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Reproductive Management and Performances of Aceh Cows, Local Indonesian Cattle Kept by Farmers in A Traditional System

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ABSTRACT

Background: Aceh cattle is one of seven local cattle breed in Indonesia that have an essential role for rural communities in the economic, social, and cultural aspect. Aceh cattle kept by smallholder farmers for beef cattle purposes, and working or preparing paddy field in a traditional system with the poor condition of colony housing, tethered in the backyard, and grazed around post-harvest paddy field. As a consequence, poor performances and low reproduction rate are general phenomena for Aceh cows.

Objective: The study was conducted to identify reproductive management and performance of Aceh cows kept by farmers with the traditional system in Aceh Province, Indonesia

Methodology: A numbers of 162 farmers located in Muara Batu, Sawang, and Nisam sub-district, North Aceh district, Aceh Province, and their cows (175 heads) were involved in this study. Farmers were interviewed using a semi-structural questionnaire to evaluate reproduction management done by farmers, while the cows were measured and recorded for their reproductive performances. The qualitative data were analyzed descriptively, while quantitative data were analyzed using one-way analysis of variance and continued with DMRT.

Results: Farmer's background on three sub-district shown the traditional system based on small ownership of cattle (3 head/farmer) and objective for saving (94,7%). The most of farmers in three different sub-districts had an excellent heat detection capability (47.2%) and applied natural mating (70.9%). Farmers at Nisam sub-district had the best management on postpartum mating, mated the cows at 110±28.19 days after calving, service per conception 1.04±0.21 times and the shortest calving intervals 12.61±1.72 months differed within Muara Batu and Sawang sub-district 14.32±3.76 and 17.11±3.65 months respectively. The first estrous age, first calving age, and estrous cycle did not differ amongst cows in three different sub-districts with the average were 27.25±3,94 months; 38.10±5,22 months; and 19.57±1,82 days, respectively.

Conclusion: Reproductive management plays a role in the productivity of Aceh cows with the traditional production system, the farmers had proper management of Aceh cows reproduction. Aceh cows kept by farmers in Nisam sub-district had the best reproductive performances in terms of postpartum mating, service per conception, and calving intervals.

KEYWORDS

Aceh cows; Local genetic resources; Production system, Productivity, Recording

INTRODUCTION

Indonesia has an abundance of local cattle breed as animal genetic resources, which has been used as sources of meat, labor dan organic fertilizer, one of them is Aceh cattle. Aceh cattle is one of seven local cattle breed and germplasm in Indonesia [1] and determined by the government through the Decree of the Minister of Agriculture, Republic of Indonesia number: 2907/Kpts/OT.140/6/2011 dated June 17th, 2011 [2, 3, 4]. Aceh cattle are original geographical distribution and spread widely in Aceh Province, Indonesia. Aceh Cattle is cultivated for generation and has long held an important role for rural communities in the economic, social, and cultural aspect of the Acehnese people [3]. The population of cattle in Aceh was dominated by Aceh cattle breed (84.93% of cattle population) at smallholder farms level [5].

The raising system for Aceh cattle carried out by the farmers is still traditional. The pen was built simply near the house or yard. Most of the farmers who raise cattle are for the side of their main job [3]. Aceh cattle kept by farmers for beef cattle purposes, and sometimes the farmers use it for working or preparing paddy field in a traditional system with the poor condition of colony housing, or they tethered in the backyard. During the day, Aceh cows are grazed around post-harvest paddy field, plantation field, and communal grazing area, and often they grazed in the hilly areas [1]. The mating system is carried out naturally with males that are owned by farmers or by artificial insemination. Farmers have a tendency to choose Bali bull straw. Health care is still traditional [4]. As a consequence, poor performances and low reproduction rate are general phenomena for Aceh cows kept by small farmers.

As the calf is mostly the sole output in beef cow enterprises, reproductive efficiency is a crucial determinant of profitability, irrespective of the system of production used [6]. Reproductive performance of cows mostly depends on the management of reproduction applied by farmers. Reproductive efficiency in cattle herds is dependent on high submission and conception rates to service, and low calling rates, therefore, monitoring of such changes to ensure their effectiveness is essential to the success of any program [7]. The primary causes of low fertility or low reproductive efficiency are poor nutritional management particularly during calving and thereafter, frequent suckling at long duration because there is no practice of weaning, use of cow in draught power, high proportion of inaccurate estrous detection, artificial insemination in incorrect time, unskilled inseminator, lack of knowledge about heat detection. Therefore, the farmers should be optimized cow performance by implementing early weaning of calves, particularly during times when forage quantity and quality are insufficient to meet cow requirements [8]. Further, suckling delays the onset of estrus in beef cows and early weaning before the breeding season has shortened the postpartum anoestrous period and increased pregnancy rates. The manipulation of the suckling and lactation stimulus has been indicated as a viable management option to decrease the postpartum interval in individual cattle breeds, and these are relatively easy and inexpensive management practices within reach of resource-poor cattle farmers in developing countries [9]. Chawala et al [10] stated that in a traditional system with the low-input production system in the tropic, an average of age first calving is 32 months. In traditional production systems, breeding is often uncontrolled, and heifers are bred at the first opportunity, and this frequently results in longer subsequent calving intervals [11]. Increased intervals from calving to first estrous are associated with reduced conception rate to the first service. Indeed, prolonged post-partum an-estrous is a significant limitation of reproductive efficiency in cow herds [7]. Genetically, Aceh cattle have their own advantages, both the ability to adapt to physical environmental conditions, ability to reproduce despite poor feed conditions, the ability to withstand a number of diseases, especially parasitic diseases [12]. However, management carried out by farmers effects on cows reproductive. There is limited information on the reproductive management and performance of Aceh cows. The information regarding reproductive management is very needed by stakeholders to improve the quality of farmers and their supporting resources by the adoption of technology. While information about the reproductive performances of Aceh cattle can be used for scientific data for based on local livestock germplasm exploration in smallholder farmers level and as a reference for the Aceh cow productivity improvement program

2. OBJECTIVES

The objective of this study is to: 1. Identify the farmers' background of Aceh Cattle, 2. Identify the feed management was carried out by Aceh cattle farmers, 3. Identify and evaluate the reproductive management was carried out by Aceh cattle farmers and 4. Identify and evaluate the reproductive performances of Aceh cows kept by farmers in three different sub-districts of Aceh Province, Indonesia.

3. MATERIALS AND METHODS

3.1. Research Area and Sampling

The research was conducted for ten months (March-December) in three different sub-districts, namely Muara Batu, Sawang and Nisam, North Aceh district, Aceh Province. The three sub-districts selected in this area were a representation of the high, medium, and low population of Aceh cattle in Aceh Province, Indonesia.

Aceh Cattle population data in Muara Batu, Sawang, and Nisam sub-district are 1.764 heads (low), 7.878 heads (high) and 4.408 heads (medium) [13]. In total, 162 farmers and around 175 heads of Aceh cows were involved in the study. A semi-structured questionnaire were used to explore the farmers' background and management of cows done by the farmers. Secondary data from local government, namely Central Bureau of Statistics (BPS) Aceh Province, Central Bureau of Statistics (BPS) North Aceh Regency, Department of Agricultural and Livestock of Aceh Province. The secondary data was also from the recording cards or books are used to obtain information on reproduction record.

The farmers and their cows were categorized in the three groups according to their hometown, namely Muara Batu district, Sawang district, and Nisam district. The farmers were interviewed using a semi-structured questionnaire to evaluate reproduction management done by farmers, while the cows were measured and recorded for their reproductive performances. Breeding-records of 175 cows were collected from the farmers. The selected cows were visited frequently, and the information on the productive and reproductive performances of each cow was collected by face to face interviews and direct measurement of the cow. During the study, the farmers' background and management, including feeding, house cleaning, bathing the cattle, and several cows owned by the farmers were also observed and recorded in the questionnaire.

3.2. Data Collection and Analysis

The data of farmers' background consisted of farmers age. Farmers experience on keeping cattle, several family members, educational background of the farmers, farmers' job, the objectives of keeping cattle, and experience on training attended by the farmers. Feeding management in this study included production systems applied by the farmers, feed component, how can the farmers find the feed.

The collected data of cows consisted of first estrous and calving age, postpartum estrous, estrous cycle, service per conception (S/C), pregnancy length, and calving intervals. Reproduction management done by the farmers consisted of the age of puberty, first mating age for male and female of Aceh cows, the ability of the farmers to detect the estrous sign, a mating method applied by the farmers, weaning time, postpartum mating and how long the farmers keep their animal for breeding purposes.

The analysis of one-way analysis of variance (*SPSS program*) was used to analyze different mean and continued by Duncan's New Multiple Range Test for significant differences ($P < 0.05$) amongst the sub-district.

4. RESULTS AND DISCUSSION

4.1. Farmers' Background

The information on farmers' background in three different sub-districts is presented in Table 1. Most of the farmers were in the productive working age since they have aged less than 50 years old and farmers in Nisam sub-district have the youngest age, differed ($P < 0.05$) compared to farmers in Muara Batu and Sawang districts. The average age of Madura cattle farmers on Madura Island is 45-51 years old [14] and in the Special Region of Yogyakarta is dominated (83,34%) by farmers over 41 years old [15]. The productive working age is expected that it will influence their production positively. The common belief is that the productivity of a farmer increases with age, reaches some mid-age peak, and then decreases with further age. Achmad et al [15] state that the age of the farmer would affect physically in doing work and making decisions in running a livestock business.

Table 1. Farmers' background of Aceh cows in three sub-district

| Parameters | Sub-district | | | Average |
|-----------------------------------|---------------------------|---------------------------|---------------------------|-------------|
| | Muara Batu | Sawang | Nisam | |
| A number of the farmer (N) | 39 | 75 | 48 | |
| Number of cattle(head) | 121 | 177 | 193 | |
| Ownership of cattle (head/farmer) | 3,10 ^b ±2,10 | 2,36 ^a ±1,83 | 4,02 ^c ±1,60 | 3,03±1,96 |
| Farmers age (year) | 48.76 ^a ±13.92 | 47.86 ^a ±47.86 | 36.95 ^b ±36.95 | 44.99±14.36 |
| Farmers experience (year) | 14.23 ^a ±14.23 | 12.81 ^a ±12.81 | 6.38 ^b ±6.38 | 11.37±10.11 |
| Family members (head) | 5.26 ^a ±1.94 | 5.37 ^a ±2.54 | 3.53 ^b ±1.59 | 4.88±2.30 |
| 1-3 (%) | 17.6 | 32.3 | 53.1 | 33.6 |
| 4-6 (%) | 70.6 | 43.5 | 46.9 | 51.6 |
| 7-9 (%) | 11.8 | 17.7 | 0.0 | 11.7 |
| ≥ 10 (%) | 0.0 | 6.5 | 0.0 | 3.1 |
| Educational background (%) : | | | | |
| Illiteracy | 5.3 | 4.2 | 0.00 | 3.2 |

| | | | | |
|-------------------------------------|------|-------|-------|------|
| Basic school | 42.1 | 43.1 | 42.2 | 42.6 |
| Junior high school | 23.7 | 40.3 | 40.0 | 36.1 |
| Senior high school | 23.7 | 11.1 | 17.8 | 16.1 |
| University | 5.3 | 1.4 | 0.0 | 1.9 |
| Farmers job (%) | | | | |
| Farmers | 86.8 | 84.3 | 95.6 | 88.2 |
| Private | 7.9 | 2.9 | 2.2 | 3.9 |
| Civil servants | 0.0 | 0.0 | 0.0 | 0.0 |
| Others | 5.3 | 12.9 | 2.2 | 7.8 |
| The objective of keeping cattle (%) | | | | |
| Saving | 94.7 | 100.0 | 100.0 | 94.7 |
| Fattening | 0.0 | 0.0 | 0.0 | 0.0 |
| Breeding | 2.6 | 0.0 | 0.0 | 2.6 |
| Others | 2.6 | 0.0 | 0.0 | 2.6 |
| Training activity (%) | | | | |
| Never | 36.1 | 50.0 | 77.8 | 55.0 |
| Ever | 63.9 | 50.0 | 22.2 | 45.0 |

Abbreviation: N: sample size

^{a,b,c} Different superscripts denote significantly different trait means between the statistical analysis ($P < 0.05$)

The farmers in three different sub-district generally have experiences on keeping cattle. Since on average, they had more than ten years of experiences. However, farmers in Nisam sub-district had the shortest experience and highest family members differed ($P < 0.05$) compared to farmers in Muara Batu and Sawang districts. Similar in Yogyakarta, beef cattle breeding activities were mostly handled and performed by farmers and their family members. Farmers with livestock business experience for 10 to 20 years with 1-3 family members involved [15]. The experience was related to age, in which older farmers usually had more experience than young farmers. Many beef cattle farmers had started their businesses at a relatively young age, inherited from their parents from generation to generation. The ownership of cattle differed ($P < 0.05$) in three sub-district and the average is three head/farmer, like in Java Island and Madura Island with two and four head of cattle/farmer [15, 17, 14]. The farmers usually coupled with integrating crop and livestock production and the use of stall feeding. The condition indicated that farmers are categorized as small businesses operate.

Table 1 also shows the educational background of the farmers in three different sub-district, which is indicated that most farmers only have a low level of educational background, more than 75% farmers only finish elementary and junior high schools. Achmad et al [15] stated that educational level did not significantly affect the profit of small-scale beef cattle business in the Yogyakarta. Although farmers usually have rich knowledge of local conditions and valuable practical knowledge or experience of how best to successfully exploit their environment, they require innovation information generated from research and development to boost their productivity. Agus and Widi [16] state that smallholder farmers are the most vulnerable stakeholder in the beef cattle production system in Indonesia. Smallholder farmers often have limited access to the inputs, information, and services they require to grow a better future. They need to be continuously empowered in terms of input technologies, financial support, information, and markets. Farmers in Nisam subdistrict receive the highest training and counseling activity than the other two sub-districts, even though they have the lowest age and experience.

The main job of the farmers was farming activities (88.2%) which is indicated that keeping cattle is a secondary activity, and it was supported by the objective of keeping cattle are saving, if they need urgent cash, they can sell the cattle. It is in line with Budisatria et al [18], that keeping animal were multifunctional purposes, the economic benefits of keeping animal, however, were low. More than 50% of the farmers have 4-6 family members. In rural areas, the family member usually actively involve keeping cattle. Achmad et al [15] was also reported that small-scale beef cattle business in Yogyakarta only used as a side job for savings so that beef cattle farmers tend to rely on the science of livestock farming which was inherited from generation to generation and did not need high education to be able to run it. Recent studies in Central Java by Budisatria et al [18], indicated that it is unlikely that keeping animal will become the primary income earner in rural households, if households have sufficient family labor for the management of animal, they are an appreciated secondary activity. The condition based on farmers' background of Aceh cows indicated that farmers are categorized as traditional system operation.

4.2. Feed Management System

The production system and feed management of farmers in three different sub-districts are presented in Table 2. The mixed production system is a usual phenomenon in Aceh Province, cattle are housed only at night, while during the day, cattle are allowed for grazing either in the grass field, the paddy field newly harvested and roadside or communal grazing area. It is in line with the previous research conducted by Wahyu and Mirza, Budisatria et al [3, 4]. Besides, since the majority of feed resources are obtained from communal grazing areas, it is not surprising that farmers rely on native grass and rice straw as feed components for cattle when the cattle housed at night.

Table 2. Feed management systems adopted by the farmers of Aceh cows in three sub-district

| Parameters | Sub-district | | | Average |
|--------------------------------|--------------------------|--------------------------|--------------------------|------------------|
| | Muara Batu | Sawang | Nisam | |
| A number of farmer (N) | 39 | 75 | 48 | |
| Production system | | | | |
| Confinement (hour/day) | 15.27 ^a ±2.10 | 17.23 ^b ±2.36 | 15.29 ^a ±1.89 | 16.45±2.42 |
| Grassing (hour/day) | 8.73 ^a ±2.10 | 6.77 ^b ±2.36 | 8.71 ^a ±1.89 | 7.55±2.42 |
| Obtaining feed (%) | | | | |
| Grazing | 54.29 | 51.28 | 85.32 | 66.54 |
| Cut and carry | 45.71 | 48.72 | 14.68 | 33.46 |
| Purchasing | 0.00 | 0.00 | 0.00 | 0.00 |
| Feed component (%) | | | | |
| Rice straw | 45.71 | 35.34 | 5.66 | 31.80 |
| Native grass | 44.29 | 62.07 | 86.79 | 62.34 |
| Improved grass | 10.00 | 2.59 | 3.77 | 5.02 |
| Roughages | 0.00 | 0.00 | 3.77 | 0.84 |
| Concentrate | 0.00 | 0.00 | 0.00 | 0.00 |
| Drinking water | <i>Adlibitum</i> | <i>Adlibitum</i> | <i>Adlibitum</i> | <i>Adlibitum</i> |
| Bating the cattle (time/week) | 0.43±1.56 | 0.18±0.34 | 0.12±0.31 | 0.22±0.82 |
| Cleaning the house (time/week) | 5.79 ^a ±2.41 | 3.80 ^b ±3.33 | 6.45 ^a ±1.71 | 5.13±2.93 |

Abbreviation: N: sampel size

^{a,b}Different superscripts denote significantly different trait means between the statistical analysis ($P < 0.05$)

A few farmers offered roughages for their cattle, and they never fed the cattle with concentrate feed. Therefore, farmers also did not purchase feed. In Aceh Jaya District provide quality feed by giving legume (*Indigofera sp*) as a protein source [3]. Aceh cattle can still graze well despite the poor conditions of grasslands. Aceh cattle spend an average time for grazing with a duration of 7.55±2.42 hours during the day and in Sawang subdistrict have shortest ($P < 0.05$). Farmers in Nisam subdistricts most often release their cows in the grazing area (85.32%) and provide the least cut and carry feed in the form of rice straw (5.66%). There is no feeds were purchased by farmers and concentrates given to all Aceh cows based on interview and observation. This indicates that the traditional system applied by farmers still has the potential to be increased for the productivity of their livestock. The higher the price of concentrate feed, the higher the costs spending on purchasing concentrates feed that would reduce the profit of beef cattle fattening business. The concentrate given as additional feed for beef cattle requires additional capital because it had to purchase at the store, different from forage feed that could be gathered by themselves [15].

Farmers usually clean the house on a daily base, although some farmers clean the cattle house every two days, farmers also rarely bating their cattle (Table 2). Farmers in Sawang subdistrict kept their cows by confinement in the house longer ($P < 0.05$) but the frequency of cleaning their house is the smallest. It can have an impact on house hygiene and cattle health. bating the cattle and cleaning the house activities is very important in livestock management because will affect the comfort and health of livestock. Nurlaelah et al [19] reported that the activity of cleaning the livestock house needed 18.2 hours per week with an average of 0.73 hours per day.

4.3. Reproductive Management System

The reproduction management, especially for the female animal, is playing a vital role in the productivity of cows because it will have an impact on the total number of calf produced during the lifetime of cows. The results concerning reproductive management at farmers level in three different sub-district in Aceh Province,

primarily on the first mating age, the ability of the farmers to detect estrous, mating method for cows, first mating after calving are listed in Table 3.

Table 3. Reproduction management applied by the farmers of Aceh cows in three sub-district

| Parameters | Sub-district | | | Average |
|-------------------------------|--------------------------|--------------------------|--------------------------|------------|
| | Muara Batu | Sawang | Nisam | |
| A number of the farmer (N) | 39 | 75 | 48 | |
| First mating age (month) | | | | |
| Male | 29.00±7.01 | 35.00±5.63 | 32.00±6.93 | 32.86±6.47 |
| Female | 25.41 ^b ±4.80 | 28.54 ^a ±4.00 | 27.52 ^a ±3.48 | 27.52±4.12 |
| Estrous detection ability (%) | | | | |
| Poor | 39.39 | 18.18 | 4.44 | 18.75 |
| Ample | 24.24 | 28.79 | 48.89 | 34.03 |
| Good | 36.36 | 53.03 | 46.67 | 47.22 |
| Excellent | 0.00 | 0.00 | 0.00 | 0.00 |
| Mating method (%) | | | | |
| Natural mating | 60.61 | 65.08 | 86.67 | 70.92 |
| Artificial insemination | 27.27 | 30.16 | 11.11 | 23.40 |
| Mixed mating | 12.12 | 4.76 | 2.22 | 5.67 |
| Weaning age (month) | 7.75±2.05 | 8.52±1.78 | 8.20±0.84 | 8.32±1.74 |

Abbreviation: N: sampel size

^{a,b}Different superscripts denote significantly different trait means between the statistical analysis at ($P < 0.05$)

The data show that average age at first mating for heifer was 27.52 months; it was ranged from 25.41 months (Muara Batu) to 28.54 months (Sawang), while the average for the male was 32.86 months. For female, farmers in Muara Batu sub-district mated their heifer at the earliest age ($P < 0.05$) compared to heifers kept by farmers in Sawang and Nisam sub-district. However, the first mating age in this study was relatively longer compared with previous study by Bakhtiar et al 2015 that reported the first mating age of Aceh cows was 23.80±2.25. It could be affected by the production systems applied by the farmers. Farmers usually rely on a grassing system which dominated by native grass, resulting in nutrient insufficiency required by the heifers. Extended first mating age of heifer for more than three years old will significantly reduce reproduction performances, the occurrence of the irregular estrous cycle, and other reproduction disorders. The age at which beef heifers should be first mated depends upon the economics of management input against returns. The delayed breeding of heifers has negative economic consequences for farmers [20].

The estrous detection ability of farmers in three different sub-districts was relatively good, although none of the farmers have an excellent ability. It should be noticed that some farmers in Muara Batu sub-district had more reduced ability compared to farmers in other sub-districts. The fact that low educational background of the farmers and almost half of the farmers never trained (Table 1) could affect farmers ability to detect estrous. Lane et al [7] clearly highlight that the quality of estrous detection, especially estrous detection accuracy has a significant impact on the productivity of cows. Problem with accuracy occurs because the herd persons doing the observing is not looking for the correct sign that a cow is in estrous. Accurate detection of estrous can be a difficult and time-consuming activity considering the relatively short but often variable duration of standing estrous and frequently low number of mount received per cow per hour [6].

On average more than 70% of farmers mated their cows by natural mating methods, only a few farmers adopt the artificial insemination methods. Farmers also combined the artificial insemination with natural mating; it is usually done when the artificial insemination method did not result in pregnant cows. Before the adoption of artificial insemination, the use of natural service sires, or breeding bulls, for reproductive management was the default method of reproductive management. The reason for using natural mating could be related to production systems, access to artificial insemination, and limited facilities. As most farmers adopt grassing based system, it is challenging to apply artificial insemination. Despite the widespread popularity of artificial insemination, many farmers still prefer the use of natural service sires due to a variety of reasons, including a common perception that it is lack of trained labor to manage artificial insemination, a reliance by some farmers on the purchase of all replacement heifers instead of rearing their own, more comfortable to manage and less expensive than artificial insemination. Syastiawan et al [21] calculate the level of adoption technology of smallholder farmers for artificial Insemination program in Liliraja sub-district Soppeng district, with variable indicators of

time needed by farmers adopting artificial insemination (40.4%), benefits and quality Insemination program (37.4%) and the range of application of Artificial Insemination (22.2%) is in the medium category.

Proper weaning, including weaning age, is a critical part of any cow or calf operation. There is no significant difference found in the management of weaning practiced by the farmers in three different sub-districts in Aceh province. The study indicated that farmers in Aceh province usually weaned their calves after more than eight months (Table 2). The weaning age in this study was longer than the previous study by Widiati and Widi [16], that reported the weaning age of Peranakan Ongole Cattle in Java is 3.5 months. Weaning late led to heavier calf weights, which would be beneficial to producers selling to a cash market and may offset declining market prices as spring progress [22]. High weaning age could be affected by the habits of the farmers who allow the calves milked to their cows until a mature age. Besides, grass-based production system practiced by the farmers contributes to the long weaning age. In the grassing based system, it is difficult to wean the calves as earlier as possible. However, Cadwell et al [22] argued that when the cattle are kept on grassing based system, the calves should be discouraged from weaning early unless the objective is for increasing cow performance.

4.4. Reproductive Performance of Aceh Cattle

Reproductive performance of an animal is highly dependent on the reproductive management of applied [5]. The reproductive performance of Aceh cow kept by farmers in three different sub-districts in Aceh province is presented in Table 4. The reproductive performances in this study include first estrous age, first calving age, postpartum estrous, estrous cycle, postpartum mating, service per conception, gestation period, and calving intervals.

Table 4. Reproductive performance of Aceh cows kept by farmers in three sub-district

| Parameters | Sub-district | | | Average |
|-------------------------------|-----------------------------|----------------------------|----------------------------|--------------|
| | Muara Batu | Sawang | Nisam | |
| A number of the cow (N) | 48 | 60 | 67 | |
| First estrous age (month) | 26.08±3.37 | 27.68±4.46 | 27.39±3.50 | 27.25±3.94 |
| First calving age (month) | 37.57±4.24 | 39.66±6.10 | 39.07±4.58 | 38.10±5.22 |
| Post partum estrous (day) | 115.00 ^{ab} ±78.84 | 138.42 ^a ±61.78 | 105.65 ^b ±19.74 | 122.13±56.56 |
| Estrous cycle (day) | 18.75±2.49 | 19.75±2.00 | 19.79±1.23 | 19.57±1.82 |
| Postpartum mating (day) | 129.00 ^{ab} ±89.16 | 156.84 ^a ±93.33 | 110.87 ^b ±28.19 | 134.88±77.82 |
| Service per conception (time) | 1.23 ^a ±0.40 | 1.17 ^{ab} ±0.37 | 1.04 ^b ±0.21 | 1.14±0.34 |
| Gestation period (month) | 9.16±0.17 | 9.21±0.24 | 9.19±0.17 | 9.19±0.20 |
| Calving intervals (month) | 14.32 ^b ±3.76 | 17.11 ^a ±3.65 | 12.61 ^c ±1.72 | 15.09±3.74 |

Abbreviation: N: sampel size

^{a,b} Different superscripts denote significantly different trait means between the statistical analysis at (P <0.05)

First estrous age of heifers kept by farmers in three different sub-districts has not differed. The average of first estrous age was 27.25 months, it ranging from 26 to 28 months (Table 4). Previous research, however, found that first estrous age was varied widely amongst local breed of cattle, for example, Aceh heifer reaches first estrous age at 20.45±2.81 months [12], Bali cows at 23,95±0,42 months [23], Peranakan Ongole at 18-24 months [24] and Katingan heifer at 23 months [25]. First estrous age is an essential determinant of reproductive efficiency, many heifers, especially *Bos taurus*, can reach puberty and breed reasonably satisfactorily at one year old. However, the cost of achieving this varies among breeds and among heifers within the same breed.

First calving marks the beginning of a cow's productive life. Age at first calving is closely related to generation interval and, therefore, influences response to selection [11]. In general, earlier first calving increases the lifetime productivity of cows. No differ on first calving age of Aceh heifer kept by farmers in three different sub-districts. It ranges from 37.57 months to 39.66 months, and the average was 38.10 months (Table 4). Long first calving age in our study could be caused by many factors, such as the grass-based production system selected by the farmers, low nutrient intakes and some farmers believe that heifers calving at two years will have retarded growth and a subsequent reduction in productivity. The study on first calving age of Indonesia local breed was varied, in Aceh heifers it was 23-24 months [26] while in Bali heifer was 36,8 months [23] and Peranakan Ongole was 30-36 month [24]. Meanwhile, in Tanzania with the low-input production system, 95% Mpwapwa heifers calved at an aged between 31.4 and 32.6 months [10]. In traditional production systems, however, breeding is often uncontrolled, and heifers are bred at the first opportunity. This frequently results in

longer subsequent calving intervals [11]. First calving marks the beginning of a cow's productive life. Improvement in the production environment may enhance the growth rate and maturity of the heifers, and hence reduce the first calving age [10].

The estrous cycle comprises all events related to reproduction occurring between two periods of sexual activity. The study indicated that the estrous cycle of Aceh cows in three different sub-districts did not differ, ranging from 18.75 to 19.79 days, and the average was 19.57 days. The estrous cycle of cattle is the period from one estrous (heat, phase of sexual receptivity) to the next estrous. For the cow and heifer, this period averages 21 days, with a typical range of 18 to 24 days in length. The ability to understand the estrous cycle will give a better understanding of reproductive management and the control of the estrous cycle. The ability to control the estrous cycle also can increase the percentage of cows that conceive at the beginning of a breeding season.

Postpartum estrous of Aceh cows kept by farmers in Nisam sub-district was shorter ($P < 0.05$) than Aceh cows in Muara Batu and Sawang sub-district, it was 105.65; 115; and 138.42 days, respectively (Table 4). However, Bakhtiar et al [12] found that postpartum estrous of Aceh cows was 127 ± 33.13 day. The high postpartum estrous in our study could be caused by long periods of pre-weaning age (more than eight months). After calving, all cows go through a period in which they do not experience estrous cycles; this is known as postpartum anoestrous. This period of temporary infertility cannot be avoided, but it can be managed to ensure that the cows return to a fertile state in a timely and economically efficient way. Postpartum anoestrous is a result of several factors related to pregnancy and calving. The two primary factors are the suckling effect and nutritional status. Exposing cows to bulls postpartum decreases postpartum interval, the bull can be biostimulator for estrous detection and natural mating. The implementation of a bull as biostimulation for one month is based on the emergence of estrus (more than 50%) following by a conception rate (33.33%) of the cow's population in smallholder farmers in Yogyakarta [27]. The high postpartum estrous will also affect the postpartum mating of cows [5]. The study indicated that Aceh cows kept by farmers in Nisam sub-district had the shortest ($P < 0.05$) postpartum estrous. The average of postpartum mating was 134.88 days or almost 4.5 months (Table 4). Postpartum mating is influenced by postpartum estrous and the accuracy of estrous detection by farmers [5]. Long postpartum estrous in our study could be affected by the farmers did not mate the cows directly when the cows were estrous, they argued that the calves still in suckling periods. They prefer to postpone mating to allow the calves suckle their cows in order to optimize pre-weaning growth.

Numbers of service per conception is one of the essential parameters of fertility. The study indicated that there was not differ of service per conception on Aceh cows kept by farmers either in Muara Batu, Sawang, or Nisam sub-districts, as presented in Table 4. The average of service per conception was 1.14 times. Bakhtiar et al [12] found that service per conception of Aceh cows ranging from 1.13 times. Generally, beef cattle in Indonesia have low productivity in the traditional system due to low conception rate is 56% [16] and service per conception in the range 1-4 times [24]. Service per conception is confounded by such factors as the physiologic fertility of the cow, semen quality, and semen handling and insemination techniques when artificial insemination is adopted. Furthermore, the parity, breed, and age of the cows inseminated also found to affect the service per conception. Gestation is the period from conception to parturition. The study found that the gestation period of Aceh cows kept by farmers in three different sub-districts in Aceh province was similar, with the average was 9.19 months.

Calving interval has been extensively analyzed and reported. It is probably the best index of a cattle herd's reproductive efficiency [11]. Calving intervals of Aceh cow kept by farmers in Nisam sub-district shorter ($P < 0.05$) (12.61 months) than Aceh cows in Muara Batu (14.32 months) and Sawang (17.11 months) sub-districts. Generally, beef cattle in Indonesia have low productivity in the traditional system due to the length of calving interval is 18-21 month [16] and in Tanzania with the same of production system have calving interval 481-505 day [10]. The longer the calving interval, the lower the reproductive efficiency of cattle [5].

The differences in calving intervals in three sub-districts could be affected by postpartum mating, estrous cycle, and service per conception. Long postpartum mating, estrous cycle and repeated service per conception will produce long days open. Since the Aceh cow in Nisam sub-district had the shortest postpartum mating and low service per conception, it is not surprising that they had shortest calving intervals. Calving interval can be divided into three periods: gestation, postpartum estrous and the service period (first postpartum estrous to conception). Furthermore, calving intervals also tend to be shorter in animals that are more productive in other respects. This may be a reflection of the effect of nutrition since more productive animals are usually fed better than unproductive animals.

Aceh cows in smallholder farmer level in this area show that the fastest first estrous age and first mating age indicated by cows reared in Muara Batu district, so that calving age also shows lowest, on the contrary in Sawang district. Aceh cows in Sawang district were weaned the longest, so the postpartum estrous also highest, although many farmers can detect estrous of their cows. This is different from Aceh cows in Muara Batu district, although the lowest weaning age, the postpartum estrous is longer than in Nisam district. This is

possible due to the ability of farmers in detecting estrous in Nisam district better than in Muara Batu district so that farmers be more appropriate to detect estrous cows especially the postpartum estrous. Aceh cows in Nisam district with faster postpartum estrous and postpartum matting causes the fastest calving interval compared to the other districts. In contrast, Aceh cows in Sawang district that had same of postpartum estrous and postpartum matting, and longest gestation period caused the longest calving interval, although the cycle of estrous shorter than in Nisam district and lower service per conception than in Muara Batu district. The results show that better reproductive management is needed. The role of Agriculture Extension Agency in providing knowledge to the farmers regards it is very important, especially in the case of estrous detection. The accuracy of estrous detection will provide better postpartum estrous, matting and service per conception. It will increase the conception rate, faster calving intervals, better reproductive efficiency and finally, the benefits obtained by smallholder farmers will also be better.

5. CONCLUSION

Reproductive management plays a role in the productivity of Aceh cows with the traditional production system. The farmers in three different sub-district had proper management of Aceh cows reproduction. However, the cows tended to have late first estrous, first calving ages, and long postpartum estrous. Aceh cows kept by farmers at Nisam sub-district had the best reproductive performances, in terms of postpartum estrous, postpartum mating days, service per conception, and calving intervals. Increased smallholder farmers' knowledge about reproductive management is needed to get better livestock reproductive performance.

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AUTHORS' CONTRIBUTION

Prof Budisatria is chief researcher, Prof Budisatria, Prof Baliarti and Dr Widi develop the idea and had an important role conceived the study in the result. Ibrahim and Atmoko (PhD Candidate) was the researcher performing data collection, data analyses, result from interpretation and wrote the manuscript. Prof Budisatria, Prof Baliarti and Dr Widi provided guidance and assisted with revision of the manuscript.

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