Jurnal Riset Veteriner Indonesia
Journal of the Indonesian Veterinary Research
P-ISSN: 2614-0187, E-ISSN:2615-2835
Volume 6 No. 1 (January 2022), pp. 48-56
journal.unhas.ac.id/index.php/jrvi/

Factors Affecting the Success of Artificial Insemination Program on Cattle in District of Woha, Bima

Lukman HY[1]*, Kuntum Khoirani[2], Nikmaturrayan[2]

[1]Department of Animal Production, Faculty of Animal Husbandry, Universitas Mataram, West Nusa Tenggara, Indonesia.
[2]Department of Animal Health, Universitas Mataram, West Nusa Tenggara, Indonesia.

*Corresponding author: lukman@unram.ac.id

Abstract

This study aims to determine the factors that affect the success rate of artificial insemination (AI) in Woha district, Bima Regency. This study method was the survey method, using primary and secondary data. Primary data was obtained by distributing questionnaires and interviews directly to farmers as additional information, while secondary data was obtained from inseminators related to the results of artificial insemination in the Woha district. The questionnaire used included questions about cattle characteristics, namely: pregnancy status, type of cattle, age of cattle, body condition score at artificial insemination, number of artificial insemination to pregnant, estrus signs, time implementation of artificial insemination, interval duration of postpartum to estrus, type of straw, insemination doses, reporting interval since lust up to artificial insemination treatment, cattle feed, stocked cattle, and farmer identity with 47 farmer respondents from 3 villages. Data were analyzed using stepwise regression with the help of SPSS. The results showed that of the 90 female cattle carried out by artificial insemination, 85.6% had a pregnancy, and 14.4% had no pregnancy. The independent variable which had the strongest correlation was the age of cows (sig. 0.006), the reporting interval since estrus to artificial insemination treatment (sig. 0.001), and cattle feed (sig. 0.004). The three factors that have the strongest correlation were based on sig. <0.05 so that it had a significant effect on the success of artificial insemination in the Woha district, Bima Regency

Key words: *Artificial insemination (AI), beef cattle, succes factor, Woha district*

Introduction

Artificial insemination (AI) in cattle has been carried out in West Nusa Tenggara since 1972, using imported frozen semen from various breeds. The intended implementation of AI is to increase the productivity and reproduction of cows (Putro and Kusumawati, 2014). However, several complex problems have appeared in Bali cattle in West Nusa Tenggara since a decade ago, such as the decline in the population of Bali cattle. There exists considerable information in the 1970s and 1980s that West Nusa Tenggara was known as a source of beef and breeds for Bali cattle and could export cattle abroad, but in the 1990s, West Nusa Tenggara could only supply the needs of inter-island beef. Then in 2000, the cattle inter-island shipments were very limited. Furthermore, the decrease in Bali cattle production was observed in the loss in body weight gain of 2.9 kg/cattle/year on Lombok. Another issue, the decline in Bali cattle

reproduction in West Nusa Tenggara, can be seen from the calf's birth in artificial insemination areas, which only reached 16.3-23.25% of the productive female cattle population (Dradjat, 2002).

Reproductive efficiency improvements in cattle breeding by optimizing artificial insemination include inducing adult cows to produce desired gender-specified every year, namely bull or heifer. The implementation of artificial insemination technology on the island of West Nusa Tenggara, especially in the Bima Regency, was expected to increase the productivity and reproducibility of Bali cattle. However, it turns out the cattle rate breeding result still shows relatively low (West Nusa Tenggara in 2014). Therefore, it is necessary to evaluate the constraints and successful implementation of the artificial insemination program to improve the resilience of livestock and cow breeding in the future.

In recent years, the AI implementation policy aimed to increase dairy and beef cattle production and productivity. According to Suprianto and Djuliansah (2016), the low livestock productivity impacts the slow population of beef cattle. This situation is also determined by the breeds and strains quality, the resource of technology, and the low-skills farmers and breeders. Several studies suggest that the AI program is the primary option in increasing cattle population and genetic quality (Rusdiana and Praharani, 2018). Some authors have also suggested improving or increasing beef cattle products through semen is by AI program (Sudarmono and Sugeng, 2016).

Previous studies by Hoesni (2015) have emphasized that the affecting factors of AI are fertility, inseminator skills, estrus detection, time of insemination, number of spermatozoa, insemination dose and semen composition and several things that can affect AI are livestock condition, farmer's education level, experience giving birth to cows, good sperm quality and experienced inseminators. One of the success keys of the AI programs is that cows are kept intensively in cages. This method will help farmers and breeders to detect lust in cows and interpret AI easily. Based on this background, an analysis is needed to identify the factors that affect the success of artificial insemination to cattle in the Woha district that can be used as a reference in increasing the success of AI in other areas where the results of insemination are not good.

Materials and Methods

Materials

This study was conducted in the Woha district consisting of 3 villages, namely Donggobolo, Risa, and Pandai, in July-October 2020. The data was obtained from inseminator records related to artificial insemination results in Woha district, analysis of questionnaires and interviews results, and observations in Woha district villages. The object of this study was the farmers and the inseminated cows conducted by an inseminator and maintained intensively.

Method

We used a systematic investigation approach via a survey method to get the data. The data proceeds in two stages: Primary data was obtained by distributing questionnaires and interviews directly to farmers as additional information, while secondary data was obtained from inseminator records related to the results of artificial insemination in the Woha district.
Questionnaire preparation

The questionnaire included questions related to cattle characteristics such as pregnancy status (pregnant/non-pregnant data obtained from the inseminator examination), strain, age, cow's

body condition score for the time of insemination, cattle used (heifer/cow), number of cows that calve each year, number of AI treatment until pregnancy, heat sign (obvious/not), the time of AI implementation (morning/afternoon), length of the postpartum interval to estrus, types of the semen straw, insemination doses, reporting interval since estrus to AI treatment, types of cattle feed, and identity of the farmer.

Respondent

We used a purposive sampling technique to determine the characteristics of the respondents, which refer to the inseminator records in the Woha district. This study was performed in three villages, namely: Risa, Donggobolo, and Pandai, that were selected based on the criteria that the cows were inseminated by the same inseminator and had the most acceptors in Woha District. A total of 47 farmers were interviewed directly and distributed questionnaires form to be filled out.

Data analysis

The collected data were analyzed and correlated with logistic regression analysis. The collected data from the inseminator and the breeders were coded to facilitate analysis and then processed with SPSS (Statistical Packet for Social Science) program (Sarwono, 2006).

Results and Discussion

In this study, we describe the profile characteristics of cattle breeders as the respondent include age, gender, education level, the main job of the respondent, experience in raising livestock, total livestock ownership, and total female livestock ownership, as presented in Table 1. The percentage of cattle breeder respondents in the Woha district supports improving productivity in the livestock sector. Malotes (2016) stated that the age-productivity is 25 to 45 years of age.

The data presented in Table 1 show that most respondents (61.70%) were those aged 45-year-olds and older, than those aged below 45-year-olds (38.30%). With this understanding stage, we believe people in this years-old have already reached the peak of the critical thinking ability to act and to make decisions carefully. As age increases, the thinking process produces something that has been considered thoroughly. This statement is similar to Kastalani et al. (2019) opinion that productive age ranges from 30 to 60-year-olds. According to Prayitno (2018), age can affect seriousness in running a business. The more mature a person and the burden of life they bear, the more motivated they will be to look for alternative businesses or be serious about running a business. The age of farmers as workers in rural farming is often a determinant of the size of the income. One of the factors that affect income and economic efficiency is the age of the breeder (Annisa et al., 2018). Another explanation of Prayitno (2018) also states that age affects work productivity in types of work that rely on physical exertion.

Our results demonstrated that most of the respondents' education level is junior high school. Only a few of the respondents are at an advanced educated level, with the percentage proportion: 10.64% have completed elementary school education, 61.70% have completed junior high school, 14.90% have completed senior high school, and 12.76% have graduated from university. The level of education affects the ability to absorb information, knowledge, and way of thinking. The adoption of the latest innovations and AI technology is involved by breeders' and farmers' education (Mulyawati et al., 2016). This opinion is directly in line with a previous study by Sutrisno in Novita et al. (2019), which states that low education can affect worker performance. The same opinion was reported by Lamarang et al. (2017) that education affects the way of thinking of farmers who will carry out their livestock business activities.

According to Hifiziah and Astuti (2015), attitudes and perspectives on livestock business have started to progress even with the farmer's low level of education. Learning from experience and knowledge increases the farmer's ability to make good and careful decisions. Contrary to the opinion of Adnan (2018) that the higher the level of education, the level of knowledge of farmers in the world of animal husbandry is getting wider, compared to farmers with low education or not receiving an education. The low level of farmers' knowledge is due to a lack of counselling by the government or related institutions. Via education, farmers have new knowledge, skills, and ways of conducting business activities so that with higher education, business results will be better.

Table 1. Profile characteristics of cattle breeders in the Woha district

Characteristics	Number of respondents mentioning	%
Age		
>45-year-olds	29	61,70
<45-year-olds	18	38,30
Gender		
Men	47	100
Women	0	0,0
Education Level		
Elementary School	5	10,64
Junior High School	7	14,90
Senior High School	29	61,70
College	6	12,76
Main Job		
Breeder	16	34,04
Farmer	18	38,30
Government employees	6	12,76
Entrepreneur	7	14,90
Breeders experience		
< 5 years	21	44,68
> 5 years	26	55,32
Number of cattle		
< 3 cattles	13	27,66
> 3 cattles	34	72,34
Number of heifer/cows		
<3 cattles	30	63,83
3-6 cattles	16	34,04
7-10 cattles	1	2,13
>10 cattles	0	0,0

Our findings on the highest percentage of the breeder's main job are farmers (38.30%). The implications of these findings are discussed in Novita et al. (2019) that the allocation of time in a job can affect performance. Hastuti (2008) stated that the main job of most breeders' respondents is farmers, which indicates that for them, animal husbandry is a side business. Cattle farming by small farmers in the Woha district is generally developed as a sideline that only raises for savings and sells whenever they need money because cows are very easy to sell. Because farmers are oriented to sell cows when needed, their orientation as heifers is reduced (Zainuri et al., 2002). Besides, there is a trend for rural farmers selling large cattle when they need money, and the cattle they save are just small cattle. The Farmers in the Woha district do not think that raising cattle is their primary business. They do not even maintain it by taking into account the economic value. The rural farmers have low consideration about the time and energy that has been expended in maintaining into account because they thought cattle were

part of the agricultural system and part of the life of farmers for generations. The experience of raising livestock to participate in the AI program is essential to support the successful implementation of AI. The concern that occurs is that if the farmer is busy working in the fields, the farmer will leave the cow and not report it to the inseminator (Zainuri et al., 2003).

Based on Table 1 shows that the percentage of breeders with <5 years of experience is 44.68% compared to the number of breeders with >5 years experience percentage is 55.32%. These results are similar to Ananta et al. (2015) that grouping the experience levels of farmers and breeders according to the experience in their livestock business. The farmer is considered an expert if they have livestock experience for more than 10-years, experienced enough if they have been in their line of business for 5-10 years and less experienced if they have only been in their work for less than 5-years. Experience affects a farmer's ability to raise his cows. The longer the farmer's experience, the greater his ability to raise livestock. Respondents' experience in raising livestock varied from one year to more than five years. The experience of breeders is generally positively correlated with productivity. The more extended the livestock experience, the more productivity they produce. The higher the level of experience in raising livestock, the better the skills and attitudes towards the livestock business they manage. Farmers' skills affect the success of artificial insemination, namely the ability, knowledge, and time spent on estrus observation. In addition, there is the possibility of misdetection or false interpretation of estrus in cattle, which they report to the AI post in the village (Purnomo et al., 2017).

The cattle farm in Woha District is a smallholder farm that most of the respondents own more than three cows with average ownership of 3-6 heads. This finding shows that the farmers make cattle farms as a side business to earn extra income that fulfils the economic needs of farmers. Hastuti (2008a) stated that to reach the break-even point (BEP) at least the farmer must have 5-10 head of cattle.

This study described the Cattle in the Woha District with several characteristics such as age, breeds, body condition score (BCS), time of AI implementation, number of AI treatments until pregnancy, the length of the postpartum interval to estrus, types of semen straw, insemination doses, reporting interval since estrus to AI treatment, types of cattle feed, signs of estrus, the cows were caged or not and the success status (pregnant or non-pregnant) as presented in Table 2.

The preference of these parameters is based on Kusumawati and Leondro (2014) that the factors that influence the success of AI are human resources (breeders and accuracy of estrus detection), physiology of cow (cow age, type of cow, feed, caged, weather and body condition score). Other findings by Adnan's (2018) go beyond previous reports, showing that the success of AI in cattle is determined by several factors, namely: the quality of frozen semen (straw), lust detection, reporting time, inseminator skills, AI techniques, feed quality and quantity, and body condition score of cattle. These factors are correlated, and if one of the values is low, the AI pregnancy rate also shows low results.

Another promising finding in this study is that cattle artificial insemination was generally carried out on cows aged 4 to 6-year-old (86.7%). The inseminated cows commonly have a body condition score (BCS) of 3 (74.4%) and 4 (21.2%) with a scoring interval of 1-5. BCS is a parameter to evaluate body condition based on visual estimation of body fat deposits under the skin, around the base of the tail, spine and hips using a score. BCS is used to determine the production potential of an animal because cows that are too fat or thin have a major risk of metabolic abnormalities, pregnancy rates, and the possibility of dystocia (Hakim et al., 2010). Together, the present findings of AI implementation time confirm no statistically significant difference between the morning time (44.4%) and afternoon time (55.6%).

Table 2. Characteristics of the factors that affect the success of artificial insemination in the Woha district

Characteristics	Pregnant (%)	Non-Pregnant (%)	Total (%)
Age at AI	7	5	12 (13,3)
< 4-year-olds / > 6-year-olds	68	10	78 (86,7)
4 to 6-year-olds			
BCS			
Score 3	58	9	67 (74,4)
Score 4	10	9	19 (21,2)
Score 5	3	1	4 (4,4)
Time of AI			
Afternoon	41	9	50 (55,6)
Morning	30	10	40 (44,4)
Length of the postpartum interval to estrus			
> 2 months	44	18	62 (68,9)
0-2 months	19	9	28 (31,1)
Types of the semen straw			
Bali	11	4	15 (16,7)
Simmental	22	3	25 (27,8)
Brahman	12	4	16 (17,7)
Limousin	9	5	14 (15,6)
Angus	14	6	20 (22,2)
AI dose			
1 straw	83	7	90 (100.0)
Interval reporting time to AI			
< 8 hours	11	9	20 (22,2)
> 8 hours	58	12	70 (77,8)
Types of cattle feed			
Grass-fed	62	18	80 (88,9)
Grass-fed + additional	8	2	10 (11,1)
Heat signs			
Obvious	78	12	90 (100,0)
Not obvious	-	-	0
Caged			
Yes	73	7	80 (88,9)
Not	8	2	10 (11,1)
AI success status			
Non-pregnant			13 (14,4)
Pregnant			77 (85,6)

Cattle that have been inseminated will experience a long period of postpartum to estrus, with a period of more than two months (68.9%). The types of straw used are usually Simmental cattle (27.8%), Angus cattle (22.2%), Brahman cattle (17.7%), Bali cattle (16.7%), and Limousine cattle (15.6%), while the insemination dose was one straw (100.0%). The estrus interval reporting time by the farmer to AI treatment was generally more than eight hours (77.8%). Cows given complete feed (grass, concentrate, and another feed addition) show an

11.1% pregnancy rate lower than cows fed grass-only diets were 88.9%. The signs of cattle in heat are entirely clear (100.0%), with the results of cattle in cages management showing 88.9%. The results of 90 cows with AI treatment show that 85.6% were pregnant and 14.4% were not.

The factors that affect the success of AI in cattle in the Woha district are presented in **Table 3**. Stepwise regression test on the dependent variable, namely: the success status of AI and the independent variables include the age of the cow, the type of cow being AI, the score of the body condition of the cow, the time of AI implementation, the length of time postpartum to estrus, types of straw, insemination doses, reporting interval since estrus to AI treatment, types of cattle feed, signs of estrus and being caged (yes/no), it is known that the independent variable that has the strongest correlation is the age of the cow (sig. 0.006), reporting interval to AI treatment (sig. 0.001), and types of cattle feed (sig. 0.004). The three factors that have the strongest correlation are obtained based on sig. <0.05 and shows a significant impact on AI success in the Woha district, with the regression equation Y= -2.459 + 1.780X1 + 2.148X2 + 2.585X3, Y is the success of AI, X1 is the age of the cow, X2 is the reporting interval to AI treatment, and X3 is the types of cattle feed.

Table 3. The results of stepwise regression analysis on the factors that affect the success of artificial insemination

AI success factors	Sig.	B
Age of cattle	0,006	1,780
Interval reporting time to AI	0,001	2,148
Types of cattle feed	0,004	2,585
Constanta	0,006	-2,459

*Sig. <0,05 = had significant effect
*B = regression coefficient value

Future studies should consider the vital issue of cow's age role in the success of AI programs more carefully. As an example, the heifer is giving birth at the first time greatly affects the productivity of the individuals because cattle that are bred at a young age or at first puberty will cause hindrances to the body development that is not optimal, and resulting the cow offspring experience the same thing, and when the cow gives birth, it will encounter difficulties (Zainudin et al., 2014). Others have shown that heifers that are not bred until they exceed the age and body size that should have been bred for the first time will cause low reproductive performance during their lifetime (Destinawati and Isnaini, 2010).

The analysis data shows that the success rate of AI with the reporting distance to the implementation of AI is generally more than eight hours, 77.8%. For the sake of AI, cows that appear to be in heat in the morning should be inseminated the same afternoon and cows that appear to be in heat in the afternoon should be bred in the morning (Adnan, 2018). The implementation of AI should not be carried out during the day because cervical mucus thickens. While cervical mucus becomes wet and slippery in the morning, afternoon and evening, this also impacts the success of AI during the day, which is lower than in the morning, afternoon or evening (Susilawati, 2000 cited by Wahyudi et al., 2013).

The cow's feed to cattle on AI treatment is only low-quality forages and has high-fiber foods (sugar cane shoots and corn stalks). Due to that type of feed, the reproductive conditions of female cows and lust that occur are less than optimal. The previous study by Susilawati (2011) explains that the need for the feed of reproduction is the same as the necessities of life, that the basic needs are met, and cows can reproduce well, especially in local livestock. Cow's feed is

the main component for the success of the livestock business (Kojo et al., 2015). The forage provided by farmers in the Woha district is grass, legumes, straw, and these cows are also grazed naturally. Farmers store hay if needed during the dry season. This hay storage does not need much because the average farmer only raises 3-6 cattle.

Female cattle need an amount of food when they are mature to develop bodyweight conditions and improve the quality of cow reproductive organs properly. This statement was highlighted by Hifijah and Asati (2015) that good quality and quantity of feed contributes 95% to the body weight gain, physical condition and body size of cows that help the development of anatomical and physiological reproductive organs to achieve maximum reproductive performance.

Conclusion

In this study, we determined that the success artificial insemination factors in the Woha district is affected by the age of cows, the reporting time interval since estrus to artificial insemination treatment, and the types of feed.

Acknowledgments

This project was supported by the source of DIPA BLU (PNBP) funds for the fiscal year 2020/2021, Universitas Mataram. We would like to thank to all students in the fifth semester at Animal Health Study Program for their contribution to this survey.

References

Adnan, D.T.J. 2018. Evaluasi Keberhasilan Inseminasi Buatan pada Sapi Berdasarkan Service Per Conception, Non-Return Rate dan Jenis Semen Beku yang Digunakan di Kecamatan Narmada Kabupaten Lombok Barat. Skripsi. Faculty of Animal Husbandry, Universitas Mataram.

Ananta, A., H. Hafid, and L.O.A. Sani. 2015. Faktor-faktor yang mempengaruhi produktifitas usaha ternak sapi bali pada peternakan transmigran dan non transmigran di Pulau Kabaena Kabupaten Bombana. J. Ilmu Ternak Tropika. 2(3): 52-67.

Annisa, N. N., Roslizawaty, Hamdan, C.D. Iskandar, Ismail, and T.N. Siregar. 2018. Peran peternak terhadap keberhasilan inseminasi buatan pada sapi di Kabupaten Asahan. JIMVET. 2(1): 155-160.

Destinawati, N. and N. Isnaini. (2010). Penampilan reproduksi sapi Peranakan simental di Kabupaten Tulungagung Jawa Timur. J. Ternak Tropika. 11(2): 41-47.

Dradjat A.S., 2002. Penampilan reproduksi sapi Bali dengan menggunakan inseminasi buatan di Kecamatan Gerung Lombok Barat. Jurnal Ilmu dan Teknologi Peternakan. 1(1):1-5.

Hakim L., G.Ciptadi, and V.M.A. Nurgiartiningsih, 2010. Model Rekording Data Performans Sapi Potong Lokal Di Indonesia. Produksi Ternak Fakultas Peternakan Universitas Brawijaya Malang. J. Ternak Tropika. 11(2): 61-73.

Hastuti, D. 2008. Tingkat keberhasilan inseminasi buatan sapi potong ditinjau dari angka konsepsi dan service per conception. Mediagro. 4(1): 12-20.

Hastuti, D. 2008a. Kajian sosial ekonomi pelaksanaan inseminasi buatan sapi potong di Kabupaten Kebumen. Mediagro. 4(2): 1-12

Hifiziah, A. and Astuti. 2015. Analisis factor keberhasilan inseminasi buatan ternak sapi potong di Kecamatan Tomnolo Pao Kabupaten Gowa. J. Teknosains. 9(1): 13-26.

Hoesni, F. 2015. Pengaruh keberhasialn inseminasi buatan (IB) antara sapi bali dara dengan sapi bali yang pernah beranak di Kecamatan Pemayung Kabupaten Batanghari. J. Ilmiah Universitas Batanghari Jambi. 15(4): 20-27

Kastalani, K., H. Torang, and A. Kurniawan 2019. Tingkat keberhasilan inseminasi buatan (IB) pada peternakan sapi potong di Kelurahan Kalampangan Kecamatan Sabangau Kota Palangka Raya. Jurnal Ilmu Hewani Tropika. 8(2): 82-88.

Kojo, R.M., Rustandi, Y.R.L. Tulung, and S.S. Malalantang. 2015. Pengaruh penambahan dedak padi dan tepung jagung terhadap kualitas fisik silase rumput gajah. J. Zootek. 35(1): 21-29.

Kusumawati, E.D. and H. Leondro. 2014. Inseminasi Buatan. Unikama, Malang.

Lamarang, Z, B. F. J. Sondakh, A.K. Rintjap, and A.A. Sajow, 2017. Peranan penyuluh terhadap pengambilan keputusan peternak dalam adopsi inovasi teknologi peternakan di Kecamatan Sangkub Kabupaten Bolaang Mongondow Utara. Zootec. 37(2): 496-507.

Malotes, J. 2016. Strategi pengembangan usaha peternakan sapi potong di Kecamatan Tinangkung Utara Kabupaten Banggai Kepulauan. J. Agroland. 23(3): 198-207.

Mulyawati, I.M., D. Mardiningsih, and S. Satmoko. 2016. Pengaruh umur, pendidikan, pengalaman dan jumlah ternak peternak kambing terhadap perilaku sapta usaha beternak kambing di Desa Wonosari Kecamatan Patebon. Agromedia. 34(1): 85-90.

Novita, C.I., M.A.N. Abdullah, E.M. Sari, and Z. Zulfian. 2019. Evaluasi program inseminasi buatan pada sapi lokal betina di Kecamatan Juli, Kabupaten Bireuen, Provinsi Aceh. Jurnal Agripet. 19(1): 31-39.

Prayitno, R.S. 2018. Analisis usaha ternak indukan sapi peranakan Simental di Kecamatan Patean Kabupaten Kendal. Agromedia. 36(1): 97-105.

Purnomo, S.H., E. T. Rahayu, and S. B. Antoro. 2017. Strategi pengembangan peternakan sapi potong rakyat di Kecamatan Wuryantoro Kabupaten Wonogiri. Buletin Peternakan. 41(4): 484- 494.

Putro P.P and A. Kusumawati. 2014. Dinamika folikel ovulasi setelah sinkronisasio estrus dengan prostaglandin pada sapi perah. Jurnal Sain Veteriner. 32(1): 22-31.

Rusdiana, S. and L. Praharani, 2018. Pengembangan peternakan rakyat sapi potong: kebijakan swasembada daging sapi dan kelayakan usaha ternak. Forum Penelitian Agro Ekonomi. 36(2): 97-116.

Sarwono, J. 2006. Analisis Data Penelitian Menggunakan SPSS. Penerbit Andi. Yogyakarta

Sudarmono, A.S dan Y.B. Sugeng. 2016. Panduan Beternak Sapi Potong. Penebar Swadaya. Jakarta.

Suprianto, S. and D. Djuliansah. 2016. Kajian aplikasi teknologi inseminasi buatan dalam upaya peningkatan produktivitas dan pendapatan usaha ternak sapi potong di Kabupaten Tasikmalaya. Mimbar Agribisnis. 1(3): 211-225.

Susilawati T. 2011. Tingkat Keberhasilan kebuntingan dan ketepatan jenis kelamin hasil inseminasi buatan menggunakan semen beku sexing pada sapi Peranakan Ongole. Animal production. 7(3): 161–164.

Wahyudi, L., T. Susilawati, and S. Wahyuningsih. 2013. Tampilan reproduksi sapi perah pada berbagai paritas di Desa Kemiri Kecamatan Jabung Kabupaten Malang. J. Ternak Tropika. 14(2): 13-22.

Zainudin, M., M.N. Ihsan, and Suyadi. 2014. Efisiensi reproduksi sapi perah PFH pada berbagai umur di CV. Milkindo Berka Abadi Desa Tegalsari Kecamatan Kepanjen Kabupaten Malang. J. Ilmu-Ilmu Peternakan. 24(3): 32-37.

Zainuri L.A., Dahlanuddin, M. Muzani, T. Panjaitan, and H. Pany. 2002. Persepsi Peternak Nusa Tenggara Barat Terhadap Sapi Bali. Research Report. Collaboration with ACIAR, BPTP Faculty of Animal Husbandry, Universitas Mataram.

Zainuri, L.A., Zaini, A, and Syamsuhaidi, 2003. Kajian dan Evaluasi Bantuan Langsung Kepada Mayarakat Bidang Peternakan Propinsi Nusa Tenggara Barat. Research Report. Collaboration with Dinas Peternakan, West Nusa Tenggara Province and Faculty of Animal Husbandry, Uiversitas Mataram.