Boer Goat Production: Progress and Perspective

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Introduction

Boer goat (*Capra hircus)* is considered to be one of the most desirable goat breeds for meat production. It has gained worldwide recognition for excellent body conformation, fast growing rate and good carcass quality. It's popularity as a meat goat breed soared during the last decade due to its availability in Australia, New Zealand and later in North America and other parts of the world. It has been demonstrated that Boer goats can improve productive performance of many indigenous breeds through cross breeding. It has a strong impact on the meat goat industry globally.

Although the exact origin of Boer goats is not clear, it is believed to be the result of a genetic pooling of African indigenous goats, Indians goats, Angora goats, and with some influence of European dairy goats. It resembles Nubian goats but with a much larger frame size. Several researchers agree that the indigenous populations were probably from the Namaqua Hottentots and from southward migrating Bantu tribes. The present day Boer goats appeared in the early 1900's when Eastern Cape ranchers started the selection of a meat type goat. The name is derived from the Dutch word "boer" meaning farmer.

There are five types of Boer goats recognized in South Africa according to South African Boer Goat Breeders' Association (http://studbook.co.za/boergoat/stand.html). The *ordinary Boer goats* are animals with good meat conformation, short hair and a variety of color patterns. The *long hair Boer goats* have heavy coats and coarse meats. The *polled Boer goats* are hornless with a less desirable confirmation. The *indigenous Boer goats* have long legs, variable and poor conformation and a variety of color patterns. The *improved Boer goats* are the primary line which breeders have been selected for.

The breed standards were first established when South African Boer Goat Breeders' Association was formed in 1959. The breed standards for the improved Boer goats include conformation, head, neck and forequarters, barrel, hindquarters, legs, skin and coverings, sexual organs, size, coloring, tail, general appearance and type, and fertility (http://studbook.co.za/boergoat/stand.html). The breed standards for Boer Goat Breeders' Association of Australia include: descended from animals exported from Africa as fullblood Boer goats, structurally sound, able to graze and breed naturally, no physical abnormality, conformation (mouth, jaw, leg, and knee), and reproductive organs (http://boergoat.une.edu.au/main.htm). Breed standards of American Boer Goat Association are similar to those of South African Boer Goat Breeders' Association and include conformation, skin and covering, reproductive organs and coloration (http://www.adga.org/breedinfo.html).

Performance testing of Boer goats started in 1970 under South African Mutton and Goat Performance and Progeny Testing Scheme (Casey and Van Niekerk, 1988). Five phases of determination: doe's characteristics, milk production, preweaning growth rate; postweaning growth rate; efficiency of feed conversion and body weight of male kids; postweaning growth rate of male kids under standardized conditions; qualitative and quantitative carcass evaluation of buck's progeny; are included in the testing. Combination of breed standards and performance testing is likely to be the better approach for the effective selection and improvement of Boer goats.

Body Weight and Growth Rate

Among all superior traits for goat meat production, heavier body weight and faster growing rate are the most notable. Birth weight of Boer kids ranges from 3 to 4 kg with male kids weighing about 0.5 kg heavier than female (Figure 1). Kids at weaning can weigh from 20 to 25 kg, depending on weaning methods and age (Lu and Potcoiba, 1988). At 7 month of age, bucks weigh about 40 to 50 kg while doelings weigh about 35 to 45 kg. At yearling, bucks weigh 50 to 70 kg and doelings weigh 45 to 65 kg. Mature weights for bucks and does are 90-130 kg and 80-100 kg, respectively. These body weights measurements can be variable because of influences of genetics, nutrition, health and disease, breeding age and method, and management system.

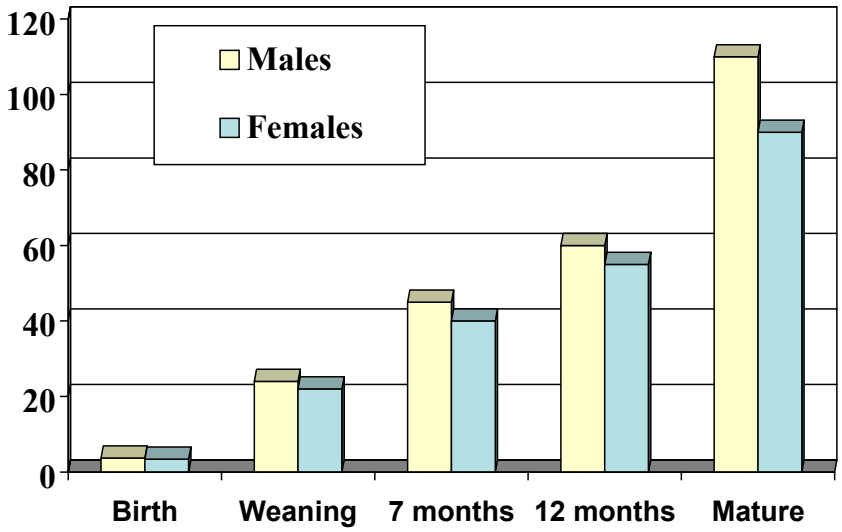

Figure 1. Body weight (kg) of male and female Boer goats at various ages

Boer goats are known to have a fast growing rate compared to other goat breeds. Growth rate of the first 12 months can be 200 g/day under good pastoral conditions. Average growth rates were recorded as 291, 272, 245, and 250 g/day from birth to 100, 150, 210, and 270 day of age in male goats, respectively (Campbell, 1977; unpublished data as cited in Van Niekerk and Casey, 1988). The corresponding rates were 272, 240, 204, and 186 g/day in female goats. It is not always objective to relate growth rate with age. Weaning methods, weaning stress and compensatory

growth can affect growth rate (Lu and Potchoiba, 1988). One example is that growth rate of Boer kids can be substantially reduced by the adaptation in the confinement alone (Van Niekerk and Casey, 1988). The average daily gain was 62, 139, 182, and 194 g for birth - 10 kg, 10 - 23 kg, 23 - 32 kg, and 32 – 41 kg body weight, respectively (Figure 2). Average daily gains were 240, 238, and 218 g/day for single, twin and triplets Boer kids raised in Namibia, respectively (Barry and Godke, 1997). The corresponding rates in Germany were 257, 193, and 182 g/day. Post weaning growth can be in excess of 250 g/day for Boer goats under extreme favorable conditions. This is substantially higher than dairy goats during birth to weaning, 125-150 g/day, and during 4 to 8 months of age, 115 g/day (Lu and Potchoiba, 1988 and 1990). Faster growing rate implies that Boer goats can potentially reach marketing weight earlier. However, it must also consider desirable carcass quality to capture maximum market return. Another important implication of faster growing rate is that Boer goats can reach breeding weight earlier. Continuous improvement in genetic selection, feeding method, and management system may contribute to even a faster growing rate in Boer goats as well as their crosses in the future.

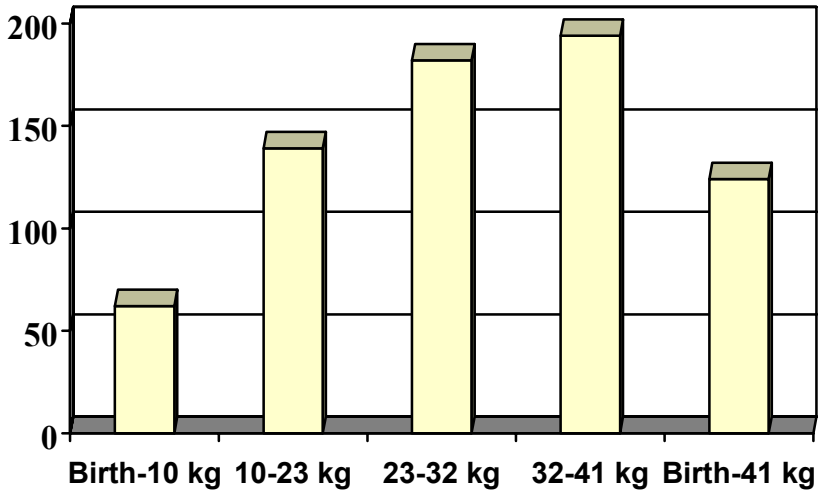

Figure 2. Growth rate (g/day) of Boer goats from birth to 41 kg body weight under confinement (Van Niekerk and Casey, 1988)

Breeding, reproduction and lactation

Unlike most of the goat breeds, Boer goats are partially seasonal breeders. Anestrus does not occur and Boer does will cycle virtually year-round if favorable rearing conditions are provided. Boer does cycle every 18 to 21 days. About 17% does cycles shorter than 13 days and 10% cycles longer than 25 days (Greyling, 1990). The mean length of estrus is 37.4 hours. Mean gestation length is approximately 148 days. Does with multiple births tend to have shorter gestation length with 1 to 2 days difference among twins and triplets. Postpartum anestrus ranges from 37 days during the kidding season to 60 days outside of kidding season (Greyling and van Niekerk, 1986). First cyclic activity postpartum can be as early as 20 days. In the southern hemisphere, sexual activity peaks during April and May when the daylight length is shortening. During October to January Boer goats are least sexually active. In the north

hemisphere, sexual activity peaks during autumn months and declines in the spring and summer. Seasonal supply of goat meat has been a major constrain for the development of a reliable and consistent market. Being polyestrous, Boer goats can be a possible solution to overcome the seasonality of meat goat market. One of the negative effects of continuous breeding all year round is that underdeveloped replacement doelings can be subjected to the buck.

Prolificacy is another major distinction of Boer goats. Average litter size is close to 2. About 50% of does produce twins and another 10 to 15% produce triplets. In certain instances close to 60% of does produced twins (Campbell, 1984). Estrus synchronization, artificial insemination and embryo transfer have been demonstrated successfully in Boer goats. In a recent study that a higher percentage (87.5%) of the indigenous goats responded to superovulation, compared to the Boer goats donors (50%) was reported (Greyling and van der Nest, 2000). Boer goats were found to produce higher quality embryos with longer induced estrous period in recipients and higher number of ovulations (17.5 vs.14.6) in donors (Figure 3). It has been demonstrated that undernutrition (4% CP) reduced scrotal circumference, testicular volume, sperm concentration and increased sperm abnormality in Boer goats (Schwalbach et al., 2000). In addition to prolificacy these technologies can and will speed up improvement through breeding.

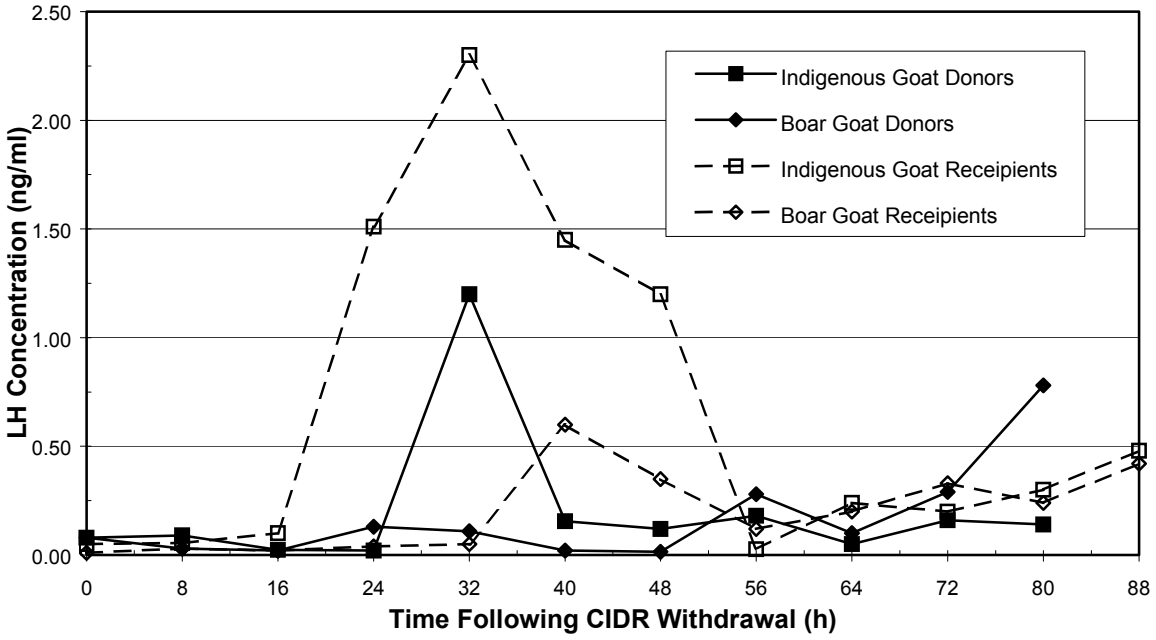

Figure 3. Serum luteinizing hormone (LH) concentration following intravaginal progesterone treatment in Boer and indigenous goats (Greyling and van der Nest, 2000)

Boer goat female kids can reach puberty at 6 months of age and are considered as early breeders. Male kids can be used for breeding at 5 to 6 months of age but can reach puberty or reach a body weight of 32 kg as early as 3 to 4 months of age. The number of does bred to a

buck ranges from 15 at 6 months of age to 25 at 8 months of age or at maturity. Breeding occurs at young age results in growth retardation. Breeding by weight can be a safe alternative.

Milk production in Boer goats is generally considered adequate for rearing multiple kids. Little difference in growth rate at weaning was reported between single and multiple births. Lactation length is shorter for meat breeds compared to dairy breeds. And milk solids are generally higher in meat breeds. Milk production during the first 12 week of lactation ranged from 1.8 to 2.5 kg/day in Boer goats (Ratts et al., 1983). Milk fat (6.4 to 9.4 %), protein (3.9 to 4.5 %), and lactose (4.6 to 4.9 %) contents were also reported. It led to the conclusion that milk fat content in Boer goats were twice of that observed in dairy goats. However, in a more recent study, milk yield ranged from 1.91 to 2.32 kg/d, fat from 3.4 to 4.6 %, protein from 3.7 to 4.7 %, lactose from 5.2 to 5.4 %, and somatic cell count from 4.8 to 9.6 x 10^5 during the first 8 weeks of lactation (Tambajong et al., 2000) (Figure 4). It seems that the milk fat content is higher in Boer goats. But it should not be surprising given the fact that no real peak was observed in milk yield during the course of study. In general, milk yield peaks at 6 to 8 weeks postpartum in lactating dairy goats (Lu, 1989). With the exception of lactose content, milk fat and protein tended to decrease over the 8 weeks period. Concentration of these two components are expected to increase when milk yield is decreased at later stages of lactation.

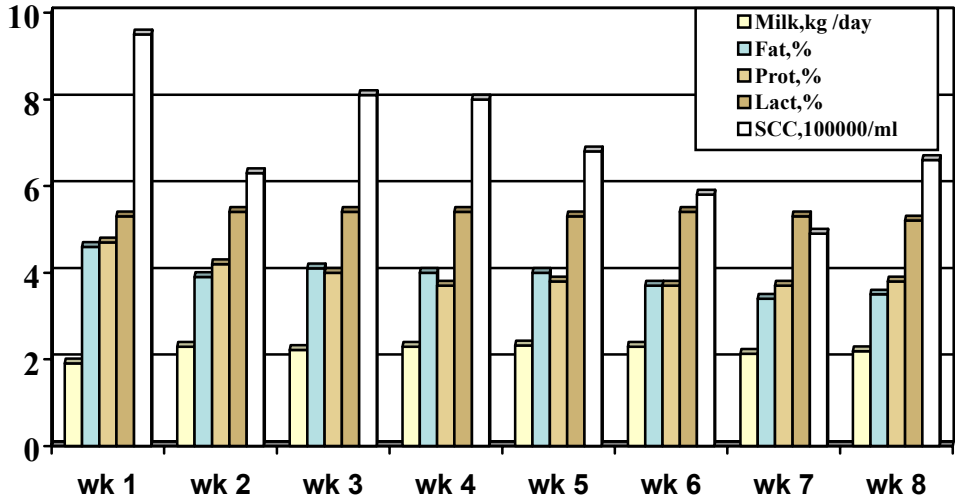

Figure 4. Milk yield and composition of Boer Goats during the first 8 weeks of lactation (Tambajong et al., 2000)

Cross breeding of Boer Goats

Because of their desirable genetic traits for meat production, Boer goats have successfully improved productive performance of indigenous breeds through cross breeding. Most notable improvement include birth weight, growth weight, weaning weight, breeding weight, mature weight, kidding rate, carcass quality (Haas, 1978; Brown and Machen, 1997; Waldron et al., 1997; Cameron et al., 2001).

Boer and Spanish crosses were reported to have higher dry matter intake, average daily gain than Spanish goats (Cameron et al., 2001). During the 15 week trail from post weaning to 24 weeks of age, average daily gain was increased by 30% through the cross breeding between Boer and Spanish goats, but the 154 g/day gain was below the 200 g/day normally observed in Boer goats (Table 1). Dry matter intake was also higher in Boer and Spanish cross. Feed efficiency, average daily gain/dry matter intake, was higher in Boer and Spanish cross. In another study, birth weight, weaning weight and average daily gain were improved by crossing Spanish, Nubian, or Angora with Boer goats (Brown and Machen, 1995?).

Table 1. Growing performance of Boer x Spanish, and Boer x Angora wethers consuming a concentrate-based diet (Cameron et al., 2001)

	Genotype		
Item	Boer x Spanish	Spanish	Boer x Angora
Body weight, kg	24.4	19.5	25.2
Average daily gain, g/d	154	117	161
ADG:DMI, g/kg	263	235	261

Feeding of high protein diets does not increase the rate of gain in Boer and Spanish cross goats (Prieto et al., 2000). As expected, the average daily gain and feed efficiency were increased by the cross breeding (Table 2). But feeding diets containing 18 and 24% crude protein did not improve weight gain and feed efficiency. The results implied that over nutrition might not increase economic return for Boer crosses.

Table 2. Effects of dietary protein concentration on DMI, ADG, and ADG:DMI ratio of crossbred Boer (3/4) x Spanish (1/4) and Spanish goat wethers (Prieto et al., 2000)

	BC[a]				SP[b]			
Item and weeks	10[c]	14	18	24	10	14	18	26
DMI, g/d	693	734	665	783	770	691	731	697
ADG, g	79	106	89	115	73	74	81	85
ADG:DMI, g/kg	118	144	133	143	95	107	110	122

[a]BC, Boer(3/4) x Spanish (1/4). [b]SP, Spanish. [c]Average dietary crude protein , %.

Cross breeding with Boer goats improved breeding weight and fertility in Spanish goats (Waldron et al., 1997). Cross breeding with Boer goats increased birth weight, growth rate, and mature weight in cashmere goats (Newman and Paterson, 1997). Fiber production and fleece weight were not different among Boer, Boer x cashmere and cashmere goats.

Grazing behavior, adaptability and disease resistance

Goats possess characteristics including versatility in harvesting forage and ability to survive under adverse foraging conditions that set them apart from other livestock species (Lu, 1988). Boer goats, with limited available information, seem to possess these characteristics. They were reported to be browser and preferred a diet dominated by browse (Viljoen, 1980). Their diets consisted of 82% browse and 18 % grass. A study conducted in Namibia indicated that Boer goats consumed 74% leaves and 26% grass (http://studbook.co.za/boergoat/value.html). Tolerance of goats toward bitterness plays an important role in maximizing grazing capacity and in biological control of weeds (Lu, 1988). Unlike sheep, Boer goats do not dig out the roots under harsh grazing condition. These characteristics make them excellent candidates for mixed grazing with cattle and sheep. Boer goats are also known to be successful in biological control of weeds.

Boer goats are known to travel long distance for food and water. Apparently their long and sturdy legs are beneficial for this survival character. In general, goats have heat resistant characteristics and less susceptible to heat stress than their livestock counterparts (Lu, 1989). There is no reason to believe that Boer goats will be the exception. Adaptability of Boer goats has been reviewed (Casey and Van Niekerk, 1988). The list includes drought resistance, tolerance of tannins, efficient fiber digestion, adartation to various ambient temperature, and lower water turn over rate.

Limited information is available regarding disease resistance of Boer goats. Because of their grazing habit, Boer goats are considered less susceptible to contamination by internal parasites (Barry and Godke, www.boergoats.com). They are thought to have exceptional ability to withstand and resist diseases such as blue tongue, prussic acid poisoning, and enterotoxemia (http://studbook.co.za/boergoat/value.html).

Boer goats are reported to have superior adrenal function and are able to maintain higher cortisol production than Angora goats (Engelbrecht and Swart, 2000). Their stress coping mechanism is equivalent to that of Merino sheep, a hardy breed. Secretion of cortisol by the adrenal cortex is essential for the induction of several gluconeogenic enzymes that enable animals to survive stressful conditions. Stress stimulates the release of corticotropin-release factor (CRF) from the hypothalamus, and CRF stimulates ACTH secretion from the anterior pituitary. The ACTH promotes the secretion of glucocoticoids from the adrenal cortex, which favor glucose production at the expense of glycolysis. Engelbrecht et al (2000) reported that cortisol production was higher in Boer goats and Merino sheep than Angora goats when intravenous injection of insulin, CRF and ACTH was conducted (Figure 5). The ability to produce higher amount of cortisol in as a result of stress may partially explain the superiority of adaptation in Boer goats.

Economic consideration

The unusual high price for Boer breeding stocks is not surprising. This is the result of supply and demand imbalance. As the supply increases, the price will fall to a more reasonable and affordable range for serious goat producers. Superovulation and embryo transfer should be

able to contribute to a faster pace of genetic improvement and a more reasonable and affordable price. The value of Boer goats should always be based on their ability to produce meat with superior carcass quality. Conformation alone will not guarantee a profitable return. Although a premium can be received by a genetically superior buck, it is the expected income from meat and carcass sales that pays the bill.

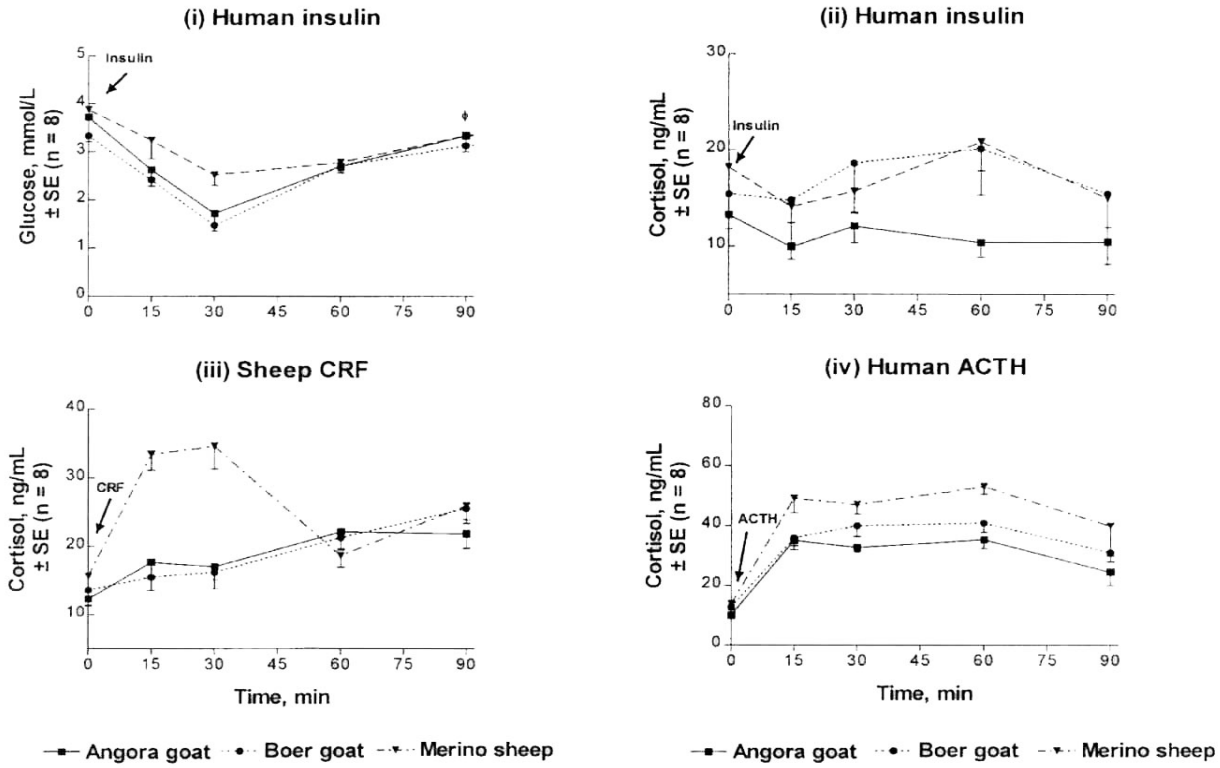

Figure 5. The effect of an intravenous injection of insulin, corticotropin-release factor, and ACTH on plasma glucose and cortisol concentrations in Angora goats, Boer goats and Merino sheep (Engelbrecht et al., 2000)

For a spring kidding program, the production entity must consider the cost of animal purchasing, grain and hay, salt and minerals, veterinary and medications, buildings and fences, marketing and transportation, vehicle, fuel, utilities, and operating capital interest. The income from the sales of kids and cull does must be able to cover the expenses. For a growing program for early-weaned kids, the expenses include milk, feed, pasture costs, veterinary and medication, facility and equipment, marketing and transportation, operating capital interest, and miscellaneous costs. The sole income of selling the kids for meat market must be able to cover the expenses. The costs: feed, death loss, veterinary and medication, salt and minerals, equipment, fuel, buck cost, marketing, taxes, interest on does and replacement; and returns: kid sold and goat culled; should be estimated on a per meat doe basis. Budget for various operation objectives must be prepared to ensure the economic return of the meat goat operation. This is especially important when larger then usual expense in incurred to access the Boer goat breeding stocks. Table 3 illustrates the importance of a successful kidding season. The profit can be quadrupled when kidding rate is doubled.

Table 3. Estimated returns to land, labor, and management at various kidding rates per doe.

	Percentage of Kids Marketed					
	75	100	125	150	175	200
Value of kids	$16.50	$22.00	$27.50	$33.00	$38.50	$44.00
Value of aged goats	2.50	2.50	2.50	2.50	2.50	2.50
Subtotal	$19.00	$24.50	$30.00	$35.50	$41.00	$46.00
Minus estimated costs	18.20	18.20	18.20	18.20	18.20	18.20
Returns to land, labor, and management	$0.80	$6.30	$11.80	$17.30	$22.80	$28.30

Note: All cost and income estimate are based on data taken from the *The Extension Goat Handbook,* Texas Agriculture Extension Service, College Station, Texas.

Source: Pennsylvania State University

Summary

Boer goats have gained worldwide recognition for excellent body conformation, fast growing rate and good carcass quality. It's popularity as a meat goat breed soared during the last decade due to its availability in Australia, New Zealand and later in North America and other parts of the world. Combination of breed standards and performance testing is likely to be the better approach for the effective selection and improvement of Boer goats. Among all superior traits for goat meat production, heavier body weight and faster growing rate are the most notable. Prolificacy is another major distinction of Boer goats. Average litter size is close to 2. Because of their desirable genetic traits for meat production, Boer goats have successfully improved productive performance of indigenous breeds through cross breeding. Most notable improvement include birth weight, growth weight, weaning weight, breeding weight, mature weight, kidding rate, carcass quality. Feeding of high protein diets does not increase the rate of gain in Boer and Spanish cross goats. Goats possess characteristics including versatility in harvesting forage and ability to survive under adverse foraging conditions that set them apart from other livestock species. Boer goats, with limited available information, seem to possess these characteristics. Boer goats are reported to have superior adrenal function and are able to maintain higher cortisol production than Angora goats. Their stress coping mechanism is equivalent to that of Merino sheep, a hardy breed. The unusual high price for Boer breeding stocks is not surprising. This is the result of supply and demand imbalance. As the supply increases, the price will fall to a more reasonable and affordable range for serious goat producers. The value of Boer goats should always be based on their ability to produce meat with superior carcass quality.

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