# Assessment of Reproductive Performance and Abortion Occurrence of Boer Goats as Influenced by Farm Systems and Feeding Practices

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## Abstract

The objective of this study was to evaluate the effect of farm systems (intensive and semi-intensive) and feeding practices on reproductive performance (kidding rate and abortion occurrence) of female Boer goats in Peninsular Malaysia. By using a survey-purposive sampling approach, a total of 212 goat farms were surveyed and 123 farms rearing Boer goats either in intensive or semi-intensive farm system with at least of a year of operation were included in the analysis. Data on feeding practices were also gathered. In both farm systems, majority of the goat producers fed their goats twice a day and about half of them (48.6%) provided feed supplement to the pregnant goat. This feeding practice was mentioned as a method to improve the kidding rate. However, no significant different was found between the two farm systems in kidding rate ($P>0.05$: intensive 1.19 ± 0.09; semi-intensive 1.10 ± 0.07). In addition, the abortion incidence was rare, particularly in early and late pregnancy in intensive and semi-intensive farm systems ($p>0.05$; $X^2 = 7.57$ and 2.21, respectively). In conclusion, the rearing Boer female goats either in intensive or semi-intensive farm systems does not affect their kidding rate and abortion frequency.

**Keywords:** Boer Goat, Survey-purposive, Kidding rate, Abortion, Pregnancy

## Introduction

Boer *(Capra hircus)* is one of the most common goat breeds that has been specifically bred for meat production and acknowledged as the World's premier meat goat by Boer Goat Breeders Association of Australia. The breed has become common and popular among the goat breeders in Peninsular Malaysia (Norhazirah et al., 2014). Since 2006, the number of Boer goats has increased annually due to the importation of Boer goats from various goat-producing countries, especially Australia (Aziz, 2007). However, the self-sufficiency level of goat meat in Malaysia is still far lower the domestic demand. The self-sufficiency level for local mutton (meat of sheep and goats) is about 13% (DVS, 2014). Meat goat production is one of the ruminant industries in Malaysia which lacks adequate supply of breeding stock and insufficient quantity of reasonably priced feed for an efficient production of mutton and milk (Ariff et al., 2015).

Compared to the other livestock production such as cattle, sheep, chicken and pig, research focusing on increasing goat production is sparse. Moreover, the productivity of goats could be affected by feed intake (Mellado et al., 2004; Shikh Maidin et al., 2008). Therefore, it would be

beneficial to study the feed intake of Boer goats in Malaysia. Animal production efficiency depends greatly on nutritional management for reproductive efficiency (focussed feeding), as embodied in the concept of 'clean, green and ethical management' (Martin et al., 2004; Martin and Kadokawa, 2006; Blache and Martin, 2009; Shikh Maidin et al., 2014). Unfortunately, in Peninsular Malaysia, there were few studies reporting on the nutritional management, especially on the type, amount and ration of goats. The study on nutritional management is important as low quality and unbalanced nutrient contents of feed resources could reduce reproductive performance and thus, lower the animal productivity (Salem, 2010).

This study was aimed to assess the effects of farm system and feeding practice on reproductive performance, mainly kidding performance and abortion occurrence of Boer goats raised in intensive and semi-intensive farms in Peninsular Malaysia. It is expected that based on the results of this study, specific nutritional management could be identified for the improvements of reproductive performance of Boer goats.

## Materials and Methods

*Survey Setting*

Surveys using purposive sampling method were carried out in eleven states of Peninsular Malaysia: Johor, Kedah, Kelantan, Malacca, Negeri Sembilan, Pahang, Penang, Perak, Perlis, Selangor and Terengganu. Data were received from a total of 212 respondents who were goat producers and have been involved in goats' breeding in intensive or semi-intensive farm management systems for more than a year. The respondents gave responses either through face-to-face interviews or through an online survey.

*Information on Farms and Questionnaires*

The questionnaires used in the surveys consisted of three sections: 1) general information, 2) feed and management practices and 3) reproductive performance of goats. In general, the questionnaires focussed on type of feeds fed, feeding practices adopted, kidding performance and abortion occurrence. Information on kidding performance and abortion occurrence were acquired based on previous records. Data from 123 Boer goat farms were analysed for the effect of feeding practice on abortion occurrences and 107 Boer goat farms were analysed for kidding performance.

*Statistical Analysis*

Data were analysed using SPSS statistics version 21.0. Data for number and percentage of Boer goat farms in Peninsular Malaysia, type of feeds fed and daily feeding practice were analysed for descriptive analysis. Kidding rate between farm system and feed supplementation practice of pregnant goats were analyzed using t-test. Kidding rate was defined as the total number of kids born in a year per total number of female goats bred per farm. Chi-square analysis was used to determine the effect of type of feeds fed and daily feeding practice on abortion occurrence within farm systems. A probability of less than $P$ =0.05 was considered significant. Data were expressed as mean ± standard error.

## Results and Discussion

*Boer Goat Farms*

Out of 212 respondents from the survey, 58% (n=123) reared Boer goats and most of

their farms were located at Pahang (16.3%), Johor (15.4%) and Negeri Sembilan (14.6%) (Table 1). This could be due to one of the core strategies implemented in Ninth Malaysia Plan (2006-2010), when the government had focussed on the enhancement of agricultural sector (Jabatan Penerangan Malaysia, 2016), thus more goat producers in these states received financial support to import Boer goats for breeding programmes. In addition, Department of Veterinary Services (DVS, 2013) reported that around 64,600 head of commercial grade Boer goats were imported into Malaysia for the breeding programmes between 2005 to 2010. Since then, the Boer goats have been bred and increased in population.

Table 1. Number (n) and percentage (%) of Boer female goats between farm systems in Peninsular Malaysia

| State | Total farm, n (%) | Farm system, n (%) | |
|---|---|---|---|
| | | Intensive | Semi-intensive |
| Pahang | 20 (16.3) | 5 (8.2) | 15 (24.2) |
| Johor | 19 (15.4) | 13 (21.3) | 6 (9.7) |
| Negeri Sembilan | 18 (14.6) | 10 (16.4) | 8 (12.9) |
| Kedah | 12 (9.8) | 4 (6.6) | 8 (12.9) |
| Pulau Pinang | 11 (8.9) | 6 (9.8) | 5 (8.1) |
| Selangor | 10 (8.1) | 8 (13.1) | 2 (3.2) |
| Perak | 10 (8.1) | 3 (4.9) | 7 (11.3) |
| Kelantan | 8 (6.5) | 5 (8.2) | 3 (4.8) |
| Terengganu | 8 (6.5) | 4 (6.6) | 4 (6.5) |
| Perlis | 4 (3.3) | 1 (1.6) | 3 (4.8) |
| Malacca | 3 (2.4) | 2 (3.3) | 1 (1.6) |
| Total | 123 (100) | 61 (100) | 62 (100) |

*Feed and Feeding Practices*

Goats in Peninsular Malaysia were commonly fed twice a day (intensive farm = 52.5% and semi-intensive farm = 45.2%; Table 2) and this finding is similar to a previous study on small ruminants tept in pens by Baumont et al. (2000). The preferred time for feeding was early in the morning and late evening. Feeding goats twice a day allowed the goat farmers to control the amount of feed consumed by the goats while allowing them to work in goat farms on a part-time basis.

In the present study, the types of feed available for the goats varied among farms, and included Napier grass, oil palm fronds, mixture of native grasses, soya hulls and commercial concentrate (pellet). However, the amount and quality of feeds provided were not recorded. The producers preferred to feed their animals *ad libitum*. From the surveys, about 50% of farmers from intensive and semi-intensive farms fed their goats with commercial concentrate (Table 3) and this was in contrast to Alimon (1990) who reported native grasses and forages were commonly selected as the main goat feed in

Malaysia. The selection of goat feed could be influenced by the cost of the feed, the availability (abundance) and nutritional content of the feed itself (Alimon, 1990; Chah et al., 2013). We suggest that most of the producers were aware of the needs of their animals mainly on nutrient intake. The advantages of commercial concentrates are also well known among the goat producers.

Table 2. Frequency of daily feeding for goat between intensive and semi-intensive of goat farm systems

| Feeding ratio/day | Farm system, n (%) | |
|---|---|---|
| | Intensive | Semi-intensive |
| 1 | 6 (9.8) | 23 (37.1) |
| 2 | 32 (52.5) | 28 (45.2) |
| 3 | 21 (34.4) | 10 (32.3) |
| 4 | 1 (1.6) | 0 (0.0) |

About half of the goat producers (more than 49.6%, Table 3) gave extra feed as supplements to their female goats. Feed supplements were given throughout pregnancy and showed a significant increase in percentage of kidding rate when this practice was adopted (1.30 ± 0.09, 0.99 ± 0.07, for with supplement and without supplement, respectively, $P>0.05$; Table 4). Feed supplementation has a great potential to improve kidding rate of goats (Bredon and Horrell, 1961; Devendra, 1989). Body condition score and live weight are mostly affected by supplementation, thus resulting in altered folliculagenesis and improved ovulation rate (Scaramuzzi et al., 2006). However, pregnancy could not be sustained because of high rate of progesterone clearance by liver (Parr et al., 1987; Parr, 1992). In contrast, dietary supplement for goats could stimulate major changes in energy homeostasis and unlikely affect progesterone concentration thus sustain embryo development (De Santiago-Miramontes et al., 2008; Shikh Maidin et al., 2014).

Table 3. Type of feed types fed to goats between intensive and semi-intensive of farm systems

| Type of feed intake | Farm system, n (%) | |
|---|---|---|
| | Intensive | Semi-intensive |
| Concentrate | 61 (49.6%) | 62 (50.4%) |
| Napier grass | 46 (52.9%) | 41 (47.1%) |
| Oil palm frond | 28 (45.2%) | 34 (54.8%) |
| Mixed of wild grass | 26 (29.9%) | 61 (70.1%) |
| Soya hulls | 26 (65.0%) | 14 (35.0%) |
| Corn stalk and leaf | 16 (84.2%) | 3 (15.8%) |
| Chinese violet | 14 (40.0%) | 21 (60.0%) |
| Silage | 13 (68.4%) | 6 (31.6%) |
| Petai belalang | 11 (47.8%) | 12 (52.2%) |
| Guinea grass | 11 (61.1%) | 7 (38.9%) |

Table 4. Effect of feed supplement on kidding rate of Boer goats

| Feed supplement | No. of farm (n) | Kidding rate (mean ± SE) |
|---|---|---|
| No | 55 | $0.99 \pm 0.07^{a}$ |
| Yes | 52 | $1.30 \pm 0.09^{b}$ |

[ab]Significantly different ($P < 0.01$). SE = standard error

*Reproductive Performance*

Reproductive efficiency, particularly kidding rate of goats, is an important parameter to measure the success of goat production. In this survey, we found that the percentage of kidding rate of goats ranged from 50 to 225%, enormously varied when compared to the range of kidding percentage of Marwari goats (60 - 70%) from a survey conducted by Joshi et al. (2005) in arid region of Rajasthan, India. The kidding rate of Boer goats reared in intensive farms was slightly higher compared to the Boer goats reared in semi-intensive farms (1.19 ± 0.09 vs. 1.10 ± 0.07; $P>0.05$; respectively; Table 5). This agrees with Patel et al. (2005) where in India, the kidding rates of goats were found to be similar between semi-intensive and intensive farms. However, a survey done in Egypt showed that the kidding rate was higher for goats kept in semi-intensive farm than in intensive farm: 2.06 ± 0.05 and. 1.27 ± 0.07, respectively (Metawi, 2011). There are several factors that could potentially affect the kidding rate, such as geographic location, body weight and condition, male to female ratio, male effects, photo- periodism, stress, nutrition, pasture composition and many other environmental factors (Mohd Khusahry, 1984; Zarazaga *et al*., 2009; Arineitwe and Ndyomugyenyi, 2013).

Table 5. Kidding rate between intensive and semi-intensive farm systems

| Farm system (n) | Kidding rate mean ± SE | P value |
|---|---|---|
| Intensive (n=50) | 1.19 ± 0.09 | 0.442 |
| Semi-intensive (n=57) | 1.10 ± 0.07 | |

SE = standard error

*Occurrence of Abortion*

In the goat industry, abortion adversely affects production, thus reduced kidding rate would lead to economic losses. From the survey abortion occurrences were detected during early and late stages of pregnancy, but found to be likely rare circumstances either in intensive or semi-intensive farm systems ($P$>0.05; Table 6), although Mauldin (2015) suggested that abortion in goats commonly occurs at about 2 mo prior to birth. Seabo et al. (1996) stated that better farm management also contributes to pregnancy success and nutritional control at particular period of pregnancy is needed to sustain embryonic growth and development (Mellado et al., 2004; Mellado and Garcia, 2014).

Table 6. Frequency and percentage of abortion occurrences of Boer goats during early and late pregnancy in intensive and semi-intensive farm systems

| Farm system | Stage of abortion | Frequency of abortion* | | | | | $X^2$ value | $P$ value |
|---|---|---|---|---|---|---|---|---|
| | | Never | Rarely | Sometime | Frequent | Always | | |
| Intensive | Early pregnancy | 17 (27.9) | 28 (45.9) | 11 (18.0) | 5 (8.2) | 0 | 7.57 | 0.11 |
| | Late pregnancy | 16 (26.2) | 27 (44.3) | 6 (9.8) | 10 (16.4) | 2 (3.3) | | |
| Semi-intensive | Early pregnancy | 20 (32.2) | 20 (32.2) | 11 (17.7) | 5 (8.1) | 6 (9.7) | 2.21 | 0.7 |
| | Late pregnancy | 21 (33.9) | 21 (33.9) | 7 (11.3) | 9 (14.5) | 4 (6.5) | | |

* Frequency of abortion occurrence based on the number of goat producers responded from questionnaire-survey

## Conclusion

Results from the surveys showed that most farmers either rearing goats in intensive or semi-intensive farm system, used a variety of animal feeds, perhaps to meet their annual kidding target. However, this practice is unlikely to affect the reproductive performance of Boer goats, mainly abortion frequency and kidding rate. Better feeding management and nutritional control such as additional feed supplements to the animals at crucial reproductive stage would be able to improve reproductive performance, thus increase farm production. More research should be conducted to design a detailed feeding supplementation practice to increase reproductive performance and productivity of goats.

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## References

Abebe, G. 2008. Reproduction in sheep and goats. In: A. Yami and R.C. Merkel (eds). Sheep and Goat Production Handbook for Ethiopia. Ethiopia Sheep and Goat Productivity Improvement Program (ESGPIP). 2008 pp. 59-79.

Alimon, A.R. 1990. Penternakan Kambing. Dewan Bahasa dan Pustaka, Kuala Lumpur, Malaysia.

Ariff, O.M., Sharifah, N.Y. and Hafidz, A.W. 2015. Status of beef industry of Malaysia. Mal. J. Anim. Sci. 18(2): 1-21.

Arineitwe, I. and Ndyomugyenyi, E.K. 2013. Boer goat production in Kikatsi Sub County, Kuruhura District, Uganda. Livestock Research for Rural Development 25(6). Accessed September 2016 from http://www.lrrd.org/lrrd25/6/arin25110.htm

Aziz, J.A. 2007. Wealth creation through livestock production. In: Proceedings of the 19th Veterinary Association Malaysia Congress. 2007 pp. 1-3.

Baumont, R., Prache, S., Meuret, M. and Morand-Fehr, P. 2000. A review: How forage characteristics influence behaviour and intake in small ruminants. Livestock Prod. Sci. 64: 15-28.

Blache, D. and Martin, G.B. 2009. Focus feeding to improve reproductive performance in male and female sheep and goats: how it works and strategies for using it. In: Papachristou, T.G., Parissi, Z.M., Ben Salem, H., and Morand-Fehr, P. (eds). Nutritional and foraging ecology of sheep and goats. Zaragoza: CIHEAM / FAO / NAGREF. 2009 pp. 351-364.

Bredon, R.M. and Horrell, C.R. 1961. Selective consumption by stall fed cattle and its influence on the results of a digestibility trial. Trop. Agric. Trin. 38: 304-397.

Chah, J.M., Obi, U.P. and Ndofor-Foleng, H.M. 2013. Management practices and perceived training needs of small ruminant farmers in Anambra State, Nigeria. African J. Agri. Res. 8(22): 2713-2721.

Ching, J. and Saad, M.Z., 2010. Reproductive performance of Boer goats imported from Australia. 5th Proceedings of the Seminar in Veterinary Sciences, 5-8 January 2010 (pp. 113). Retrieved at http://psasir.upm.edu.my/31423/1/Proceedings-56.pdf

De Santiago-Miramontes, M.A., Rivas-Munoz, R., Munoz-Gutierrez, M., Malpaux, B., Scaramuzzi, R.J. and Delgadillo, J.A. 2008. The ovulation rate in anoestrous female goats managed under grazing conditions and exposed to the male effect is increased by nutritional supplementation. Anim. Reprod. Sci. 105: 409-416.

Devendra, C. 1989. Nutrition of and Feeding Strategies for Sheep in Asia. Philippine Council for Agriculture, Forestry and Natural Resources Research and Development; International Development Research Centre. Sheep Production in Asia: Proceedings of the Workshop on Sheep Production in Asia, PCARRD, Los Barfos, Laguna, April 18-23, 1988. C. Devendra and P.S. Faylon (eds.), Los Banos, Laguna: PCARRD and IDRC, 1989. (Book Ser. No. 80/1989). 1989 pp. 21-42.

DVS. 2013. Malaysian livestock breeding policy. Department of Veterinary Services, 2013. Accessed July 2016 from http://www.dvs.gov.my/documents/10157

DVS. 2014. Livestock statistics. Department of Veterinary Services, 2014. Accessed August 2014 from http://www.dvs.gov.my/statistik

Jabatan Penerangan Malaysia, 2016. Rancangan Malaysia Kesembilan. Accessed October 2016 from http://pmr.penerangan.gov.my/index.php/ekonomi/1354-rancangan-malaysia-kesembilan.html

Joshi, A., Vema, P.K., Kumar, S., Maurya, V.P., Gulyani, R. and Mittal, l.P. 2005. Survey on reproductive status and management of Marwari goats in farmer flock of arid region of Rajanstan. Indian J. Anim. Prod. Mgmt. 21(4): 113-115.

Lu, C.D. 2002. Boer goat production: Progress and perspective. http://hilo.hawaii.edu/uhh/vcaa/documents /boergoatproductionprogressandperspective2002.pdf

Malan, S.W. 2000. The improved Boer goat. Small Rumin. Res. 36(2): 165-170.

Martin, G.B. and Kadokawa, H. 2006. "Clean, green and ethical" animal production. Case study: Reproductive efficiency in small ruminants. J. Reprod. Dev. 52: 145-152.

Martin, G.B., Rodger, J. and Blache, D. 2004. Nutritional and environment effects on reproduction in small ruminants. Reprod. Fertil. Dev. 16: 491-501.

Mauldin, J. 2015. Causes of Abortions in Goats. http://www.jackmauldin.com/abortion. html. Accessed June 6, 2015.

Mellado, M. and Garcia, J.E. 2014. Effects of abortion and stage of lactation on chemical composition and mineral content of goat milk from mixed-breed goat on rangeland. APCBEE Procedia 8:1-5.

Mellado, M., Valdez, R., Lara, L.L. and Garcia, J.E. 2004. Risk factors for conception, abortion, and kidding rates of goats under extensive conditions. Small Rumin. Res. 55: 191-198.

Metawi, H.R. 2011. Economic sustainability of goat production under different production systems in Egypt. In: A. Bernues, J. P. Boutonnet, I. Casasus, M. Chentouf, D. Gabina, M. Joy, A. Lopez-Francos, P. Morand-Fehr and F. Pacheco (eds). Economic, social and environmental sustainability in sheep and goat production systems. Zaragoza: CIHEAM / FAO / CITA-DGA. 2011 pp. 185-190.

Mohd Khusahry, M.Y. 1984. The Problems of Goat Production in Malaysia. In J.W, Copland (ed). Goat production and research in the tropics: Proceedings of a workshop held at the University of Queensland, Brisbane, Australia, 6-8 February 1984. AClAR Proceedings Series No. 7, p. 118, pp. 4-14.

Norhazirah, A.H., Shohaimi, S., Nulit, R. and Shikh Maidin, M. 2014. Feed intake and kidding rate of goats under intensive and semi-intensive management systems in Peninsular Malaysia. In: C.S.Y. Yong, M. Shikh Maidin, G. Annavi, and W.H. Wan Ibrahim (eds). Malaysian International Biological Symposium, 28-29 October 2014 in Putrajaya, Malaysia. 2014 pp. 148.

Parr, R.A., Davis, I.F., Fairclough, R.J. and Miles, M.A. 1987. Overfeeding during early pregnancy reduces peripheral progesterone concentration and pregnancy rate in sheep. J. Reprod. Fertil. 80: 317-320.

Parr, R.A. 1992. Nutrition-progesterone interaction during early pregnancy in sheep. Reprod. Fertil. Dev. 4: 297-300.

Patel, A.K., Mathur, B.K. and Kaushish, S.K., 2005. Kidding performance of arid goat breeds under different management systems. Indian J. Small Rumin. 11(2): 140-144.

Salem, H.B. 2010. Nutritional management to improve sheep and goat performances in semi-arid regions. Revista Brasileira de Zootecnia 39: 337-347. http://dx.doi.org/10.1590/S1516-35982010001300037

Seabo, D., Aganga, A.A. and Mosienyane, M. 1996. Reproductive performance of Tswana ewes and Boer does in south-eastern Botswana. In: Proceedings of the Third Biennial Conference of the African Small Ruminant Research Network, UICC, Kampala, Uganda. Small Ruminant Research and Development in Africa. ILRI (International Livestock Research Institute) Nairobi, Kenya. 1996 pp. 293-295. https://books.google.com/books?isbn=9291460117. Accessed June 23, 2016.

Shikh Maidin, M., Blackberry, M.A., Milton J.T.B., Hawken P.A.R. and Martin, G.B. 2014. Nutritional supplements, leptin, insulin and progesterone in female Australian Cashmere goats. APCBEE Procedia 8: 299-304.

Shikh Maidin, M., Chadwick, A., Khaiseb, P.C., Hawken, P.A. and Martin G.B. 2008. Reproductive performance of Australia Cashmere goats supplemented with lupin grain. Reprod. Fertil. Dev. (Suppl.) 20: 42-42.

Scaramuzzi, R.J., Campbell, B.K., Downing, J.A., Kendall, N.R., Khalid, M., Munoz-Gutierrez, M. and Somchit, A. 2006. A review on the effects of supplementary nutrition in the ewe on the concentration of reproductive and metabolic hormones and the mechanisms that regulate folliculogenesis and ovulation rate. Reprod. Nut. Dev. 46: 339-354.

Zarazaga, L.A., Guzman, J.L., Domìnguez, C., Perez, M.C., and Prieto, R. 2009. Effects of season and feeding level on reproductive activity and semen quality in Payoya buck goats. Theriogenology. 71: 1316-1325.