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Research Article

Comparative Study of Production Performance and Income of Bali Cattle Farmers at Different Altitudes and Maintenance Typologies

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Abstract | This research aims to evaluate the productivity of Balinese cattle maintained at various elevations and assess farmer income levels across various rearing system typologies. The study was carried out in the North Central Timor Regency, province of East Nusa Tenggara, in the sub-districts of West Miomaffo, Central Miomaffo, Insana, North Insana, Biboki Moenle'u, and Biboki Anle'u between April 2023 to October 2023. 285 Balinese cattle, including 82 calves, 105 weaned beef cattle, and 98 heifers. This research used mixed methods to obtain qualitative and quantitative data, a survey was conducted by 180 breeders from 18 respondent groups. Respondents must meet two requirements: have raised Bali cattle for at least five years and own at least three cows. A basic random sampling technique was employed to identify the sample, which involved selecting sample members randomly from among farmer respondents in six sub-districts without considering strata. The findings demonstrated that Balinese cattle raised in highland areas performed better in production and differed significantly from those raised in lowland areas. With average birth weights of 14.70 (cow calf) and 16.21 (bull calf), for weaning weights of 107.43 (cow calf) and 109.37 (bull calf), and for the weight of mothers aged > 4-5 years, 248.11 the income of cattle breeders is greatest for breeders with the TDKT system reach IDR 7,137,737.00, followed by the SIMK system, which the breeder's income amounting to IDR 5,377,735.00, the SLMK system provides an income of IDR 4,692,278.00, and finally, the TDSM system only provides an income of IDR 3,272,054.00.

Keywords | Production performance, Farmer income, Bali cattle

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INTRODUCTION

The cattle industry is a strategically significant and growing source of animal protein. This is consistent with rising per capita consumption and demand for livestock products (Tahuk and Bira, 2020). The rising demand for livestock products is also partly due to changes in consumption patterns and ways of life. High-protein foods like burgers, roast beef, and other processed meat items are preferred by modern consumers. Dairy items like cheese and yoghurt are likewise becoming more and more common in modern diets. The livestock sector has grown due to changes in eating patterns and lifestyles (Sikone *et al*., 2022). Aside from that, rising income levels across the board also make a substantial contribution. Livestock products are more readily available in higher-income communities and are typically more expensive than plant-based protein substitutes. This causes increased demand for livestock products, particularly dairy, beef, and chicken (Setiaji *et al*., 2017). In this regard, the livestock industry is

essential to supplying the world's growing need for animal protein. The long-term sustainability of animal production also heavily depends on developing ecologically responsible and sustainable agricultural technologies. Livestock must continue to evolve and adapt to satisfy the increasingly complicated demands of consumers, as this sector is being driven by several variables (Saptana and Daryanto, 2013). Beef demand in Indonesia is supplied by local cattle, BX (Brahman cross) cattle, and frozen meat (Faturokhman *et al*., 2015). Domestic beef production in 2023 was recorded at 442,783 tons, with an estimated demand for beef reaching 695,390 tons; this figure shows that Indonesia's beef production is still low. Food needs (36.33%) require more strenuous efforts to increase the supply of local cattle production. According to data released by the Directorate General of Animal Husbandry, the population of beef cattle in Indonesia is only 63.67% of the beef cattle in the country, so to meet the national shortage, it has now reached 18,6019,247 heads, with the largest group of beef cattle being cattle. Bali, namely 4.8 million heads (32.31%), contributes 26.92% compared to other cattle breeds (Ditjen, 2023).

Livestock-based agribusiness proliferates when the land base becomes limited, and demands for integrated farming systems become increasingly rational, along with demands for efficiency and effectiveness in land use. The pattern of integration or diversification of crops and livestock (especially ruminant livestock) is expected to become an integral part of dry-land farming businesses (Kusuma *et al*., 2017). The primary approach to developing cattle farming areas is integrating with other rural farming businesses, both plantations and food crops (Rosyid and Rudiarto, 2014). In order to ensure that the many branches of the farmer's household farming company have a close-knit, mutually beneficial, and profitable relationship, alignment with the area's traits and potential is necessary. It is anticipated that using food crop by-products as the foundation for animal feed will provide direct and indirect value (Amirudin, 2017). Using natural resources in the animal husbandry industry is one solution that can be used to solve food problems, especially animal food. This is because Indonesia's geographical location is ideal for developing the beef cattle agribusiness industry by maximizing the climate and seasons, as well as the abundance of natural resources (forage for animal feed) that are ready to be optimized (Zhi *et al*., 2019).

North Central Timor (TTU) is one of the districts in the province of East Nusa Tenggara (NTT), with an area of 2,669.7 km^2. It is one of the production centres for beef cattle, especially Bali cattle. Total population of Bali cattle as large as 12.73% of the cattle population in NTT. The development of the Bali cattle population in this district continues to increase from 120,669 head in 2016 to 126,413 head in 2017, to 128,264 head in 2018, and 129,325 head in 2019, with beef cattle farmer households (CFH) of 24,951 CFH. The daily cattle rearing system carried out by farmers in this region can generally classified into four types of housing systems, including: (1) cattle are kept in cages; (2) cattle are tied in the field during the day and penned in a pen at night; (3) livestock are released in the field during the day and kept in pens at night in the colony pen; and (4) livestock are released day and night. Until now, its role in the family economy has remained a side business after food crops (Basuno, 2017). However, if cattle are raised using a fattening system, they can contribute 44.15% of total household income (Sunarto *et al*., 2016).

Conditions in the region also show that in some sub-districts where livestock farming business is more advanced, livestock are managed in a semi-intensive way, namely how to feed livestock by looking for grass and utilizing legume leaves (lamtoro, gamal, turi and sengon) to provide feed for their livestock and also by tying their animals to pasture and locked up at night (Sio *et al*., 2017). Access to livestock production facilities (an apron) and the family's limited human resources are the barriers to company development that prevent traditional small-scale business breeders from growing into larger-scale enterprises. As a result, the livestock business remains a part-time endeavour and serves as a savings account. Nonetheless, TTU district is one of the country's significant beef cattle producers, sending beef animals to Samarinda and Jakarta each year for meat.

The obstacles faced in the development of beef cattle in TTU district, in aggregate are; low daily weight gain, of cows and long calving interval. The continuous decline in genetic quality and performance every year is exacerbated by the slaughter of productive heifers, the farming community still positions itself as a keeper, the scale of beef cattle farming business is still small and scattered and farmers still adhere to the traditional extensive rearing system and cattle breeding with traditional patterns (natural mating). The objectives of this study are to: (1) assess the productivity of Bali cattle maintained at various elevations; and (2) explore farmer income distributions across various rearing system.

MATERIALS AND METHODS

This research was carried out from April 2023 to October 2023, in the sub-districts of West Miomaffo, Central Miomaffo, Insana, North Insana, Biboki Moenle'u, and Biboki Anle'u, North Central Timor Regency, NTT province. The location determination is based on the consideration that the selected sub-districts have different altitudes (highland and lowland areas), have the most significant number of livestock farmer groups, and have

varying levels of livestock population in range 1.75-3.50 animal units per hectare.

This research used 285 Bali cattle, 82 calves, 105 weaned beef cattle, and 98 heifers. This research used mixed methods to obtain qualitative and quantitative data, a survey was conducted by 180 breeders from 18 respondent groups (Creswell, 2016). Respondents must meet two requirements: have raised Bali cattle for at least five years and own at least three cows. A basic random sampling technique was employed to identify the sample, which involved selecting sample members randomly from among farmer respondents in six sub-districts without considering strata (Sugiyono, 2017).

Research variable

Birth weight: Birth weight is the weight of livestock obtained through direct weighing of calves after birth no later than 3 (three) days after lambing using scales.

Weaning weight: Weaning weight is obtained by direct measurement using a measuring tape then corrected towards weaning weight of 1 year or (365 days) and parent age correction factor, because generally in the research area calves are weaned at the age of between 6-12 months. The formula used for adjustment (Bere *et al*., 2019), namely:

$$CWW = \left(\frac{BW-CBW}{\text{age when weighed}} \times 160 + WW205\right) \times \frac{\bar{x}_{male}}{\bar{x}_{female}} \times PACF$$

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Information: WW = weaning weight; CWW= Corrected weaning weight; BW= Body weight at the time of measurement; CBW= Calf birth weight; PACF= Parent age correction factor.

Body weight of adult parents: Body weight of Balinese cattle in the study area was determined through measurements of chest circumference, body length and shoulder height.

1. Measurement of body length and chest circumference:
   - Body length (BL), the distance between the side end of the shoulder bone (Tubbercullum humeralis lateralis) to the end of the sitting bone (Tubercullum ischiadium), measured using a measuring stick (units in cm).
   - Chest circumference (CC), measured circularly in the chest cavity behind the shoulder bone joint (Os scapula) using a measuring tape (units in cm).
2. In the results of this study the body weight of Balinese cows was determined using the Lambourne formula modified (Warmadewi *et al*., 2020):

$$BW = \frac{(CC)^2 \text{ cm X BL cm}}{10840}$$

Data analysis methods

The data analysis begins by reviewing all available data from various sources through observations, interviews, and documents related to Bali cattle production performance, including birth weight, weaning weight, adult body weight, and daily weight gain. The data obtained were analyzed using the T-test, according to (Komariah *et al*., 2015).

$$\textbf{Revenue Cost Ratio} = \frac{\textbf{TR}}{\textbf{TC}}$$

Information: X_A: Sample average A; X_B: Average sample B; n_A : Number of sample data A; n_B: Number of sample data B; S^2_A: Sample variety A; S^2_B: Sample variety B

For revenue analysis, data is processed with an econometric approach model (Sikone *et al*., 2024) as described below:

Total fixed costs = Cage depreciation + equipment depreciation
Total variable costs = Phamacetic + vaccine + feed cost + calf+ labor
Total cost = Total variable costs + total fixed costs
Total revenue = Price (IDR/kg) x body weight x number of livestock sold
Total profit = Total revenue – total costs

The formula for calculating the revenue cost ratio (R/C) is as follows:

$$\text{Revenue Cost Ratio} = \frac{TR}{TC}$$

If the R/C Ratio > 1, then the business being run is profitable or worthy of development. If the R/C Ratio < 1, then the business is at a loss, or not worth developing. Furthermore, if R/C Ratio = 1, then the business is at the break even point.

RESULTS AND DISCUSSION

Generally, the cattle raised by breeders on Timor Island and the TTU district are Bali cattle. This breed is more sought after by breeders due to several advantages, namely a high level of fertility, resistance to heat stress, and the ability to utilize less nutritious forage, manifested in the form of optimal weight gain. The production performance studied in this research includes.

Birth weight

Birth weight is a valuable metric for gauging a livestock's growth rate during the prenatal stage and representing the body's potential for the following stage. Table 1 displays the average measurement results of the birth weight of Bali cattle at the study site.

Table 1: Bali cattle's average birth weight.

Location (asl)	Body weight	
	Male	Female
Higland areas (>500 masl)	n= 19 (16.21±1.58)[a]	n= 23 (14.70±2.03)[a]
Lowland areas (<500 masl)	n= 18 (13.78±1.70)[b]	n= 21 (12.62±1.86)[b]

Description: There is a significant difference (P<0.05) as indicated by the superscript in the same column.

Table 2: Average Bali cattle body measurements, size, and weaning weight.

Location (asl)	n	Parameters		
		CG (cm)	BL (cm)	BW (kg)
Higland areas (>500 masl)	Male = 27	109.37±7.57[a]	102.41±6.80[a]	114.17±21.68[a]
	Female = 30	107.43±7.21[a]	97.77±7.78[a]	104.87±18.70[a]
Lowland areas (<500 masl)	Male = 23	101.96±9.60[b]	92.26±11.12[b]	91.01±27.55[b]
	Female = 25	106.72±6.78[b]	89.72±11.21[b]	94,28±15.02[b]

Description: There is a discernible difference (P<0.05) between the superscripts in the various columns. BW: body weight, BL: body length, CG: chest girth.

Weaning weight

Weaning weight influences body weight gain and an animal's capacity for environmental adaptation. Hence, it can be used to predict the body weight of cattle in the future. Table 2 displays the average weaning weight of Bali cattle as a consequence of the study.

Parent weight

Adult weight is one of numerous production characteristic measures that show how productive Bali cattle are the study's findings regarding the mother cow Bali's average body weight are shown in Table 3.

Table 3: Average body dimensions, age, and body weight of Balinese mother cattle.

Location (asl)	Parameters	Age of cattle	
		>4-5 (n=22)	>5 (n=23)
Higland areas	CG (cm)	148.32±5.08	152.26±6.28
(>500 masl)	BL (cm)	122.00±12.62	119.04±10.09
	BW (kg)	248.11±31.93[a]	256.20±40.08[a]
		>4-5 (n=18)	>5 (n=20)
Lowland areas	CG (cm)	146.78±6.86	148.45±3.22
(<500 masl)	BL (cm)	111.17±5.52	112.15±9.67
	BW (kg)	221.31±22.07[b]	228.30±24.25[b]

Description: Superscripts in various columns indicate a significant difference (P<0.05). BW: body weight, BL: body length, CG: chest girth.

Average daily weight gain

Daily weight increase (ADG) measurements revealed no discernible variation in ADG between Bali cattle in the highlands and lowlands. Table 4 displays the study results for the mother cow Bali's average body weight.

Based on the typology of the maintenance system, Balinese cattle producers can be classified into four income levels. Table 5 provides a detailed view of these typologies.

Table 4: Balinese cattle's average daily gain (ADG).

Location (asl)	ADG (kg)
Higland areas (>500 masl)	n=26 (0.46±0.07)[a]
Lowland areas (<500 masl)	n=29 (0.43±0.07)[a]

Description: The same column's superscript indicates no discernible change (P>0.05).

Production performance

Table 1 shows that the average birth weight of Bali cattle in highland areas is better than in lowland areas, and in aggregate, the birth weight of male Bali cattle is heavier than female cattle. The results of the statistical analysis show that altitude differences significantly affect cows' birth weight. Male livestock generally have superior genetic potential than female livestock for birth weight. Ashari (2013) stated that the average birth weight of male Bali cattle was 17.50 kg, higher than that of female cattle, which was only 16.02 kg. Birth weight is influenced by genetics (breed and parents) and the environment (sex of the calf, duration of pregnancy, age of the parent, and weight of the parent and feed). Seasonal variations and the maintenance site also influence the birth weight of calves, as it is directly linked to the amount of feed available in the field or pasture. Rainy-season calves will weigh more at birth because the flora that grows at this time of year is more varied, including different types of field grass and agricultural waste, and because feed output is higher than during the dry season.

Table 2 shows that the average weaning weight of Balinese cattle in the highlands, both male and female, is higher than in the lowlands. The results of the statistical analysis showed that sex and location in the maintenance pattern

Table 5: Economic analysis of the beef cattle business.

Analysis parameters	Transaction value per business typology (IDR)							
	TDKT		SIMK		SLMK		TDSM	
	Value (IDR)	Contribution (%)	Value (IDR)	Contribution (%)	Value (IDR)	Contribution (%)	Value (IDR)	Contribution (%)
Cost								
Fixed costs								
a. Cage shrinkage	95.509	0,76	55.417	0,55	8.810	0,08	-	-
b. Equipment depreciation	4.588	0,04	3.643	0,04	-	-	-	-
Variable costs								
a. Calves	9.333.333	74,43	8.866.667	87,27	9.900.000	93,63	9.676.286	98,93
b. Feed cost	1.781.250	14,2	782.917	7,71	385.171	3,64	-	-
c. Labor	1.253.333	9,99	425.000	4,18	252.857	2,39	-	-
d. Pharmacetic and vitamins	72.562	0,58	26.635	0,26	26.821	0,25	105.000	1,07
Total cost	12.540.576	100	10.160.278	100	10.573.659	100	9.781.286	100
Revenue	19.678.313		15.538.013		15.265.937		13.053.340	
Profit	7.137.737		5.337.735		4.692.278		3.272.054	
R/C	1,57		1,53		1,44		1,33	

Notes: TDKT: The livestock system in the pen continues, SIMK: Day Tie System in the Field and Night in the Cage, SLMK: Loose Day cattle system in the Night field Colony enclosure, and TDSM: Livestock System Released Day and Night

had a significant effect on weaning weight (P<0.05). The Indonesian National Standard (SNI, 2020), shows that average weaning weight in this study is a lower. The Indonesian National Standard for young female Balinese cattle breeds aged 18–24 months: body length size in the class I category is 112 cm, class II = 105 cm, and class III = 101 cm; chest circumference size in the class I category is 139 cm, class II = 130 cm, and class III = 124 cm. This shows that the body dimensions, length, and chest circumference of Bali cows in the study area have yet to be measured (SNI, 2020).

The weaning body weight of male and female Balinese cattle in the highlands is higher than that of Balinese cattle in the lowlands, indicating that differences in place or location can affect performance, especially the weaning weight of Bali cattle. The difference in the weaning weight of male and female livestock is more due to hormonal factors, namely, luteinizing hormone (LH), which also affect the higher weight of male calves. This LH hormone stimulates Leydig cells to secrete the hormone testosterone, which supports the speed of growth of the hormone testosterone and increases protein anabolism, which increases nitrogen storage and the number and thickness of bone muscular fibres. The hormone estrogen produced by females can accelerate bone calcification, so females are smaller than males (Firdausi *et al*., 2012).

The statistical analysis results in Table 3 show that the average body weight of Bali cattle in the highlands is higher than that of Bali cattle in the lowlands (P<0.05) for all age categories. In aggregate, this size is smaller than Indonesian National Standard (SNI, 2020), namely Bali cattle aged > 24-36 months, with chest circumference for class I = 179 cm, class II = 158 cm, and class III = 148 cm, while body length for class I = 133 cm, class II = 124 cm, and class III = 119 cm. The average body weight of Bali cattle mothers at the research location at the age of >4-5 years was between 221.31 kg and 248.11 kg, higher than the results of research by (Hikmawaty *et al*., 2014; Kurniawan *et al*., 2021) which reported that the body weight of Bali cattle mothers was between 170 kg (NTB); 207.89 kg (Bali) and 221.30 kg (Sulsel). The results of this study are lower than research by (Suryani *et al*., 2017), which reported that the body weight of parent Bali cattle in the livestock breeding center Denpasar Bali breeding stock area was 246.51 kg. This caused by fluctuations in feed availability in pastures. Differences in body weight of Bali cattle in various places are also greatly influenced by their environmental as a manifestation of their adaptability (Telupere and Katipana, 2014; Harsita and Amam, 2021).

Table 4 shows that the ADG of Bali cattle reared in the high and lowlands research locations is similar. However, the average ADG resulting from this study is more significant than research by (Habaora *et al*., 2020), which states that ADG of Bali cattle grazed on local forage ranges between 0.2 and 0.4 kg/head per day. The body weight gain of Bali cattle with high quality of feed can reach 0.6–0.7 kg/day, depending on gender (Warmadewi *et al*., 2020). The variance in the quantity and quality of feed, along with factors like gender, parent's age, yearling, and

season, affect the livestock's performances. Additionally, the number of animals kept varies from five to six per family member. Because if the number of animals raised is less, there will be enough feed, and farmers will be more concerned in raising livestock, which has an impact on the faster weight is achieved so that livestock is sold faster. After reaching adulthood, the growth rate steadily slow (Rusdiana *et al*., 2016). Sari *et al*. (2022) reports that body weight gain occurs fastest in the phase before sexual maturity. The results of Ashari's Study (2013) show that the level of livestock productivity in Timor is generally influenced by livestock based on age, sex, birth, death and duration of livestock in breeding. Improving the quality of beef cattle must be emphasized on improving the nature of production and reproduction supported by good management in zootechnical and bioeconomic terms and the handling pattern is carried out holistically.

Farmer income based on the typology of the maintenance system

Based on the rearing system, the revenue of Balinese cattle farmers can be explained as follows:

The livestock system in the pen continues (TDKT)

Farmers in this area typically use the Livestock Rearing System in a Continuous Shed (TDKT), also referred to as the intensive maintenance system, to fatten their cattle. This is typically accomplished by tethering cattle under trees or by housing them in permanent, semi-permanent, or emergency cages. These animals are placed in residential areas where their owners reside. Compared to other maintenance systems, feeding is accomplished by cutting and carrying with greater quality and quantity. Natural or field grass, king grass, kapuk leaves, turi leaves, lamtoro, and other forages palatable for cattle consumption are among the types of fodder that are typically provided to animals. Typically, the farmer's pasture is used to grow all of the fodder that is removed from the field. The duration required to attain selling body weight also decreases comparatively (± 14 months).

Table 5 demonstrates that the calve cost is largest of production cost component. Calve cost in TDKT system, is IDR 9,333,333 or 74.43% of the total production costs. This is followed by feed costs, which come in second place and amount to IDR 1,781,250, or 14.20%, and labor costs, which come in third place and amount to IDR 1,253,333 or 9.99% per production period. Breeders can earn IDR 19,678,313 through the TDKT system, with an additional IDR 7,137,737 per month. If split down monthly, this amounts to IDR 509,838.

The percentage of production costs–components reveals that variable expenses account for the biggest percentage, exceeding 99.20%. The costs associated with purchasing calve account for the largest contribution of production cost at 74.43%. The variable cost component increases with the quantity of calve acquired and the selection of parents of cattle based on a body weight of more than 250 kg. Because they are based on the size of the company or the number of animals that farmers keep, variable costs make up the majority of production expenses; the more livestock there is, the more variable costs will be incurred (Nasaruddin *et al*., 2015; Setiadi *et al*., 2021). The number of workers required will rise with higher work intensity in proportion to the number of cattle raised in continuous cages through the use of the livestock system (Noach and Lalus, 2020). The work specifications mostly deal with tasks linked to caring for cattle, such as finding, gathering, and feeding fodder, cleaning cattle and livestock enclosures, and doing a variety of other tasks. The typical scale of cattle company ownership for the TDKT maintenance typology varies between 2.25-5.50 animal unit, according to the findings of the field study. Raising animals in this system is typically as a priority business, with the feed sources from inheritance and others.

Day tie system in the field and night in the cage (SIMK)

The typology of maintaining the livestock system in the field and Night in the Pen (SIMK), commonly known as the combination pattern of extensive and intensive, is usually carried out on cattle that will be used as labor to plow agricultural land. In addition, farmers in this rearing system have a relatively large number of cattle, and usually some are raised by moving, and some are released on pasture. The average scale of livestock business (ownership) for the typology of SIMK maintenance is higher in females and calves because it is more in the breeding system, which is 10.10 ST, and only a few males, which are 1.50 ST.

Looking at Table 5, we can see that, the biggest cost in SIMK system is cost for purchasing parent cattle. This costs are average IDR 8,866,667, or 87.27% of the total production costs. The feed cost are IDR 782,917, or 7.71%, and the third largest of production cost component is labor costs, IDR 425,000, or the equivalent of 4.18% per production period. The SIMK system contributes income to farmers of IDR 15,538,013, with a farmer's income of IDR 5,377,735.

This pattern's method of rearing cattle involves giving them a rope that is 15-20 m long. The cattle will be tethered in the pasture from dawn to dusk, with a 2-3 hour gap between each tether. At night, the cattle will be herded back into the pen surrounding the house. In order to ensure that the cows in the new area receive enough feed, the farmer will relocate the mooring place during the day. Before the cattle below return to the pen in the afternoon

or evening, the farmer will bring drinking water or lead the cows to the closest water source. The three components of environment, management, and livestock seeds interact to determine productivity. The interaction of these three variables paints a picture of the current state of beef cattle ranching in TTU, which is characterized by a tendency toward lower production performance. According to (Mullik *et al*., 2018), the productivity of Bali cattle in the conventional extensive rearing system (free release in the field) is extremely poor from a technical standpoint. The availability of grass in the fields, which is mostly composed of poor-quality fodder with an extended dry season (eight months), exacerbates this situation. According to (Jelantik and Malelak, 2023), this is one of the elements that most likely has a role in the low productivity of Bali cattle in this area.

Loose day cattle system in the night field colony enclosure (SLMK)

The type of livestock rearing system during the day in the pasture at night in a colony pen (SLMK), which is also commonly referred to as an extensive rearing pattern; in this rearing system, the livestock are released into the pasture in the morning to eat their food without being controlled. Afternoon or evening, the livestock is herded to the nearest river or water source to drink. After mid-afternoon, the livestock is herded back to the colony pen so that when there is grass available in the pasture, and it starts to run out, their livestock productivity decreases. People who have more livestock need more energy to collect feed. Farmers who adhere to this rearing pattern are generally not used to planting grass for animal feed. Therefore, the system of releasing livestock or grazing livestock is their choice.

Breeders in nearly every sub-district in the TTU area have been practicing this pattern of upholding the SLMK system for a considerable amount of time-more than 15 years. This is due to its striking resemblance to the dryland farming practice of slash-and-burn combined with cattle rearing. In order to build and execute a logical system for beef cattle breeders, it is vital to know what factors drive breeders to use a grazing system that is more reliant on hereditary rearing methods passed down from parents with varying degrees of portions. According to (Mullik *et al*., 2018), the productivity of Bali cattle in conventional large-rearing systems in NTT is quite low from a technical standpoint. According to (Nalle *et al*., 2017), three factors contribute to the low productivity of Bali cattle kept in large systems: (1) a low birth rate, (2) a high calf death rate, and (3) a low net growth rate.

Based on Table 5, it can be seen that, the largest cost component in SLMK system is the cost of purchasing feeder livestock, which is IDR 9,900,000 or the equivalent of 93.63% of the total of production costs, followed by the second largest component being the feed cost component, which is equal to IDR 385,171 or 3.64%, and the third largest cost component is labor costs, which amount to IDR 252,857 or the equivalent of 2.39% of each production cycle. The SLMK system provides income for farmers of IDR 15,265,937 and income of IDR 4,692,278.

The percentage of pregnancy rates for Bali cattle in this rearing system is always dynamic and varies over time, both in one grazing group and in different grazing groups. Several factors include the presence of males in the grazing group because the presence of males is absolute in the natural mating of cows in pastures; rainfall patterns and rainy days, which influence the availability of feed in the pastures. Grazing; and the health of female and male cattle is uncontrolled and susceptible to disease attacks. Traditional breeders in this area generally tend to retain young female cattle in preparation for replacement stock, and young male cattle will be sold immediately after weaning so that the number of male cattle in the field is small (Kusuma *et al*., 2017).

Livestock system released day and night (TDSM)

Another name for this type of livestock system called Left Free Day and Night (TDSM), is the classic extensive rearing system. Breeders on the island of Timor generally use this as the oldest rearing strategy. Because all of the breeder's cattle are allowed to roam freely on meadows, moors, shrubs, or woodlands to find food on their own, this system is considered to be highly traditional. Thus, animals, which often congregate in herds, provide for all of the necessities of life in the form of food. The farmer brings the herd of cattle to the closest water sources during the day so they can drink. The animals are corralled in basic cages constructed from local materials at night, which might be either a circle of wood or stone. When looking for cattle who have become lost in the bushes or when the cattle are separated from the rest of the herd, the traditional pen is also used as a place to stamp the owner's name on the thigh and as a neck hanger (source of sounds) as a marking. These cages are typically placed in residential areas to make it easier for the owner to accompany or watch over their cattle.

Looking at Table 5, we can see that the cost for raising Bali cattle with the day and night livestock system (TDSM) is very different from financing for other types of livestock maintenance. In the TDSM type of financing, IDR 9,676,286 is used to buy feeder animals, which is 98.93% of the total amount, and IDR 105,000 is set aside for pharmacetic and vitamins, which is 1.07%. The TDSM system provides income for breeders of IDR 13,053,340 with an income of IDR 3,272,054.

The reasons behind the choice of a freelance rearing system are due to the limited number of family workers and limited food during the dry season, as well as the inheritance of rearing methods passed down from generation to generation by parents (Nalle and Tiro, 2019). Bali cattle have advantages in terms of reproductive power, carcass percentage, and quality of meat and skin. However, they have limitations in terms of growth speed and body weight size if they are in an extreme climate environment. Yoku *et al*. (2014) explained that many factors indirectly influence livestock productivity from the microclimate aspect, namely temperature, air humidity, radiation and wind speed, evaporation, and rainfall. The choice of implementing a free-range system in the Bali cattle farming business that has been adopted so far basically carries risks in the form of death rates and livestock loss (Rauf *et al*., 2015). Extreme topographic conditions and low levels of supervision and control cause cases of loss of livestock due to theft (Sukada *et al*., 2016), cold shock, being trapped in ravines and bushes (especially calves), as well as various other causal factors (Rosyid and Rudiarto, 2014).

CONCLUSIONS AND RECOMMENDATIONS

Several conclusions can be drawn as a common thread in this research, are Bali cattle raised in highland areas have better production performance. With average birth weights of 14.70 (cow calf) and 16.21 (bull calf), for weaning weights of 107.43 (cow calf) and 109.37 (bull calf), and for the weight of mothers aged > 4-5 years, 248.11 the income of cattle breeders is greatest for breeders with the TDKT ayatem reach IDR 7,137,737.00, followed by the SIMK system, which the breeder's income amounting to IDR 5,377,735.00, the SLMK system provides an income of IDR 4,692,278.00, and finally, the TDSM system only provides an income of IDR 3,272,054.00.

NOVELTY STATEMENT

The typology of beef cattle rearing systems in TTU district can be categorized into 4 (four) typologies: The livestock system in the pen continues (TDKT), Day tie system in the field and night in the cage (SIMK), Loose day cattle system in the night field colony enclosure (SLMK) and Livestock system released day and night (TDSM).

AUTHOR'S CONTRIBUTION

HYS and EYN designed a research concept, analyzed data and drafted a manuscript. GB, EKB and YK designed research concept and prepared a manuscript.

CONFLICT OF INTEREST

The authors have declared no conflict of interest.

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