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Selection of Bali cattle based on birth weight and calving interval records at West Nusa Tenggara Province of Indonesia

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ABSTRAK

Berat lahir dan jarak kelahiran adalah sifat produktivitas yang dapat ditingkatkan dengan program seleksi. Akan tetapi, standar berat lahir yang diinginkan pada program seleksi penting untuk mencegah kejadian distokia. Penelitian ini bertujuan menyeleksi sapi Bali (*Bos javanicus*) berdasarkan Perkiraan Nilai Pemuliaan berat lahir (PNP_{BL}) dan Kemampuan Produksi Paling Mungkin pada berat lahir ($KPPM_{BL}$) dan jarak kelahiran ($KPPM_{JK}$). Sebanyak 758 data BL dikoleksi dari Pulau Lombok dan Sumbawa, Nusa Tenggara Barat. Rerata BL anak sapi Bali 15,69±1,70 kg (Lombok) dan 13,49±1,89 (Sumbawa). Rerata JK induk sapi Bali dari kedua pulau sekitar 385 hari. Selanjutnya, nilai heritabilitas (h^2) BL pada kedua pulau sekitar 0,90. Nilai repitabilitas (r) BL pada kedua pulau 0,30. Sementara itu, nilai r JK di pulau Sumbawa 0,39. PNP_{BL} pada sapi jantan tertinggi +4,25 kg dengan No ID: 0838 (Sumbawa). Nilai PNP_{BL} pada anak sapi tertinggi +6,07 kg dengan No ID: 0917 (Sumbawa). Nilai tertinggi $KPPM_{BL}$ +2,67 kg pada induk No ID: 0872 (Sumbawa). Nilai terendah $KPPM_{JK}$ -25,70 hari pada induk No ID: 02076 (Lombok).

Kata kunci : Sapi Bali, berat lahir, jarak kelahiran, PNP, KPPM

ABSTRACT

Birth weight and calving interval are included of productivity traits that can be increased by selection program. However, the standard of desirable birth weight in cattle during the selection program is important to prevent dystocia incident risk. This study was aimed to select Bali cattle (*Bos javanicus*) based on Estimated Breeding Value of birth weight (EBV_{BW}) and Most Probable Producing Ability of birth weight ($MPPA_{BW}$) and calving interval ($MPPA_{CI}$). Total of 758 records data of BW were collected from Lombok and Sumbawa islands, West Nusa Tenggara Province. Research showed the average of BW in Bali calves were 15.69±1.70 kg (Lombok) and 13.49±1.89 (Sumbawa). The average of CI in Bali cows at both islands were about 385 days. In addition, the heritability (h^2) values of BW in both islands was about 0.90. The repeatability (r) values of BW in both islands were about 0.30. Meanwhile, the r

value of CI in Sumbawa island was 0.39. The highest of EBV_{BW} for sire was +4.25 kg by bull's ID: 0838 (Sumbawa). Meanwhile, the highest of EBV_{BW} for calves was +6.07 kg by calf's ID: 0917 (Sumbawa). The highest of $MPPA_{BW}$ was +2.67 kg by cow's ID: 0872 (Sumbawa). The lowest of $MPPA_{CI}$ was -25.70 days by cow's ID: 02076 (Lombok).

Keywords : Bali cattle, birth weight, calving interval, EBV, MPPA.

INTRODUCTION

Bali cattle (*Bos javanicus*) is one of Indonesian native cattle that adapted well in Bali island. Bali cattle were declared as the Indonesian native cattle since year 2010 through decision of Indonesian Ministry of Agriculture No: 325/Kpts/OT.140/1/2010. Kaswati et al. (2013) reported that the average of weaning weight (205 days of age) and yearling weight (365 days of age) in Bali cattle at the breeding station (Bali island) were 88.59±16.15 kg and 131.12±25.50 kg respectively. In addition, Priyanto et al. (2019) reported that the average of slaughter weight, carcass weight and dressing percentage in Bali cattle were 275.56±61.93 kg, 141.04±35.61 kg and 50.95±3.49% respectively. Recently, Bali cattle was adapted well in many islands of Indonesia. Mansur *et al.* (2016) reported that the average of adult weight in Bali cattle at Barru Regency (Sulawesi island) were 158.63±34.27 kg (male) and 185.72±46.37 kg (female) Soekardono *et al*. (2009) reported that the average of body weight in Bali cows (about 1.5 - 2.0 years of age) were 157.00±20.59 kg (Lombok island) and 172.93±20.64 kg (Sumbawa island). In contrast, Samberi *et al*. (2010) reported that the reproductive efficiency (RE) in Bali cattle at Yapen archipelago (Papua Province) was 88.38% and included low category (RE < 100%).

Selection program to Bali cattle in the outsite of Bali island is important to increase the growth traits in cattle. Selection in the livestock can be performed with conventional and molecular methods. The conventional selection in the cattle can be obtain using Estimated Breeding Value (EBV) and Most Probable Producing Ability (MPPA) analysis. Unfortunately, the study to select Bali cattle in the outsite of Bali island with conventional method is not reported. Selection with conventional method is very complicated because this method need a large number of performance records and pedigree information. Therefore, most of the conventional selection study in Bali cattle were applied in the breeding station at Bali island.

This study was carried out to select Bali cattle in Lombok and Sumbawa islands with conventional selection method. In this study, two records data of birth weight and calving interval were used to select Bali cattle in West Nusa Tenggara (WNT) province. Previous studies reported that BW of calves can be used as the selection criteria to select the best cattle (Bakir *et al*., 2004; Putra *et al*., 2015; Said *et al*., 2016). Moreover, the genetic correlation (rg) between birth and weaning weights in cattle were included of moderate to high categories (rg > 0.50) such as Brangus (0.78), Fogera (0.60) and 0.87 for Sumba Ongole (Neser *et al*., 2012; Bekele *et al*., 2016; Putra *et al*., 2018). Hence, the birth weight can be used as the selection criteria to increase weaning weight.

Moreover, the standard of desirable birth weight is important to prevent dystocia incident risk in cows. Meanwhile, the calving interval can be used as the selection criteria to obtain the cows with good reproductive trait. However, this study is important as the first conventional selection study in the Bali cattle outside of Bali island. In addition the results of this study can be used as the early information to select Bali cattle in WNT province with conventional method in the future.

MATERIALS AND METHODS

Place and Samples

The records data of birth weight in Bali cattle from year 2012 to 2018 were collected from Bureau of Artificial Inseminantion (BIBD Banyumulek) and Bureau of Breeding and Forages Center (BPT-HPT Serading). In addition, both institutions of BIBD Banyumulek and BPT-HPT Serading were located at Lombok and Sumbawa islands respectively (Figure 1). Therefore, both islands were included the main area of West Nusa Tenggara (WNT) province. The WNT province located between longitude 115° 46' - 119° 5' E and latitude 8° 10' - 9° 5' S about 11 to 3,726 m above the sea level. The maximum temperature in WNT province ranged between 31.1°C - 33.0°C and minimum temperature ranged between 22.8°C - 24.7°C. The humidity in WNT province about 79 to 85% and rainfall

Figure 1. The Breeding Tract of Bali Cattle in Lombok (A) and Sumbawa (B) Islands of Indonesia

average occuring 1212 to 1800 mm/year. Amount of 758 records data of birth weight (BW) in Bali cattle from BIBD Banyumulek (400 records) and BPT-HPT Serading (358 records) were used in this study. Birth weight measurement was taken from each calf with spring weighing scales.

Management of Animals

The Bali cattle in BIBD Banyumulek (Lombok island) were managed with semi-intensive management system in the farmer groups farm. The feed ration containing of king grass (*Pennisetum purpuphoides*), nutgrass (*Cyperus rotundus*), corncob and rice bran. Feed ration of corncob (4 kg), rice bran (6 kg). Thus, king grass (10 kg/head/day), corncob (5 kg/head/day), field grass (8 kg/head/day), and commercial concentrate (3 kg/head/day) were given to the cattle. The water was given by ad libitum and pregnancy and health examination were performed every month. The artificial insemination (AI) method was performed in this farm using Bali straw from BIBD Banyumulek. Therefore, the Bali cattle at BPT-HPT Serading (Sumbawa island) were kept by ranching management system. Every morning (09.00) to evening (16.00) cattle were managed in the pasture. The feed ration containing of elephant grass (*Pennisetum purpureum*), star grass (*Cynodon plectostachyus*) and rice bran. Feed ration of rice brand (1 kg/head/day) and concentrate (0.5 kg/head/day) were given to the cattle before managed in the pasture. The concentrate containing of water content (44.34%), dry matter (55.66%), crude protein (15.15%), TDN (80.07%), fat (13.15%) and rough fiber (14.26%). The natural mating method was performed in this breeding station using Bali bull. The herd was consisted of 1 bull and about 50 cows and every year the bull was exchanged. The water was given by ad libitum in the pasture and pregnancy and health examination were performed every month.

Standardization Data

Data of body weight (BW) in calves were standardized or corrected based on Hardjosubroto (1994) as follows:

$$CF_{Sex} = \frac{\overline{X}_{BW \text{ of male calves}}}{\overline{X}_{BW \text{ of female calves}}}$$

where CF_{Sex} is the correction factor of body The calculaion of CF_{Sex} only used for female calves and important to reduce the data variation from sex effect.

Data Analysis

Data of BW were analyzed to describe the effect of sex, year, parity and season. Data of sex, year and parity were collected from records data of herds book. Thus the season of birth was classified into two categories of dry (April - September) and rainy (October - March). Thus, the data were analyzed using General Linear Model (GLM) with formula according to Steel and Torrie (1980) as follows:

$$Y_{ijkl} = \mu + S_i + T_j + P_k + M_l + E_{ijkl}$$

Where

Y_{ijk} is the observation of trait; μ is the common mean; S_i is the effect of i^{th} sex of calf; T_j is the effect of j^{th} year; P_k is the effect of k^{th} parity; M_l is the effect of l^{th} season; and E_{ijk} is the experimental error.

The heritability (h^2) value was analyzed using paternal halfshib correlation model through analysis of variance (ANOVA) method with a mathematical model according to Becker (1992) as follows:

$$Y_i = \mu + \alpha_i + e_i$$

Where Y_i is the observation of trait; μ is the common mean; α_i is the effect of i^{th} sire; and e_i is the experimental error. Therefore, the h^2 value was estimated using formula according to Becker (1992) as follows:

$h^2 = 4t$

$$t = \frac{\sigma_S^2}{\sigma_S^2 + \sigma_W^2}$$

$$SE(h^2) = 4\sqrt{\frac{2(1-t)^2[1+(k-1)t]^2}{k(k-1)(S-1)}}$$

$$k = \frac{1}{S-1}\left(N - \frac{\sum n_i^2}{N}\right)$$

Where h^2 is the heritability value; σ_S^2 is the variance component of sire; σ_W^2 is the variance component of individu; $SE(h^2)$ is the standard error of heritability; S is the number of sire; n_i is the number of progeny per sire; and N is the total number of progeny.

The repeatability (r) value was analyzed using interclass correlation method based on two records of birth weight with a mathematical model according to Warwick e*t al.* (1990) as follows:

$$r = \frac{\sum X_1X_2 - \frac{(\sum X_1)(\sum X_2)}{N}}{\sqrt{\left(\sum X_1 - \frac{(\sum X_1)^2}{N}\right)\left(\sum X_2 - \frac{(\sum X_2)^2}{N}\right)}}$$

Where r is the repeatability; X_1 is the record of trait 1; X_2 is the record of trait 2; and N is the number of data pairs.

The relative estimated breeding value (EBV) and Most Probable Producing Ability (MPPA) of birth weight were analyzed using mathematics formula according to Hardjosubroto (1994) as follows:

$$EBV_{Sire} = \frac{n\,h^2}{1+(n-1)r}\left(\bar{P}_{prog} - \bar{P}_{pop}\right)$$

$$EBV_{Prog} = h^2\left(P_{ind} - \bar{P}_{pop}\right)$$

$$MPPA = \frac{n\,r}{1+(n-1)r}\left(\bar{P}_{Prog} - \bar{P}_{Pop}\right)$$

Where EBV_{Sire} is the estimated breeding value of sire; EBV_{Prog} is the estimated breeding value of progeny; MPPA is the most probable producing ability of cow; n is the number of progeny; h^2 is the heritability value; r is the repeatability value; P_{Prog} bar is the mean of trait in progeny; P_{pop} bar is the mean of trait in population; and P_{Ind} bar is the trait of individu.

The relative accuration (RA) calculation was performed in this study to measure the accuracy of selection for bulls using mathematical formula according to Hardjosubroto (1994) as follows:

$$RA = \frac{1}{2}\sqrt{\frac{n}{1+(n-1)t}}$$

$t = Rh^2 + c$

Where RA is the relative accuracy; n is the number of progeny per sire; R is 0.25 (halfsib correlation); c is 0.00 (no correlation assumed) or 0.10 (correlation assumed).

RESULTS

Birth Weight and Calving Interval

The BW of Bali calves in Lombok was higher than Sumbawa island ($P<0.05$) as presented in Table 1. The BW in male calves were higher than female calves at both islands.The BW of calves in Lombok island at year 2017 to 2018 were about 16.00 kg and higher than year 2013 to 2015 (about 15.00 kg). In this study, records data of BW in Lombok island for year 2012 and 2016 were not available. Meanwhile, the highest of BW in calves at Sumbawa island was showed at year 2012 and 2015 (about 15.00 kg). Commonly, the CI of calves that born in dry and rainy seasons were similar in both islands (about 385 days). According to the records data, most of calves in Lombok and Sumbawa islands were born in season of rainy (62%) and dry (92%) respectively. According to Table 1, three factors of sex, year and parity were affected to BW in both island. Meanwhile, factor of season was affected to BW in Sumbawa island.

Heritability and Repeatability

The h^2 value of BW in both islands were about 0.90 as presented in Table 2. Meanwhile, the r value of BW in both islands were about 0.30. Despite, the r value of CI in Sumbawa island was 0.39. In this study, the estimation of r value for CI in Lombok island was not performed because of no parallel parity records data. The SE values of

Table 1. Non-Genetic Factors of Actual Birth Weight (Kg) in Bali Calves and Calving Interval (Days) in Bali Cows at Two Different Islands in West Nusa Tenggara Province

Variable	Lombok island (N)	Sumbawa island (N)
Sex		
Male	16.13±1.89[a] (180)	13.81±2.01[a] (188)
Female	15.33±1.47[b] (215)	13.15±1.71[b] (170)
Year		
2012	-	15.02±2.19[ac] (43)
2013	15.64±1.86[a] (198)	13.49±1.86[ac] (79)
2014	15.88±1.63[b] (139)	12.71±1.43[ab] (69)
2015	15.08±1.06[b] (39)	15.06±1.94[ac] (41)
2016	-	12.69±1.17[b] (51)
2017	16.63±1.69[ab] (8)	12.39±1.17[b] (33)
2018	16.20±0.84[ab] (5)	13.44±1.45[ab] (41)
Parity		
I	15.08±1.45[a] (175)	13.43±2.09[a] (161)
II	15.75±1.78[ab] (43)	13.26±1.55[b] (89)
III	16.27±1.71[b] (64)	13.76±1.81[ab] (47)
IV	16.38±1.80[b] (61)	14.16±2.07[a] (31)
V	15.97±1.67[ab] (38)	13.64±1.65[ab] (22)
VI	16.22±1.40[ab] (18)	12.25±0.96[ab] (4)
Season		
Dry	15.74±1.81 (151)	13.52±1.93[a] (329)
Rainy	15.66±1.64 (249)	13.17±1.39[b] (32)
Total	15.69±1.70 (400)	13.49±1.89 (358)
CI (days)	385.91±99.43 (33)	385.39±45.22 (67)

[a,b] Different supersript in the same column shows significantly different (P<0.05). N: number of animal; CI: calving interval

h^2 were showed lower than h^2 value in both islands.

Estimated Breeding Value and Most Probable Producing Ability

The EBV_{BW} in Bali bull at Lombok and Sumbawa islands were presented in Table 3 and Table 4 respectively. Total records data of BW that used for h^2 and r estimations were 633 records and 120 records respectively. Thus, the h^2 value in this study was obtain using dataset from 13 bulls (Lombok island) and 7 bulls (Sumbawa island). Selection of Bali bulls in this study based on the two parameters of EBV_{Sire} and RA. Bali calves were selected based on EBV_{prog} for BW. Bali cows were selected by $MPPA_{BW}$ and $MPPA_{CI}$.

The highest of relative EBV_{BW} for sire at Lombok and Sumbawa islands were +3.94 kg (bull's ID: 11509d004) and +4.25 kg (bull's ID:

Table 2. Heritability and Repeatability Estimations for Some Productivity Traits of Bali Cattle in Two Different Islands at West Nusa Tenggara Province

Location	N_S	N_{Prog}	σ_S^2	σ_W^2	k	h^2±SE	r (N)	
							BW	CI
Lombok island	13	284	0.43	1.37	22	0.96±0.36	0.36 (51)	-
Sumbawa island	7	349	0.90	2.75	50	0.99±0.48	0.37 (69)	0.39 (41)

N_S: number of sire; N_{Prog}: number of progeny; σ_S^2: variance component of sire; σ_W^2: variance component of individu; k: constanta; h^2: heritability; SE: standard error; r: repeatability; N: number of data pairs; BW: birth weight; CI: calving interval

0838) respectively. Total of 25 bulls in Lombok island were evaluated in this study and only 11 bulls were ranked through RA values. Meanwhile, the highest of EBV_{BW} for calves in Lombok and Sumbawa islands were +3.74 kg (calf's ID: sm0007) and +6.07 kg (calf's ID: 0917) respectively (Table 5). Overall the EBV_{BW} for sire and calves in Lombok island were higher than Sumbawa island as show in Figure 2.

Moreover, the highest of $MPPA_{BW}$ in Lombok and Sumbawa islands were +2.28 kg (cow's ID: 02009) and +2.67 kg (cow's ID: 0872) respectively (Table 6). In addition, the lowest $MPPA_{CI}$ in Lombok and Sumbawa islands were -25.70 days (cow's ID: 02076) and -26.59 (cow's ID: 0583) respectively (Table 7). Overall the $MPPA_{BW}$ in Lombok island was higher than Sumbawa island as shows in Figure 3. In addition, overall the $MPPA_{CI}$ in both island were similar.

DISCUSSIONS

The different of BW of Bali calves between Lombok and Sumbawa islands can be caused by different management system. The semi-intensive management and AI method can be caused the BW in Lombok island was higher than in Sumbawa island. Furthermore, the straws that used for AI were produced from selected bulls by BIBD Banyumulek. Tavares *et al.* (2012) reported that the BW of Bali calves in the breeding station at Bali island (BPTU-HPT Denpasar) were 18.37±1.65 kg (males) and 18.27±120 kg (females). Kaswati *et al.* (2013) reported that the corrected BW of Bali cattle in the BPTU-HPT Denpasar was 17.80±1.08 kg. Despite, Pemayun *et al.* (2014) reported that BW of Bali calves in the south Bali area were 15.62 kg (traditional system) and 16.94 kg (three strata forage system). Prasojo *et al.* (2010) reported that overall the BW of Bali calves in Gianyar, Bali and Badung (Bali island) was 18.40±1.60 kg. Gunawan and Jakaria (2011) reported that two factors of year and season were affected of BW in Bali calves at BPTU-HPT Denpasar. Factor of sex, year, parity and season also affect to BW in other Indonesian Ongole cross cattle (Hartati *et al.,* 2015). Meanwhile, Putra e*t al.* (2018) reported that two factors of year and season were affected of BW in Sumba Ongole cattle. According to the previous studies, the BW of Bali calves in Bali island was highest than in two islands at WNT province. The intensive selection program with good breeding practices for Bali cattle in BPTU-HPT Denpasar was caused the highly of BW in Bali island.

Siswanto *et al.* (2013) reported that the CI of Bali cattle in BPTU-HPT Denpasar was 350.46±27.98 days and lower than in WNT province. In addition, Pemayun *et al.* (2014) reported that CI of Bali cattle in the south Bali area were 402 days (traditional system) and 384 days (three strata forage system). Soekardono *et al.* (2009) reported that the CI of Bali cattle in Lombok Barat (Lombok island) and Dompu (Sumbawa island) were 457.80 days and 470.10 days respectively. Despite, the CI of Bali cattle in Yapen archipelago (Papua) and Banyuasin (Sumatera island) were 410.40 days and 428.10 days respectively (Samberi *et al.,* 2010; Susanti *et al*., 2015) and higher than in this study. The CI of Bali cattle in this study were similar to the Bali cattle in the south Bali area that managed with three strata forage system.

The h^2 value of BW in Bali cattle at WNT province was included of high category (h^2 >0.30) with low of SE value. High category of h^2 value for BW was showed in Red Chittagong (0.50), Horro (0.62), Nellore (0.37), Bali (0.85), Brahman

Table 3. Estimated Breeding Value of Birth Weight (Corrected) and Relative Accuracy of Bali Bulls in Lombok Island

Rank	Sire	N_{Prog}	X_{CBW} (kg)	EBV_{Sire}(kg)	Relative accuracy		Remark
					c = 0.00	c = 0.10	
1	11509d004	30	17.66	+3.94	0.97	0.83	Accurate
-	01738	2	18.38	+3.21	0.64	0.61	Not accurate
-	03724	3	17.92	+3.04	0.71	0.67	Not accurate
-	0874	4	17.46	+2.52	0.76	0.70	Not accurate
2	11012I003	84	17.01	+2.39	1.00	0.85	Accurate
-	sm201401	2	17.00	+1.27	0.64	0.61	Not accurate
-	0750	2	17.00	+1.27	0.64	0.61	Not accurate
-	241015	6	16.71	+1.25	0.83	0.75	Doubting
-	ni201412	2	16.80	+0.99	0.64	0.61	Not accurate
-	0886	2	16.80	+0.99	0.64	0.61	Not accurate
-	01678	6	16.54	+0.91	0.83	0.75	Doubting
3	01822	21	16.31	+0.52	0.95	0.82	Accurate
4	03889	30	16.22	+0.31	0.97	0.83	Accurate
-	pb201304	9	16.05	-0.11	0.88	0.78	Doubting
5	01026	18	16.04	-0.15	0.94	0.81	Accurate
-	03773	3	15.85	-0.42	0.71	0.67	Not accurate
-	0686	2	15.75	-0.59	0.71	0.67	Not accurate
6	02641	22	15.71	-0.97	0.95	0.82	Accurate
7	03452	35	15.56	-1.38	0.98	0.83	Accurate
-	02641	4	15.15	-1.75	0.76	0.70	Not accurate
8	02620	12	15.31	-1.83	0.91	0.80	Accurate
9	02951	34	15.35	-1.91	0.98	0.83	Accurate
-	01907	9	14.86	-2.76	0.88	0.78	Doubting
10	03482	27	14.92	-2.95	0.97	0.83	Accurate
11	00723	19	13.77	-5.69	0.94	0.82	Accurate

N_{Prog}: number of progeny; X_{CBW} : means of corrected birth weight; EBV_{Sire}: estimated breeding value of sire; Accurate (RA > 0.80)

(0.57) and Bonsmara (0.36), Friesian Holstein (0.40) and Sumba Ongole (0.66) cattle (Afroz *et al.,* 2011; Abera *et al.,* 2013; Regatieri e*t al.,* 2012; Kaswati *et al.,* 2013; Rakwadi *et al.,* 2014; Rahman *et al.,* 2015; Putra *et al.,* 2018). Moderate of h^2 value ($0.10 < h^2 < 0.30$) for BW was showed in Vrindavani (0.29), Tuli (0.21), Charolais (0.23) and Ongole cross (0.28) cattle (Singh *et al.,* 2010; Rakwadi e*t al.,* 2014; Vostry *et al.,* 2015; Hartati *et al.,* 2015). Low of h^2 value ($h^2 <0.10$) for BW was showed in Aceh (0.06) and Fogera (0.06) cattle (Sari *et al.,* 2016; Bekele *et al.,* 2016). High h^2 value of BW suggested that selection based on this trait will be effective to increase gain of BW. The variation of h^2 value in this study compared to previous studies might be due to different of

Table 4. Estimated Breeding Value of Birth Weight (Corrected) and Relative Accuracy of Bali Bulls in Sumbawa Island

Rank	Sire	N_{Prog}	X_{CBW} (kg)	EBV_{Sire}(kg)	Relative accuracy		Remark
					c = 0.00	c = 0.10	
1	0838	42	15.47	+4.25	0.97	0.83	Accurate
2	0948	43	15.30	+3.81	0.97	0.83	Accurate
3	1454	79	13.85	+0.09	0.99	0.84	Accurate
4	0631	41	13.69	-0.33	0.97	0.83	Accurate
5	0431	69	13.00	-2.14	0.98	0.84	Accurate
6	0980	51	12.95	-2.24	0.90	0.83	Accurate
7	0383	33	12.73	-2.76	0.96	0.83	Accurate

N_{Prog}: number of progeny; X_{CBW} : means of corrected birth weight; EBV_{Sire}: estimated breeding value of sire; Accurate (RA > 0.80)

Table 5. The Best Five Bali Calves With Positive Estimated Breeding Value for Corrected Birth Weight

Location / Calf	Sire / Straw	Dam	Sex	CBW (kg)	EBV_{Prog} (kg)
Lombok island					
sm0007	11012I003	02009	Male	20.00	+3.74
03948	241015	01003	Female	18.90	+2.69
03936	03452	0556	Male	18.00	+1.82
08761	0886	0876	Female	17.85	+1.68
an201507	02951	bn201101	Female	16.80	+0.67
Sumbawa island					
0917	0838	0422	Female	15.23	+6.07
0561	0948	0900	Female	16.80	+5.13
0601	1454	0327	Male	15.00	+5.09
0909	0838	0900	Male	16.50	+4.14
0555	0948	0898	Female	16.80	+3.99

CBW: corrected birth weight; EBV_{Prog}: estimated breeding value of progeny

breeds, environment, number of data structure and statistical analysis used for estimation (Hossain *et al.,* 2018). The SE value in this study was lower than h^2 value and can be suggested that the h^2 estimation in this study was accurate. Furthermore, the h^2 value of BW in this study can be used as the one of the technical coefficient in the conventional selection program of Bali cattle at WNT province in the future.

The r value of BW and CI in Bali cattle at WNT province was included of high category (r>0.30). Setiyabudi *et al. (2016)* obtained the high category of r value for BW in Bali cattle at BPTU-HPT Denpasar (0.99) and higher than in this study. High r value for BW was reported in Friesian Holstein (0.34), Aceh (0.36), and Madura cows (0.46) (Bakir *et al.,* 2004; Putra *et al.,* 2014; Tribudi and Prihandini, 2019). Meanwhile,

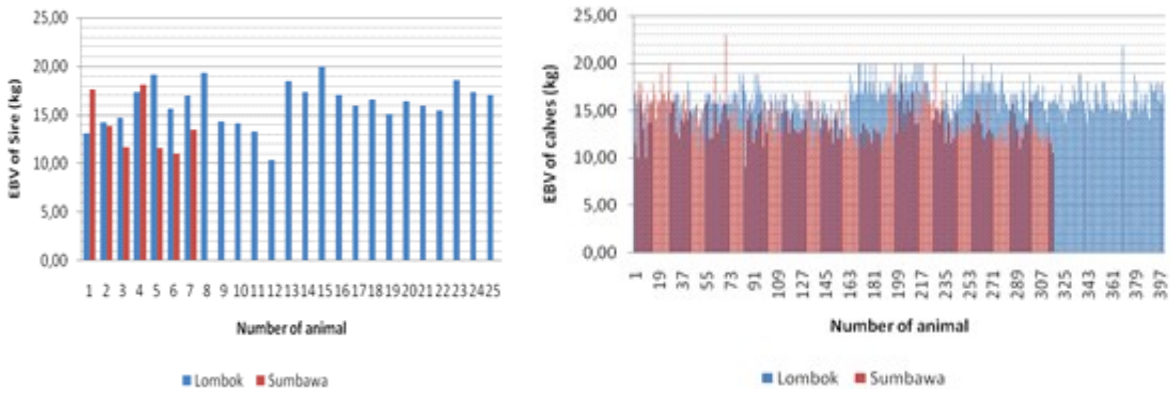

Figure 2. The Histograms of Absolute Estimated Breeding Value (EBV) for Birth Weight in Bali Bulls and Calves at WNT Province

Table 6. Table 6. The Best Five Bali Cows Based on Most Probable Producing Ability With Two Records Data of Birth Weight

Location / Cows	N_{Prog}	X_{CBW} (kg)	$MPPA_{BW}$ (kg)
Lombok island			
02009	2	20.00	+2.28
02054	2	19.00	+1.75
01024	2	18.50	+1.49
02076	2	18.00	+1.22
02019	2	17.00	+0.69
Sumbawa island			
0872	2	18.45	+2.67
0907	2	17.35	+2.08
0895	2	16.85	+1.81
0896	2	16.80	+1.78
0319	2	16.00	+1.35

N_{prog}: number of progeny; X_{CBW} : means of corrected birth weight; $MPPA_{BW}$: most probable producing ability of birth weight

moderate r value (0.10<r<0.30) for BW was showed in Red Sindhi (0.17), Friesian Holstein (0.21), Jersey (0.13), Sumba Ongole (0.10) and Friesian cross (0.30) cows (Mustafa *et al.,* 2002; Aksakal and Bayram, 2009; Nandolo, 2015; Said *et al.,* 2016; Islam *et al.,* 2017).

The r values for CI in this study was included of high category (r>0.30). Recently, the new study to report the r value for CI of Bali or native cattle in Indonesia are not reported. However, previous studies reported that high r value for CI were showed in Thari (0.35) and Kedah-Kelantan (0.34) and White Fulani (0.43) cattle (Sivarajasingam, 1975). The moderate r value (0.10 < r < 0.30) was showed in Tunisian Holstein (0.15), Ethiopian Holstein (0.23) and Mpwapwa (0.10) cattle (M'Hamdi *et al.,* 2011; Ayalew *et al.,* 2017; Chawala *et al.,* 2017). The low r value (r < 0.10) for CI were showed in Japanese Black (0.09), crossbred beef (0.04),

Table 7. The Best Five Bali Cows Based on Most Probable Producing Ability of Calving Interval

Location / Cows	N	X_{CI} (days)	$MPPA_{CI}$ (days)
Lombok island*			
02076	1	320.00	-25.70
602064	1	329.00	-22.19
01023	1	340.00	-17.90
01025	1	352.00	-13.22
02010	1	378.00	-3.08
Sumbawa island			
0583	2	338.00	-26.59
0482	2	345.00	-22.66
0022	2	348.00	-20.98
0397	2	350.00	-19.86
0354	2	353.00	-18.18

**Based on the r value from Sumbawa island; N: number of records data; X_{CI} : means of calving interval; $MPPA_{CI}$: most probable producing ability of calving interval

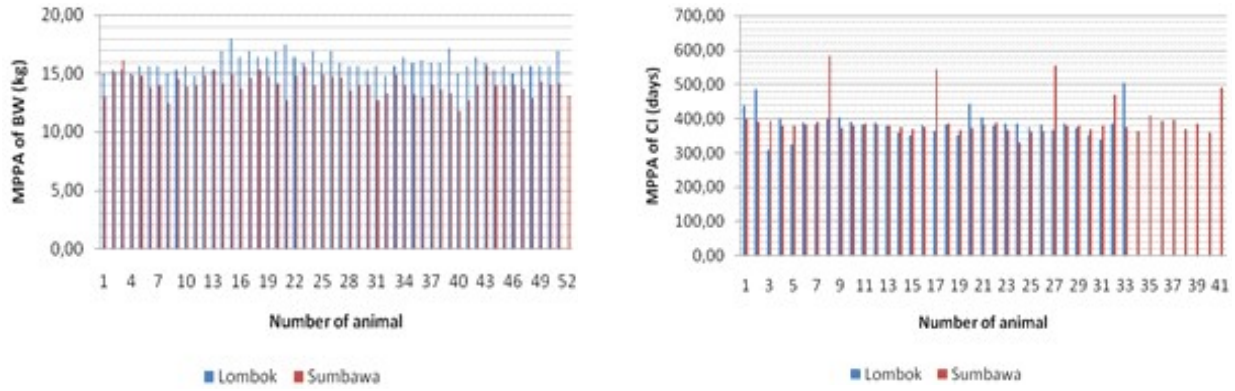

Figure 2. The Histograms of Absolute Most Probable Producing Ability (MPPA) for Body Weight (BW) and Calving Interval in Bali Cows at WNT Province

Iranian Holstein (0.06), Overo Colorado (0.05), Turkish Holstein and Czech Holstein (0.09) cattle. (Oyama *et al.,* 2002; Silva *et al.,* 2015; Rahbar *et al.,* 2016; Montaldo *et al.,* 2017; Ersöz and Ertuğrul, 2018; Brazakova *et al.,* 2019). High r value in this study can be suggested that overall cows had high repetition value (probability) to perform similar records data of BW and CI traits. Therefore, selection of Bali cows can be performed based on two records data of both traits.

EBV_{BW} and MPP_{ABW} values of Bali cattle in this study were higher than reported in the Aceh bull (+0.42 kg), calf (-0.02 kg) and cow (+0.001 kg) in BPTU-HPT Indrapuri (Putra *et al.,* 2014). Hilalah *et al.* (2018) reported that the highest EBV_{BW} of Bali calf in BPTU-HPT Denpasar was +0.46 kg and lower than in this study. Intaratham

et al. (2008) reported that the highest EBV_{BW} in Northeastern Thai indigenous cattle was reached of +74 kg and lower than in this study (+6.07 kg). In addition, Atil *et al.* (2005) reported that the EBV_{BW} in Friesian Holstein calf was ranged from -3.12 to +2.99 kg. According to Table 3, the highly of RA values (RA>0.80) were reached in the sires with had a large number of progenies. Therefore, low RA value in a bull indicates that selection in this bull is not accurate because of less number of progeny for analysis. (Putra e*t al.,* 2015).

CONCLUSION

The h^2 value of BW in Bali cattle at WNT province included of high category and can be described that BW of Bali cattle in this province can be increased based on BW. The r value of BW and CI in Bali cattle at WNT province included of high category and described that cows evaluation can be conducted with two records data of these traits. The cattle with positive of EBV and MPPA values can be used for breeding program in WNT province.

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