The Effect of Upgrading Indigenous Goat Breeds with German Alpine on Milk Yields at Manyatta Division of Embu County

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Abstract

Crossbreeding between exotic improved goats and indigenous breeds has brought about genetic improvement resulting in a faster growth rate and more milk production. A study was carried out with the objectives of demonstrating the milk production in F_1, F_2, F_3, and F_4 cross-bred goats and to determine the breeding level that is suitable for milk production at the farm level at Manyatta division, Embu County. *Farm records from 24 farmers, distributed into four dairy goats keeping groups (blocks) on milk production was collected from 81 goats of F_1, F_2, F_3, and F_4 generations. The average flock size was 8.8 goats per farmer but ranged between 4-20 goats. A large proportion of 90.7% of the respondents kept goats for milk production. Milk yield data were analyzed using analysis of covariance, analysis of variance, and mean separated using least significant difference. Standard management practices were evident with little variation in feeding, health management, and other husbandry practices between farmer groups. The average milk production was 2.4, 3.6, 4.6, and 5.9 litres for F_1, F_2, F_3, and F_4, respectively. The mean milk yield differed significantly between different filial generations and increased with upgrading. Filial generations and blocks were significant, hence different mean milk production in each filial. Factors such as filial age at first kidding and filial age had no significant influence/effect on milk production. There were no interactions between blocks and filial generation. This meant that the blocks and filial generation are independent of each other. Goats at F_4 generation of breeding performed better in milk production and lactation length than those in F_1, F_2, and F_3 and therefore are recommended as the most suitable filial for milk production in Manyatta, Embu County.*

Keywords: Goats, Filial, milk yield

INTRODUCTION

Tropical Africa is an essential area of goat production, with one-third of the world's goat population. Goats have become popular in recent years as a pathway out of poverty (Ahuya *et al.*, 2004) due to its critical socio-economic role through meat, milk, and skin production. They require small land area, a few facilities to manage, provide milk to households, reproduce rapidly for quick returns to investment, easy to sell for emergencies to meet family needs, and are an attractive venture for women and youth groups. Their milk supply families, who own them with better quality daily dietary intakes, improve their health status of members with low immune systems, as is the case among children, the elderly, and HIV/AIDS patients. Improved milk production will economically empower the farmer leading to better livelihoods and contribute positively to the national economy. However, these can be achieved when more biologically efficient and adaptable goat genotypes are kept under sustainable feed resource management and improved husbandry practices (Winrock International 1992; FARM-Africa 1996).

The Government of Kenya partnered with GTZ and Farm Africa to introduce dairy goat upgrading programs in medium to high potential areas. It encouraged farmers to upgrade their indigenous goats using exotic temperate types, particularly German Alpine, British Alpine, Toggenburg, and Saanen. The focus for upgrading was to improve milk production in both Kenya and the Eastern Africa region (Ahuya and Houston, 1997; Gichohi, 1998; Ayalew *et al*., 2003). Alpine dairy goats have the potential of producing up to four litres of milk in a day when reared under proper management (Devendra et al., 1982; Hetherington 1996). Špehar et al. (2019), noted an alpine dairy goat average milk production of 2.3kgs per day.

More work on improved goat genotype has been carried out by GTZ and Farm-Africa supported projects which are based on participatory farmer approaches. Genetic improvement must go hand in hand with dissemination to realize development in the livestock sector and improve rural livelihoods. Insufficient information on production indicating milk yields in each level of upgrades has led to varying levels of upgrading being recommended.

The benefits that farmers enjoy from upgrading include faster growth rate and more milk production from the cross-bred filials due to the exploitation of the hybrid vigor. Productivity, when applied to livestock, refers to either amount of product or efficiency of production (James and Carles, 1996). In any production system, productivity will be uniquely influenced by complex interactions of environment, biological, and socio-economic variables (Omore, 1998).

(Ahuya *et al.,* 2003) showed that cross-bred goats, both F_1 and ¾ Toggenburg, produced 2.6 and 3.6 litres per day of milk, respectively, compared to 300 milliliters produced by the East African goat.Earlier work done by the Small Ruminant Collaborative Research Support (SR-CRSP) in Kenya showed that goats could produce 5.5 litres with little supplementation, while East Africa goat produced 100ml per day (Ruvuna *et al.*, 1988).

A monitoring and evaluation exercise (Dairy Goats Association of Kenya of 1998) found that milk yields from F_1 and F_2 generations realized from cross breeding German alpine buck and indigenous goats were 1.5 and 1.7 litres per day, respectively, after feeding the kids.

Goats of F_3 generation, a cross breed from German alpine buck and an F_2 generation doe have been reported to produce 3-4 litres of milk per day (DLPO 2007, 2008). Cross-bred goats can produce 2-4 litres of milk daily for 6-8 months under good nutrition, but when upgraded to 75%, Toggenburg doe milk yield can even be higher (KARI, 2005). The success of most breeding improvement programs is dependent on their compatibility with breeding objectives and the involvement of farmers (Kosgey, 2004). The current study demonstrates the comparative milk production of different goat genotypes and makes it easier to estimate or quantify the amount of milk that can be available from farmers for marketing. The main objective of the current study was to determine the suitable breeding level among F_1, F_2, and F_3 and F_4 generation of goats with suitability for milk yield at Manyatta Division.

METHODOLOGY

Study Area

Manyatta Division borders' Central Division to the south, Runyenjes the east, Kirinyaga county to the West and Mt. Kenya forest to the north. The division covers a total area of 111.7 Km2, excluding the Mount Kenya forest, which forms part of Manyatta. The altitude range is between 1400m-1500m above sea level, for lower areas and between 1500m-4500m for upper areas towards the pick of Mt. Kenya. Manyatta division has four Agro-ecological zones, which include LH, LH1, UM1, and UM2, which provide the division with favorable climatic conditions for farming as a business. The rainfall pattern is bimodal and ranges between 1100mm-1800mm per anum.

Data Collection and analysis

Data on milk production in each filial, number of times milked, lactation length, and age at first kidding, were collected from 81 goats, of various genotypes from farm records of participating farmers. These farmers were all members of one of the four self-help groups identified for the study. The farmers' groups are voluntary self-help organization which shares a breeding buck. The buck is housed at the home of one of the group members, which is considered as the buck station, and is used to mate with the does belonging to both members and non-members. The buck is kept at the same buck station mating does for one year and then rotated to another group and a new pure German alpine buck brought to that group to avoid inbreeding. The farmers belong to the Dairy Goat Association of Kenya (DGAK), which is a community-based organization with the responsibility of supervising and coordinating the breeding activities of the improvement program.

The goat genotypes involved in this study were the F_1 generation cross-bred arising from mating the indigenous goats with the German Alpine buck, as well as the F_2, F_3, and F_4 generation crosses obtained from backcrossing F_1, F_2, and F_3 respectively to different and unrelated German Alpine bucks. The cross-bred goats are owned by the farmers, while the pure German Alpine belongs to the Dairy Goat Association of Kenya.

The goats were managed under confinement or zero-grazing and fed on indigenous and established fodder crops in a cut and carry system. The Farmers have been encouraged to establish forages such as Calliandra, Leucaena Sesbania, and Mulberry (*Morus alba*), which are used mainly as supplements. Minerals and water are provided daily. Data were analyzed using both analysis of covariance and analysis of variance, and significant mean separated using least square difference and standard error of means.

RESULTS AND DISCUSSION

The average land size at manyatta location is 2 acres, with a population density of 661 persons per $km^{2,}$ and 87% of the population depend on agriculture for their livelihoods. Those farmers keeping goats had an average flock size of 8.8 goats with a preference for crossbreeds due to their high growth rates, milk yield, and early maturity compared to indigenous goats.

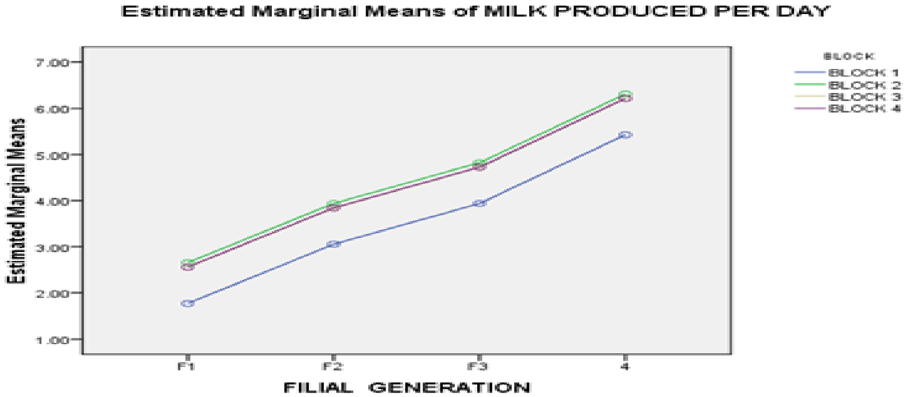

Figure 6: Milk production (kg) trends with purity towards Alpine

The analysis of covariance ruled out any significant effects of age at first kidding and filial age on milk yield among the various genotypes of goats. These factors cannot, therefore, be utilized in any prediction of milk yield at the process of upgrading of indigenous goats using the German alpine dairy goat.

There was a significant ($P \leq 0.05$) difference in milk yield among filials in different blocks. This might be attributed to management differences, particularly the availability of feeds among the farmer groups that participated in the study. There was, however, no meaningful interactions between filial and block.

Figure 1 shows significantly ($P \leq 0.05$) lower milk yield in block 1 but comparably higher but similar yields among blocks two (2), three (3) and four (4). An increase in milk yield with upgrading manifested a similar rate in increase.

Figure 1 shows that there was no interaction between the filial generation and blocks as it was detected earlier during the analysis of covariance. It also highlights the increasing trends of milk production with increasing upgrading from filial generation 1 to filial generation 4. These findings agreed with Nimbkar *et al*. (2011), who reported that crossbreeding indigenous goats with temperate dairy breeds improved goat milk production in the highlands of India. Rewe *et al*. (2006) reported an increase in revenue from milk yield with increasing genetic gains. This author, however, caution on the unavailability of breeding bucks and does due probably to economic considerations in the search and keeping of breeding stock.

Table1 Daily milk yield by filial within blocks (kg)

Filial/block	Block1	Block2	Block3	Block4	mean
F1	1.7	2.8	2.7	2.7	2.5±0.5
F2	3.0	3.8	3.7	3.7	3.6±0.37
F3	3.9	4.9	4.6	4.8	4.6±0.38
F4	5.3	6.3	6.2	6.1	5.9±0.46
mean	3.5±1.5	4.4±1.4	4.3±1.5	4.3±1.4	

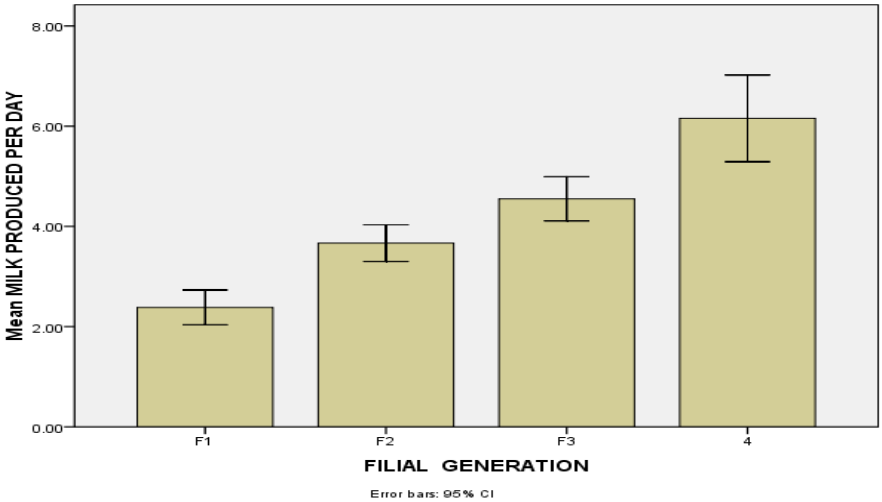

Figure 2: Mean daily milk yield (kg) among filial generations

Figure 2 shows that there was a significant ($P \leq 0.05$) difference in mean daily milk yields (kg) with filial 1 generation producing three times lower amount of milk than Filial 4. Table 1 shows milk production both among filial generations and blocks. The average daily milk yields significantly increased from 2.5 to 3.6 to 4.6, to 5.9 litres in F_1, F_2, F_3, and F_4 respectively, with an average lactation length of 6 months. This shows that, filial generation levels, significantly determines milk yields. The results in the current study are higher than those by Špehar et al. (2019), who noted an average daily milk production of 2.3 kgs in Alpine dairy goats. According to Simm *et al*. (1996), the improvement of livestock through breeding and selection can be rapid when there are large genetic differences between breeds in the trait of economic importance. The environment under which production takes place must, however, be synchronized to suit the exotic genetic resource which was developed under better management for higher production. From records, the study found lactation milk yields to be 432, 652, 828, and 1062 litres for F_1, F_2, F_3, and F_4, respectively. The results are superior especially for F_2, F_3 and F_4 to those found by Crepaldi et al. (1999) of 583kgs in Alpine goats per lactation in a study in Lombardy (Italy).

These milk yields excluded the amount consumed by the kids because the farmers preferred suckling them after morning milking to bucket feeding hence kept records only for what they harvested. The farmers preferred suckling of the kids more because it is less labor-intensive and incidences of diarrhea.

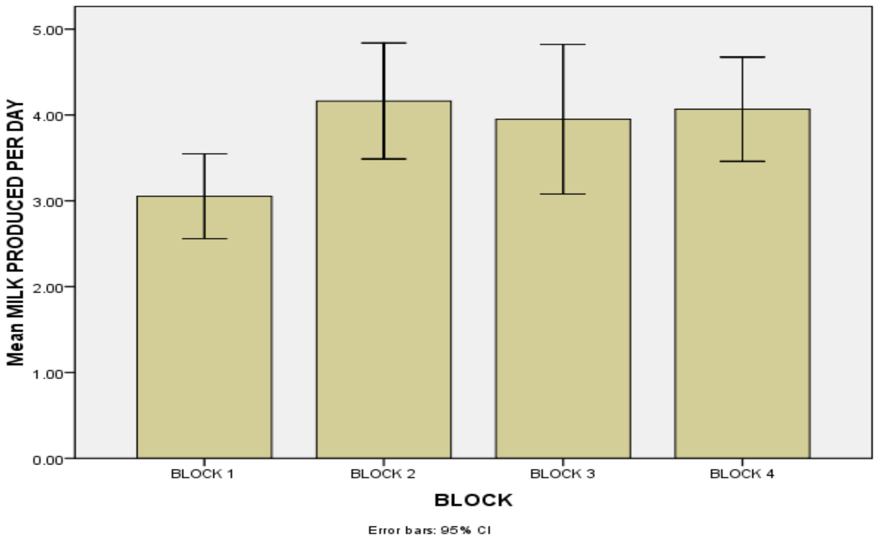

Figure 7: Mean milk yields (kg) among blocks

Figure 3 indicates how block 1 had significantly ($P \leq 0.05$) lower mean milk production compared to blocks two, three, and four, which had similar mean milk yields. At the same time, figure 3 magnifies the different levels at which filial generations-maintained milk yields across blocks. The reason behind the variation is attributed to feeding, as indicated by 5% of the farmers who indicated that they lacked land for fodder production. However, 95% of the farmers in the study region utilize both established high-quality pasture and concentrates in their production systems. The farmers in block one might require some feeding intervention to match the genetic improvement they are undertaking on their goats. A small number (8%) of farmers, particularly from block 1, did not use concentrates due to their high cost.

CONCLUSION

Results from the study indicates that F_4 had a better performance in milk production compared to lower filials and that milk production differs significantly between different filial generations and increases with the increasing upgrading levels. The impact of the upgrading can be attested by the increasing number of cross-bred goats and the harvestable milk currently found in the study area. These milk yields excluded the amount consumed by the kids as farmers preferred suckling them after morning milking to bucket feeding hence determining the amount consumed by the kid was limited.

RECOMMENDATIONS

1. From the study results, the researcher recommends goats at F_4 generation as the most suitable filial to be reared by farmers for the desired milk production.
2. Farmers should practice bucket feeding when feeding kids instead of suckling so that the actual milk yield per goat can be recorded.
3. Development of a simple and easy recording and monitoring system to improve record keeping. This will ensure monitoring of the pedigree performances and ensure the sustainability of the program.

4. The program needs to be duplicated among farmers elsewhere in Kenya and the region, to allow for continued exchange of proven breeding stock without compromising on breeding quality.
5. The researcher recommends a further study that will consider the amount of milk suckled by the kids as a factor determining milk production in the filial upgrades.

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