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SHORT COMMUNICATION

The Productivity Evaluation of Madura Cattle Under Beef Cattle Research Station Breeding Management

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Abstract

Madura cattle is one of the local beef cattle that have high adaptability to the influence of tropical environments and is one of the local germplasms that must be maintained and increased in productivity. This study aimed to evaluate the productivity of Madura cattle under Beef Cattle Research Station (BCRS) Breeding Management. The Madura cattle were 138 dams and 6 sires, which come from the selective collection. They were developed under BCRS breeding management, such as, application of natural mating in Litbangtan communal-pen models with the sex ratio of 1 male for 15-20 females. The parameters were first mating age, first partus age, calving interval (CI), days open (DO), calving rate (CvR) and calf crop (CC). The results showed that the first mating age of Madura cattle was (average ± SE) 23.2±1.26 months, first partus age 32.7±1.25 months. Madura cattle had the shortest CI 358.1±22.1 days with DO 78.1±22.1 days, CvR and CC 70% and 90%, respectively. The age of first mating and partus of Madura cattle come from the selective collection were similar with Madura cattle in their original place. It was because of the identical mating pattern; while the CI and DO value got better with time of observation. It was concluded that developing Madura cattle under BCRS breeding management improved their reproduction value.

Keywords: *Beef Cattle Research Station, Breeding management, Madura cattle, Productivity*

Besi Sığırı Araştırma İstasyonu Islah Yönetimi Kapsamında Madura Sığırlarının Verimliliğinin Değerlendirilmesi

Öz

Madura sığırı, tropikal ortamların etkisine yüksek adaptasyon kabiliyetine sahip yerel besi sığırlarından birisi olup, korunması ve verimliliğin artırılması gereken yerel gen kaynaklarından biridir. Bu çalışmada, Besi Sığırı Araştırma İstasyonu (BCRS) Islah Yönetimi kapsamında Madura sığırlarının verimliliğinin değerlendirilmesi amaçlamıştır. Selektif koleksiyondan138 dişi ve 6 erkek Madura sığırı seçildi. Bunlar, Litbangtan ortak kafes modeli ile 15-20 dişi için 1 erkek olacak şekilde doğal çiftleşme yöntemi ile BCRS Islah Yönetimi kapsamında büyütüldüler. Parametreler, ilk çiftleşme yaşı, ilk doğum yaşı, buzağılama aralığı (CI), servis periyodu (DO), buzağılama oranı (CvR) ve buzağı verimi (CC) idi. Sonuçlar, Madura sığırlarının ilk çiftleşme yaşının 23.2±1.26 ay ve ilk doğum yaşının 32.7±1.25 ay (ortalama ± SE) olduğunu göstermiştir. Madura sığırları, 78.1±22.1 günlük servis periyodu ile en kısa buzağılama aralığına (358.1±22.1) ve %70 buzağılama oranı ve %90 buzağı verimine sahipti. Selektif koleksiyondan gelen Madura sığırlarının ilk çiftleşme yaşı ve ilk doğum yaşı, orijinal yerlerindeki Madura sığırlarına benzerdi. Bunun nedeni, aynı çiftleşme modelinin uygulanmasıydı ve buzağılama aralığı ve servis periyodu değerleri gözlem süresince daha iyi hale geldi. Madura sığırlarının BCRS Islah Yönetimi altında yetiştirilmesinin üreme değerlerini iyileştirdiği sonucuna varılmıştır.

Anahtar sözcükler: *Besi Sığırı Araştırma İstasyonu, Islah yönetimi, Madura sığırı, Verimlilik*

INTRODUCTION

Madura cattle is one of the Indonesian local beef cattle that still exists and widely developed in East Java, especially Madura Island. As an asset of genetic resources (germplasm) local to Indonesian cattle, the existence of Madura cattle must be maintained both in terms of population and genetic purity [1].

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Madura cattle have some advantages such as they have good growth in poor quality of forage, have high adaptability to tropical environments, and can run fast, hence it is usually used for racing (karapan), and has a good body appearance, so it is also used as an "exhibition" cattle (sonok). Madura cattle also has a percentage of carcasses is high with good-quality meat [2]. These advantages can be a good reason to put them as local cattle for meat producers like other local beef cattle.

The beef cattle population in Indonesia was approximately 17.118 million in 2019, however, the real population of madura cattle has not yet been confirmed. DGLS [3] reported Madura cattle population was approximately 635.000 or 5.16% of the total beef cattle population in 2010 (12.3 million). They are spread out in four districts in Madura Island. So far, the breeding activities of these cattle have focused more on producing superior cattle through coincidental selection. Especially in Madura Island, as the Madura cattle development area, selection serves more to produce Karapan cattle, namely bulls that are able to run fast, agile and have muscular skeletons [4] and Sonok cattle are tame and beautiful-looking cows [5] and is usually selected based on the superior female pedigree [6]. Karapan and Sonok cattle are the diversity of traditions and cultures as well as a portrait of the community's love for Madura cattle. Nurlaila and Zali [7] also reported that Madura cattle not according to these criteria will be used as regular beef cattle. This is the reason why Madura cattle still exist and thrive in Madura Island.

But lately, the reproductive performance of Madura cattle has reportedly begun to decline markedly by high calf mortality, long calving intervals, low birth rates and slow genetic improvement. Calving Interval (CI) and Days Open (DO) are two common measures used to determine the reproductive performance of livestock. The mean length of the calving intervals of a cow determines to the large extent her total productivity [8]. Karnaen et al.[9] also reported that the range of Madura cattle birth weights in Madura Island was just from 16 to 17 kg while the range of weaning weights was from 76 to 80 kg.

Improvement of Madura cattle productivity through breeding activities is still being done both through genetic improvement and selection. Basically, animal productivity is influenced by genetic (internal) and environmental (external) factors as well as the interaction of these two factors [10]. Therefore, the success of the productivity improvement of Madura cattle can only be achieved if genetic improvements are followed by improving environmental conditions, so the selected cattle have the opportunity to fully express their genetic potential.

The Indonesian Beef Cattle Research Station *(Loka Penelitian Sapi Potong Grati)* as one of the Technical Implementation Unit (TIU) under the Indonesian Agency for Agricultural Research and Development, Indonesian Ministry of Agriculture has developed Madura cattle from 2013 until now. The Madura cattle breeding pattern uses a BCRS breeding management that keeps the cattle in a Litbangtan communal pen. One of the strengths of this management system is efficiency in effort and time that have some good impact. The main good impact was able to shorten the calving interval; therefore, it directly improves reproductive efficiency. This study aimed to evaluate the productivity of Madura cattle that were developed under BCRS breeding management.

Materials and Methods

Ethical Approval

The following experiment was conducted under the guidelines of the Indonesian Code of Practice for the Care and Use of Animals for Scientific Purposes and was approved by the Indonesian Ministry of Agriculture Animal Ethics Committee (Balitbangtan/Lolitsapi/Rm/14/2019).

Animal and Data Collection

Data were collected from the herd of Madura cattle in BCRS at Grati, Pasuruan, East Java for 6 years from 2014 to 2019. Productivity data were from 138 Madura dams and 6 Madura sires with the age range of 1-year-old. The variables observed were the body weight of dams and sires, gestation detection, date of birth, calf sex, and birth weight.

Breeding and Feed Management

The research method was carried out with recorded variable data periodically as requirements on a certain physiological status. As a breeding concept, the BCRS breeding management referred to the concept of good breeding management that considers the environmental impact as well as the genetic. This concept was used as a treatment in this research.

The Litbangtan communal pen was used (3 m^2/head) for the main pen in the current research. This pen was used as a mating and gestation pen until 8 months of gestation. Individual pens were used for prospective sires and sires which were not being in use for mating; while lactation pens were used for dams that were gestation by 8 months, give birth, and continued by lactating up to 40 days of calf age. The mating system applied was referred BCRS breeding model also. The model was carried out by the 15 to 20 steady heifers/dams placed in a communal pen together with a selected sire. Furthermore, the first gestation detection (rectal palpation/RP) was conducted 3 months after mating and the second one was done in the following month or 4 months after mating.

Standard feeds were used in this experiment, and the feeds consist of common roughage (elephant grass and rice straw) and additional feed which was mixed from the

agricultural, plantation, and agroindustries byproducts. The nutrient contents were about 8-9% crude protein (CP), 57-60% total digestible nutrient (TDN), and 20-22% crude fiber (CF). The ration ingredients and its formulation were not permanent, it depends on the availability of feedstuff. The ration was adjusted to the physiological status of the cattle. Generally, cattle consumed 2.5-3.5% of their body weight.

Data Analysis

Observations on reproductive performance were recorded periodically; the variables were gestation cattle, birth rate, date of birth, body weight at birth. The other supporting variables were also recorded such as body weight and body size. All variable collected data were analyzed and used to determine some parameters descriptively. The parameters were the first mating age, first partus age, calving interval, days open, calving rate and calf crop.

The first mating age was calculated by subtracting the birth date from the estimated gestational age for 280 or 285 days. The calving interval (CI) was the amount of time (days or months) between two birth times on the same cow sequentially. Days open (DO) was calculated as the time period between calving and conception in a given cow [11]. Calving rate (CvR) is the percentage of the number of birth calves as a result of the first insemination or subsequent insemination.

Results

Study on the productivity evaluation in Madura cattle showed that the average body weight and the shoulder height of Madura dams were 178.9±2.5 and 110.2±0.04 while Madura sires were 236±6.0 and 130.1±0.08, respectively. The performance of Madura cattle resulted from the selective collection is presented in *(Table 1)*. In this study, the reproductive performance of Madura dam specifically first mating and first partus age on BCRS breeding management *(Table 2)*. Calving interval data are almost certainly obtained

***Table 1**. The average body weight and shoulder height of madura dams and sires*

Sex	n	BW+SEM	SH+SEM
Dams	123	178.9±2.5	110.2±0.04
Sires	6	236.0±6.0	130.1±0.08

***n:** number of samples; **BW:** body weight; **SH:** shoulder height; **SEM:** standart error of mean*

***Table 2.** First mating and partus of Madura dams*

Reproduction Variable	n	Month+SEM
first mating age	124	23.2±1.26
first partus age	124	32.7±1.25

***n:** number of samples, **SEM:** standar error of mean*

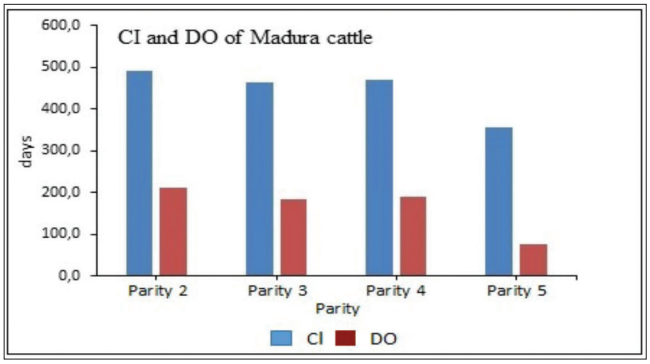

Fig 1. Calving interval and days open of Madura cattle

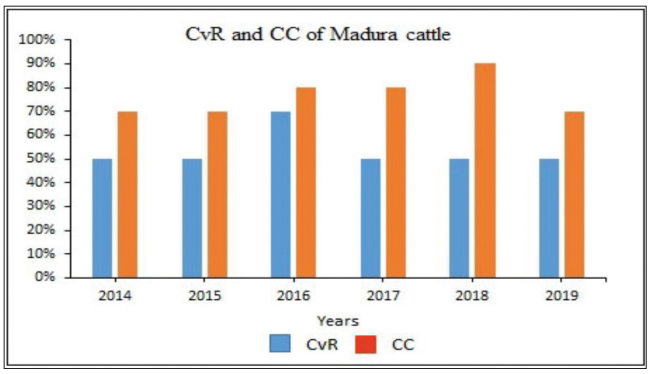

Fig 2. Calving rate and calf crop of Madura cattle

from the second partus point in different years, so the data would be easier to interpret if presented based on the parities, as shown in *Fig. 1*. CI value *(Fig. 1)* in the second parities was 491.4±14.6 days, while the third and fourth parities were almost the same and were 462.8±18.6 days and 469.3±25.1 days and the shortest CI value obtaining at fifth parities was 358.1±22.1 days. The variety of CI values in BCRS was largely occurred by the length of the DO. The DO values of Madura cattle in this study were 211.4±14.6, 182.8±18.6, 189.3±25.1 and 78.1±22.1 days for consecutive observations based on parities. In addition, productivity performance also included Calving Rate (CvR) and Calf Crop (CC) and shown in *(Fig. 2)*. The calving rate of Madura cattle was quite high and varied from year to year between 50% until 70%. In BCRS, Madura calf crop in the last six years recorded (2014 to 2019) fluctuated from 70 to 90% (average 74%).

Discussion

The body weight and shoulder height of Madura dams and sires come in quite high. Both of them were higher than the standards set by the Ministry of Agriculture no. 3735/Kpts/HK.040/11/2010. The standard stated shoulder height of Madura sire at 24-36 months was 105 cm and for Madura dam was about 102 cm [12]. While the Indonesian National-Standard, SNI 7651.2: 2013 issued by National Standardization Agencies (BSN) reported the shoulder

height on the first class of quantitative requirements at 12-<18 months was 122 cm for Madura sire and 116 cm for Madura dam [13]. The mean shoulder height of Madura sire in this study (130.1±0.08 cm) is higher than in the Class I category in Indonesian National Standard, which is 12-<18 months and 122 cm for Madura sire and while the mean shoulder height of the Madura dam (110.2±0.04 cm) is lower from the size of the Indonesian National Standard and is 116 cm [13]. The result was in agreement with Nurgiartiningsih et al.[14] reported cow body weight was one indicator for livestock productivity, which can be predicted by the size of the linear body of the cow. The high correlation indicated that chest girth could be used as a parameter for estimating body weight of female Madura cattle.

The animal genetic potential was measured based on their production and reproductive performances. Quantitative data of biological-potential on production and reproduction performance phenotypes were not be separated from the environmental influence where the livestock kept. The result in this study showed that age was similar to the Madura-cattle first mating age developed in Pamekasan Regency, Madura Island, which was reported 23.44±2.57 months [15]. Kutsiyah [2] reported the age was relatively lower in Sapudi Island (21.12±0.16 months) and in Sumenep and Pamekasan Regency were 19.85±0.81 [16].

Early pregnancy is the key to successful livestock production [8]. The first mating age of an animal is very closely related to the management of both feeding and mating management. The Madura cattle were directly placed together in the Litbangtan communal pen since their coming in 2013. A communal pen was entered by 15-20 sire with a dam, the pen was also used as a mating pen. This model leads to the first mating age faster; the Madura cattle first mating age in BCRS occurred before two years. The first mating age of Madura cattle in BCRS was an estimation because the animal mating system was natural and nobody knew precisely the mating time. It can be counted down from the first partus age, the length of the gestation period on Madura sire is 280-285 days.

The first partus age of Madura cattle under BCRS breeding management was relatively same as the results of Nurlaila et al.[17] and Wisono et al.[15] study in Pamekasan, Madura, that reported 33.92±3.88 months and 34.63±2.46 months, consecutively. Meanwhile, Kutsiyah [2] reported the first partus age of Madura cattle in Sapudi Island was rather better 31.97±6.43 months.

The reproduction status of Sonok cattle in Pamekasan District was quite good. The first age of mating was 23.40±4.17 months, it was relatively the same as Madura cattle under BCRS breeding management 23.2±1.26 months. By these observations both on first mating and partus age indicated the BCRS breeding management took a good influence on the reproductive performance of Madura cattle. Many factors affect the reproductive performance of beef cattle including the type of feed consumed, feed quality, and peripartum diseases.

Calving interval (CI) is the time between two successive calvings so that it is only available for cows from the second parity onwards, in tropical and subtropical regions between 12-14 months. Calving interval can be divided into three periods, gestation, post-partum anoestrus (from calving to first estrus) and service period (first postpartum estrum to conception) [18]. The ideal calving interval is 12 months, which is 9 months for the gestation and 3 months for days open (DO) which defines the number of days between calving and the next conception. The days open may be used to provide exclusive lactation for the calves. However, calving interval are also affected by the production system, the length of postpartum estrus, length of gestation, and length of gestation is influenced by genetic and environmental factors [19]. A good reproductive performance is when a dam able to produce one calf in one year.

The CI values in this study tended to vary based on parities and it was different of CI of Madura cattle on Sapudi Island was 442.9±65.70 days [3]. The variety of CI values in BCRS was largely occurred by the length of gestation and the length of the DO. A longer DO result in a higher CI value and this circumstance is a debilitate for breeding activities. The DO value in this study was different from the report of Nurlaila et al.[17] amounting to 168.67 days. The difference in CI and DO values in Madura cattle breeding was most likely caused by differences in feed and variations in feed ingredients, breeding patterns, and mating management. CI is mainly determined by the open day between birth and conception and influenced by the cycles of estrus, reproduction, and conception. Breeding management which also affects the CI value includes feeding, time of insemination or time of heat detection.

The highest CvR was obtained in 2016 of 70%, the value indicates that Madura cattle have a good reproductive efficiency reflected in a high CvR, the value was about 55-65%. The results of other studies show that of the 77 cattle that were mated, 56 cattle were conception or pregnant at the first mating with Conception Rate (CR) was 73%. Calving rate was the most important trait, indicating that the economic effect of the reproductive performance is very high in an integrated beef production system. The size of this CR was also due to quality good stud used in mating, improvement efforts management in heat detection by observing the behavior of cows, namely, indicates a reduced appetite, restless behavior, and often comes out mucus, swollen, red, wet, as well the accuracy of the mating performed. The calving rate can reach 62% on two times perfect insemination, without producing a calf, artificial insemination considered to be unsuccessful. Several factors determine the low CvR value were embryo

death and feeding of cows not in accordance with their conditions and physiological.

Calf crop is the number of calves weaned to a particular cow group in percent. In this study, the average value of Calf Crop was 74% almost the same as the studied by Susilawati [20] at about 75%. Increasing the calf crop can be done by paying attention to the time and length of estrous, the accuracy of mating, nutrition and disease control. Based on the performance progress of Madura cattle outside Madura Island (BCRS), it has shown several increased reproductive performances. Therefore, the condition of Madura cattle can be used as the basic population for performance testing and breeding programs to achieve an increase in the genetic quality of Madura cattle to support the conservation program for Madura cattle as local genetics Indonesian resources.

In conclusion, the performance of Madura cattle under Beef Cattle Research Station breeding management showed improvement on their productivity value including the values of CI, DO, CvR and CC.

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Conflict of Interest

Authors declares that there is no conflict of interests.

Author Contributions

HH planned, designed the research, analyzed all data and drafted manuscript. ML, NHK, PKS, HPF, RW and DMD contributed and help in the research. All authors concurred with the submission and subsequent revisions submitted by the corresponding author.

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