



Factors Affecting Bull Breed Choices of Smallholder Farmers in Lombok Tengah Regency, West Nusa Tenggara Province, Indonesia

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Abstract | This study aimed to analyze the factors affecting the decision-making process of beef cattle farmers in choosing bull semen for artificial insemination (AI) in Lombok Tengah Regency, West Nusa Tenggara, Indonesia. The bull semen choice was classified into three categories: Bali cattle, exotic cattle, and both. Respondent selection was carried out using a purposive sampling method, with 95 respondents. Data were collected through interviews using a structured questionnaire that had been tested for validity and reliability. Data were analyzed descriptively and Pearson correlation to ascertain the relationship between these social, technical, and economic factors with the choice of bull breed. The results showed that 51.58% of farmers prefer frozen semen from exotic cattle breeds, aiming to produce larger calves with a market price 90–110% higher than Bali calves. In contrast, 22.11% of respondents chose frozen semen from Bali cattle to purify the Bali cattle breed. Farmers' decision-making process in choosing bull breeds for AI mating showed a positive correlation with total cows owned ($r_s = 0.24$), cow breed ($r_s = 0.51$), and AI cost ($r_s = 0.47$). Hence, it can be concluded that farmers' decision-making in choosing frozen semen for beef cattle is influenced significantly by social (total cows owned), technical (breed of cows), and economic (AI cost) factors.

Keywords | Farmers, Preference, Breeding, Artificial insemination, Beef cattle, Crossbreeding

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INTRODUCTION

A tropical country, Indonesia possesses various genetic resources for meat production, including cattle, buffalo, goats, sheep, chickens, ducks, pigs, and other species. Cattle are the primary source of meat in Indonesia. The projected beef production in Indonesia for 2022 is estimated

to be 498.92 tons. The meat production is derived from a cattle population of 18.61 million heads (BPS-Statistics of Indonesia, 2023), with up to 90% of the overall production originating from the smallholder farming systems. The conventional agricultural practices, including traditional methods of feeding and breeding, have resulted in low agricultural output and have contributed to the insufficient

supply of beef in Indonesia (Agus and Widi, 2018; Santoso and Prasetyono, 2020).

Beef cattle farmers in Indonesia continue to utilize natural mating for breeding management, particularly in semi-intensive and extensive farming systems in the eastern part of Indonesia, including Nusa Tenggara, Sulawesi, and Maluku islands (Hilmiati *et al.*, 2024; Sulfiar *et al.*, 2022). Utilizing locally accessible bulls in the mating system is a challenge in enhancing cattle productivity. An effective solution to this issue is to employ artificial insemination (AI) as a method of mating with the assistance of technology.

The selection of AI technology was based on its utility in genetic enhancement, prevention of sexually transmitted diseases, enhancement of male efficiency, and reduction of operational expenses (Mwangi *et al.*, 2019). Productivity in Bali cattle resulting from mating with the IB method has a higher daily body weight gain than natural mating results (Warmadewi and Bidura, 2021). Increased productivity in cattle resulting from mating with AI positively impacts seller prices and increases farmers' income (Valergakis *et al.*, 2007).

The primary focus of beef cattle production in Indonesia, particularly in breeding, is concentrated in five provinces. East Java and Central Java provinces are the main areas for the development of two breeds of cattle: Ongole Grade (PO) cattle and PO crosses with exotic cattle breeds. Meanwhile, the provinces of South Sulawesi, West Nusa Tenggara, and East Nusa Tenggara are the main areas for developing Bali cattle and Bali cattle crosses. As a development area for Bali cattle and its crosses, the adoption of AI technology in West Nusa Tenggara Province allows beef cattle farmers to have a wide selection of bull breeds including Simmental, Limousin, Angus, and Bali cattle (Baliarti *et al.*, 2023; LukmanHy *et al.*, 2023; Sutarno and Setyawan, 2016; Warman *et al.*, 2023). Thus, the availability of semen from these various breeds makes farmers more flexible in choosing the breed for AI.

Choosing a breed of bull is an important decision for farmers, affecting their productivity and profitability in raising cattle. There have been many studies on the adoption of AI technology. Various factors certainly influence farmers' adoption of technology. These factors include the socioeconomics of farmers, agroecology, organization, information and perceptions of farmers, farming, and the technology itself (Suri *et al.*, 2022; Suteky, 2021; Ugochukwu and Phillips, 2018). Until now, no information has been found regarding the influence of these factors on farmers in choosing the bulls used for IB.

Therefore, it is necessary to research the factors affecting beef cattle farmers to choose frozen semen for artificial

insemination in Lombok Tengah Regency, West Nusa Tenggara. This information is important as there are limited reports on the development of Bali cattle and their crosses in the area. This area, which has the highest beef cattle population on the island of Lombok at 32.31%, is dominated by intensive systems and artificial insemination mating methods (BPS-Statistics of Nusa Tenggara Barat Province, 2022; Soekardono *et al.*, 2013). This study aimed to examine the factors impacting farmers' decision-making when choosing bull breed for artificial insemination. These determinants encompass three factors: social, technical, and economic. This research adds to the existing knowledge on the factors influencing farmers' decision-making when choosing beef cattle studs in wet tropical countries. This research can assist policymakers in formulating policies for promoting agricultural technology and livestock development, taking into account the community's specific needs.

MATERIALS AND METHODS

ETHICAL APPROVAL

The study received approval from the Research Ethics Commission of the Faculty of Veterinary Medicine at Universitas Gadjah Mada, Yogyakarta (approval number: 00018/EC-FKH/EKs/2021).

RESEARCH AREA

The research was carried out in Lombok Tengah Regency, specifically in three districts: Batukliang, Pringgarata, and Jonggat. The selection of the research site for data collection was guided by recommendations from the local Agriculture Agency, which specified that the site should be a hub for beef cattle breed and the practice of artificial insemination. Geographically situated within the coordinates of 116°05' to 116°24' East longitude and 8°24' to 8°57' South latitude. The region experiences a tropical climate characterized by a pronounced dry season and a rather substantial rainy season that persists throughout the year. The mean precipitation is 160.7 mm, and the temperature fluctuates between 23 and 31°C (BPS-Statistics of Lombok Tengah Regency, 2023).

DATA COLLECTION

Respondents were selected by purposive sampling. The criteria for respondents are Bali cattle breeders and their crosses who raise cattle for breeding, have cows mated with artificial insemination method (at least one calf), and are willing to be the study's respondents. A total of 95 Bali and Bali crossbred cattle breeders were involved in this study. The study was conducted for eight months (January-August) 2022.

Data were collected by enumerators using a structured questionnaire. The questionnaire was developed based on literature studies and focus group discussions in preparing

Table 1: Definition of variables and classification of measurement types.

Variabel	Definition	Type of measurement
Dependent Variabel		
Bull semen	The Bull semen used was categorized into three categories	Category (1=Bali cattle, 2=Exotic Cattle, 3=Both)
Independent Variabel		
Social factor		
Age	Age of the respondents (years)	Category (1=25-37, 2=38-49, 3=50-61, 4= more than 61)
Education	Educational level of the respondents	Category (1=no school, 2=elementary school, 3=junior high school, 4=senior high school, 5=college graduate)
Main occupation	Respondent's main occupation	Category (1=cattle breeder, 2=crop farmer, 3=farmworker, 4=others)
Livestock experience	Respondents' experience in raising cattle	Category (1=1-5, 2=6-10, 3= 11-15, 4= >15)
Land ownership	Total land owned by farmer (m ²)	Category (1=no land, 2=less than 1100, 3=1100-2000, 4=more than 2000)
Total of cows ownership	The total of cows owned (head)	Category (1=1, 2=2, 3=3, 4=>3)
Cattle ownership	Number of cattle raised by respondents with Tropical Livestock Unit (TLU) (Cow=1, Bull=0.8, Heifer=0.8, Yearling=0.6, Calf 3-12 Month = 0.4, Calf <3 month=0.3) based on Dida <i>et al.</i> (2017)	Category (1=Less than 2, 2=2.1-3.0, 3=3.1-4.0, 4=More than 4)
Technical factor Breed of cows	The breed of cow owned	Category (1=Bali cattle, 2=Crossbreed, 3= Bali and Cross-breed cattle)
Economic factor		
AI cost	Respondents' expenses for mating/AI cow in Indonesian rupiah units (IDR)	Category (1 =Less than 51.000, 2 = > 51000-100000, 3 = 101000-150000, 4= More than 150000)

the research protocol and questionnaire (Table 1). The questionnaire instrument was tested for validity and reliability. The validity test results of all indicators were valid with a significance level of <0.05. Meanwhile, the value of $r = 0.68$ was obtained based on the reliability test.

STATISTICAL ANALYSIS

Descriptive analysis was used to calculate the frequency of independent variables and farmers' experience in selling artificially inseminated calves. The relationship between social, technical, and economic factors with the selected bull breed was analyzed using Spearman Rank correlation analysis. Data analysis was conducted using SPSS® software version 25.

RESULTS AND DISCUSSION

SOCIAL, TECHNICAL AND ECONOMIC FACTORS

The social determinants examined in this study encompass age, education level, informal education, main occupation, farming experience, cattle ownership, total of cows ownership, breed of cows, and AI cost. Data from these factors are shown descriptively in Table 2. Most beef cattle farmers were aged 25 to 61 years, 91.58% of the total farmers. Most respondents (51.58%) were educated up to primary school.

The main occupation of the respondents varied. Crop Farmers made up 67.37% of the respondents, followed by cattle breeders (20%), farmworkers (5.26%), and others (7.37%). The data indicate that 80% of cattle raising is considered a secondary job. Livestock farming experience refers to the duration respondents have been engaged in the cattle rearing. The study revealed that the cattle farmers in Lombok Tengah Regency have an average livestock farming experience of more than five years, precisely 72.63% of respondents. Some individuals possess farming experience of up to 50 years, as evidenced by data distribution.

Respondents in this study were classified as smallholder farmers. The scale of livestock ownership is still relatively small, with 82.11% of respondents owning less than 3 TLU and 54.74% owning two cows per farmer. These cattle are raised using agricultural waste products and wild grass on the land. The land ownership of the respondents was relatively small, with only 13.68% owning more than 2000 m² of land. Meanwhile, 43.16% of respondents did not own land to provide feed for their cattle.

A variety of breeds have developed in Lombok Tengah Regency. The predominant cows breeds raised by farmers were Bali cattle (40%), crossbred cattle (35.79%), and a combination of Bali cattle and crossbred cattle (24.21%)

Table 2: Descriptive statistics of the independent variables.

Variables	Group of Bulls Breed			
	Bali bull % (n=21)	Exotic bull % (n=49)	Both % (n=25)	Total % (n=95)
Age (year)				
25-37	14.29	22.45	28.00	22.11
38-49	23.81	34.69	24.00	29.47
50-61	57.14	36.73	32.00	40.00
More than 61	4.76	6.12	16.00	8.42
Education				
No school	23.81	20.41	-	15.79
Elementary school	28.57	20.41	72.00	35.79
Junior high school	14.29	28.57	8.00	20.00
Senior high school	23.81	24.49	12.00	21.05
College	9.52	6.12	8.00	7.37
Main occupation				
Cattle breeder	9.52	16.33	36.00	20.00
Crop farmer	76.19	69.39	56.00	67.37
Farmworker	4.76	8.16	-	5.26
Others	9.52	6.12	8.00	7.37
Livestock experience (year)				
Less than 5	19.05	28.57	32.00	27.37
5-10	28.57	18.37	8.00	17.89
11-15	9.52	14.29	12.00	12.63
More than 15	42.86	38.78	48.00	42.11
Land ownership (m²)				
No land	52.38	46.94	28.00	43.16
Less than 1100	28.57	24.49	48.00	31.58
1100-2000	4.76	14.29	12.00	11.58
More than 2000	14.29	14.29	12.00	13.68
Cattle ownership (TLU)				
Less than 2	57.14	40.82	20.00	38.95
2.1-3.0	33.33	38.78	60.00	43.16
3.1-4.0	4.76	6.12	16.00	8.42
More than 4.0	4.76	14.29	4.00	9.47
Total of cows (Head)				
1	38.10	48.98	8.00	35.79
2	61.90	40.82	80.00	55.79
3	-	6.12	8.00	5.26
More than 3	-	4.08	4.00	3.16
Breed of cows				
Bali	100.00	14.29	40.00	40.00
Crossbreed	-	69.39	-	35.79
Bali and crossbreed	-	16.33	60.00	24.21
AI cost (IDR)				
Less than 51000	38.10	-	-	8.42
51000-10000	47.62	20.41	24.00	27.37
100000-150000	9.52	65.31	56.00	50.53
More than 150000	4.76	14.29	20.00	13.68

Exotic cattle (Simmental, Limousin, Angus); TLU is tropical livestock unit; Crossbreed (Simmental x Bali; Limousin x Bali; Angus x Bali); There is no predetermined limit on the expenses associated with AI. The costs incurred are entirely at the discretion of the farmer and cover the entire process from mating to pregnancy.

(Table 2). The results revealed that individuals who possessed Bali cows preferred males belonging to the Bali cattle breed (*Bos Javanicus*). Respondents with crossbred cows have a preference for male offspring from exotic cattle breeds (*Bos Taurus*). Respondents who had both Bali and crossbred cows selected both groups.

The expense associated with mating beef cattle in Lombok Tengah Regency depends on variation based on the specific breed of the male utilized for mating. In general, the expense incurred by farmers when choosing frozen semen from Bali cattle (*Bos javanicus*) for mating purposes is lower than that of exotic cattle (*Bos taurus*) (Table 2). Even farmers aware that it is a government program typically contribute IDR 30,000 (\$2.11) for transportation.

BEEF CATTLE FARMERS' EXPERIENCES IN SELLING CALVES

The study utilized the respondents' experience in selling self-bred calves to enhance the validity of its findings. The data was derived from the respondents' recent experience in selling calves. The ensuing discourse on calf sales is predicated on the breed-specific selling price of cattle. The statistics regarding calf sales are displayed in Table 3. The calf's breed is determined by the combination of the cow's breed and the bull's breed utilized for breeding. The mating resulted in the acquisition of four breeds of calves: Bali cattle, Simmental-Bali (Simbal), Limousin-Bali (Limbal), and Angus-Bali. Calves were sold by farmers when they reached the age of five months to one year. The findings indicated that crossbred calves commanded higher selling values, with Limbal, Simbal, and Angus-Bali ranking ascending.

Table 3: Calf selling price.

Breed	Calf Age (Year)	Selling Price (IDR)	
		Mean	S.D
Bali	0.5 - 1.0	7,266,666	1,781,518
Simmental-Bali	0.42 - 1.0	15,147,058	2,343,639
Limousin-Bali	0.42 - 1.0	15,400,000	2,951,459
Angus-Bali	0.42 - 1.0	13,833,333	1,060,660

IDR: Indonesian rupiah; SD: Standard deviation.

CORRELATION OF FACTORS AFFECTING ON BEEF CATTLE FARMERS' IN CHOOSING BULL BREDS

The correlation between social, technical, and economic factors on the choice of bull semen in the Lombok Tengah Regency of West Nusa Tenggara, Indonesia, is presented

Table 4: Spearman's rank Correlation between social, technical, and economic factors with farmers' decision-making in choosing beef bulls breed.

	BuBr	Age	Edu	MaOc	LivEx	LaOw	CaOw	ToCo	CoBr	AIC
BuBr	1	-.056	-.035	-.164	.003	.089	.173	.240*	.514**	.473**
Age		1	-.463**	-.155	.401**	.070	.048	-.050	.003	-.027
Edu			1	.398**	-.100	.049	.063	.074	.014	.009
MaOc				1	.000	.191	-.078	-.021	.000	-.053
LivEx					1	.014	.060	-.133	-.038	.166
LaOw						1	.094	-.014	.043	.122
CaOw							1	.604**	.311**	.109
ToCo								1	.337**	.113
CoBr									1	.338**
AIC										1

BuBr: Bull breed; **Edu:** Education; **MaOc:** Main occupation; **LivEx:** Livestock experience; **LaOw:** Land ownership; **CaOw:** Cattle ownership; **ToCo:** Total of cow; **CoBr:** Cow breed; **AIC:** AI cost; *: significant at $p < 0.05$; **: significant at $p < 0.01$.

in Table 4. Substantial significant relationships were observed between the breed of bull selected and total of cows ownership (0.24), cows breed (0.51), and mating cost/AI (0.47). The breed of bull chosen by farmers was positively correlated with the breed of cows and the total of cows they had (Table 1). This indicates that farmers with more than one cow preferred choose exotic cattle or both breeds. Furthermore, farmers tend to prefer the breed of bull according to the breed of cows they have.

This study found that the purpose of Bali cows mating with Bali bulls is purification and replacement stock, which has a higher fertility rate than crossbred cows. Meanwhile, crossing Bali cows with exotic bulls was conducted to obtain offspring with a larger body size, which is economically profitable because the higher seller price.

Mating is an operational cost that farmers must bear while raising beef cattle. The findings indicate a positive and significant correlation between the costs associated with mating and the process of choosing frozen semen (Table 4). As farmers increasingly choose frozen semen from exotic cattle bulls, the breeding costs borne by farmers also rise proportionally.

Characteristics of people refer to inherent qualities an individual exhibits, manifested through consistent mindset, attitudes, and behaviour toward the environment (Andarwati *et al.*, 2018). The farmers' age in this research is within the productive age range, which spans from 15 to 64 years. Furthermore, there was no significant correlation between the age of the breeder and the chosen bull breed. An individual in the productive age often possesses the capacity for employment and exhibits proficient cognitive abilities (Abdillah *et al.*, 2022). The farmers' prime occupation years are anticipated to be advantageous for the optimal functioning

of the beef cattle farming business due to their propensity for being active, receptive to guidance, and amenable to knowledge transfer (Budisatria *et al.*, 2021).

Education is one of the common determinants in the adoption of new agricultural technologies. Education and technology adoption have a positive correlation (Dissanayake *et al.*, 2022). As in the case of sorghum farmers in Somalia, farmers with higher educational status have an increased adoption rate of newly introduced varieties (Egge *et al.*, 2012). Similarly, in this study, although the correlation between education and selection was not significant, there was an indication of increased adoption of exotic cattle breeds by farmers with secondary education.

The farmers with medium to high level formal education have the potential to develop livestock through faster adaptation and technology transfer. Highly educated farmers possess the ability to enhance and shape their mindset of embracing new technology and innovations. The farmers' level of formal education will directly impact their level of knowledge and insight. The impact of education can be characterized as on both cognitive and non-cognitive domains. Education has cognitive impacts that encompass farmers' acquisition of fundamental literacy and numerical skills. The non-cognitive effect refers to the change in the mindset of farmers who attend school, particularly regarding time discipline, teamwork, and other related factors (Eric *et al.*, 2014).

In addition to formal education, informal education, such as counseling and training, is important in improving farmers' knowledge and understanding of technology adoption. Informal education can enhance farmers' knowledge and understanding of innovative practices that positively impact their agricultural endeavours. Furthermore, informal

education is crucial in enhancing farmers' agricultural labor skills (Noor and Dola, 2011; Setiana *et al.*, 2020). According to Murshed-E-Jahan and Pems (2011), prioritizing the training of farmers to enhance productivity and revenue is more crucial than offering financial assistance.

In this study, the agricultural sector is the primary occupation of the respondents. Accordingly, the integration of agriculture with livestock is an ongoing practice. Agriculture utilizes by-products such as rice straw and corn straw to produce animal feed. Cattle contribute to the production of compost fertilizer for crops. Meanwhile, Budisatria *et al.* (2019) found that cattle farmers in Aceh, Indonesia, consider cattle breeding a secondary job with several functions, although it yields limited economic advantages.

Some individuals possess farming experience of up to 50 years. The experience is acquired from parents engaged in livestock farming since their early years. The experience level will enhance knowledge and skill in farming, bolstering the beef cattle farming business pursued (Marisa and Sitepu, 2020). Direct exposure to farming activities serves as an effective instructor, as experienced farmer's exhibit greater caution in their actions and can enhance their skills through experiential learning (Kardin *et al.*, 2018).

The scale of ownership is less than four tropical livestock units (TLU) in this study consistent with the cattle ownership patterns seen on Java Island, Madura Island, and Sumatra Island, where farmers typically have two to four cows per farmer (Budisatria *et al.*, 2019; Widi *et al.*, 2021). Furthermore, the total of cows per farmer found in this study is consistent with the scale of ownership of PO cattle and their crosses in Central Java and Yogya, which is one to two cows per farmer (Agustine *et al.*, 2022). The data suggested that the respondents still possessed cattle on a limited scale, which might be attributed to farming being a supplementary occupation for them. The magnitude of a business will impact the revenue level, with farmers experiencing increasing income levels as the scale of livestock ownership increases (Ibrahim *et al.*, 2021). Livestock ownership determines farmers' motivation to manage their business (Prabawati *et al.*, 2021).

Utilizing crossbreeding techniques to generate F1 offspring is frequently used in cow breeding projects. Local cattle in the area are typically well-suited to the local environment and have superior fertility, particularly regarding good maternal traits, and good adaptability. These cattle are subsequently breed with exotic bull through artificial insemination techniques (Leroy *et al.*, 2016; Woldeyohannes *et al.*, 2024). The respondents in this study were also involved in the practices described. The cross allows the heterosis effect to manifest in the offspring, leading to enhanced performance in growth attributes (Galukande *et*

al., 2013). Crossbreeding leads to a performance enhancement of 0 to 10% for growth traits and 5 to 25% for fertility traits (Widyas *et al.*, 2022).

Crossbreeding, a popular breeder choice, often involves exotic cattle such as Simmental, Limousin, and Angus. These breeds, known for their big-size body characteristics, are frequently selected as studs. Breeders, especially those with first-generation parents of these crosses, continue to breed with exotic cattle, resulting in crossbred generations with a higher composition of exotic blood. This trend is of particular concern due to the regulations set by the Minister of Agriculture, Republic of Indonesia (No.54/Permentan/OT.140/10/2006 and No.101/Permentan/OT.140/7/2014) regarding beef cattle breeding guidelines. These regulations stipulate that the blood composition of exotic cattle (temperate) should not exceed 50%. Previous research has shown that Bali cattle crossed with exotic cattle tend to have larger body sizes but lower reproductive performance (Baliarti *et al.*, 2023). This is a significant consideration for breeders, as the breeding sector should not only focus on body size but also on reproductive performance to achieve the goal of producing one calf per year.

The cost of artificial insemination (AI) in this study differs from the findings of Setiana *et al.* (2020) where the cost of mating beef cattle in Brebes, Central Java, is at least IDR 50,000. Meanwhile, according to the study conducted by Talib *et al.* (2020) the expense of mating Bali cattle in Gowa Regency, South Sulawesi, is IDR 100,000 for both natural mating and artificial insemination. The various expenses associated with mating are influenced by factors such as breed, stock availability, distance, and the availability of liquid N2.

The cost aspect plays a crucial role in decision-making since the presence of funds or farm business loans will impact farmers' decisions when embracing technological innovations (Troiano *et al.*, 2023). AI cost is significantly correlated with the choice of bull breed in this study. Various factors influence the use of AI, namely insemination costs and conception rates (Howley *et al.*, 2012). Farmers opt for artificial insemination as it offers several advantages, such as preventing the spread of venereal diseases, utilizing superior males, expediting the incorporation of new genetic traits, and producing more productive and profitable calves (Baruselli *et al.*, 2018). The current lack of information on the number of breeders in the study area is a challenge, but it also opens up exciting opportunities for further research. We hope that future research will not only replicate our findings but also explore additional factors that influence breeders' choice of bull breed for artificial insemination, thereby increasing the body of knowledge about these factors.

CONCLUSION AND RECOMMENDATIONS

Beef cattle farmers in Lombok Tengah Regency, West Nusa Tenggara Province, Indonesia, prefer exotic cattle breeds as they produce calves that command better market prices than Bali cattle. Farmers choose frozen semen from Bali bulls to purify and replace their breeding stock. The decision-making process of farmers in choosing frozen semen for artificial insemination in beef cattle is significantly influenced by social (total of cows), technical (breed of cows), and economic (AI cost) factors. The farmers' enthusiasm for crossbreeding cows with exotic breeds requires assistance from the government and the establishment of requirements for crossbred cows so that the purity of Bali cattle itself is maintained.

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NOVELTY STATEMENT

There have been many studies on the adoption of artificial insemination technology, but there is no report on what factors influence farmers in choosing the breed of bulls used for AI, so this is interesting to study. This study seeks to identify the factors that influence the choices of frozen semen among Bali and Bali crossbred cattle breeders. This research is the first of its kind and aims to provide insights into the factors that impact breeders' decisions when chosen bull breeds. The findings of this study will be crucial in the development of Bali cattle and its crossbreeds in the breeding centers located in West Nusa Tenggara.

AUTHOR'S CONTRIBUTIONS

Adi Tiya Warman: Conceptualization, methodology, investigation, data analysis, and writing original draft preparation, editing.

Panjono: Supervision, conceptualization, writing, review and editing.

Bayu Andri Atmoko: Project administration, validation, writing, review and editing.

Tri Satya Mastuti Widi: Writing, review and editing.

Sigit Bintara: Writing- Review and editing.

Endang Baliarti: Writing, review and editing.

CONFLICT OF INTEREST

All authors declare that they have no conflict of interest in the finances or data used in this manuscript.

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