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Characterisation of productivity and diseases affecting dairy goats in smallholder systems of Greater Thika Region, Kenya

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Abstract

The current cross-sectional study aimed at characterising the productivity and diseases affecting dairy goats kept by smallholder farmers in three sub-counties in Thika Region, Kenya. Standard questionnaires were administered to 240 farmers through face-to-face interviews and the outputs were analysed using descriptive and inferential statistics. The farmers mainly kept crosses of Toggenburg (45.9 %), Kenyan Alpine (29.5 %) and Saanen (17.4 %) dairy goats. The average dairy goat flock size was 4.5 (range 1–23) and 77.5 % of the goats were kept for production of milk for domestic consumption. The average milk production per goat per day was 1.26 litres (range 0.5 to 3.5 litres) and was significantly ($p < 0.05$) associated with sub-county of origin, main occupation of the owner, breed, and lactation stages. Goats were mainly fed on napier grass, maize stovers, natural grass and hay; and these feeds did not influence ($p > 0.05$) the milk production levels. The farmers identified helminthosis (84.6 %), pneumonia (32.9 %), coccidiosis (25.8 %) and mastitis (25 %), as the most prevalent goat diseases. In conclusion, the study showed that dairy goat farming in greater Thika Region was characterised by low-input with an objective of provision of milk for home consumption. The observed challenges of low milk productivity and diseases should be addressed by the local extension workers through training on improved husbandry, nutrition and health management of the dairy goats.

Keywords: Dairy goats, milk production, feed, diseases, small ruminants

1 Introduction

The dairy goat population in Kenya has been increasing gradually from an estimated 6,000 heads 30 years ago to 175,000 countrywide in 2013 (Shivairo *et al*., 2013). In recent years, efforts have been made to improve milk production and growth rate of indigenous goats through crossbreeding with exotic breeds. The main breeds of dairy goats that are currently reared in Kenya include cross-breeds of indigenous breeds and Toggenburg, Alpine, Saneen and Anglo-Nubian (Kosgey *et al*., 2008; Shivairo *et al*., 2013). The introduction of dairy goats has led to increased milk production, hence improved nutrition, income and overall livelihoods of the small-scale farmers (Eik *et al*., 2008; Safari *et al*., 2008).

Among the smallholder mixed crop-livestock farmers, dairy goat rearing is popular as it is regarded as a means of raising income and nutrition standards for the rural poor. The continued increase in human population, loss of grazing land through settlements and food production, and increased demand for milk and milk products, makes it difficult for small-scale farmers to keep cattle for milk production. Therefore, the alternative of high milk yielding livestock especially dairy goats that requires less forage and space per animal is quite interesting. Further, as goats have smaller body sizes, high prolificacy and shorter inter-generation periods as compared to the large ruminants, it is much easier for farmers to destock and restock quickly (Richardson, 2004).

In spite of the growth of goat farming in some parts of the country, only a few studies have documented the characteristics of the farming systems and the challenges faced

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by the farmers (Kipserem *et al*., 2011; Shivairo *et al*., 2013). The challenges which have been noted included high cost of feeds, labour inputs, diminishing land units, diseases, increased disease control costs, low milk yield and infertility (Kipserem *et al*., 2011). These studies have focused on areas such as Meru and Nyeri Counties in Central Kenya where non-governmental organisations have been operating cross breeding programmes (Kosgey *et al*., 2008). However, in other areas such as Thika region where farmers are adopting dairy goat farming without proper technical guidance, very little is documented on the productivity and challenges faced by the farmers.

The current study aimed at characterising the dairy goat farming, and the health and production challenges impact on the dairy goat productivity in the greater Thika region. This will create a basis for justifying interventions aimed at making the dairy goat enterprise sustainable. Results generated in the current study will act as a database source to increase productivity of dairy goats in the study area.

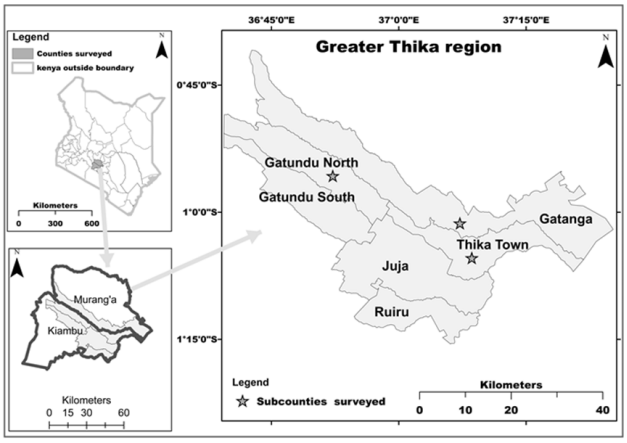

Fig. 1: *Map of Thika region showing the various sub-counties (Thika Town, Gatundu North and Gatanga) in the study area (source: Extracted and overlayed layers of data from Centre for Humanitarian data (data.humdata.org) using QGIS version 3.14.16))*

2 Materials and methods

2.1 Study area description

The Greater Thika region comprises of the Ruiru, Thika West, Thika East, Gatanga, Gatundu North and Gatundu South sub-counties. This region covers an area of 1960.2 square kilometers, bordering Nairobi city to the south (Fig 1). It lies between latitudes 3° 53' and 1° 45' South of the Equator and longitudes 36° 35' and 37° 25' East. With a human population of 674,868 (KNBS, 2009), the population density in the region is high (952 people km²) and this has led to the fragmentation of land. Rainfall is bimodal and ranges from 500 mm – 1,300 mm while average temperature is 18.7 °C. This study was conducted in the administrative sub-counties of Gatanga, Gatundu North and Thika. These were classified as the greater Thika region. According to Livestock Production Office (LPO) the Greater Thika region records over 1,000 farmers practising dairy goat farming and they keep an estimated population of about 5,000 dairy goats (Kiambu County Director of Veterinary Services, personal communication).

2.2 Study design and sample size determination

A descriptive cross sectional study design was used. A sample size of 240 small-scale farmers was determined using the formula described by Mugenda & Mugenda (1999). The 240 farmers who owned dairy goats were randomly selected through a multistage, stratified sampling based on list of farmers provided by the Livestock Production Office. Informed consents were obtained from all individual participants included in the study. Each sub-county was apportioned its share of farmers being proportionately dependent on the total known population of dairy goat farmers as listed by the Livestock Production office. The total number of goat farmers selected in Thika, Gatanga and Gatundu North sub-counties were 75, 52 and 113, respectively.

2.3 Data collection

Data for this study was collected between May and June 2016, through structured questionnaires, which aimed at exploring the dairy goat husbandry practices such as housing, feeding, reasons for keeping the goats and breeds kept. The selected farmers were also interviewed on the diseases that afflict the dairy goats in their farms.

2.4 Data analysis

The data collected was coded and entered into a Microsoft Excel 2007 version 12 (Ms Excel 2007, Microsoft, USA) spreadsheet. The data was thereafter analysed using Statistical Package for Social Sciences (SPSS) version 16.0 (Chicago, SPSS Inc Statistical package) and MS Excel software. Descriptive statistics were presented as tables. Univariate Analysis of Variance (ANOVA) was used to test differences in daily milk yield between breeds of goats, lactation stage, type of feed, sub-county of origin, sizes of land and occupations of the farmer. A level of $p < 0.05$ was considered statistically significant.

Table 1: *Distribution of dairy goat breeds kept by the farmers across the three sub-counties.*

	sub-county								
	Gatanga		*Gatundu North*		*Thika*		*Total*		*P-value*
*Breed**	*No.*	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*	
Toggenburg	154	35.0	181	47.8	164	61.0	499	45.9	0.001
Saanen	32	7.3	118	31.1	39	14.5	189	17.4	0.074
Anglonubian	5	1.1	0	0.0	6	2.2	11	1.0	0.535
Indigenous	0	0.0	47	12.4	21	7.8	68	6.3	0.265
Kenya Alpine	78	17.7	33	8.7	210	78.1	321	29.5	0.109
Total	440	100.0	379	100.0	269	100.0	1088	100.0	

* Exotic breeds crossed with indigenous breeds

3 Results

3.1 Dairy goat husbandry practices

The majority (45.9 %) of the dairy goats were crosses of indigenous goats with Toggenburg followed by the Kenyan alpine, Saanen, and Anglonubian at 29.5 %, 17.4 % and 1 %, respectively. Pure indigenous goats made up 6.2 % of the total dairy goat population. There was uneven distribution ($p = 0.001$) of breeds of goats kept by farmers in the various sub-counties. In Gatanga and Gatundu North sub-counties the main breed of goats was Toggenburg while in Thika sub-county, Kenya Alpine was the main breed kept (Table 1).

The overall mean number of dairy goats owned by the farmers in the study was 4.5 (SD ± 3.5), with Thika Sub-county having the highest (5.9 ± 4.2), followed by Gatanga (5.2 ± 3) and Gatundu North sub counties (3.4 ± 2.7). There was a significant variation ($p = 0.0001$) in the mean dairy goat flock sizes across the three sub counties.

Table 2: *Dairy goats flock structure in the study area as distributed by age and sex.*

Goat type	*Total*	*%*
Bucks	106	9.7
Male kids	105	9.7
Dry does	194	17.8
Male growers	93	8.5
Female kids	163	15
Lactating does	295	27.1
Female growers	132	12.1
Total	1088	100.00

As shown in Table 2, the lactating does were the majority (27.1 %) in the flocks kept by the farmers, followed by the dry does (17.8 %) and female kids (15 %). There were no significant ($p = 0.243$) differences between the proportions of ages and sex of flock types kept by the farmers in the study region.

The source of first dairy goat for the various farmers varied with the majority (77.1 %) having purchased their first dairy goat, 18.8 % received their first goat as donation from organisations, 3.3 % from friends and 0.8 % inheriting from their parents. Majority (46.2 %) of the dairy goat farmers used hired bucks to serve the does while those who used project bucks, own bucks, and artificial insemination were 27.5 %, 25.4 % and 0.8 %, respectively. In descending order, farmers mainly kept the goats for provision of milk (77.5 %), income (11.3 %) and manure (6.3 %) (Table 3). A few farmers kept the goats for prestige (4.6 %) and as a form of insurance (0.4 %). Across the sub-counties, the percentage of farmers keeping goats for provision of milk for domestic use was significantly ($p = 0.001$) higher in Gatundu North compared to the other sub-counties. Further, the proportion of farmers who kept the goats to provide manure was higher ($p = 0.005$) in Thika sub-county compared to the other sub-counties (Table 3).

The animal housing types identified in the study area were raised floor types (59.2 %) and normal ground types (40.8 %), with varying modifications of either. The stables were constructed of mainly timber. The dairy goats were fed through zero grazing method (cut and carry) (81.5 %), free grazing (6.7 %) and tethering (12.1 %). Depending on the season the types of feed fed to the dairy goats were natural growing grass and shrubs (94.8 %), followed by maize stovers (76.7 %), napier grass (74.2 %) and farm weeds (61.7 %). Other types of feeds that were provided to the goats as supplements were Calliandra (24.6 %), pineapple peels (13.8 %) and sweet potato vines (22.1 %) (Table 4). The farmers who indicated that they fed the dairy goats with commercial feeds (which consisted of a variety of commercial feeds such as dairy meal, maize germ, wheat pollard,

Table 3: *Main purpose for keeping dairy goats in Thika region.*

	sub-county								
	Gatanga		*Gatundu North*		*Thika*		*Total*		*P-value*
Reason	*No.*	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*	
Milk for domestic use	40	76.9	96	85.0	50	66.7	186	77.5	0.001
Milk for income	11	21.2	9	8.0	7	9.3	27	11.3	0.641
Manure	0	0.0	2	1.8	13	17.3	15	6.3	0.005
Insurance	0	0.0	1	0.9	0	0.0	1	0.4	0.632
Prestige	1	1.9	5	4.4	5	6.7	11	4.6	0.234
Total	52	100.0	113	100.0	75	100.0	240	100	

Table 4: *Types of feed provided to dairy goats in Thika region, Kenya (n=240).*

Feed type	*Number of farmers*	*Percentage (%)*
Napier	178	74.2
Maize stovers	184	76.7
Hay	70	29.2
Natural growing grass	227	94.8
Kitchen waste	95	39.6
Pineapple peels	33	13.8
Farm weeds	148	61.7
Calliandra	59	24.6
Sweet potato vines	53	22.1
Commercial concentrates*	46	19.2
Mineral Supplements*	140	58.3

*Commercial dairy meal, maize germ, wheat pollard, wheat bran from local manufacturing companies

wheat bran) and minerals were 19.2 % and 58.3 %, respectively.

3.2 Dairy goat's milk productivity

The results from the study showed that the overall mean milk production per dairy goat per day was 1.26 L (range = 0.5 – 3.5 L/goat/day). This was significantly (p = 0.004) related to the sub-county, with goats in Gatanga, Thika and Gatundu North sub-counties recording an average of 1.35, 1.19, and 1.18 L per goat per day, respectively (Table 5).

The average daily milk production per goat was greater (p = 0.224) for farmers with land parcels above 1.0 acre (1.67 L/goat/day), when compared to those with less than 1.0 acre (1.26 L/goat/day). Further, the average milk production per goat for farmers whose main occupations were private businesses, crop and livestock farming only and those in salaried employment were 1.44 L/goat/day, 1.30 L/goat/day and 1.01 L/goat/day, respectively (p = 0.032).

Farmers who kept Kenyan Alpines goats recorded a higher milk production average of 1.38 L/goat/day followed by those with Saanen crosses, Toggenburg crosses, indigenous goats and Anglonubian crosses who produced 1.28, 1.21, 0.98 and 1.00 L/goat/day, respectively (p = 0.018). Farmers who were milking their goats at the early stage of lactation (under 3 months) recorded a higher (p = 0.003) daily average milk production per goat, compared to the rest. Milk production was also compared to the main type of feed fed to the goats. The highest (1.81 L/goat/day) and lowest (1.59 L/goat/day) mean milk production was obtained for goats whose main feed was napier grass and hay, respectively (p = 0.734).

3.3 Common diseases affecting dairy goats

According to the farmers, helminthosis was the most (84.6 %) common disease encountered, followed by pneumonia (32.9 %), coccidiosis (25.8 %) and mastitis (25 %) (Table 6).

The study revealed that farmers detected helminthosis through observation of the various symptoms such as rough hair coat (80.8 % of the farmers), emaciation (51.3 %), coughing (50.4 %), scouring (37.9 %), reduced milk production (33.8 %), presence of worm segments in faeces (30.8 %), unthriftness (17.9 %) and pale mucus membranes (12.9 %) in the goats. Majority (97.1 %) of farmers dewormed their dairy goats on a yearly basis. Over half (55 %) of the farmers dewormed their dairy goats on their own while the others depended on private animal health practitioners (22.9 %), government extension officers (12.9 %), farm help (8.8 %) and neighbours (0.45 %). The farmers indicated that the other diseases including pneumonia, mastitis, coccidiosis, anaplasmosis, heart water, mange and retained placenta were diagnosed by the animal health extension officers.

Table 5: *Relationship between variables and milk productions in the study area.*

	Variable	*N (n=240)*	*Mean [L/goat/day]*	*P-value*
Sub-county of origin	Gatanga	51	1.35	0.004
	Gatundu North	113	1.18	
	Thika	75	1.19	
Land size	< 1 acre	119	1.67	0.224
	1> acre	121	1.26	
Main occupations	Business	27	1.44	0.032
	Crop and livestock farming	171	1.3	
	Salaried	41	1.01	
Breeds	Kenya Alpine	119	1.38	0.018
	Saanen	51	1.28	
	Toggenburg	2	1.21	
	Indigenous	15	0.98	
	Anglonubian	52	1.00	
Lactation stage	< 3 Months	65	1.68	0.003
	3-4 Months	101	1.16	
	>4-5 Months	56	1.06	
	>5 Months	17	0.91	
Main type of feed fed to the goats	Napier	42	1.65	0.734
	Maize stovers	45	1.65	
	Hay	21	1.59	
	Natural grass	60	1.69	
	Farm weeds	38	1.81	
	Sweet potato vines	33	1.74	

Table 6: *Dairy goat diseases commonly encountered by farmers in the study area (n=240).*

Disease condition	*Farms with history of disease*	*Percentage (%)*
Pneumonia	79	32.9
CCPP*	6	2.5
Mastitis	60	25.0
Abortion	22	9.2
Coccidiosis	62	25.8
Anaplasmosis	19	7.9
Helminthosis	203	84.6
Heart water	4	1.7
Eye infection	45	18.8
Mange	43	17.9
Bloat	23	9.6
Wounds	22	9.2
Abscesses	17	7.1
Retained placenta	1	0.4

*Contagious Caprine Pleuropneumonia

Most (92.9 %) farmers controlled ectoparasites such as ticks, mange, fleas and lice. Spraying with ectoparasiticides was the most (70.0 %) commonly used method of vector control. Other methods included acaricide dusts (20.0 %), immersion dips (1.7 %) and pour-ons (1.2 %).

4 Discussion

The current study investigated the production and health characteristics of dairy goat farms in Thika region in Kenya. The main breeds of dairy goats kept were crosses of exotic dairy goat breeds with the indigenous goat breeds at various levels of crossbreeding. For most farmers, there were no records of breeding and this can be a major challenge in dairy goat farming (Shivairo *et al*., 2013; Mbindyo *et al*., 2018). The farmers in neighbouring counties such as Kirinyaga, Nyeri and Meru keep similar types of breeds, although in these counties there is an organised breeding scheme (Ahuya *et al*., 2004; Shivairo *et al*., 2013). In Thika region, lack of improved dairy goat breeds and organised breeding scheme is a major challenge, which can be solved through the help of extension workers from the government and local NGOs.

The average dairy goat flock size in the region was 4.5, majority of them being lactating does. This flock size was less than reported in neighbouring Nyeri County (Mbindyo

et al., 2018). The farmers mostly used own bucks or hired one from their neighbours which could lead to inbreeding. There were no programmes to regulate breeding and farmers haphazardly purchased any goat and this has also been reported for the central region of Kenya (Mburu *et al*., 2014). Therefore, farmers should join a formal dairy goat association and use project bucks or artificial insemination which is available in Kenya.

In the present study, the goats were mainly reared under intensive production systems with most of the farmers rearing their goats in zero-grazing systems and feeding them using cut and carry methods. The goats were fed with a variety of feeds which included naturally growing grass and shrubs, napier grass (cultivated on-farm) and maize stovers (especially during dry season). Feeding with high quality fodder that can be easily grown on-farm and supplementation with concentrates was rarely done and this will have led to the low milk production amongst the goats kept by the studied farmers. These findings are consistent with those from other parts in Kenya (Ogola *et al*., 2010; Mburu *et al*., 2014).

The present study found that the milk production in this region ranged from 0.5 to 3.5 litres per dairy goat per day. This compares well with the findings of Mburu *et al*. (2014) in their study in Nyeri, Kenya, where they found milk production levels to be ranging between 0.98 litres and 2.96 litres per goat per day depending on area and breed. The milk production recorded for the breeds in Kenya is far below those recorded for pure breeds whose production can range from 3 litres to over 5 litres (Haenlein, 2004). The findings of this study showed that the sub-county of origin, main occupation of the owner, breed, and lactation stages significantly affected the milk production of the dairy goats. It has been shown that the actual amount of milk produced during a lactation period is affected by factors such as breed, litter size, parity, stage of lactation, and health of does during pregnancy, season of kidding, physiological state, disease, feed availability and stress from the environment (Mellado *et al*., 2003; Salama *et al*., 2005).

Farmers in the present study identified helminthosis, pneumonia, coccidiosis and mastitis as the most common disease conditions encountered. These findings are consistent with the study undertaken elsewhere (Ahuya *et al*., 2004) who recorded similar category of diseases in Meru County, Kenya. In other countries, similar spectrums of diseases have been observed in dairy goats (Ramachadran *et al*., 2006; Shija *et al*., 2014; Donklin and Boyazoglu, 2004). Amongst the farmers, diagnosis for helminthosis was mainly based on clinical signs that were not pathognonomic. The poor diagnosis of helminthosis amongst farmers can lead to a misuse of anthelmintics. A few farmers were able to use the pale mucus membranes as symptom of helminthosis. Thus, these farmers can be amenable to training on the use of farmer friendly FAMACHA® charts which is based on examination of mucous membranes and have been successfully implemented in countries like Brazil (Vilela *et al*., 2012). A recent study in Indonesian Borneo showed that targetted selective deworming of Kacang goats led to improvement in mean anaemia score by 11 % and more than doubling of the proportion of goats scoring with healthy hematocrits from 12 % to 26 % (Wyatt *et al*., 2019). Such a strategy, which also minimises emergence of anthelmintic resistance, should be evaluated amongst the low resource farmers in Kenya.

5 Conclusions

In summary, the smallholder dairy goat production system in Thika Region, Kenya is characterised as low-input with an objective of provision of milk for home consumption and income generation. A number of challenges including diseases and low milk productivity were noted. In future, the nutritive value of the wide variety of feeds in the study area should be investigated with an intention of developing an improved ration. There is need for farmers to be trained on improved husbandry, nutrition and health management of the dairy goats. Future research and development approaches should address these constraints in order to improve the livelihoods of the low resource small farmers.

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Conflict of interest

The authors declare that they have no conflict of interest.

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