |
| 3.  | 2015 | 299,240           | BPS Sultra, 2016 [6] |
| 4.  | 2016 | 331,958           | BPS Sultra, 2017 [7] |
| 5.  | 2017 | 370,772           | BPS Sultra, 2018 [8] |
| 6.  | 2018 | 298,692           | BPS Sultra, 2019 [1] |
| 7.  | 2019 | 419,882           | Horticulture and Livestock Service Office |

Bali cattle breed were about ±95% (90%-99%) of beef cattle population in Southeast Sulawesi. The other cattle breeds were crossbreed between Bali cattle and Limousine, Simmental, Brahman Cross or Ongole Cross. The Horticulture and Livestock Service Office of Southeast Sulawesi Province released beef cattle population data in December 2018 in which the cow population was more than the bull population (52% vs 8%, the rest were the young bull, heifers and calves).

Bali cattle (Bos sondaicus) is grouped into small size cattle because its body is relatively small in posture compared to European cattle (Bos taurus) and Indian cattle (Bos insidicus) so that the average production of meat per head is also small. This explanation is supported by data on the Indonesian cattle population and beef production compared to Malaysia, China, and Australia, as presented in Table 2.

Table 2. Comparison of cattle population and beef production in several countries

| Countries | Cattle population (heads) | Beef production (tonnes) | Sources |
|-----------|--------------------------|--------------------------|---------|
| Indonesia | 16,433,000               | 498                      | Dirjen PKH, 2019 [9] |
| Brazil    | 23,255,000               | 9,900                    | Kementan, 2018 [10] |
| China     | 96,850,000               | 7,325                    | Kementan, 2018 [10] |
| Australia | 25,500,000               | 2,300                    | Kementan, 2018 [10] |

The small body size of Bali cattle is generally related to genetic traits and environmental contribution effects such as feed quality and quantity as well. Suwiti et al. [11] reported that Bali cattle had low plasma bovine growth hormone levels (1.50±0.78 µg/ml) compared to other breeds (1.7-3.3µg/ml) [12, 13]. Growth hormone is well-known hormone responsible for animal growth.

The average beef production in Southeast Sulawesi increased 6.5% annually during 2013-2019, but there was a production decline in 2015 (17.4%) and 2019 (3.0%) (Figure 1). In 2013 and 2014 beef production reached 3,848,798 kg and 4,330,193 kg, respectively. While the number of slaughtered beef cattle in 2013 and 2014 were 22,979 heads and 25,637 heads, respectively [5]. The data indicated that the average of meat conversion of beef cattle in Southeast Sulawesi was only 168.2kg (one beef cattle produced 168.2 kg of meat) which was lower than national meat conversion (241kg).
3. Reproduction Aspects of Bali cattle

The increase of cattle population is an indicator of cattle productivity. The higher the increase in cattle population in a certain place, then the productivity of cattle in that place can be classified as good or high. Efforts to increase the population of cattle can practically be conducted by managing the birth of calves in which one cow should produce one calf per year. In fact, this is not easy to achieve due to several limiting factors, such as the availability of bulls in the field or the lack of artificial insemination (AI) technician. Consequently, cow with estrus cannot mate on time and should be waiting until the next estrus cycle for mating. Moreover, lack of knowledge of farmers about estrus sign which make the right time to join the cattle is elapse. Those factors could prolong inter calving interval of cow and finally could reduce the reproductive efficiency of herd. Several researches in Bali cattle reported that calving interval of bali cattle was 363-370 days [14], while gestation period ranged between 257-331 days [15].

The fertility of Bali cattle in Southeast Sulawesi is diverse because of several factors such as bull availability, nutrition, poor understanding of estrus sign, disease, etc. In the area where natural mating is dominant, the existence of bull is necessary. However, it was hard currently to have proven bull in the field because most of them were sold out for several reasons. The conditions have negative effect on genetic improvement of beef cattle because only males with low reproductive performance have the opportunity to mate the cow and produce calf with low productivity. Fortunately, in transmigration settlement that artificial insemination applied well or in area where Bali bull with good performance is always available, the fertility of Bali cattle is good, indicated by a short period of anestrus post parturition (40-60 days) or normal calving interval (12-13 months). Moreover, the cow of Bali cattle have long reproductive periods, she still has fair fertility up to 13-15 years of age (unpublished data). Moreover, Saili et al. (2018) [16] reported that service per conception of bali cattle which using artificial insemination and natural mating were 1.47 and 1.63, respectively. While inter-calving interval of these two mating system (AI and natural mating) were 12.96 months and 12.32 months, respectively.

The using of chilled sexed sperm through AI method has been also applied in bali cattle following synchronization. The results showed that 62.90% of cows showed estrus following synchronization, estrus post synchronization occurred at 71.73 hours following synchronization, and estrus quality was 2.5. There were 82.54% of inseminated cows was predicted to be pregnant after first insemination indicated by non return rate. However, only 73.02% could maintain the pregnancy up to calving. Whereas 78.26 % of newborn calf was male calf (Saili et al., 2017)[17].

![Figure 1. Dynamic of Beef Production (kg) in Southeast Sulawesi (2013-2019)](image-url)
4. Feed and Nutrition of Bali Cattle

The quality and quantity of feed consumed by cattle raised by people in Southeast Sulawesi are greatly influenced by the patterns of raising cattle. Cattle kept in extensive systems, the animal only consumed natural grass whose quality fluctuates and tends to below. While in the semi-intensive system, the cattle are tethered in the field where native grass available during day light and the animals are took back home, kept them in the pen and fed additional feed such as rice bran or tofu dregs. Some farmers also fed their cattle with elephant grass, setaria or king grass which have better quality than natural grass and some time they combine the natural grass with legume such as Gliricidia or Macroptilium. However, in general the daily intake has not reached the production requirement so that the growth of cattle is still low. This is confirmed by the average body condition score of cattle which are still below 3 (scale 1-5). Several field studies of Bali cattle reported that the daily body weight gain of Bali cattle kept in semi-intensive and intensive systems was only around 0.1 - 0.3 kg per day [18, 19, 20]. Our previous project on fattening of Bali bull using concentrate revealed that the average daily gain of Bali cattle could reach 0.66kg when Bali cattle fed an additional concentrate of 1 - 1.5% body weight per day.

Quigley et al. [2] reported that Bali cattle appear to have maintenance ME requirements comparable to other cattle species, based on the diets and class of animal in their experiment. However, the efficiency of use of ME for LWG was low. The experiment also indicated that Bali cattle unsuited to high input–high output finishing systems, particularly when alternative cattle breeds are available. Nevertheless, because of their small mature size and low absolute requirements for feed, Bali cattle are well suited to the low input–low output systems used by smallholder farmers, particularly cow-calf producers whose supplies of high-quality feeds are limited. The data demonstrated potential strategies to increase LWG within smallholder farming systems, such as the use of tree legumes and feeds of higher ME content. Further testing of the existing nutritional models for indigenous cattle species is warranted, as may be the development of models specific for these different species of animals and the production systems under which they are maintained.

Another experiment in which fermented cocoa pod was fed solely or in combination with rice bran showed a comparable result. Twenty-five male Bali cattle, 12 months of age and 118±3 kg (s.e.m.) live weight were used in this experiment. The results showed that Bali cattle can successfully be offered a diet containing cocoa-pods at 10gDM/ kg live weight/day but not ad libitum. Treatment of cocoa-pods with Aspergillus niger will result in a modest increase in average daily gain and feed intake above untreated cocoa-pods for this class of cattle. However, within the context of the smallholder crop-livestock system in eastern Indonesia it is unlikely that such a strategy would be adopted and sustained due to the additional labor requirements, costs involved and technology and training required. The use of Aspergillus niger to improve the feed value of low-quality feed resources available in Australia warrants investigation [21].

5. Conclusions

Some factors have contributed to the productivity dynamics of Bali cattle in Southeast Sulawesi Province but the quality and quantity of feed are still the main issue to be develop to meet good productivity of Bali cattle in Southeast Sulawesi. Farmer has to be advocated continuously to use productive grass instead of natural grass combine with legume to fed cattle in order to increase the daily gain of growing cattle and to maintain body condition score of cow. Moreover, reproduction management should be handled well by providing selected proven bull in each region and cross-breeding using artificial insemination in Bali cattle is applied only for producing commercial stock.

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