Jurnal Sain Peternakan Indonesia
Available at https://ejournal.unib.ac.id/index.php/jspi/index
DOI: https://doi.org/10.31186/jspi.id.18.3.140-147

P-ISSN 1978-3000
E-ISSN 2528-7109
Volume 18 Issue 3 July-September 2023

Reproduction and Production Performance of Swamp Buffalo (*Bubalus bubalis*) at the Small-Scale Holder Farmer in Sragen Regency, Central Java, Indonesia

N. A. Nastiti, J. Riyanto, R. Dewanti, M. Cahyadi, A. K. Wati, W. Pawestri, and Y. Yanti

Animal Science Department, Faculty of Agriculture, Sebelas Maret University
*Correspondence: yuliyanti_fp@staff.uns.ac.id
Revised: 2023-07-31, Accepted: 2023-06-30, Publish: 2023-09-27

ABSTRACT

This research aimed to determine the performance of swamp buffalo reproduction and production at the small-scale holder farmer in Sragen Regency, Central Java, Indonesia, from June to September 2021. The method used in this research was a survey with a census (complete) sample determination. Data collection applies to interviews, observations and literature studies. Research parameters used in reproductive performance were calving interval (CI), service per conception (S/C), age of the first estrus, age of first birth and postpartum estrus. In contrast, production performance parameters were chest circumference, body length and estimated body weight. The result of research on reproductive performance showed that the average CI were 13.2±0.9 months, S/C 1.25±0.4 time, age of first estrus 2.7±0.6 years, age of first birth 3.7±0.5 years and postpartum estrus were 30–60 days. The result of research on the production of male buffalo body length was 205.3±1.7, and the body length of female buffalo was 127.2±4.3 cm, whereas the chest circumference of female was 205.3±1.7 cm and the chest circumference of the male was 189±2.8 cm. The estimated body weight of females and males were 516.7±7.7 kg and 445.2±11.9 kg. Based on the result of the research, the characteristics of swamp buffalo reproduction and production in Sragen Regency were classified as good.

Keywords: buffalos, production, reproductive performance, calving interval

INTRODUCTION

The population of Indonesia from year to year has increased relatively. According to the 2020 population census held by the Central Bureau of Statistics, the population increase each year is 3.26 million people or an increase of 1.25% per year to more than 273 million people, according to the Ministry of Home Affairs (2022). As the population increases in Indonesia, people are also aware of the importance of consuming protein to meet their nutrient requirements, especially animal protein. Animal protein can be obtained from cows, chickens, goats, sheep, and buffalo. This increase in demand for animal protein is not balanced by the increase in population and livestock production, where the demand for beef is 717,150 tons. In comparison, the availability of beef is 422,533 tons (Tawaf, 2020).

Buffalo is one source of animal protein. Buffalo in Indonesia was dominated by swamp buffalo as much as 95%, while the remaining 5% is river buffalo, widely maintained in North Sumatra (Kampas, 2008). The development of buffalo in Indonesia is relatively small, with as many as 1,179 million heads spread throughout Indonesia (Central Bureau of Statistics, 2020). This is due to the interest of people accustomed to beef compared to buffalo meat. In addition, it is well known as slow reproductivity performance.

Good livestock productivity is influenced by good maintenance management to produce good products, including reproductive efficiency. Reproductive efficiency can be seen from the conception rate, the calving interval, the service per conception and the birth rate (Suharyati and Hartono, 2015). One measurement of livestock productivity can also be done by collecting data on livestock body sizes. Data that can be measured include body length, hip height, shoulder height, age, and poel.

Sragen Regency is one of the regencies in Central Java province with sizeable agricultural land, mainly rice. Agricultural waste in the form of rice straw is often used as animal feed, one of which is buffalo. Buffalo's population in Sragen Regency 2015 was as many as 324 head (Central Bureau of Statistics, 2015). This number is less than in 2018, with as many as 419 heads (Central Bureau of Statistics, 2018). The buffalo population experienced a drastic decline of around 91% in 2021; there were 30 buffalo. Buffalo population decline is thought to be due to several factors, such as the changes in farming interest (buffalo to beef cattle), young farmer preferences, the decreasing buffalo meat demand in some areas, and low productivity (Praharani et al., 2009) and reproductivity. Farmers still have many obstacles, especially the lack of knowledge and

awareness of the importance of efficient management.

In addition, there has never been researched information about buffalo's productivity and reproductive performance in Sragen. This study aims to determine the performance of reproduction and production of buffalo in Sragen Regency, Central Java, Indonesia.

MATERIALS AND METHODS

This research was carried out from June to September 2021 in three districts: Sumberlawang District, Jenar District, Sambungmacan District, and Sragen Regency, Central Java province.

The material used in this study is the buffalo as the object of research that was chosen thoroughly (census method). Livestock consists of 28 heads spread across three districts in Sragen district: Sumberlawang District, Jenar District and Sambungmacan District. The Buffalo population in the research site is shown in Table 1, while the sample of male and female buffalo age data is shown in Table 2. The tools used in this study were a measuring stick, an animated questionnaire, stationery and documentation tools.

Table 1. Total buffalo population in Sragen Regency in 2020

District	Villages	Total of buffalos (Head)
Sumberlawang	Mojopuro	4
Jenar	Dukuh	4
Sambungmacan	Gringging	22
	Total	30

Table 2. Age of buffalo cattle in Sragen Regency in 2021

Age group (years)	Total of Buffalos (head)	
	Male	Female
≤ 1	8	1
1-3	4	2
4-6	1	6
7-9	-	4
≥ 10	-	2

This study was conducted for four months through three stages: pre-survey, survey and data collection. The pre-survey stage collects information about the research site's population, farmers and environmental conditions through the relevant institutions and checks the location. The survey phase was conducted by collecting the required data through direct interviews with respondents based on questions prepared for farmers in the Sragen Regency.

Variables in livestock reproduction were observed consisting of calving interval (CI) (Hoesni, 2015), service per conception (S/C) (Hoesni, 2015), Age of first sexual intercourse (Ismudiono et al., 2010), the age of first childbirth (Hafez, 1980) and the first lust after childbirth (Rohman, 2018). Livestock production measurements include chest circumference, body length and alleged body weight. According to Sumantri et al. (2021), chest circumference is measured using an Animeter® by wrapping the animator just behind the elbow (3rd-4th rib), the front legs are perpendicular to the axis using a measuring tape while the body length is measured in absolute terms, namely by measuring the livestock from the shoulder point to the Sitting Bone (pine bone) using a measuring stick. According to Syamyono et al. (2013), body weight estimation can use the formula Schrool.

$$\text{Weight} = \frac{(the\ heart\ girt\ (cm)+22)^2}{100}$$

The data obtained in the study were analyzed using descriptive analysis to describe and explain the phenomena occurring in the research object. Descriptive analysis is done by collecting, compiling, processing, presenting, and Analyzing numerical data to provide an orderly, concise, and clear picture of a symptom, event, or situation (Sholikhah, 2016).

RESULTS AND DISCUSSION

Farmers' characteristics in the Sragen Regency can be seen in Table 3. The general condition of farmers in Sragen Regency mostly has the main job as rice farmers. Raising buffalo was a side job that is as much as 67%, and raising cattle was the primary job as much as 33%. The average farmer who has a primary job as a farmer has fewer buffaloes or no more than five because the time the farmer has will be divided into his main job. On the contrary, they were raising livestock as the main occupation has more livestock or more than five heads. Farmers will have more time for buffalo maintenance, such as health, cage cleaning and grazing time. According to Isyanto (2015), small-scale farms in Indonesia are carried out as a side job because more time is used for the main job. In addition, the increasing number of livestock will require more time, so the large number indicates that raising livestock is the main occupation.

Table 3. Characteristics of buffalo farmers in Sragen Regency 2021

Characteristics of Farmers	Respondent (person)	Percentage (%)
Breeding		
a. Main occupation	2	33%
b. Part-time jobs	4	67%
Breeder age		
a. 25- 65 years old	1	17%
b. > 65 years old	5	83%
Education		
a. No school	3	50%
b. End of elementary school	1	17%
c. Junior high school	2	33%
Breeding experience		
a. 1-50 years old	3	50%
b. >50 years old	3	50%
Ownership		
a. ≤ 5 heads	4	67%
b. > 5 heads	2	33%
Information extension		
a. Can not	5	83%
b. Can	1	17%
Raising system		
a. Intensive	0	0
b. Semi-intensive	6	100%
c. Extensive	0	0
Cage cleaning frequency		
a. One time per day	2	33%
b. Two times per day	3	50%
c. > 2 times per day	1	17%
Mating		
a. Natural	6	100%
b. IB	0	0
Feed		
a. Rice straw	0	0
b. Airy lawn	2	33%
c. Mixed (rice straw and concentrate)	4	67%
d. concentrate	0	0

Characteristics of the age of farmers showed about 83% were non-productive. According to Arisandi (2018), the productive age is a population ranging from 15-64 years or the entire population in a country that can produce goods and services. It means that buffalo farmers in Sragen Regency were already at a vulnerable age with lower body strength and lower ability to apply technology.

The educational characteristics of buffalo farmers vary, but most farmers were out of school (50%), elementary school graduates (17%) and junior high school graduates (33%). The average breeder already has breeding experience from childhood to old enough. As many as 50% of farmers have more than 50 years of experience. According to Utami (2016), the experience of raising livestock significantly influences the business's success. The longer the farmer has the experience of raising cattle, the easier it will be for the farmer to overcome the difficulties he experiences, such as problems with raising buffaloes.

The buffalo-rearing system that was applied is still traditional by following the traditions handed down by parents or family. As many as 83% of farmers have never received knowledge about the buffalo-rearing system from the local government and related institutions. This is because there was no provision for extension buffalo in Sragen. Their knowledge comes only from decades of breeding experience and from inheritance from their parents.

Buffalo rearing was carried out semi-intensively by all farmers in Sragen Regency. Buffaloes were in cages at night until morning. Buffalo was grazing for one to two times a day. Grazing was usually in the morning and afternoon

for one to two hours in the fields, rice fields, or rivers. Farmers at the time of grazing were more watching and waiting for the buffalo than left or left to do other activities. When it is enough, the buffalo will be directed back to the cage. The advantage of the semi-intensive system is that it can provide some animal feed and facilitate natural mating with other groups of buffalo belonging to another farmer (Suhartina and Susanti, 2017)—lack of a semi-intensive system during the dry season, where the feed on the land becomes limited.

The frequency of cage cleaning by farmers varied, ranging from once a day (33%), twice a day (50%) and more than twice a day or cleaning at any time (17%). Cleaning twice a day was usually done by farmers in the morning and evening. Cage cleaning was done when the farmer knew there were buffalo faeces. Then, the farmer would immediately clean it. Appropriately managed cages, such as dirt cleaning, cause the cage floor to remain clean to reduce the risk of infection or disease (Mursyid et al., 2020) and livestock to be healthy.

The mating system in Sragen Regency only relies on natural mating. Mating occurs in the pen directly or in the field during grazing. Buffalo farmers tend to be less interested in the existence of the IB program. This is because there was no buffalo male semen available. In addition, farmers are concerned that if mated IB, female buffalo will be more easily stressed and difficult during childbirth and failure. The disadvantage of this natural mating system is that it can cause inbreeding, where inbreeding has a negative impact, including low pregnancy, death during pregnancy or when the livestock is still young (Rias et al., 2020). The advantage of natural mating is that cement quality is relatively good, producing a good S/C value (Lumbantoruan and Sihombing, 2018).

The feeding system for buffalo cattle was dominated by grazing, especially during the rainy season when the field grass grows abundantly. Feeding was done at once when the buffalo grazed. In addition to giving directly in the field, some farmers provide a variety of feed such as rice straw and sugarcane leaves. Rice straw and sugarcane leaves tend to be given when buffaloes are in cages or when harvesting rice and sugarcane. The feed given to the buffalo was not mixed concentrate, only the type of forage available in the farmer's environment. Rice straw has a low level of digestibility (Yanti and Yayota, 2017), but buffaloes can make good use of the feed. This is because the buffalo's digestive movements are more extended, and the absorption becomes more so that the digestive process is more efficient (Suhartina and Susanti, 2017).

Reproduction

Reproductive performance in terms of calving interval, number of mating or services per conception (S/C), age of the first estrus, age of first birth and postpartum estrus are presented in Table 4.

Table 4. Female reproductive characteristics in Sragen Regency

Reproductive Characteristics	Average
Age of the first estrus (year)	2.7±0.6
Age of first birth (year)	3.7±0.5
Postpartum estrus (day)	30-60
Service per conception (time)	1.25±0.4
Calving interval (month)	13.2±0.9

The age of the first estrus in female buffalo in Sragen Regency was, on average, 2.7±0.6 years. The data obtained in this study was faster when compared with previous studies. One was in West Aceh Regency at 35.79 months or 2.9 years (Nardi et al., 2017). In general, puberty female buffalo experienced slow sexual maturity (Muhakka et al., 2013), which ranges from 2.5 years to 3 years (Siregar, 2012). The occurrence of estrus and ovulation indicated sexual maturity in female cattle.

The age of first birth buffalo in Sragen Regency was an average of 3.7±0.5 years, which is lower than in the study by Rasyid et al. (2017) in the District of East Simeulue, Simeuleu Regency was 3.9 years. The age of first mating buffalo influences the age of first birth.

Table 4 above shows buffalo postpartum estrus ranges from 30-60 days. This figure was faster when compared with Rashid et al. (2017) in East Simeulue District, which ranges from 90-180 days. Postpartum estrus is influenced by the process of involution or a process in which the female reproductive organs return to normal or not pregnant (Rashid et al., 2017). Factors that can cause sooner or later postpartum estrus include feed given, environment and maintenance management. The better feed quality will accelerate the arrival of the postpartum estrus.

The number of S/C female buffalo in Sragen Regency was 1.25±0.4. This study showed that the value of S/C was lower than the study by Budiarto et al. (2019) is 1.4±0.4. The results of this study were also lower than Ciptadi et al. (2019),

which is 1.7 in mud buffalo in East Java. A good S/C number was 1-2 times, with a high S/C value indicating low livestock fertility (Siregar, 2012). The success factor of females experiencing pregnancy can be influenced by the fertility conditions of females and males and the time of lust. The value of S/C female buffalo in Sragen Regency was included in the excellent category.

The calving interval (CI) or calving distance of female buffalo in Sragen Regency was an average of 13.2±0.9 months. CI in this study was lower or better than that of buffalo in Pampangan Regency, South Sumatra province (Muhakka et al., 2013 and in Karanganyar Regency (Nurhadiyanto et al., 2022), which was 14 months. The postpartum estrus and the length of pregnancy influence the lambing distance. The longer the postpartum estrus, the longer the lambing distance. In addition, a failed mating can lead to a long gap between one birth and the next (Muhakka et al., 2013).

Production

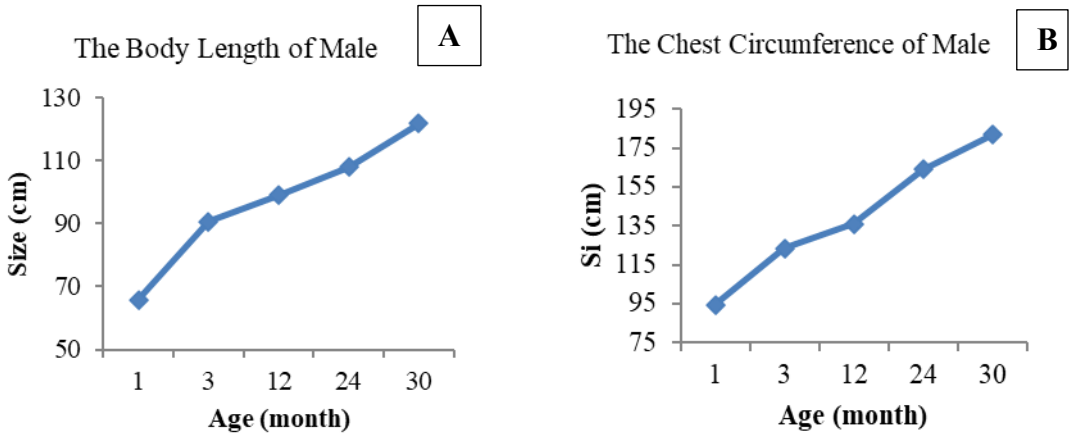
Buffalo production performance in this study reviewed the chest circumference, body length and the estimated body weight. Chest size, which includes chest circumference and body length of adult buffalo, is presented in Table 5. In contrast, the male buffalo's body length and chest circumference graph is presented in Picture 1.

Table 5. Buffalo body size in the form of body length and chest girth in Sragen Regency in 2021

Age (month)	Body Length (cm)		Chest Girth (cm)	
	Male	Female	Male	Female
1	65.85	72.7±6.1	94.65	103.3±7.4
3	90.7	-	123.57	-
12	99	-	136	-
18	-	111.2±4.8	-	169.2±9.8
24	107.85	-	164.15	-
30	121.7	-	181.65	-
> 36	123.3±1.2	127.2±4.3	189±2.8	205.3±1.7

Chest circumference and body length are some of the body parameters that can be measured to determine the growth rate of buffalo. Figure 1 (A) shows that the male buffalo aged under three years has an increased growth rate of body length. The average body length of adult males and females was 123.3±1.2 cm and 127.2±4.3 cm. This study was lower than that of Mufiidah et al. (2013) in the female parent in the District of Tempursari, Lumajang, which is 134.65±6.05 cm.

The chest girth of a male buffalo under three years of age increases, as shown in Picture 1 (B). The average chest circumference of buffalo in adult males and females was 189.0±2.8 cm and 205.3±1.7 cm. The results of this study were higher than those of Mufiidah et al. (2013) in the female parent in the District Tempursari is 195.95±2.99 cm.



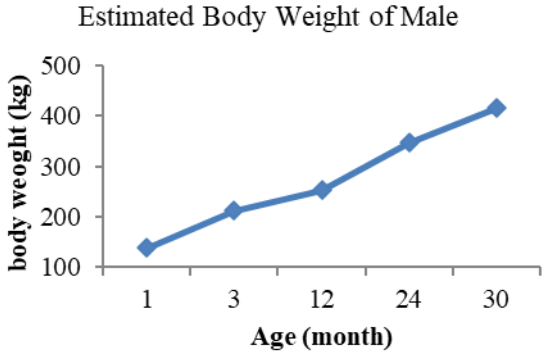
Picture 1. Body length Chart (A) and chest circumference chart (B) male buffalo in Sragen Regency

Based on the above results, the chest circumference and body length of buffalo aged more than three years females are more extensive than males. The increasing age will increase until adulthood (Komariah et al., 2018). Buffalo, with a more minor age, have a smaller chest circumference and body length than adults. Large chest circumference and body length can be affected by age, sex and feed given to livestock. In addition, it is also influenced by genetic potential, environment and maintenance management (Prasethia, 2020).

The estimated body weight of buffalos in Sragen Regency was presented in Table 6, while the graph of the estimated body weight of male buffalos was presented in Picture 2.

Table 6. Estimated weight of buffalo cattle in Sragen Regency in 2021

Age (Month)	Body Weight (kg)	
	Male	Female
1	138.5	157.1±18
3	211.9	-
12	253.3	-
18	-	365.4±37.6
24	346.8	-
30	415.45	-
> 36	445.2 ± 11.9	516.7±7.7



Picture 2. Graph of estimated body weight of male buffalos in Sragen Regency

Buffalo body weight is one of the parameters of livestock productivity, which can be estimated by linear measurement of the buffalo body, especially chest circumference and body length (Hadini and Badarudin, 2016). According to Sumantri et al. (2021), an increase in cattle body weight is accompanied by an increase in body length and chest circumference. Still, an increase in chest circumference correlates more with increased body weight. Based on Picture 2, the body weight of male buffalo under three years increased. The average body weight of adult males and females was 445.2 ±11.9 kg and 516.7 ±7.7 kg. This indicates a higher body weight compared to the study by Mufiidah et al. (2013) that the female parent in the District Tempursari was 406.82 ±9.97 kg and the male in Serang was 300.3 ±39.90 kg (Komariah et al., 2018).

Body weight can be affected by age, sex and feed given to livestock. The age of livestock can affect all conditions and livestock productivity, such as reproductive performance and production. According to Hadini and Badarudin (2016), the higher the age, the longer the body measurements results. This is because age has a relationship with changes in body size.

Overall, the reproduction of buffalos in Sragen is relatively good. This is based on the results of studies that show that these reproductive parameters have a good average figure. In addition, buffalo production is also relatively good because the growth rate continues to increase with age until adulthood.

CONCLUSION

This study concludes that the buffalos in Sragen were still maintained in the traditional system with a semi-intensive maintenance system. Characteristics of reproduction and production of buffalos in Sragen are still in good condition.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ACKNOWLEDGMENT

The authors are grateful to Sebelas Maret University for supporting this study through the Non-APBN Research Grant with contract number 260/UN27.22/HK.07.00/2021.

REFERENCES

Arisandi, F. 2018. Faktor-faktor yang mempengaruhi produktivitas karyawan penyadap di PT.Bridgestone Sumatera Rubber estate. Skripsi. Universitas Muhammadiyah Sumatera Utara.

Central Statistics Agency (BPS). 2015. Banyaknya ternak besar menurut Kecamatan di Kabupaten Sragen 2015-

2017. https://sragenkab.bps.go.id/indicator/24/88/2/banyaknya-ternak-besar-menurut-kecamatan-di-kabupaten-sragen.html (Accessed 10 November 2021, 17.45 WIB).

Central Statistics Agency [BPS]. 2018. Banyaknya ternak besar menurut Kecamatan di Kabupaten Sragen 2018-2020. https://sragenkab.bps.go.id/indicator/24/88/1/banyaknya-ternak-besar-menurut-kecamatan-di-kabupaten-sragen.html (Diakses 10 November 2021 pukul 17.45 WIB).

Badan Pusat Statistik [BPS]. 2020. Statistik Indonesia 2020. Badan Pusat Statistik. Jakarta.

Budiarto, A., G. Ciptadi, L. Hakim, and A. I. Putri. 2019. Reproductive performance and fertility index of swamp buffalo (*Bubalus bubalis*) in ngawi regency, east java. In Journal of Physics: Conference Series. 1146(1) p. 012024. IOP Publishing. doi:10.1088/1742-6596/1146/1/012024.

Ciptadi, G., A. Budiarto, L. Hakim, A. I Putri, P. Finawati, and M. H. Ubaidillah. 2019. The reproductive characters of swamp buffalo in small holder farm in East Java, Indonesia. In IOP Conference Series: Earth and Environmental Science 247 (1) p. 012019. IOP Publishing. doi:10.1088/1755-1315/247/1/012019.

Hadini, H. A. and R. Badaruddin. 2016. Pendugaan bobot hidup kerbau menggunakan ukuran dimensi tubuh sebagai dasar penentuan harga di Pulau Kabaena. Jurnal Ilmu dan Teknologi Peternakan Tropis 3(2): 16-20. doi: http://dx.doi.org/10.33772/jitro.v3i2.1680.

Hafez, E. S. E. 1980. Reproduction in farm animal. Blackwell Publishing. Philadelphia.

Hoesni, F. 2015. Pengaruh keberhasilan inseminasi buatan (IB) antara sapi bali dara dengan sapi bali yang pernah beranak di Kecamatan Pemayung Kabupaten Batanghari. Jurnal Ilmiah Universitas Batanghari Jambi. 15(4): 20-27. doi: http://dx.doi.org/10.33087/jiubj.v15i4.119.

Ismudiono. 2010. Fisiologi reproduksi pada ternak. Universitas Airlangga Press, Surabaya.

Isyanto, A. Y. 2015. Faktor-faktor yang berpengaruh terhadap curahan waktu kerja pada usaha penggemukan sapi potong di Kabupaten Ciamis. Mimbar Agribisnis: Jurnal Pemikiran Masyarakat Ilmiah Berwawasan Agribisnis. 1(1):1-6. doi: http://dx.doi.org/10.25157/ma.v1i1.27.

Kampas, R. 2008. Keragaman fenotipik morfometri tubuh dan pendugaan jarak genetik kerbau rawa di Kabupaten Tapanuli Selatan, Propinsi Sumatera Utara. Skripsi. Fakultas Peternakan, Institut Pertanian Bogor, Bogor.

Komariah, Burhanuddin, and N. Permatasari. 2018. Potential and development analysis of swamp buffalo in Serang District. 06(3):90-97. https://journal.ipb.ac.id/index.php/ipthp/article/view/26186.

Lumbantoruan, M. and J. M. Sihombing. 2018. The rate of pregnancy of swamp buffalo for natural mating and artificial inseminationin Siborong-Borong District, North Tapanuli. Jasa Padi. 3(2):26-29. https://jurnal.pancabudi.ac.id/index.php/jasapadi/article/view/433.

Nurhadiyanto, L., Y. Yanti, J. Riyanto, R. Dewanti, A. K. Wati and W. Pawestri. Reproductive performance of female buffalo (Bubalus bubalis) in Karanganyar Regency, Central Java, Indonesia. IOP Conf. Series: Earth and Environmental Science. 1001(2022) 012020. doi:10.1088/1755-1315/1001/1/012020

Mufiidah, N., M. N. Ihsan, and H. Nugroho. 2013. The productivity of female swamp buffaloes (*Bubalus bubalis carabanesis*) in terms of reproductive performance and body measurements at Tempursari Subdistrict Lumajang Regency. Jurnal Ternak Tropika 14 (1):21-28.

Muhakka, Riswandi, and A. I. M. Ali. 2013. Karakteristik morfologis dan reproduksi kerbau pampangan di Propinsi Sumatera Selatan. Jurnal Sain Peternakan Indonesia. 8(2):111-120. doi: https://doi.org/10.31186/jspi.id.8.2.111-120.

Mursyid, M. H., A. Rosyidi, W. Wariata, and M. Sriasih. 2020. Endoparasitic infestation case on buffalo (*Bubalus bubalis*) in West Praya District of Central Lombok. Jurnal

Ilmu dan Teknologi Peternakan Indonesia (JITPI), Indonesian Journal of Animal Science and Technology. 6(1):39-50. doi: https://doi.org/10.29303/jitpi.v5i2.66.

Nardi, S., M. A. N. Abdullah, and E. M. Sari. 2017. Reproductive characteristics of female in buffalo Johan District of Heroes Aceh West District. Jurnal Ilmiah Mahasiswa Pertanian. 2(3):203-209. https://doi.org/10.17969/jimfp.v2i3.4154.

Praharani, L., E. Juarini, and I. G. M. Budiarsana. 2009. Parameter indikator inbreeding rate pada populasi ternak kerbau di Kabupaten Lebak, Provinsi Banten. Seminar dan Lokakarya Nasional Kerbau. Bogor.

Prasethia, Y. 2020. Penampilan ukuran tubuh kerbau lumpur (*Bubalus bubalis*) Di Kecamatan Akabiluru Kabupaten Lima Puluh Kota. Skripsi. Fakultas Peternakan, Universitas Andalas, Payakumbuh.

Rasyid, S., E. M. Sari, and Mahyuddin. 2017. (Reproductive characteristics of female buffalo Simeulue, Simeulue Timur sub-district, district of Simeulue. Jurnal Ilmiah Mahasiswa Pertanian Unsyiah. 2(1):277-278. doi: https://doi.org/10.17969/jimfp.v2i1.2180.

Rias, M. I., R. A. Putra, and F. Madarisa. 2020. Kajian Sistem Pengelolaan Usaha Peternakan Kerbau di Kabupaten Sijunjung. Agrifo: Jurnal Agribisnis Universitas Malikussaleh. 5(2):113-121. doi: https://doi.org/10.29103/ag.v5i2.3563.

Rohman, T. 2018. Produktivitas kerbau rawa (*B. bubalis carabanesis*) di wilayah sentra pengembangan kerbau di Desa Guwosobokerto, Kecamatan Welahan, Kabupaten Jepara. Thesis. Universitas Brawijaya, Malang.

Sholikhah, A. 2016. Statistik deskriptif dalam penelitian kualitatif. Komunika: Jurnal Dakwah Dan Komunikasi. 10(2):342–362. https://doi.org/10.24090/komunika.v10i2.953.

Siregar, M. 2012. Performan produksi dan produksi ternak kerbau di Kecamatan Purba Kabupaten Simalungun. Laporan Penelitian. Fakultas Peternakan Universitas HKBP Nommensen, Medan.

Suhartina and I. Susanti. 2017. Strategi pengembangan usaha ternak kerbau yang dipelihara secara tradisional berdasarkan peluang dan tantangan. MaduRanch Jurnal Ilmu-ilmu Peternakan. 2(1):37-44.

Suharyati, S. and M. Hartono. 2015. The influence of farmer management on bali cattle reproduction effeciency in Pringsewu Regency, Lampung Province. Jurnal Penelitian Pertanian Terapan. 16(1):61-67. doi: https://doi.org/10.25181/jppt.v16i1.77.

Sumantri, I., A. D. Habibah, and R. G. P. Hidayanto. 2021. Model estimasi bobot badan dan produksi karkas kerbau Kalimantan Selatan yang dipelihara dengan sistem kalang. Prosiding Seminar Nasional Lingkungan Lahan Basah. 6 (2).

Syamyono, O., E. Purbowati, E. Kurnianto, D. Samsudewa, E. T. Setiatin, and Sutopo. 2013. Uji keakuratan rumus pendugaan bobot badan berdasarkan ukuran tubuh pada kambing kejobong jantan muda dan dewasa. Prosiding Seminar Nasional Peternakan Berkelanjutan. Fakultas Peternakan, Universitas Padjadjaran Jatinangor, Bandung.

Tawaf, R. 2020. Ketersediaan daging nasional. Webinar Musyawarah Nasional Ismapeti 16.

Utami, L. S., B. Syahdar, and S. T. Sirajuddin. 2016. Corellation between farmers characteristic and farm scale of bufallo farming in Sumbang Village Curio District Enrekang Regency. 4(3):146-150. doi: http://repository.unhas.ac.id/handle/123456789/17004.

Yanti, Y. and M. Yayota. 2017. Agricultural by-products as feed for ruminants in tropical area: nutritive value and mitigating methane emission. Reviews in Agricultural Science. 5: 65-76. doi: http://dx.doi.org/10.7831/ras.5.65.