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Evaluating Performance of Crossbreed Calves in Manokwari, West Papua, Indonesia

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Abstract The study aim is to evaluate the performance of crossbreed calves in Manokwari, west papua, Indonesia. The parameters were used for evaluating that are quantitative traits (wither height, body length, chest girth, body weight) and qualitative traits (phenotypes) in sub-district of Prafi in Manokwari district. The result showed that crossbreeding with artificial insemination between Bali cattle and breed Simmental, Limousine, Ongole and Brahman likely produce breed calves with better performance indicated by body size such as wither height, body length, chest girth, body weight and increasing body weight compared to Bali cattle. Phenotype analysis showed all croosbreeding cattle have various phenotypes. It can be concluded that crossbreed Brahman-Bali (*Brahbal*) likely showed better performance than other breeds.

Keywords Performance, Crossbreed, Body measurement, Bali cattle, Manokwari

1. Introduction

Manokwari, West Papua, Indonesia develop Bali cattle breeding, But it has some serious problems such as Productivity of Bali cattle are considered low. There is tendency of decreased genetic quality of Bali cattle as shown in decreasing of body size [1]. Local goverment support the program for cattle breeding center in Manokwari. The goverment provide Bali cattle and crossbreeding program using artificial insemination (AI) from several superior breeds such as Simmental, Limousin, Brahman, Ongole and Bali cattle.

Semi-intensive strategy or traditional livestock is used for keeping the cattle in Manokwari. This strategy affect to cattle growth and reproduction. So, they use AI program for the solving this problem. Therefore, evaluating the AI program is necessary to know the successful strategy. The study aim is to evaluate the performance of crossbreed calves cattle in Manokwari, west papua, Indonesia.

2. Materials and Methods

Research was done with direct survey method all AI center in Prafi. AI center have a program of crossbreeding between Bali cattle and some bulls breeds (Simental, Limousin, Ongole, Brahman and Bali) [2]. 37 cattle mans were involved and 50 breeds (breeds of Simental x Bali, Limousin x Bali, Ongole x Bali and Bali x Bali.) were used for research sample. Performance formula was used for performance analysis [3]:

$$Xi\_corrected = \frac{\overline{Xi}}{\overline{Xj}}\,\overline{Xj}$$

Notes:
Xi = Corrected size
$\overline{Xi}$ = Standard of samples average
$\overline{Xj}$= Average of corrected samples
Xj = Observation size

2.1. Sample Collection

There were five groups observed in this study: first offspring of breeds, cement, age of cattle. Parameter of performance analysis that are body length (BL), chest girth (CG), wither height (WH), body weight (BW). Weighing was performed twice a week.

Primary and secondary data were obtained such as presence of jawls, predominant skin color, border line of body color and ass, tail color, color of line of body and leg, tail color, black eye circle, lack backline, and presence of horn and its direction, and hump. Measuring percentage of phenotype was done with formula below [4]:

$$\%\ Phenotype\ A = \frac{\Sigma\ Phenotype\ A}{N}\ x\ 100\%$$

Note:
A = Qualitative traits.
N = Total samples

Comparison of value of quantitative traits on body length, productivity between offspring of Simental x Bali (Simbal), Limousin x Bali (Limbal), Ongole x Bali (Ongbal) and

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fellow Bali, was analyzed using GenStat (one-way ANOVA).

3. Result and Discussion

3.1. Productivity of Crossbreed Calves

The result of performance analysis between crossbreed calves and some breeds showed in Table 1.

Statistical Analysis showed there was significant difference in wither height (WH) of breeds among males (P<0,05), as well as Duncan Test showed there was difference between WH of Bali cattle with crossbreed cattle of *Bos indicus* breed, but there was no difference between WH of Bali cattle and breed of *Bos taurus*. There was no difference between breed of *Bos indicus* and *Bos Taurus.* Similar finding was also found in study of Handiwirawan et al., which showed WH of Bali cattle is lower than breeds [8]. Difference on WH between breeds and Bali cattle in this study occurs due to difference of genetic. Environmental factors did not necessarily affect since cattle were located in same environment. Junaidi reported that genes are major points which is carried from parents where basic pattern of growth was determined by ancient genes such as skin color, body height, face shape, and other characters including components involved in metabolism [9]. Size of body dimension was determined by sex and age of livestock and its environment. Sariubang et al., reported that introduction of breed into a population increases birth weight, wither height, and chest girth in its first offspring (F1) [10].

Although there was no difference between chest girth (CG) of crossbreed cattle and Bali cattle (P>0,05), but average of chest girth in crossbreed cattle was higher than Bali cattle, where there is tendency that *Bos indicus,* specifically Brahbal, has higher average of CG. Small size of CG of subtropical breed cattle (Simbal and Limbal) in this study was caused by lack of ability in adapting cattle to environment. Chest girth in cattle was affected by sex, age, and its environment such as fodder provided in maintenance region or height of its region [10]. According to Setiadi et al., CG is also determined by size of skeleton which is affected by genetics, and body condition or environment [11]. Since environment was relatively similar in this study, genetics is therefore suggested to affect size of CG.

Table 1. Average of vital statistic (cm) and body weight (kg) of breed cattles at 18-35 months

Age (month)	**Simbal (n)**	**WH (cm)**	**BL (cm)**	**CG (cm)**	**BW (kg)**
0-17	11	102.36±8.16	108.55±13.56	132.27±19.65	159.09±54.34
18-35	7	119.8^{ab}±4.76	123.2±2.55	155.2±14.15	328.8±63.27
≥36	2	127±1.41	129.5±2.12	165±7.07	349±36.77
Age (month)	**Limbal (n)**	**WH(cm)**	**BL(cm)**	**CG(cm)**	**BW(kg)**
0-17	4	109.75±3.77	116.25±8.3	128.25±21.87	178.75±46.75
18-35	5	119.2^{ab}±2.95	120.4±10.04	153.6±3.85	317.6±27.12
Age (month)	**Ongbal (n)**	**WH(cm)**	**BL(cm)**	**CG (cm)**	**BW(kg)**
0-17	1	99	95	114	125
18-35	5	120.4^{a}±3,36	124±7.04	162.6±7.99	339.2±43.61
Age (month))	**Brahbal (n)**	**WH(cm)**	**BL(cm)**	**CG(cm)**	**BW(kg)**
0-17	2	83±4.24	81±11.31	106±8.49	103±15.56
18-35	7	120.71^{a}±4.31	127.43±13.21	163±12.9	346.43±35.58
≥36	1	127	139	184	458
Age (month)	**Bali (n)**	**WH(cm)**	**BL(cm)**	**CG(cm)**	**BW(kg)**
0-17	2	85.5±0.71	83.5±2,12	112.5±2,12	127±15.56
18-35	5	107^{b}±7.58	112.6±11.67	149.2±8,64	269.6±42.58

Note: Simbal=Simmental Bali; Limbal=Limousin Bali; Ongbal=Ongole Bali; Brahbal=Brahman Bali; n= Total of samples; WH= Wither Height; BL= Body Length; CG= Chest Girth; BW= Body Weight

Analysis results showed there was no significant difference between body weight (BW) of breed cattle among breeds (P>0,05). Average of BW of Bali breed (18 - 35 months) in this study was not significantly different due to bulls breeds, although there is tendency that crossbreed cattle and *Bos indicus* has higher average of BW. Insemination using semen of *Bos indicus* and *Bos taurus* in population of Bali cattle in Manokwari increased better average of BW compared to offspring of pure Bali cattle. It is associated with Depison that breeding between parents of Bali cattle with bulls of Simental or Limousine or Brahman or Ongole always resulting better BW compared to breeding between Bali cattle and its bulls [7]. Results showed that offspring with high BW also has high PB and LD where body size gain is followed by body weight gain. BW was found similar in breeds calves of cross breeding due to similar environmental factors and management of maintenance. Interaction of environmental factors with genetic factors has been a common issue in livestock. Interaction occurs if there are changes in productivity of cattle of certain region that relocated in different region despite containing genes of superior males. It is associated with Hardjosubroto, performance of livestock is affected individually by genetics, environment, and interaction between both [12]. Environmental factors are fodder, maintanence system, and climate in sub-district of Prafi, district of Manokwari, causing genetic effects on stud are not quite shown. Hardjosubroto also reported that percentage of environment is higher (70%) than genetics (30%). Simply put, all breed cattles which breeds to Bali cattles has same potentials in subdistrict Prafi, Manokwari [12].

ADG in breeds cattles was almost similar and there was no significant difference (P>0,05), not only caused by similar quantity and quality of fodder but also incompatible environment spesifically on *Bos taurus* which is classified in subtropical cattles affecting ADG obtained. Average of breed cattles ADG (18-35 months) in this study although there was no difference affected by male breeds, there was tendency that ADG of breed castle was higher compared to *Bos indicus* (Table 2).

Table 2. Average of daily gain of breed cattle (kg)

Breed	n	PBBH
Simbal	5	0.26±0.12
Limbal	5	0.38±0.06
Ongbal	5	0.41±0.25
Brahbal	7	0.45±0.21
Bali	5	0.36±0.24

Environmental factors such as temperature and humidity, management of maintenance, quantity and quality of fodder and low capacity of oil palm area are considered affecting productivity of breed cattles in Manokwari, aside from adaptability to environment. Adaptability of *Bos indicus* in this study enhanced its productivity (BW and ADG) compared to *Bos Taurus.* Similar finding was also found in previous studies (Setiadi et al., that breed *Bos indicus* is highly adaptive among fellow breed cattles [11].

High temperature in Prafi lowland (22°C-32°C), physiologically suppress fodder consuming and increase water consuming leading to growth surpression as results of lower fodder consuming. Semi-intensive maintenance management used in Prafi Manokwari which is semi free, cattle are fed in morning to oil palm area for 10-11 hours and then caged around afternoon thus cattle are in comfort zone for only 4 hours, from 6 to 10 o'clock in the morning. Aryogi et al., reported that between subtropical and tropical there is comfort zone at 22 to 10 [13].

This condition is suggested causing temperature stress on breed cattle, *Bos taurus* spesifically, from noon to afternoon. Moreover, following older age, cattle above 7 months causing cattle becoming proper homeotherm that is breed cattle of *Bos taurus* are compatible to low temperature [13]. Location in this study was on high temperature causing temperature stress on cattle leading to low feed nutrient consuming and disrupting ADG. Temperature stress causes low nutrient consuming and high water consuming which inhibits growth [14]. It is associated with study of Marai et al., that temperature stress causes poor ADG [15].

High air humidity in location on 82- 85%, potentially increases difficulty on breed cattle, *Bos taurus* spesifically, in heat wasting which enhances environmental stress [16]. Pearce reported that *Bos taurus* on high temperature and humidity causing temperature stress leading to high temperature disrupting heat wasting [17]. Cattles enhances its physiology activity or decreasing heat production in balancing body heat. It disrupts productivity on BW and ADG in Prafi.

Farizaldi states capacity is not only affected by soil fertility and farming pattern but also climate such as light and rain fall [18]. Additional fodder is fed to cattle in cage such as native grass or king grass in small amount conducted without combination of high quality fodder which therefore affects PBB of cattle. Semi-intensive maintenance system is not effective for causing low quantity of fodder and unsuitable location which do not support growth and development of cattle. Fodder is a major factor affecting growth rate required in proper amount with good quality [19].

3.2. Qualitative Trait of Breed Cattle

Performance of qualitative trait as characteristics of breed cattle in variety of feather color, face color, eye circle, coat color, foot and ass line color, black back line, on back and tail color. Results showed variety of body hair color of breed cattle was highly diversed compared to Bali as shown in Table 3.

Table 3. Diversity of body hair color of breed (%)

No	Phenotype	Simbal		Limbal		Ongbal		Brahbal		Bali	
		Bull	Cow	Bull	Cow	Bull	Cow	Bull	Cow	Bull	Cow
		10	8	7	2	2	4	4	6	3	4
1.	Face color										
	White/black	70	100	71.4	50	50	75	66.67	83.33	0	0
	Similar to body color	30	0	28.6	50	50	25	33	16.67	100	100
2.	Eye circle										
	Present	30	50	14.3	100	100	100	33.33	66.67	100	100
	Absent	70	50	85.7	0	0	0	66.67	33.33	0	0
3.	Black ear line										
	Present	40	62.5	100	50	50	0	66.67	50	100	100
	Absent	60	37.5	0	50	50	100	33.33	50	0	0
4.	Dominant coat color										
	Brown	30	37.5	0	50	0	50	33.33	16.67	0	0
	Red-brown	40	62.5	57.1	50	0	0	33.33	50	0	100
	White	10	0	0	0	75	50	0	33,33	0	0
	Black	20	0	42.9	0	25	0	33.33	0	100	0
5.	Foot line color										
	Clear	0	12.5	0	0	0	0	66.67	33.33	100	16.67
	Unclear	80	50	85.7	50	0	75	33.33	50	0	33.33
	Similar to body color	20	37.5	14.3	50	100	25	0	16.67	0	0
6.	Black Back band										
	Present	20	0	0	0	0	0	0	50	100	100
	Absent	80	100	100	100	100	100	100	50	0	0
7.	Hindquarters color										
	Clear	30	0	0	0	0	25	66.67	33.33	100	100
	Unclear	70	100	100	100	100	75	33.33	66.67	0	0
8.	Tail color										
	Black	40	50	100	100	50	100	100	66.67	100	100
	White	10	0	0	0	0	0	0	0	0	0
	Red-brown	30	40	0	0	0	0	0	0	0	0
	Other	20	10	0	0	50	0	0	33.33	0	0

As shown in Table 3, frequency of face color phenotype of breed cattle was commonly different than in Bali where face color was predominantly white/black as Supriyantono states face color of Bali is similar to body color. It indicates phenotype of breed highly affects on face color of calves [20].

Black eye circle was found inbreed cattle which have similarity to Bali. Eye circle is a trait found on Bali, also found in Ongole as in accordance to Agriculture Minister Decree No. 2841 / Kpts / LB.430 / 8/2012 regarding Determination Breed of local Ongole (PO) Cattle, states that eye of PO is big and light with black skin around eyes.

Five breeds are dominated black ear line indicating effects of Bali phenotypes on breed cattles. Black ear line was present in both males and females. Population of breeds observed showed variety of dominant colors. Alteration of color on breed calves, spesifically on male, indicates increasing levels of gene determining red color inherited from breeds such as Simental and Limousin. Combination of colors from two different breeds generates mixed colors (*diluted*) expressed variety of colors to offspring [21].

Black color on breeds Simbal, Limbal, Ongbal and Brahbal indicates breeding *Bos taurus* and *Bos indicus* with Bali generate similar phenotype on black color from Bali males. According to Talib et al., post-puberty color of Bali cattle (12-18 months) is darkened and turns into black at adult stage [22]. There was white Simbal due to effects of albino allele carried in parents. According to Schmutz et al., albino occurrence is rarely found in cattle due to absence of pigmen in cattle due to mutation on *tyrosinase* (TRY) gene in albino cattle [23].

Body colors as results of breeding are diverse and some are deviated from original color of Bali cattle which is black on male and red-brown on female. It refers to study by Supriyantono that characteristic of Bali cattle in Manokwari is commonly black colored for males and red-brown for

females [20]. It was found dark colored neck in several cattle indicating it is classified in wild cattle [24].

Observation on legs color line in breed calves in Table 3 showed phenotype of unclear legs color line was highly found, followed by equal color of legs and body, and clear legs color line. Similar findings were also found on ass color line which phenotype of unclear ass color line was high. Legs and ass of Bali cattle are white colored with clear line referring to study of Supriyantono [20].

According to Supriyantono, and also noted in Agriculture Minister Decree No 325/Kpts/OT.140/1/2010 regarding Determination Breed of Bali Cattle, black back band located longitudinally along back as character of Bali, is rarely found which concluded that this qualitative traits are predominantly inherited by males [20]. Deviation of color pattern out of cattle standard indicates introduction of other breeds genotype [25].

Tail color on breeds (Table 3), was predominantly black. Other tail color which is mixed of brown and black, or brown and white, or black and white or brown, black, and white, found in Simbal bulls (20%), Ongbal bulls (50%), and Brahbal cows (33,33%) respectively. Red-brown was also found in Simbal bulls (30%) and Simbal cows (40%), whereas white color is found in albino Simbal bulls. Alteration of colors in breeds compared to Bali indicates role of red gene referring to Alberts et al., that red gene is inherited from Simmental [26].

Decreasing or increasing of color intensity in breeds in Manokwari is suggested caused by polygene (multiple genes) carried by each breed cattle, although there are only few genes regulating color pattern each individual. According to Suryo, polygene is one of a double genes serial determining quantitative inheritance (character) [27]. Qualitative traits of individual such as exterior characteristic regulated by one or multiple genes and least or none of environmental factors involved [12]. Therefore, difference of breeds and Bali is likely caused difference of genetics between both groups. Environmental factors do not neccesarily affect since cattle are treated in similar environments.

Diversity of breeds causes diversity in offspring of Bali cattle which is common characters in a population. Diversity is not only present among breed, but also in same breed. *Crossbreeding* causes diversity of horn of population. Diveristy of horn form can been in Table 4.

Results showed breeds calves and breeds are commonly horned whereas there is some breed which are hornless: Simbal (10%), Limbal males (14,3%) and Ongbal females (25%). According to Riz et al., sex, age, and deficiency of calcium plays role in affecting difference of horn form. Sex is major factor causing difference where horn in male is bigger compared to females [29]. Growth of horn in breeds female are commonly upward, some are backwards, some are likely forwards whereas in males are commonly backwards and least is forwards otherwise. Length and growth form of cattle is diverse and gradually extend. Results showed general form of breed cattle as shown in Table 5 which was dominated by cattle with small and thin jawls and humpless.

Table 4. Diversity of horn form of breed cattle

No	Phenotype	Simbal		Limbal		Ongbal		Brahbal		Bali	
		Bull	Cow	Bull	Cow	Bull	Cow	Bull	Cow	Bull	Cow
		10	8	7	2	2	4	4	6	3	4
1.	Horn										
	Present	90	100	85,7	100	100	100	100	100	100	100
	Absent	10	0	14,3	0	0	0	0	0	0	0
2.	Direction										
	Absent	10	37,5	14,3	0	0	0	0	0	0	0
	Backward	30	25	14,3	0	50	25	66,67	33,33	0	33,33
	Forward	10	0	0	50	0	0	0	33,33	0	0
	Upward	50	37,5	71,4	50	50	75	33,33	33,33	100	66,67

Table 5. Diversity of body of brees cattle

Phenotype	Simbal		Limbal		Ongbal		Brahbal		Bali	
	Bull	Cow	Bull	Cow	Bull	Cow	Bull	Cow	Bull	Cow
	10	8	7	2	2	4	4	6	3	4
Jawls										
Small and thin	90	100	57,1	100	50	100	33,33	83,33	100	100
Big and thick	10	0	42,9	0	50	0	66,67	16,67	0	0
Hump										
Present	0	0	0	0	0	0	0	0	0	0
Absent	100	100	100	100	100	100	100	100	100	100
Back line										
Straight	90	100	100	100	100	100	100	100	100	100
Curve	10	0	0	0	0	0	0	0	0	0

According to Setiadi and Diwyanto, size of jawls is commonly associated with sex [25]. Male cattle tend to have big and thick jawls compared to females. Hump is usually found in Ongole and Brahman whereas it is absent in first offspring with Bali, although it was found that cattle with hump in second offspring which was not included in research subjects. That increasing in percentage of male ancient blood causes increasing levels of phenotype from F1 to BC1.

Form of back line in cattle shows ideal form of cattles which consist of three criteria: sunken, straight and convex [25]. Generally, breed has straight back line. According to Handiwirawan and Subandriyo, Bali cattle have straight back line classified in *Bos sondaicus* and *Bos banteng* [30].

4. Conclusions

Crossbreeding with artificial insemination between Bali cattle and breed Simmental, Limousine, Ongole and Brahman likely produce breed calves with better performance indicated by body size such as wither height, body length, chest girth, body weight and increasing body weight compared to Bali cattle. Breeding using cement of Brahman male commonly produce better body size compared to breeding with Simmental, Limousine, Ongole and Bali. Phenotype analysis showed all croosbreeding have various phenotypes.

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