Jurnal Ilmiah Peternakan Terpadu

Status Reproduksi dan *Net Replacement Rate* Sapi Brahman *Cross* di Koperasi Produksi Ternak Maju Sejahtera Kecamatan Tanjung Sari Kabupaten Lampung Selatan

Reproductive Status and Net Replacement Rate Brahman Cross in Livestock Production Cooperative Maju Sejahtera Tanjung Sari District South Lampung Regency

Sri Suharyati[1*], Dani Al Fajri[1], Sulastri[1]

[1] Department of Animal Husbandry, Faculty of Agriculture, University of Lampung. Jl. SoemantriBrodjonegoro 1, Bandar Lampung, 35145, Lampung, Indonesia
[*] Corresponding Author. E-mail address:sri.suharyati@fp.unila.ac.id

ABSTRAK

Penelitian ini bertujuan untuk mengetahui status reproduksi, *Natural Increase)*, *Net Replacement Rate* dan *Output*, sapi Brahman *Cross* di Koperasi Produksi Ternak Maju Sejahtera, Kecamatan Tanjung Sari, Kabupaten Lampung Selatan. Pengambilan data dilakukan selama satu bulan, dimulai pada Desember 2019 sampai Januari 2020. Data diambil dari semua peternak sapi Brahman *Cross* di Koperasi Maju Sejahtera dengan cara wawancara terhadap responden. Hasil penelitian menunjukkan semua ternak betina sapi Brahman *Cross* di Koperasi Maju Sejahtera dikawinkan dengan metode kawin alami, umur kawin sapi pertama adalah 2 tahun, *(CI)* 12,4 bulan, *Natural Increase (NI)* adalah 29,48 %, dan nilai *Net Replacement Rate (NRR)* lebih dari 100% (670,4%), *Output* sebesar 52,43%.

ABSTRACT

The purpose of this study was to determine the reproductive status, Natural Increase (NI), Net Replacement Rate (NRR), and Output, of Brahman Cross cattle in Maju Sejahtera Cooperative, Tanjung Sari District, South Lampung Regency. This research was conducted in one month, started from December 2019 to January 2020. Data was collected from all Brahman Cross cattle breeders in the Maju Sejahtera Cooperative by interviewing respondents. Female cattle are used natural mating methods. The age of first mating of heifers is two years. Calving interval (CI) of Brahman Cross cattle at Maju Sejahtera Cooperative is 12.4months. Natural Increase (NI) of Brahman Cross cattle in Maju Sejahtera Cooperative is 29.48%. The Net Replacement Rate (NRR) value of male Brahman Cross cattle at the Maju Sejahtera Cooperative is more than 100% (670.4%). The output of Brahman Cross cattle at the Maju Sejahtera Cooperative is 52.43%.

1. Introduction

South Lampung Regency is one of the areas of Lampung Province which has good potential for the development of beef cattle. The Maju Sejahtera Cattle Production Cooperative, Tanjung Sari District, is one of the potential breeder groups for the development of Brahman Cross cattle. This is also supported by areas that have a very adequate availability of animal feed sources. Planting forage fodder can be done in almost every corner of the area because there is still vacant land that can be used to plant the forage.

2. Materials and Methods

The research was carried out from December 2019 to January 2020 with Brahman Cross cattle at the Maju Sejahtera Cattle Production Cooperative, Tanjung Sari District, South Lampung Regency, Lampung Province.

2.1. Material

The materials used were the Brahman Cross cattle owned by the Maju Sejahtera Cattle Production Cooperative, Tanjung Sari District, South Lampung Regency, which consisted of an male (10 heads), female (107 heads), and calves (56 heads). The tool used is a questionnaire for farmers.

2.2. Method

The research was conducted by survey using the total sampling method. The data taken include primary data obtained through interviews with respondents. Data on the number of male and females cattle , calves and heifers, the number of male and female kids born were used to calculate the NI, NRR, and Output values based on the livestock breeding theory recommended by Sumadi et al. (2004).

The research was carried out in several stages, the first was a pre-survey to determine the population of Brahman Cross cattle in the Maju Sejahtera Cattle Production Cooperative, and the condition of the farm, then the research was carried out by taking data from Brahman Cross cattle breeders by interviewing and then tabulated the interview data on the questionnaire sheet.

Data were collected through direct observation and interviews with respondents which included: (1) respondent identity; (2) cattle management; (3) reproductive status

(age at first mating, age at first partus, type of birth and sex, *calving interval*, bulls and cows were used, mating system); (4) number of calves, young cattle, bulls male and cows; (5) incoming and outgoing cattle in the past year; (6) the partus in the last year; (7) the birth calves in the last year; (8) number of cow deaths in the last year. The research data were presented in tabular form and analyzed descriptively.

3. Results and Discussion

3.1. *Identity of Breeder and Management of Cattle Breeding in Maju Sejahtera Cattle Production Cooperative*

3.1.1. *Age of breeder and livestock experience.*

The results (Table 1) can be seen that the average age of Brahman cross cattle breeders in Maju Sejahtera is 50.93 ± 8.28 years . This shows that the age of the breeders in the research location is still in their productive age. Productive age is one of the factors that can support livestock rearing. Farmers with productive age have more enthusiasm and great ability to develop livestock raising businesses so that they can increase productivity and family income.

Manyamsari and Mujiburrahmad (2014) suggest that the development of thinking skills occurs with increasing age. The skills of farmers aged >64 years are lower than those of farmers aged 28-64 years. Maryam *et al.* (2016) stated that when a worker reaches a certain age, for example 55 years, 60 or 65 years, a worker must enter a period of no longer productive. Age has an influence on work productivity in types of work that rely on physical labor (Makatita et al., 2014).

3.1.2. *Level of education of breeders*

The average level of education of farmers from the results of the study is elementary school graduates (40.7%), junior high school (18.52) and high school (37.0%) and bachelor degree (3.70%). Research results Kurnia et al. (2019) shows that the level of education has an influence on the success of the livestock business. Sandi et al. (2018) stated that the relatively low level of education causes livestock to not experience significant changes because in general smallholder farmers always practice traditional farming habits and find it difficult to accept the introduction of livestock technology. According to Makatita et al. (2014), education affects the ability of farmers to apply technology. Low education causes limited thinking ability and reasoning ability of a new

innovation, this causes lower insight to advance compared to highly educated breeders. Mulyawati et al. (2016) states that behavior is all actions taken by a person which are generally influenced by three things, namely knowledge, attitudes and skills.

Breeders who have higher thinking power and are flexible in responding to a problem will always try to improve a better level of life. Manyamsari and Mujiburrahmad (2014) explain that education is a planned process of developing one's knowledge and attitudes, which will form insight into an object that will ultimately lead to decision making. The higher a person's level of education, their quality will increase and vice versa, the lower the level of education, their quality in terms of knowledge, skills, attitudes and insights, the development of reasoning power, and analysis is also lower.

3.1.3. Occupation

Based on the research data, most of the main jobs of Brahman cross cattle breeders are farmers. This can be seen from the potential of the village which is suitable for agriculture. The business of raising cattle is used as a side job and savings to increase family income. The Brahman cross cattle business kept by members of the Maju Sejahtera is still on a small scale. According to Hadi and Ilham (2002), the small number of livestock businesses in intensive farming areas is due to the fact that livestock are kept by farmers with limited management.

3.1.4. Goal

The aim of the breeder's goal in raising Brahman cross cattle in the Tanjung Sari Maju Sejahtera Cooperative, it is known that 100% of the main goals are to produce offspring. The results of this study are much higher than those of Anggraeni *et al.* (2016), the purpose of raising beef cattle to get offspring/breeding in Sriwedari Village, Tegineneng District, Pesawaran Regency is 67%. According to Yusdja and Ilham (2004), the business pattern of most breeders is nursery or child rearing, and only a small number of breeders specialize in fattening livestock.

3.1.5. Maintenance management

The results (**Table 1**) show that the Brahman cross cattle rearing system in the Maju Sejahtera is 100% caged. This shows that all breeders in the Maju Sejahtera use a

colony-intensive cage system. The use of the colony cage model can increase the efficiency of beef cattle rearing with the advantages of water and labor efficiency; maintenance efficiency and shorten calving distance; livestock comfort is maintained; guaranteed compost quality (faeces and urine); and increase business scale. Cattle maintenance with a group cage system is to place several female cows in a cage together with a male so that the female cow can be bred by a male when the cow is in heat, this helps the cows to mate on time and increase their reproductive efficiency (Nurhakiki and Nur Halizah, 2020).

The feed provided by farmers at the Maju Sejahtera Tanjung Sari Cooperative is in the form of concentrate and forage. The composition of the feed provided is forage which is provided in the form of field grass, elephant grass and various types of legume and ramban plants, as well as the concentrate given in the form of onggok, tofu dregs, corn and bran.

Table 1. The identity of the respondents Brahman cross cattle breeders in the Maju Sejahtera Cattle Production Cooperative in 2020.

No.	Variables	Maju Sejahtera Cattle Production Cooperative
1	Age (years)	Farmer's50.93 ± 8.28
2	Length of raising (years)	8.56 ± 0.71
3	Education (%)	
	a. No school	0
	b. SD	40.74
	c. SMP	18.52
	d. SMA	37.04
	e College	3.70
4	Main occupation (%)	
	a. Farmers	77.78
	b. Private	11.11
	c. Others	11.11
5	Maintenance Objectives (%)	
	a. nursery	100
	b. Fattening	0
6	Maintenance Motives (%)	
	Main Business	25.93 Side
	business	59, 26
	Savings	14.81
7	Total Population	173 (heads)
8	Total Parent	107 (heads)
9	Total births	56 (heads)
10	Number of Respondents	27

Frequency of feeding Brahman cross cattle in the Maju Sejahtera were carried out 2 times/day as much as 48.18% and feeding 3 times/day as much as 51.85%, meaning that the feeding carried out by farmers was more 3 times/day, meaning that the feeding carried out by different breeders was different feed 2 to 3 times/day. The management of feeding in the Maju Sejahtera Cooperative is better than the results of Sandi et al. (2018), Livestock in Sejaro Sakti Village, Indralaya District, Ogan Ilir Regency are only fed once a day in the afternoon in very limited quantities.

The average farmer cleans the cage 1.41 ± 0.49 times a day and the cage cleaning system is where the cattle are left in the cage and then the manure is collected to be used as compost. Cleanliness of the cage is maintained to prevent disease transmission. This is in accordance with the opinion of Abidin and Soeprapto (2006) which states that efforts that can be made for disease prevention are maintaining the cleanliness of the cage environment, regular deworming, and periodic vaccinations.

3.2. Reproductive Status of Brahman Cross Cattle in Maju Sejahtera Cattle Production Cooperative, Tanjung Sari District, South Lampung Regency.

3.2.1. Mating System

The results of the study (**Table 2**) indicate that at the research location, natural mating was carried out. Breeders use a group/umbaran cage model marriage. The use of natural mating with a group/umbaran cage model has the benefit of making it easier for males to marry females. The results of Sudirman's research (2016) show that the marriage system does not show a significant effect on the pregnancy rate of Donggala cattle in Sigi Regency.

The bulls used for mating at the study site came from the results of the performance test selection, namely based on the *performance/progeny test* (Directorate General of Animal Husbandry (2007). At this stage, the bulls tested were in the age range of $1.5 – 2$ years so they had just entered optimal early stage of growth before reaching sexual maturity

3.2.2. Age of first mating

The results (Table 2) show that the age at first mating of Brahman cross cattle in Maju Sejahtera Cooperative is 24 months (2 years) for females and 48 months (4 years)

for males. longer than the results of research by Desinawati and Isnaini (2010) which showed that the age at first mated to a female Simmental Crossbreed was 19.77 ± 3.62 months, whereas according to Hardjopranjoto (1995), the age of mating for heifers was 14-25 months. If the cow is mated too quickly it will affect the cow's reproductive system, a cow that is too small will cause difficulties during childbirth, as well as allowing the death of the calf and delaying mating will increase the cost of rearing. According to Hoffman (1997) age at first marriage is one of the important factors to reduce the cost of raising heifers so that by not delaying the optimal age of marriage and age of first calving, it can increase the efficiency of maintenance costs.

3.2.3. *Post partum mating (PPM)*

The results showed that the *post partum mating of* Brahman cross cattle averagein Maju Sejahtera Cooperative was 2.27 months. This result is smaller than the research result of Riyanto et al. (2015) which showed PPM results of 4.02±0.35 months. Post*partum mating is* influenced by several factors, including the length of weaning age and the condition of the mother's body weight after giving birth. Fulfillment of feed needs is also a factor that affects livestock fertility.

3.2.4. *Weaning age*

The average weaning age of Brahman cross cattle in Maju Prosperous Cooperative is 3.30 months. The results of the study at this research location were better than the duration of weaning cattle in Wonosari District, Gunung Kidul Regency for 5.29 months (Suryadi, 2016). This could be due to better calf weaning management and feed provision. According to Pratiwi *et al.* (2008), calf management and adequate feed availability can increase reproductive efficiency and have an impact on beef cattle productivity. Weaning performed at the age of more than 3 months can prolong the period of lust after delivery and extend the birth spacing. According to Hastuti (2006) weaning can be done at the age of 1 (one) month, but this can cause the calf to experience stunted growth.

3.2.5. *Calving interval*

Table 2 shows the average *calving interval of* Brahman cross cattle in Maju Sejahtera Cooperative is 12.4 months. *The Calving interval* at the study site is shorter

when compared to the results of Anggraini et.al's research .(2016) in Sriwedari Village, Tegineneng District, Pesawaran Regency, which is 14.02 months. Calving Interval in Maju Sejahtera Cooperative is influenced by a good gestation period, feeding with adequate nutrition, timely mating and breeders always recording livestock reproductive activity.

Hadi and Ilham (2002) mention a good birth interval of 1 year or 12 months. In this research location, the *calving interval* is ideal. Ball and Peters (2004) stated that the reproductive efficiency of a female cow is said to be good if it gives birth to one calf within a year.

Table 2. Reproductive status of Brahman cross cattle, Maju Sejahtera Cattle Production Cooperative, Tanjung Sari District, South Lampung Regency

No.	Variable	Maju Sejahtera Cooperative
1	Number of Parent (tails)	107
2	Introduction to estrus	
	a. Good (%)	0
	b. Enough (%)	100
	c. Less (%)	0
3	How to marry	
	a. Artificial Insemination (%)	0
	b. Natural mating (%)	100
4	Age at first mating (Months)	
	a. Males	48 ± 3.2
	b. Female	24
6	Mating after childbirth (Months)	2.27 ± 0.44
7	Weaning Age (months)	3.30 ± 0.55
8	Spacing (months)	12.4 ± 0.53
9	Number of Births	
	a. Male (heads)	29
	b. Female (heads)	27
10	Retention Age Limit	
	a. Male (Year)	9 ± 0.81
	b. Female (Year)	7 ± 0.95
11	Time to use	
	a. Male (Year)	4 ± 0.53
	b. Female (Year)	3 ± 0.88

3.3. Natural Increase

   Natural increase or natural growth is calculated based on the difference between the birth rate and the death rate within one year (Hardjosubroto, 1994). An area with a high NI in a certain population shows the ability of the area not to need replacement livestock and can sell the rest of the substitute livestock to other areas (Sumadi *et al.,*2004). The research data in Table 3 shows that the NI value of Brahman Cross cattle in Maju Sejahtera is 29.48%.

   The research results of Brahman cross cattle in the Maju Sejahtera are higher than the NI for cattle in Wonosari, Gunung Kidul, namely 18.24% (Suryadi, 2016). And higher than research results Budiarto *et al.* (2013) which resulted in NI in Bali cattle of 27.40%. The high *NI* at the study site was due to the high calf birth rate in the last 12 months and the low calf mortality at the study site. The NI value is smaller than the results of the study of Kusuma *et al.* (2017) which resulted in the NI value of PO cattle in Kebumen Regency, Central Java of 40.78. The high and low value of *natural increase* in cattle is caused by population structure, birth rate, and death rate. A high percentage of births will produce a high *natural increase* if the percentage of deaths is low and vice versa.

3.4. Net Replacement Rate (NRR)

   The NRR value of research results on male Brahman Cross cattle in the Maju Sejahtera Cooperative is 670.4%, which means that the location has been able to provide prospective male parents themselves without having to include prospective replacement cows from outside the area. The female cows in the Maju Sejahtera are still below <100%, which is only 43.77%, which means that the location has not been able to provide prospective female parents and must provide substitute cows from outside the area. Hardjosubroto (1994) states that the livestock population is declared to have a livestock surplus if the NRR is above 100% and is declared as a source area for seeds and if it is less than 100% it means that there is a reduction in the livestock population in the area.

   Based on the results of the study in Table 3, it shows that the NRR value of female cows at the study site is 43.77%, which means that the females in the Maju Sejahtera Cooperative have not been able to provide their own prospective parents and must include prospective substitute cows from outside the area because the female cows in the location these are naturally bred so that more females are needed to meet the needs of the site. The

need for replacement livestock will be quite high if the length of use of livestock is in a short period of time. In contrast, the need for substitute livestock in an area is low if the use of livestock is longer (Sumadi *et al.*, 2011).

3.5. Output

The results showed that the output of Brahman Cross cattle in Maju Sejahtera Cooperative was quite high, namely 52.43%. This result is greater than Kusuma *et al.* (2017) which produces PO cattle output in Kebumen Regency, Central Java by 39.73%.

Table 3. *Natural Increase* (NI), *Net Replacement rate* (NRR) and Brahman cross cattle output in Maju Sejahtera, Tanjung Sari District, Regency South Lampung

No	Variable	Maju Sejahtera Cooperative
1	Number of calf births (tails)	56
2	Average percentage Calf births to population (%)	32.37
3	Number of cattle deaths/year (heads)	5
4	Percentage of deaths to population (%)	2.89
5	NI 12 months(%)	29.48
6	NI 12 months in males (%)	16.76
7	NI 12 months in females (%)	15.61
8	Class NI 12 months	High
9	NRR (mean) in %	
10	a. NRR male (%)	670.4
11	b. NRR female (%)	43.77
12	Total Output (%)	52.43
13	Total Output (tail)	30

According to Sumadi et al. (2004) the percentage of *output* is the sum of rejected livestock with the remaining *replacment stock*. Thepercentage *output* is divided into three to obtain a range of low, medium and high values. The reproductive potential that can affect the output value is the birth and death rate of the calf to adulthood. A high calf birth rate and low mortality will be able to provide replacement livestock in greater numbers. The need for replacement livestock is the percentage of adult livestock divided by the length of use of adult livestock in the population, then when adult livestock are removed from the population so that potential replacements are immediately used as elders in the population while the removed adult cattle are rejected livestock (Sulastri, 2014) .

The *output* or potential figure in a livestock-producing area is very important because it is to determine the ability of an area to provide livestock for market needs so that a map of the potential of the area can be made that can be used as a basis for increasing its productivity (Sumadi *et al.*, 2004).

6. Conclusion

Reproductive status of Brahman Cross cattle in Maju Sejahtera Cattle Production Cooperative, age at first mating is 2 years (24 months) while male cattle at mating age are 4 years (48 months), *Calving interval (CI)* Brahman cross cattle in Maju Sejahtera Cattle Production Cooperative is 12.4 months. *Natural Increase (NI)* is 29.48%. *Net Replacement Rate (NRR)* above 100% (670.4%). *The output* is 52.43%.

References

Abidin, Z., Soeprapto. 2006. Penggemukan Sapi Potong. Agro Media Pustaka. Jakarta.

Anggraini, S., Sulastri, S. Suharyati. 2016. Status Reproduksi Dan Output Berbagai Bangsa Sapi Di Desa Sriwedari, Kecamatan Tegineneng Kabupaten Pesawaran. *Jurnal Ilmiah Peternakan Terpadu*. 4(1): 47-54 DOI: http://dx.doi.org/10.23960/jipt.v4i1.p%25p

Ball, P.J., A.R. Peters. 2004. Reproduction in Cattle Third Edition. Wiley-Blackwell. Philadelphia

Desinawati, N., N. Isnaini. 2010. Penampilan Reproduksi Sapi Peranakan Simmental Di Kabupaten Tulungagung Jawa Timur. *J. Ternak Tropika*. 11(2*): 41-47*

Budiarto, A., L. Hakim, Suyadi, VM. A. Nurgiartiningsih dan G.Ciptadi. 2013. Natural Incresae Sapi Bali di wilayah instalasi populasi dasar Propinsi Bali. *J. Ternak Tropika* 14(2): 46-52

Hadi, P.U., N. Ilham. 2002. Problem dan prospek pengembangan usaha pembibitan sapi potong di Indonesia. *Jurnal Penelitian Pengembangan Pertanian,* 21(4): 148-157

Hardjopranjoto, S. 1995. Ilmu kemajiran pada ternak. Airlangga University Press. Surabaya

Hastuti, E., 2006. Respon Seleksi Tidak Langsung Berat Satu Tahun Akibat Seleksi Pada Berat Sapih Anak Sapi Bali Hasil Inseminasi Buatan di Kabupaten Merangin Propinsi Jambi. Skripsi. Fakultas Peternakan. Universitas Jambi.

Hoffman, P.C. 1997. Optimum body size of holstein replacement heifers. *J. Anim. Sci.* 75(3): 836-845. DOI: 10.2527/1997.753836x

Kurnia, E , B. Riyanto , N.D. Kristanti. 2019. Pengaruh Umur, Pendidikan, Kepemilikan Ternak Dan Lama Beternak Terhadap Perilaku Pembuatan Mol Isi Rumen Sapi Di Kut Lembu Sura*. Jurnal Penyuluhan Pembangunan* 1 (2): 40-49. DOI https://doi.org/10.34145/jppm.v1i2.166

Kusuma, S.B., N. Ngadiyono, Sumadi. 2017. Estimasi Dinamika Populasi dan Penampilan Reproduksi Sapi Peranakan Ongole Di Kabupaten Kebumen Provinsi

Jawa Tengah. *Buletin Peternakan* 41 (3): 230-242. https://doi.org/10.21059/buletinpeternak.v41i3.13618

Makatita, J., Isbandi, S. Dwidjatmiko. 2014. Tingkat Efektifitas Penggunaan Metode Penyuluhan Pengembangan Ternak Sapi Potong di Kabupaten Buru Provinsi Maluku. *J.Agromedia.* 32(2):64-74. DOI: https://doi.org/10.47728/ag.v32i2.95

Manyamsari, I., Mujiburrahmad. 2014. Karakteristik Petani dan Hubungannya dengan Perilaku Petani Lahan Sempit. *Agrisep.* 15(2): 58-74

Maryam, M.B. Paly dan Astati. 2016. Analisis Faktor-Faktor yang Mempengaruhi Penentu Pendapatan Usaha Peternakan Sapi Potong (Studi Kasus Desa Otting Kab. Bone). *Jurnal Ilmu dan Industri Peternakan*. 3(1): 79-100. DOI: https://doi.org/10.24252/jiip.v3i1.3921

Mulyawati, I. M., D, Mardiningsih, S. Satmoko. 2016. Pengaruh Umur, Pendidikan, Pengalaman dan Jumlah Ternak Peternak Kambing Terhadap Perilaku Sapta Usaha Beternak Kambing di Desa Wonosari Kecamatan Patebon. *J. Agromedia.* 34(1): 85-90. DOI: https://doi.org/10.47728/ag.v34i1.134

Nurhakiki, Nur Halizah. 2020. Manajemen Pemeliharaan Sapi Bali Di UPT-Pt HPT Pucak, Dinas Peternakan dan Kesehatan Hewan Provinsi Sulawesi Selatan. *Jurnal Peternakan Lokal* 2(1): 20-24

Pratiwi, WC., L. Affandhy, D. Ratnawati. 2008. Pengaruh Umur Penyapihan Terhadap *Performans* Induk Dan Pertumbuhan Pedet Sapi Potong Di Kandang Kelompok. *Prosiding Seminar Nasional Sapi Potong,* 24 November 2008, Palu 115-122.

Riyanto, J., Lutojo, D.M. Barcelona. 2015. Kinerja Reproduksi Induk Sapi Potong pada Usaha Peternakan Rakyat di Kecamatan Mojogedang. *Jurnal Sains Peternakan* 13 (2): 73-79. DOI: https://doi.org/10.20961/sainspet.v13i2.11478

Sandi, S., M. Desiarni, Asmak. 2018. Manajemen Pakan Ternak Sapi Potong di Peternakan Rakyat di Desa Sejaro Sakti Kecamatan Indralaya Kabupaten Ogan Ilir. *Jurnal Peternakan Sriwijaya* 7(1): 21-29. DOI: https://doi.org/10.33230/JPS.7.1.2018.7080

Sudirman. 2016. Pengaruh metode perkawinan terhadap keberhasilan kebuntingan Sapi Donggala di Kabupaten Sigi. *E-Journal Mitra Sains,* 4(3) :22-27

Sulastri. 2014. Karakteristik Genetik Bangsa-Bangsa Kambing di Provinsi Lampung. Disertasi. Fakultas Peternakan. Universitas Gadjah Mada. Yogyakarta

Sumadi, H. Mulyadi, T. Hartatik dan R.D. Mundingsari. 2011. Estimasi Potensi Pembibitan Sapi Potong Di Kecamatan Wonosari Kabupaten Gunung Kidul Daerah Istimewa Yogyakarta. Laporan Hibah Penelitian Tematik Laboratorium. Universitas Gadjah Mada. Yogyakarta

Suryadi. 2016. Pendugaan Natural Increase Sapi Potong di Kecamatan Wonosari Kabupaten Gunung Kidul Daerah Istimewa Yogyakarta. Skripsi. Fakultas Peternakan. Universitas Gadjah Mada. Yogyakarta.

Yusdja, Y., N. Ilham. 2004. Tinjauan kebijakan pengembangan agribisnis sapi potong. *Analisis Kebijakan Pertanian* 2(2): 183-203. DOI: http://dx.doi.org/10.21082/akp.v2n2.2004.183-203