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Influences of Conventional Feeding Regimen on the Productivity of Bali Cattle in Samarinda

[1]Hamdi Mayulu, [1]Siti Maisyaroh, [1]Surya Nur Rahmatullah and [2]Irsan Tricahyadinata

[1]Department of Animal Sciences, Faculty of Agricultural, Mulawarman University, Indonesia
[2]Department of Management, Faculty of Economics and Business, Mulawarman University, Indonesia

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Corresponding Author:
Hamdi Mayulu
Department of Animal Sciences, Faculty of Agricultural, Mulawarman University, Indonesia
Email: hamdimayulu@unmul.ac.id

Abstract: The pattern of Bali cattle farming in Indonesia is dominated by traditional livestock systems which are identical to local feeding (without taking into account the needs of cattle. This study aims to determine the effect of conventional feeding on the productivity of Bali cattle in Lempake Village, North Samarinda Sub-district, Samarinda City. The study targeted male Bali cattle and measured chest circumference for body weight gain (BWG), Average Daily Gain (ADG), and feed weighing to obtain Dry Matter Intake (DMI) and feed efficiency. The data were analyzed using a multiple linear analysis with the help of a computer program SPSS to assess the correlation between productivity and the independent variables, namely X_1 = DMI; X_2 = BWG; X_3 = ADG; and X_4 = feed efficiency. The results showed that the samples had an average DMI, BWG, ADG, and feed efficiency of 16.54, 0.43, 0.43 kg/head/day, and 2.58%, respectively. The regression equation obtained was $Y = -1{,}974+0{,}005X_1-0{,}0559X_2+ 11{,}685X_3+ 1{,}1287X_4$ and the coefficient of determination revealed that all the variables had a 90.6% effect on Bali cattle productivity. Bali cattle had a productivity value of 1.85, which shows that the fattening business was profitable or economically feasible.

Keywords: Bali Cattle, Conventional Feed, Productivity

Introduction

Beef cattle is a large ruminant commodity that is widely reared to meet the animal protein needs of the community (Greenwood, 2021). Meanwhile, Bali cattle are Indonesian native livestock, which are in great demand because of their easy adaptability to macroclimatic conditions environment, high carcass percentage (Santi *et al*., 2021), and efficient use of feed (Muhamad *et al*., 2021). They are advantageous by feeding efficiently to carcasses (Santoso and Prasetiyono, 2018), but this must be supported by proper management (Tahuk *et al*., 2021). The pattern of Bali cattle farming in Indonesia is dominated by conventional livestock systems, which contributed to low productivity (Muhamad *et al*., 2021).

This system is closely related to local feeding without considering the animal's needs (Hanayanta *et al*., 2017). Furthermore, the availability of feeds used often fluctuates and is influenced by seasonal variations (Alemneh and Getabalew, 2019), consequently, their quality and quantity are uncertain (Makkar, 2004; Wanapat and Rowlinson, 2007). These conditions harm cattle productivity. The provision of adequate quality feed is expected to increase the productivity of Bali Cattle (Muhamad *et al*., 2021), which can be assessed using Dry Matter Intake (DMI), Body Weight Gain (BWG), Average Daily Gain (ADG) and feed efficiency. Therefore, this study aims to determine the productivity of Bali cattle fed with conventional feed. This study aims to determine the effect of conventional feeding on the productivity of Bali cattle.

Methods

Time and Location of the Study

This study was carried out from March to May 2021 in Lempake Village, North Samarinda Sub-district, Samarinda City, East Kalimantan. Furthermore, dry matter and moisture content analyses were performed at the Chemical and Biochemical Laboratory of Agricultural Products, Department of Agricultural Products Technology, Faculty of Agriculture.

Materials and Equipment

The materials used include forages i.a *Eleusine indica (Belulang grass)*, *Hymenachne amplexicaulis* (*Kumpai)*,

Maize stover, and *Pennisetum purpurreum*) and additional feed samples (soybean curd waste and mung bean skin) (Table 1). The equipment used consists of a measuring tape with a sensitivity level of 0.1 cm, scales, stationery, and a camera for documentation.

The Rearing Microclimatic Conditions of the Male Bali Cattle

Male Bali cattle as the object of research (60 heads >2.5 years old) are kept traditionally with an intensive maintenance system. The enclosure system applies an open cage construction with temperatures ranging from 28.2-36.20^{0}C, average humidity of 74%, using an asbestos roof, wooden walls, concrete floor construction, having natural ventilation (relying on the wind), the natural lighting system (using sunlight at during the day) and artificial (using lights at night), equipped with a smooth drainage system and cleaning the cage twice a day (morning and evening). Bali cattle are given drinking water ad libitum and feed (fresh forage and additional feed in the form of tofu dregs and mung bean shells) is given gradually with a frequency of three times a day, namely in the morning, afternoon and evening or according to the availability of feed and the ability of farmers to provide feed.

Data Collection Methods

The data consists of primary and secondary data. Primary data were collected through a survey method with interviews and observation of the cattle farmers, while secondary data were obtained from relevant institutions, such as Statistics Agency in Samarinda City.

Feed Consumption Intakes

The feed intake and the remnants were weighed daily to calculate the amount of feed consumption (in DM) using a formula approach (Hanayanta *et al*., 2017):

$$DM\ intake = \frac{DM}{100} \times Feed\ Consumption(kg) \quad (1)$$

The water contents measurement and/or fresh forage drying were carried out in two stages. The first involved wind drying where the samples were dried to a constant weight and the forage obtained was then used for water analysis at 105°C for 4 to 6 h (Ahadi and Effendi, 2019). A formula approach was used to calculate the water content:

$$Moisture\,content(MC) = \frac{(A-B)}{C} \times 100\% \quad (2)$$

where:
A = Initial empty grail weight
B = Grail weight after drying and
C = Sample weight

The equation used to determine the DM of the samples (Bashir *et al*., 2017) was as follows:

$$DM = (100 - MC) \quad (3)$$

Body Weights

The Body Weights (BW) of Bali cattle were calculated (Kusuma *et al*., 2017) as follows:

$$BW = \frac{(CC+22)^2}{100} \quad (4)$$

where:
BW: BodyWeight (kg) with rondo measuring tape and
CC : Chest circumference (cm) (Fig. 1)

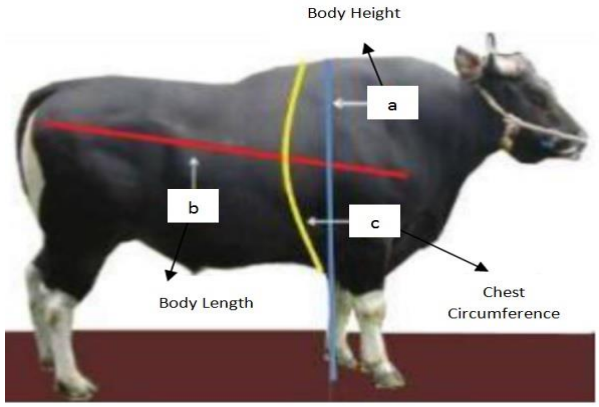

Fig. 1: Method for chest circumference measurement in Bali Cattle (Reconstructed from Suwiti *et al*., 2022)

Table 1: Dry matter and moisture contents

	Amount	
Feeds	MC (%)	DM (%)
Eleusine indica(Fresh)	15.12	84.88
Eleusine indica (Leftover)	15.53	84.47
Pennisteum purpurreum(Fresh)	15.00	85.00
Pennisetum purpurreum (Leftover)	13.37	86.63
Maize stover (Zea mays) (Fresh)	14.36	85.64
Maize stover (Zea mays)(Leftover)	14.08	85.92
Hymenachne amplexicaulis (Rudge) Nees (Fresh)	13.86	86.14
Hymenachine amplexicaulis (Rudge) Nees (Leftover)	15.27	84.73
Soybean curd waste	87.66	12.34
Mung bean skin	66.67	33.33

Source: Chemical and biochemical laboratory of agricultural products, 2021

Daily Body Weight Gains

Daily body weight gains were determined by weighing the samples before (initial) and after (final) treatment, then calculated (Mayulu *et al.*, 2021) as follows:

$$ADG = \frac{W_2 - W_1}{t} \quad (5)$$

where:
W_1 = Initial body weight (kg),
W_2 = Final body weight (kg) and
t_1 = Observation duration (30 days)

Feed Efficiency

The feed efficiency was calculated by dividing the pre-measured body weight gain (BWG) by total feeds consumption and multiplying by 100% (Wati and Yusuf, 2020) as follows:

$$Feed\ Efficiency(\%) = \frac{BWG}{Dry\ Matter\ Intake} \times 100 \quad (6)$$

Sampling

The sample population consists of 60 heads from 30 respondents with the assumption that they were Bali cattle and the minimum ownership was 2 heads.

Data Analysis Methods

The data were analyzed using a multiple linear analysis with the help of a computer program Statistical Package for the Social Sciences (SPSS) to determine the correlation of the independent variables.

The multiple linear regression formula (Sugiyono, 2017) was as follows:

$$Y = a + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + e \quad (7)$$

where:
Y = Productivity
X_1 = Feed consumption
X_2 = BWG
X_3 = ADG
X_4 = Feed efficiency
a = Constant
b = Regression coefficient and
e = Error

Results and Discussion

Dry Matter Intake of Bali Cattle

Dry matter is the total amount of ingredients in a feed without moisture (Mayulu *et al*., 2021) and is the basic unit for determining the number of nutrients while formulating a ratio (Seymour *et al*., 2019). Furthermore, it can act as a gastric filler, a stimulant for the digestive tract walls, and helps to strengthen enzyme formation (Mayulu, 2015). Dry matter intake is used to determine cattle performance (Vazquez and Smith, 2000) and it is a key variable in assessing feed efficiency (Seymour *et al*., 2019). The majority of Bali cattle in Lempake Village were fed with *Eleusine indica (Belulang grass)*, *Hymenachne amplexicaulis* (*Kumpai)*, Maize stover, and *Pennisetum purpurreum*, soybean curd waste, and mung bean skin, but the forages are often administered during the late maturity stages. This contributed to increased feed's crude fiber contents, consequently, the forage quality was lowered. The quantity, quality, and adequacy of feed nutrients (forage) affect the productivity and efficiency of the beef cattle business (Flaten *et al*., 2019; Barbero *et al*., 2020).

The average DMI of Bali cattle in Lempake Village was 16.54 kg/day (5.3%) out of 311.15 kg (Fig. 2). Dry matter intake is influenced by energy requirements, the number of feeding, and the feed's nutritional contents. Mayulu *et al.* (2021) stated that the ability of beef cattle to consume DMI is closely related to the physical capacity and condition of the digestive tract. The current results showed that the DMI was lower compared to that of samples fed with Napiergrass and Maize stover, namely 23.35 kg/head/day (Mayulu *et al*., 2021). The standard dry matter requirement for male Bali cattle is 3% of body weight (Tahuk *et al*., 2021), hence, the value obtained was very sufficient. Adequate DM intake can meet their organic materials needs and serve as a source of energy (Mayulu *et al*., 2021).

Body Weight Gains of Bali Cattle

The efficiency of beef cattle fattening efforts can be assessed based on body weights because it is related to their ability to utilize feed consumption (Mayulu *et al*., 2021). Good absorption increases the productivity of Bali cattle and carcass yields.

The growth of Bali cattle was characterized by an increase in their size and body weights. Body weight gain on reached 324.15 kg (observation 30 days) (Fig. 3).The average BWG of samples was 13 kg/head/30 days, which was similar to the average of 13.2 kg/head/30 days obtained from others fed with Napiergrass and Maize stover (Mayulu *et al*., 2021). However, it was higher compared to that of cattle fed with forages where a value of 6 kg/head/30 days was recorded (Sari *et al*., 2016).

Feed quality and availability are assumed to be the main factor affecting the BWG of Bali cattle because weight gains are closely related to the nutritional value of feed and the level of digestibility (Mulia *et al*., 2015). Other influencing factors include breeds, age, sex, environment, and management, which cause variations in cattle growth (Damayanti *et al*., 2018). Aside from the DM intakes, the BWG was also influenced by the feed's

quality and its nutritional value affects the microbial growth indigestion as high fiber content affects consumption and digestibility (Riswandi *et al*., 2020). Conventional feeding in the form of grass along with agricultural by-products with low nutritional value (high crude fiber) often causes low BWG (Baco *et al*., 2019). Different weight gains are related to the body's response to the feed given (Hafid, 2021).

Average Daily Gain of Bali Cattle

Average daily gain is the growth in body size measured based on the increase in weight during the observation time (30 days) expressed in kilograms (Mayulu *et al*., 2021). It is also the parameter used to measure and determine livestock growth (Tahuk *et al*., 2018). Furthermore, achieving the ADG level is an indicator of success in feed management (Mayulu *et al*., 2021).

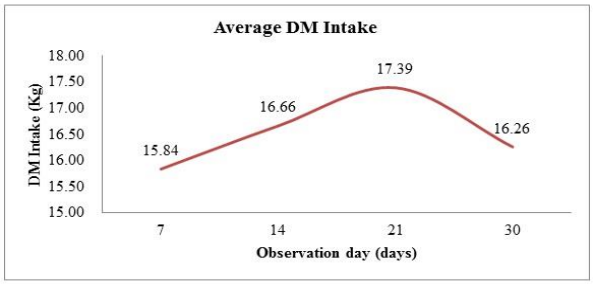

Fig. 2: Average dry matter intake of Bali cattle

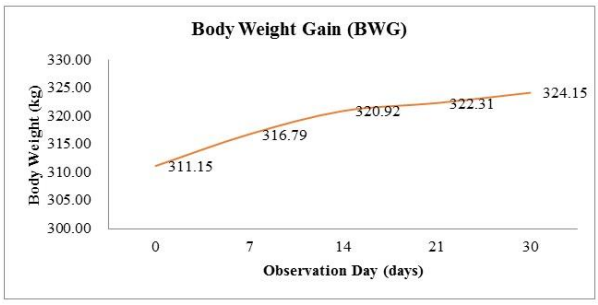

Fig. 3: Body weight gain of Bali cattle

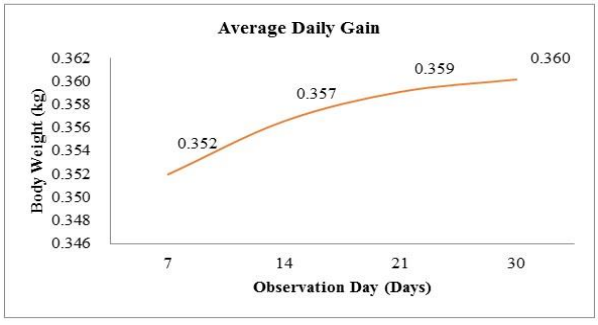

Fig. 4: Average daily gain of Bali cattle

An ADG value of 0.43 kg/head/day (Fig. 4) was obtained from Bali cattle fed with conventional feed, which was higher compared to others fed with field grass (0.29 kg/head/day) with a DM intake of 7.02 kg/head/day (Pribadi, 2015)

However, it was lower than that fed with Napiergrass and corn stover with an average DM intake of 23.35 kg/head/day where a value of 0.44 kg/head/day was recorded (Mayulu *et al*., 2021). The daily body weight gains were influenced by the amount and type of feed consumed (Hanayanta *et al*., 2017). Variation in ADG is related to the energy contents of the feed provided (Mayulu *et al*., 2021).

Feed Efficiency of Bali Cattle

Average feed efficiency of 2.58% was obtained from Bali cattle fed with conventional feed, indicating that every 1 kg of dry matter consumed produces a weight gain of 0.0258 kg. Furthermore, the results showed that the value recorded was low because a normal feed efficiency ranges from 7.52-11.29% (Hendri *et al*., 2014). The low value was caused by low conventional feed quality and the BWG (Usman *et al*., 2013). This indicates that the level of feed consumption was high but the BW produced was low. The DM and the type of feed given were sufficient to meet the cattle's needs but did not produce a high BW. Feed efficiency was influenced by the amount of DM in feed and the ability of livestock to utilize it (Damayanti *et al*., 2018).

Productivity of Bali Cattle

Productivity is influenced by genetic and environmental factors (Santoso and Prasetiyono, 2018). Several production performance indicators are used to assess Bali cattle productivity including live weights and body weight gain by measuring all factors used. Furthermore, an average value of 1.85 (>1) was obtained, indicating that the productivity of samples fed with conventional feed-in Lempake Village was in a good category. In business feasibility, when Revenue Cost Ratio (R/C) >1, this implies that the fattening business is profitable or economically feasible. The value obtained showed that conventional feeding in the Village can meet Bali cattle nutrient requirements and increase their production values, but it was not optimal due to low feed efficiency.

The productivity in the tropics is influenced by the quality and quantity of feed, especially forage (Costa *et al*., 2021). The availability of sufficient feed is closely related to increased production (Cordeiro *et al*., 2022) as it is one of the main inputs in beef cattle production costs (Benedeti *et al*., 2021). Conventional feeding by prioritizing forage is expected to reduce production inputs because the feeds are easy to obtain at a low price. The maintenance system can also affect the level of products produced. The productivity of cows with conventional

rearing, which involves carrying out fattening as a side business is one of the breeder's limitations while providing quality feed cause low body weight produced.

A determination coefficient (R^2) of 0.906 was obtained, which indicates that the consumption variables of DMI (X_1), BWG (X_2), ADG (X_3), and efficiency (X_4) were responsible for the 90.6% productivity, while variables outside the research parameters accounted for the remaining 9.4%. Furthermore, all the variables had a very significant ($p<0.01$) effect on productivity. X_1, X_2, and X_4 partially have a significant ($p<0.05$) effect on productivity, while X_3 has a full significant ($p<0.05$) effect.

The dry matter intake is an important variable that can be used as a performance index in a fattening system because it is closely related to ADG and carcass weights. The results showed that X_1 had an effect on the productivity of Bali cattle with significance ($p<0.05$) and coefficient values of 0.008 and 0.151, respectively. This indicates that when the consumption of dry matter increases by 1 kg, productivity increases by IDR 0.151. Stated that daily DM consumption in a fattening system has a potential effect on cattle performance.

The results also showed that an increase in body weights (X_2) had an effect on productivity with significance ($p<0.05$) and coefficient values of 0.006 and -0.560, respectively. This indicates that when body weights increase by 1 kg, productivity decreases by IDR0.560. The BW obtained was influenced by the ability of livestock to absorb feed nutrients to produce weight gains (Gustiani and Permadi, 2015), thereby leading to an increase in productivity.

The daily BWG of cattle has a genetic correlation (Olsen *et al*., 2020) and is influenced by feed intake (Marchesini *et al*., 2018). The results showed that ADG (X_3) had an effect on productivity with a significance ($p<0.05$) value of 0.049. High daily BWG indicated that the livestock is undergoing good growth, which has a positive effect on productivity. The coefficient of X_3 obtained was 11,685, which indicates that when ADG increases by 1kg, productivity also increases by IDR 11,685.

Feed efficiency is a complex multifaceted trait that is controlled by various biological processes (Kenny *et al*., 2018). Furthermore, it is related to feed intake and digestive mechanisms, such as feeding behavior, digestion, and rumen microorganisms (Cantalapiedra-Hijar *et al*., 2018). The results showed that it had an effect on productivity with a significance value of 0.000. It can also be used to determine the ability of feed to produce body weights (Wiyatna *et al*., 2012). The feed efficiency (X_4) of Balinese cattle fed conventional feed was 1,287, which indicates that when it increases by 1%, productivity increases by IDR 1,287.

Conclusion

Conventional feeding affects the productivity of Bali cattle in Lempake Village. The study showed that the targeted animals had an average DMI, BWG, and ADG of 16.54, 0.43 kg/head/day, and 2.58%, respectively. A feed efficiency of 2.58% was also obtained, which indicates that every 1 kg of DMI produced a weight of 0.0258 kg. Bali cattle had a productivity value of 1.85, which shows that the fattening business was profitable or economically feasible.

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Author's Contributions

Hamdi Mayulu: Designed research, funding, investigation, project administration, writing, and revision from the original draft.

Siti Maisyaroh: Assisted in collecting data in the field including weighing feed and analysis in the laboratory.

Surya Nur Rahmatullah: Verify the data.

Irsan Tricahyadinata: Verify data and analyze statistical data.

Ethics

The research was carried out on farmers by taking feed without disturbing the comfort of livestock. Body weight was measured using a measuring tape and calculated using the Schroll formula, in general, this study did not have a negative impact and disturb the comfort of livestock. This research has referred to the international protocol The ARRIVE guidelines (Animal Research: Reporting of In Vivo Experiments) NC3Rs: National Center for the Replacement Refinement & Reduction of Animals in Research".

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