Analysis of factors affecting to the income of Bali cattle farmers in Barru Regency, South Sulawesi Province, Indonesia

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Abstract. South Sulawesi is an area of development of native Bali cattle in Indonesia. Bali cattle farming are playing an essential role in supporting the economy of household farmers. This research aimed to analyze the factors that affect to the income of Bali cattle farmers. The study was conducted from June to September 2019 in Barru regency, South Sulawesi province, Indonesia. The total number of respondents was 121 farmers, including 75 respondents on the Bali cattle breeding enterprise and 46 respondents on the fattening enterprise. Data were analysed by using descriptive statistics, while determining the factors that affect to income using Multiple Linear Regression. The results showed that factors affecting to the income of farmers were the number of Bali cattle ownership and the dummy for non-formal education (livestock training). The factor that negatively affects was the dummy for the cattle production system. Improvement in calving interval of cows parameter and average daily weight gain of bulls can increase income. Manure utilization can generate more revenue. This study suggested that the government provide more variety and more frequent livestock training and procurement of cows and bulls.

1. Introduction
Bali cattle are mainly playing a vital role in smallholder beef farming enterprises, including investment opportunities, alternative source of income, employment for the rural populations, and as a business enterprise to generate income [1,2]. Bali cattle are Indonesian native cattle that can produce high carcass, mostly bull Bali cattle [3,4]. Bali cattle have a high ability to convert low quality feed, have good quality meat with a high protein percentage, well adapted to the tropics, have the ability bodyweight to grow fast, and have antibodies against dangerous diseases such as Jembrana [5,6]. Bali cattle are spread over 26 provinces in Indonesia, especially in South Sulawesi, NTT, NTB, Lampung, Central Sulawesi, South Kalimantan, West Kalimantan, and East Java [7]. However, the Bali cattle population in 2008–2015 decreased both in population and genetic quality [8].
The government policy mandates Barru regency, South Sulawesi province, as a strategic development area for the Bali cattle breed that needs support in ensuring beef cattle farming sustainability. Also, Barru regency, as one of the village breeding centers and the Superior Livestock Breeding and Livestock Forage Center of Denpasar (BPTU-HPT Denpasar) in Bali Province in Bali province, focuses not only on breeding but also on fattening as a producer of superior beef cattle and has a high selling price [9]. Beef cattle production on smallholder farmers in Barru regency can be classified into two major systems: breeding and fattening Bali cattle farming systems.

Beef cattle farming systems are a way of rearing cattle for getting profitable from live-cattle and meat production. Nevertheless, many farmers are still developing beef cattle farming as savings that cattle can be sold at any time to fulfill household needs [10,11]. The success of beef cattle enterprises is generally seen by loss and profit. Therefore, income has become the main objective in every beef farming system.

Although there are many constraints to develop Bali cattle, the rising demand for beef presents farmers opportunities to raise income. The previous studies showed that the raised income was not only affected by the prices of production inputs but also by socio-economic characteristics of farmers [12,13]. This paper is concerned with two forms of type cattle production, including breeding and Bali cattle fattening. This research aims to analyze the factors that affect the income of Bali cattle farmers in Barru regency, South Sulawesi province, Indonesia. Identifying these factors provides recommendations for farmers, farm managers, and government policy to increase the income of Bali cattle farmers.

2. Research method

2.1. Study area

The study was conducted from June to September 2019 in Tanete Riaja district, Barru regency, South Sulawesi province. Tanete Riaja district was selected as a study area based on recommendations and a list of household smallholder Bali cattle production from data Agriculture Services of Barru regency. The administrative and extension officers in the study areas were accompanied during data collection. The total number of respondents was 121 farmers. Bali cattle breeding enterprises' selection criterion was that the household kept two cows for cow-calf production, where all of the 75 respondents were interviewed. Selecting Bali cattle enterprises used the criterion that the household fattened two bulls. Forty-six farmers were selected with different lengths of the fattening period: 11 farmers fattened Bali cattle for six months, and 35 others fattened Bali cattle for nine months.

2.2. Data collection

This research used interviews which can be guided by questionnaires to collect information from the farmers. It included questions on respondents' characteristics, composition and Bali cattle herd size, production and reproduction performance of Bali cattle (service per conception, calving interval, initial and selling live weight estimation, average daily gain), and economic variables (cost of inputs and outputs).

2.3. Data analysis

Data analysis was done by descriptive and quantitative. Descriptive analysis was used to explain the characteristics of respondents. Quantitative analysis was used to analyze farmers' income and determine socioeconomic factors that affect the farmers' income by using multiple linear regression model. Equations of the model can be written as follows:

\[ Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + D_1 + \beta_3 X_3 + D_2 + D_3 + \beta_4 X_4 + \mu \]
Y = Farmers’ income (IDR/farmer/year)
α = intercept
β₁ …β₄ = regression coefficient
X₁ = Bali cattle ownership (AU)
X₂ = formal education (score)
1 = none
2 = elementary school
3 = junior high school
4 = high school
5 = college
X₃ = experience of keeping cattle (year)
X₄ = member of household (person)
D₁ = dummy of non formal education
1 = follow of training
0 = unfollow
D₂ = dummy of cattle production systems
1 = breeding
0 = fattening
D₃ = dummy of land rent
1 = land rent
0 = no land rent
μ = stochastic disturbance term

3. Results and discussion

3.1. Characteristics of respondents and herd size
Table 1 gave an overview of the characteristics of respondents for breeding and fattening Bali cattle enterprises.

| Items                              | Breeding          | Fattening         |
|-----------------------------------|-------------------|-------------------|
| Education level                   | Frequency | % | Frequency | % |
| - None                            | 3          | 4.00 | 2          | 4.35 |
| - Primary school                  | 35         | 46.67 | 14         | 30.43 |
| - Junior school                   | 12         | 16.00 | 8          | 17.39 |
| - Senior High school              | 18         | 24.00 | 18         | 39.13 |
| - College                         | 5          | 6.67  | 2          | 4.35 |
| Member of household (person)      | 4.24±1.43  | 4.00±1.89       |
| Experience on keeping cattle (year) | 11.97±6.27 | 12.57±7.82     |
| Main occupation                   | Frequency | % |       | % |
| - Farmer                          | 71         | 94.67 | 42         | 91.30 |
| - Teacher                         | 1          | 1.33  | 2          | 4.35 |
| - Entrepreneur                    | 3          | 4.00  | 2          | 4.35 |
| Forage land size (hectare)        | 0.33       |       | 1.02       |
The level of education can affect the ability to manage Bali cattle production. The level of education in fattening enterprises farmers were dominanted by graduated from senior high schools (table 1). The condition indicated that fattening enterprises using beef production is more complicated than breeding enterprises.

The member and structure household of farmers contribute to the operation of Bali cattle activities. Operation activities included: feed the cattle, clean the pens, and so on. The forage land size on breeding Bali cattle enterprises was 0.33 hectares. The forage land size at fattening enterprises were broader because they required high feed input. In Vietnam, farmers who increased forage land indicate decreased labor and improved cattle production performance [14].

Farmers running Bali cattle breeding enterprises have an average of 2.75 ± 0.92 heads of Bali cows (table 2). With these of Bali cows, farmers sold calves off weaning (young bulls) every year. The sale of calves increased family income and limit the herd in Bali cattle ownership. Farmers limited Bali cattle ownership to specific head numbers so that the time and cost of keeping Bali cattle were not too high. Every year, the sales of young bulls made the number of beef cattle of farmers stable from year to year [11]. Meanwhile, in fattening enterprises, Bali cattle's average ownership was 4.13 ± 3.49 heads or 2.48 ± 2.10 AU. All of them were young bulls as feeder cattle. Young bulls have the potential for rapid weight growth, making them suitable for fattening enterprises that prioritize rapid weight gain in a short period.

Table 2. Composition and herd size of Bali cattle

| Herd composition | Breeding | Fattening |
|------------------|----------|-----------|
|                  | Head     | AU        | Head     | AU        |
| Adult            |          |          |          |          |
| - Cow            | 2.75±0.92| 2.75±0.92| -        | -        |
| Young            |          |          |          |          |
| - Bull (feeder cattle) | -      | -        | 4.13±3.49| 2.48±2.10|
| Calf             |          |          |          |          |
| - Male           | 0.81±0.80| 0.20±0.20| -        | -        |
| - Female         | 1.01±0.89| 0.25±0.22| -        | -        |
| Bali cattle ownership/farmer | 4.57±1.77| 3.20±1.05| 4.13±3.49| 2.48±2.10|
| Total Bali cattle | 343.00  | 240.25  | 190.00  | 95.00    |

Calf: 1-11 months, young: 12-24 months, mature: >24 months, AU = animal unit

3.2. The performance reproduction and production Bali cattle and income analysis of farmers

The technical parameters of breeding Bali cows include d service per conception (S/C) was 1.39 times, not too different from the research from Bamualim and Wirahayati (2005) was 1.49 times [15]. This value of S/C was standard because of the massive services of Artificial Insemination on Barru regency [16,17]. The Calving Interval (CI) of cows was 16.31 months. This value was longer than the ideal standard of CI Bali cattle was 14–15 months [18,19]. The high time of CI indicated a deficiency of protein and energy in the feed. The finding of calf mortality was 7.43% lower than the research of [20] was 8-9% lower. Meanwhile, Bali cattle's production parameters included the average initial weight of the feeder cattle was 111.76 kg/head. This weight was greater than the standard bodyweight required by Guntoro (2002), which was 110 kg/head [21]. The results of the average daily weight gain (ADG) was 0.41 kg/day, and the selling weight was 264.65 kg/head, lower than the standard of Suwita et al (2013) was 0.8 kg/day and the selling weight of 275-300 kg/head [22].
Overall, the technical parameters of production in the Bali cattle breeding enterprise have met the ideal standard. In contrast, in fattening enterprises, it was necessary to improve ADG to increase farmers' income. In general, feeding Bali cattle systems in South Sulawesi province was tethered grazing and the cut-and-carry feed [2]. Consequently, production performance was lower than Bali cattle in Bali province that applies intensive feeding [23]. This condition made many farmers rent land to plant forage (elephant grass) because feed forage significantly increased body growth and weight gain.

Table 3. The income of Bali cattle breeding and fattening enterprises in Barru regency (IDR/farmer/year)

| Parameters                  | Number | Breeding       | Fattening 6 months | Fattening 9 months |
|-----------------------------|--------|----------------|--------------------|--------------------|
|                             |        | Cost           | Total              | Cost               | Total              | Cost               | Total              |
| Investment costs            |        | 18,062,509     | 5,826,819          | 2,083,116          |
| - Pens (unit)               | 1      | 1,670,000      | 1,670,000          | 5,168,181          | 5,168,181          | 1,651,143          | 1,651,143          |
| - Equipments (pkg.)         | 1      | 321,080        | 321,080            | 658,638            | 658,638            | 431,973            | 431,973            |
| - Cow (head)                | 3      | 5,357,143      | 16,071,429         |                    |                    |
| Production costs            |        | 5,564,350      | 71,790,514         | 27,234,472         |
| - Feed (pkg.)               | 1      | 2,989,409      | 2,989,409          | 7,513,427          | 7,513,427          | 2,100,288          | 2,100,288          |
| - Labor (man-days)          | 71/188/83 | 33,000        | 33,000             | 619,650            | 619,650            | 27,41,062          | 27,41,062          |
| - Health care (pkg.)        | 1      | 44,226         | 44,226             | 166,182            | 166,182            | 58,257             | 58,257             |
| - Land rent (pkg.)          | 1      | 130,667        | 130,667            | 136,364            | 136,364            | 192,857            | 192,857            |
| - Electr. & water (pkg.)   | 1      | 55,728         | 55,728             | 115,167            | 115,167            | 47,246             | 47,246             |
| - Loan                      |        | 9,985,455      | 9,985,455          | 2,428,095          | 2,428,095          |
| - Feeder cattle (head)      | 8 and 3 | 5,959,677     | 5,959,677          | 47,677,419         | 47,677,419         | 6,555,556          | 6,555,556          |
| Total cost                  |        | 23,626,859     | 77,617,333         | 29,317,588         |
| Revenue                     |        |                |                    |                    |
| - Selling calf (head)       | 3      | 4,670,000      | 14,010,000         |                    |
| - SLV of cow (head)         | 3      | 7,750,000      | 23,250,000         |                    |
| - SLV of pens (head)        | 1      | 171,806        | 171,806            | 521,364            | 521,364            | 137,343            | 137,343            |
| - Selling bull (head)       | 8 and 3 | 11,477,273    | 91,818,184         | 12,140,000         | 36,420,000         |
| Total revenue               |        | 37,431,806     | 92,339,548         | 36,557,343         |
| Income                      | 13,804,947 | 14,722,215    | 7,239,755          |

Fattening enterprises generated income of IDR 14,722,215/farmer/year for fattening Bali cattle for six months, while fattening Bali cattle for nine months generate income of IDR 7,239,755/ farmer/year. The total income from the fattening of Bali cattle for six months was due to sales of bulls as much as four heads/period, of which in one year, there were two periods. The total income of farmers in the two types of long fattening period Bali cattle can be increased if it increased the revenue item from manure. Economically, the farmer's income increased if the farmers sold manure and used manure and urine as fertilizer [24,25].

Breeding enterprises generated an income of IDR 13,804,947 farmer/year. This amount of income was close to the amount of income generated from fattening the Bali cattle for six months. Apart from the fact that farmers in this enterprise have more number ownership of Bali cattle, it was also because
Bali cattle's reproduction performance was at an ideal standard. To maintain the ideal standard of reproductive performance, especially the CI of Bali cattle, farmers needed continuous artificial insemination services [26].

3.3. Factors affecting to the income of Bali cattle farmers

Multiple linear regression analysis using Eviews software version 7.0 showed that the adjusted R-square value was 0.7397 (table 4). This value means the independent variables, including the number of Bali cattle, the level of formal education, the dummy for non-formal education, experience on keeping cattle, the dummy for cattle production, the dummy for land rent, and the number of household members had an effect of were 73.97%. Other factors were influenced by other independent variables that were not included in the estimation model. The independent variables that have a positive effect on income were the Bali cattle ownership (P<0.01) and the dummy for non-formal education (P<0.05). In contrast, the dummy for cattle production (P<0.01) was affected dependent variable negatively.

| Independent variable                        | Coefficient | Std. Error | t-Statistic | Prob   |
|--------------------------------------------|-------------|------------|-------------|--------|
| Constanta                                  | -2518549.   | 5623175.   | -0.447887   | 0.6551 |
| Bali cattle ownership (X1)                 | 4999598.    | 434303.8   | 11.51175*** | 0.0000 |
| Formal education (X2)                      | 1785858.    | 1041369.   | 1.714913    | 0.0891 |
| Dummy of non-formal education (D1)         | 5849098.    | 2843572.   | 2.056954**  | 0.0420 |
| Experience on keeping cattle (X3)          | 19487.07    | 158181.0   | 0.123195    | 0.9022 |
| Dummy of cattle production (D2)            | -18213351   | 2361862.   | -7.711436***| 0.0000 |
| Dummy of land rent (D3)                    | -4241973.   | 3381498.   | -1.254466   | 0.2123 |
| Member of household (X4)                   | 75954.38    | 682639.2   | 0.111266    | 0.9116 |

The number of Bali cattle raised by farmers affected the income of the farmers. Thus, farmers in the breeding enterprise need to increase the number of cows, while fattening enterprises with the addition of feeder cattle. However, the increase in the number of Bali cattle required additional capital and forage land area. The non-formal education was followed by the farmers, namely livestock training. Several kinds of livestock training include processing and preserving feed, Bali cattle's reproductive health, and cattle production management.

4. Conclusions

The factors that affect the farmers' income were the number of Bali cattle ownership and non-formal education (livestock training). Production and reproduction parameters, including calving interval of cows and the average daily gain of bulls, should be improved. The use of manure can generate more revenue. Reducing the length of the fattening period for farmers who fatten Bali cattle for nine months was recommended to be six months per period. The government should provide more frequent training in cattle production management to farmers, procurement of cows and bulls, and training on manure utilization.
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