Madura cattle stratification as a signature of traditional selection and diverse production systems

N Widyas¹, S Prastowo¹, R Haryanto², T Nugroho³ and T S M Widi³

¹Department of Animal Science, Sebelas Maret University, Surakarta, Indonesia
²Livestock Health and Technical Services, Waru, Pamekasan, Indonesia
³Faculty of Animal Science, Universitas Gadjah Mada, Yogyakarta, Indonesia

Corresponding Author: nuzul.widyas@staff.uns.ac.id

Abstract. Farmers practiced-selection and diverse production systems applied on Madura cattle and procured a stratification system. We aimed to study the Madura cattle population structure, especially in Sonok area. Focused group discussions and interviews involving farmers, key-persons and stakeholders were conducted. Data on mature body measurements and weight were collected. The strata bottom up were commercial cattle, pajangan (multiplier) and elite. The breeding pyramid’s shape, however, was distorted; as pajangan was of the largest number. Elite dams were the selected ones, eligible to participate in local contests on body conformation and aesthetic. Sires were the descendant of the elite dams. No specific selections were conducted on sire lines. Elite dams and pajangan were mated with sires; female offspring become elite replacements if they manage to enter the contest; else they stay as pajangan. Pajangan’s female offspring failed to enter the contest were kept as dams. Farmers did not keep written records; however, mating was always done with inbreeding in consideration. This system managed to improve the cattle’s performance; mature wither height for elite dams were 115.54±1.45 and 131.55±9.30 cm while body weights were 236.26±14.12 and 393.88±43.94 kg on measurement year 2009 and 2017 respectively.

1. Background
Madura cattle is a native breed from Indonesia. They are reported to be the product of mating between Zebu (Bos indicus) and Wild banteng (Bos javanicus) which hybridization had happened more than 1500 years ago [1–4]. Nowadays, Madura cattle had diverged into three sub populations: the Karapan, the Sonok and common/commercial Madura cattle (Rudi Haryanto, 2017, Personal communication).

Around the 12-13th century, during the Dutch colony, paired bull race (Karapan) was introduced by a local landlord as a soil ploughing festival and gain massive popularity [5]. This cultural event however, had brought negative effect towards the genetic quality of Madura cattle in general [2]. The bulls in Madura were selected for their lighter and smaller body to be able to run faster. In 2011, at the biggest Karapan event, only 30 pairs were eligible to participate because there were less and less Madura bulls with minimum wither height of 120cm, which was the requirement to join the competition [2]. This issue has become a concern of the local government as well as the farmer communities.

Meanwhile, on the northern part of the island, there is another cultural event called Sonok. It is a body conformation contest held in Pamekasan district for Madura cows where only the selected and
well-trained cows, fulfilling certain criteria were eligible to join the contest. The background of Sonok event was originated from the pride of the local farmer when showing off their beautiful and well-maintained cattle [6]. On late 60’s this event was organized by local government and farmers as a festival after tobacco harvesting season. Due to its nature, only cattle with good body conformation, posture and exterior were selected in order to produce Sonok-quality cows [2,4,7]. These two traditional events have brought up three sub-populations within the Madura cattle population (commercial, Karapan and Sonok) with distinctive physical characteristics as results of different production systems and breeding strategies.

Madura cattle are owned by smallholder farmers with around two to five cattle per household on average [2]. Cattle were kept traditionally with intensive system. Whilst some of the Madura farmers have adopted Artificial Insemination (AI) following the government’s program, most of Sonok farmers prefer natural mating following their traditional breeding system (Rudi Haryanto, 2017, Personal communication). Study area will be covering three sub-districts in Pamekasan, Madura, East Java, Indonesia. The sub-districts were: Waru, Batu Marmar and Pasean. These sub-districts were chosen because they are the main sources of Sonok elites and they are where the original Sonok events take place.

The fact that the Sonok farmer’s communities were able to maintain (or even improve) the quality of their cattle through a cultural event and traditional breeding system is an interesting finding. In this paper we presented the results of our study in documenting the population structure of Madura cattle as well as their breeding strategies in Sonok sub-population area. This study is necessary as a guideline in maintaining, conserving and utilizing our local genetic resources while accounts for the local culture and wisdom.

2. Methodology
Participatory approaches through focused group discussions (FGD) were conducted to gather information regarding the traditional breeding system. The discussions involved 30 Sonok farmers and key persons such as government officials, the head of Sonok community and village elders. We conducted semi structured interview with the aforementioned information sources separately. The interview topic including the identity of the farmers, the cattle ownership, the experience in cattle keeping, the technical and management aspects, the origin of the cattle owned, price per head, selection procedures, mating system and pedigree information. We also attended and documented the Sonok event of August 2017. Information were obtained with the research design following the methods by Widi et al., (2014). Through FGD and interviews we observed a hierarchical population structure of three strata based on their performance and pedigree information.

Phenotype data of the cattle’s body weights and measurements at of mature cows (>3 years old) were obtained by either direct measurement on the cattle or from the recorded data of the Livestock technical Service Unit, Department of Agriculture, Waru sub-district, Pamekasan, Madura, East Java, Indonesia; this area is specialized in Sonok cattle farming. In total 29, 180 and 85 sample cows from year 2015, 2016 and 2017 respectively were retrieved. Local farmers are aware of the inbreeding risk; thus, mating is planned among unrelated individuals. Pedigree information, however, are not available and only remembered by heart; thus, need to be constructed.

3. Results and discussions
Madura cattle body measurements and weight are presented in Table 1. Data from year 2009 was obtained from unclassified population all around the Madura isles, hence it included information from commercial, Sonok and Karapan sub-populations [9]. Madura cattle body performance data from year 2012 was obtained from the same population as this study; which was the Sonok cattle area covering three sub-districts: Waru, Batu Marmar and Pasean in Pamekasan, Madura [8]; whereas data for year 2015-2017 was originated from our own data collection.

The comparison of body weight and measurements between Sonok, Karapan and commercial cows can be clearly observed in Table 1. The mixed Madura cattle population in 2009 were considerably
smaller compared to the following years results [9]. Meanwhile, data from year 2012 alone showed that Sonok cattle is the largest (392.30±60.40) among the three sub-populations [8]. Sonok cows was heavier in 2012 data compared to the observations in year 2015-2015 simply because of the difference in age of the measured cows. In year 2012, data were collected from Sonok cows with average age of 4.55 years whereas in our study the observed cows were aged 3 years or more. These findings implied that the selection criteria in Sonok event managed to improve the performance of Madura cattle population. The detail of Sonok events and the breeding system inclusive the selection procedure in Madura cattle population are explained in the following sections.

### Table 1. Mean (±) standard deviation of Bali cattle’s body weight and measurements.

| Variables                | Year          |
|--------------------------|---------------|
|                          | 2009 (n=59)^1 | 2012 (n = 61)^2 | 2015 (n=29)^3 | 2016 (n=180)^3 | 2017 (n= 85)^3 |
| Wither height (cm)       | Mixed         | Sonok         | Karapan       | Commercial     | Sonok         | Sonok         |
|                          | 115.5±1.45    | 128.40±6.10   | 116.40±4.90   | 119.20±10.70   | 127.93±5.90   | 127.71±9.26   | 131.55±9.30   |
| Body length (cm)         | -             | -             | -             | -              | 128.03±6.92   | 129.20±12.48  | 134.14±8.73   |
| Chest girth (cm)         | 140.81±3.01   | -             | -             | -              | 164.48±13.54  | 160.64±16.12  | 171.10±11.11  |
| Body weight (Kg)         | 236.26±14.12  | 392.30±60.40  | 294.30±43.00  | 279.10±89.00   | 306.97±71.26  | 384.47±79.74  | 393.88±43.94  |

^1Measurements was taken from unclassified Madura cattle population [9]; ^2Measurements was taken from Sonok farmer’s community [8]; ^3Sonok cows data from Livestock Health and Technical Services, Waru, Pamekasan.

### 3.1. The Sonok events

Nowadays, Sonok event takes place every month, eight months per annum started on April until November depend on the weather and other cultural or religious occurrences. The three Sonok sub-districts organized the event in turn. In each event up to 200 pairs of cows from all over the isle of Madura joined the contest. The cows were decorated and paired using ‘pengonong’ which originally wooden bar placed on the cattle’s shoulders during soil ploughing. During each pair performance, traditional music was played and dancer will walk and dance along the cows. There is no winner in the Sonok contest. Instead, the jury (consisted of government officials and influential people) would comment on each performing pair and then give suggestions on how to improve the cattle. For their cows to be eligible to enter the Sonok contest is a pride for the farmers. The better the cows, more positive comments from the jury will increase the pride of the farmers and the price of the cows. This event gives farmers opportunity to gather, share information and even trade their cattle. The adult Sonok cows on productive age could cost around 3,000-6,500 Euros, while the bulls would cost half.

### 3.2. Physical characteristics and selection criteria

In order to be eligible for Sonok, a cow had to undergone several steps. Started from two months of age the cows were assessed for their exterior characteristics as seen on Table 2.

Only the young female calves which fulfilled those criteria were categorized as ‘pajangan’ or Sonok candidates. Further observations were done when the heifer aged 1-1.5 years. Additional characteristics were added such as: the presence of hump and lower hump, compact bottom, long and deep chest, long legs with healthy nails and height between 126 and 130cm. Above two years old, cows are considered as mature with the following criteria: wither height 117-143cm, body length 111-161cm, chest girth 136-190cm and body weight 400-700Kg.

Selection was only done based on the phenotype; selection only on female line. Parental lineages were considered however, pedigree records were not available. Shall the mature cows failed to suffice
the criteria, they are not eligible the title of Sonok and to be sold or kept as dam. Sonok only concern on cows, the bulls are out of interest of this event.

**Table 2. Exterior characteristics of calves as Sonok candidates**

| No. | Body parts | Characteristics |
|-----|------------|-----------------|
| 1.  | Head       | Perfect triangle shaped, no defect or deformation, big mouth and nose in dark colour |
| 2.  | Coat       | From golden paddy colour to brick red |
| 3.  | Eyes       | Almond shaped with black rims |
| 4.  | Ears       | Small like bamboo leaves and straight upwards |
| 5.  | Horns      | Two perfectly shaped horns bent toward the centre of the head |
| 6.  | Dewlap     | Flabby in horizontal direction |
| 7.  | Backline   | Black or dark brown line along the back |

Source: Sonok farmer’s community conventions

3.3. **Traditional breeding strategy**

Through preliminary study we observe a hierarchical population structure of three strata based on their performance and pedigree information. They are: lower stratum is the least performed cattle as slaughtered/final stock (commercial); second/middle stratum as the multiplier stock (pajangan); and the upper stratum as the nucleus stock (elite). The population structure in Madura cattle follows open nucleus breeding scheme with Sonok cows and Sonok descendants’ bulls were at the top of the hierarchy as elites.

![Figure 1. Population structure and simplified cycle of Madura cattle](image)

The total population of Madura cattle were around 1.3 million heads in 2015. There were only around six to seven hundred heads were categorized as Sonok and around 200 heads of elite males. Most of the population fell under the category of pajangan cattle. They did not involve in any cultural activities and sold as commercial stock for beef cattle (Figure 1A). However, common cattle which happened to arrive at Sonok centres and passed the early exterior selection could enter the Pajangan group. It is unclear of how many cattle were categorized as Pajangan; as in principle, Pajangan consisted of young Sonok descendants and the best of common cattle which raise up to this stage. Pajangan which did not pass the Sonok selection will be mated with elite bulls to produce offspring or sold as final stock (Figure 1B).

After fully mature the cows undergo further selection procedure, a few could enter the elite stage or Sonok. These cows were only allowed to mate with elite males which were the sons of Sonok cows in previous generations. The flowchart of the selection and replacement procedures is presented in Figure 1B. Farmers are fully aware of inbreeding and the consequences; it is thus they conduct rotational mating in order to avoid it. It is known that within small population size, careful planning of mating is necessary and the most common procedure used is by rotating or exchanging the usage of male as
genetic resources among breeding group [10,11]. In Waru, Batu marmar and Pasean, each region has their own Sonok farmer’s community. Every community possess a breeding population which consisted of few elite bulls and Sonok cows. Mating between elites were done naturally and programmed to avoid inbreeding by exchanging males among villages. The pedigree information is considered and remembered by heart without any written records.

The whole integrative process from the management and breeding strategy had developed Sonok to be a Madura cattle sub-population with the best body weight and body measurements traits while maintaining its other superior traits especially in fitness. This achievement, of course cannot be taken for granted; in the middle of advanced and high-cost technology in animal breeding and genetics, a traditional approach had delivered a sustainable and culture-friendly system which able to maintain, conserve and utilize our own animal genetic resources.

4. Conclusions
To conclude our findings, the traditional breeding system in Sonok sub-population has been a success in maintaining and conserving the Madura cattle as one of Indonesian native cattle. However, in order to sustain and improve the breeding program, more information need to be collected and the advancements in modern breeding technology could be adapted without leaving out the culture and local wisdom.

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