The Benefits of Different Management Interventions on the Performance of Goats in Oodi Village, Kgatleng District: Botswana

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(Associate Institution of University of Botswana)

THE BENEFITS OF DIFFERENT MANAGEMENT INTERVENTIONS ON THE PERFORMANCE OF GOATS IN OODI VILLAGE, KGATLENG DISTRICT: BOTSWANA.

A Dissertation Submitted in Partial Fulfillment of Master of Science Degree in Animal Science.

By

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Abstract

The aim of this research was to find the benefits of supplementation with molasses urea block (MUB) and Ivermectin injections on the growth as well as on gastro-intestinal parasites load of goats grazed extensively, during the wet season. Experimental animals were blocked by age (adults & weaners) and allocated into two (2) dietary treatments (MUB supplementation and no supplementation). Goats were allocated two injection treatments (Ivermectin dewormed & no deworming).

Supplemented and dewormed weaner goats had higher ($P < 0.05$) weights at the end of the wet season since they grew at a higher ($P < 0.05$) rate than control weaners. A low ($P < 0.05$) egg per gram count (EPG) was evident for supplemented and dewormed weaners at the end of the season. A similar trend was observed for supplemented and dewormed adult goats which also exhibited a higher ($P < 0.05$) average daily growth (ADG) than control animals, On the contrary supplemented adult females had a lower ($P > 0.05$) weights and ADG at the end of the season but had low ($P<0.05$), EPG.

The other objective was to find out how management practices affected the profitability of smallstock relative to marketing constraints and production constraints. Data was collected by administering a questionnaire and analysed by Statistical Package for Social Sciences (SPSS). Smallstock farmers in Oodi extension area preferred to sell their animals to individuals and secondly to butcheries. Lack of organised smallstock market was identified as a marketing constraint. Production constraints included aged farmers, illiteracy, lack of record keeping, high cost of labour and feeds and lack of health management strategies. The farmers' management practices indeed affected the profitability of their animals. Farmers who had a health management strategy, fed their smallstock, low input costs on their stock and sold their animals made more profit than farmers who did not carry out the above mentioned practices.

CERTIFICATION

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STATEMENT OF ORIGINALITY

I, Mmoloki Moemi hereby declare to The Botswana College of Agriculture, University of Botswana that this Thesis is my original work except the references made and that it has never been submitted for a degree award in any other University.

Student Name

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Finally my sincere gratitude goes to my wife Mrs. K. Moemi, and my sister Mrs. T Baitse for their incessant moral support.

DEDICATION

This work is dedicated to my families, who were the pillar of my strength, motivationally and morally throughout my studies. Most importantly it is dedicated to my main supervisor Dr. C.M. Tsopito who was my mentor and brother to me throughout the course of my studies and research.

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LIST OF ABBREVIATIONS

ANOVA ..... Analysis of Variance
AOAC ..... Association of Official Analytical Chemists
CAM ..... Control adult males
CAF ..... Control adult females
CWF ..... Control weaner females
CWM ..... Control weaner males
DVET ..... Department of Veterinary Services
EPG ..... Eggs per gram count
FAO ..... Food and Agricultural Organisation
GoB ..... Government of Botswana
Kg/day ..... Kilograms per day (weight)
LIMID ..... Livestock Management & Infrastructure Development
MOA ..... Ministry of Agriculture
MFDP ..... Ministry of Finance and Development Planning
SWM ..... Supplement weaner males
SWF ..... Supplement weaner females
SAF ..... Supplement adult females
SAM ..... Supplement adult males
SPSS ..... Statistical Package for Social Sciences
ADF ..... Acid Detergent Fibre;
DM ..... Dry Matter;
CP ..... Crude Protein;
NDF ..... Neutral Detergent Fibre,
K ..... potassium;
P ..... phosphorus;
Na ..... sodium;
N ..... nitrogen;
Ca ..... calcium;
Mg ..... magnesium;
Fe ..... iron;
Zn ..... zinc.

DECLARATION

The research described in this thesis was carried out at the Department of Animal Science and Production, Botswana College of Agriculture, An associate institute of the University of Botswana Gaborone, under supervision of Dr C.M. Tsopito, Professor E.Z Mushi, Dr P Malope and Dr N.M Tselaesele.

This is to declare that this thesis compilation was done from my own experimental investigation except for acknowledged or cited references, and has not been presented to any university for a degree purpose.

Mmoloki Moemi

Botswana College of Agriculture

Signature: ..... Date: .....

I Dr. C.M. Tsopito as the major supervisor hereby declare that I have approved the submission of this thesis for assessment.

Signature: ..... Date: .....

CHAPTER ONE
GENERAL INTRODUCTION

1.0 Background

Goats are small ruminants which belong to the family *Bovidae*, and genus tribe *Capra* (Mowlem, 1992). They are predicted as the first ruminants to be domesticated some 8000 years ago, in the ancient civilization along the Nile River. Goats and sheep have helped people to survive and thrive for countless generations. The goat (*Capra hircus*) is thought to have been the first animal to be domesticated for economic purposes in South-west Asia 7,000 BC (Peacock, 1996).

Over 80% of the smallstock, 70% of which are goats, are in the hands of traditional farmers; Women, who are among the poorest, own more goats than their male counterparts who have more resources and can afford to own cattle. Ownership of goats by the poorer sector of farmers is encouraged by the government of Botswana (GoB) through a number of projects/policies and programmes (Mrema and Rannobe, 1994). Despite the amount of research that has been carried out for many years a majority of sheep and goats are still kept under the communal grazing areas, which have an implication on the management of such factors of production as: breeding, nutrition, herd/flock management, record keeping, disease and parasite control and management of rangelands.

According to the Food and Agricultural Organization [FAO] (2007), sheep and goats are estimated at 1.1 and 0.83 billion heads, respectively, they are second and fourth largest livestock groups in the world. The same organisation reported that sheep production is of higher value in developed countries (40%) than goat production (5%) and goat production more important in developing countries (95%) than developed countries (5%). The report further points out that the overall production of these two species of livestock has increased tremendously in developing countries, especially in the arid and semi-arid regions of Africa; Botswana included, but have decreased or stagnated in developed countries. The goat is probably more popular by virtue of its widely consumed meat and milk.

1.1 Justification

Regardless of effort made by the Government of Botswana, GoB; through subsidies to improve production and productivity, the current population of goats and sheep in Kgatleng (23 065 goats & 4274 sheep) in 2008, there is still large amount of meat (63 469 kg chevon & 307 087 kg mutton) and live animals (10 464 sheep & 705 goats) imported respectively, (Department of Veterinary Services 2008, MoA, 2009). The quantities of imported chevon and mutton are higher than the amount that could be obtained from 41 632 kg locally slaughtered animals (Department of Animal Production [DAP] 2007), implying that there are some management problems with regard to production and marketing of the goat / sheep products in the country. Production aspects such as reproduction, nutrition and health are very crucial for the success of any small ruminant enterprise.

The challenge is to identify and document management practices that would result in profitability, reduced production constraints and to identify sustainable marketing channels that can be used by smallstock farmers.

1.2 Objectives

Study 1

The main objective of this study is to investigate the performance of smallstock based on nutritional and health management interventions applied.

Specific Objectives:

- To measure the effect of feeding molasses urea block on the performance of smallstock.
- To determine the effect of parasites control and treatment on the performance of smallstock.

Study 2

The main objective of the study is to investigate the socio-economic benefits of management interventions in study 1.

Specific Objectives

- To identify marketing channels in the area.
- To determine the profitability of smallstock.
- To identify social benefits derived from the nutritional and health management interventions.
- To identify the production and economic constraints of small stock production.

1.3 Hypotheses:

Study 1:

a) Ho: Supplementing smallstock with molasses urea block does not improve the performance of smallstock.

H_A: Supplementing smallstock with molasses urea block improves the performance of smallstock.

Study 2:

b) Ho: Administering anthelmintic/coccidiostat injections does not have effect on the performance of smallstock

H_A: Administering anthelmintic/coccidiostat injections has an effect on the performance of smallstock.

CHAPTER TWO
LITERATURE REVIEW

2.1 Production Constraints

Smallstock production like any other livestock production enterprise has got limiting factors. Mucuthi and Munei (1994), studied constraints to small ruminant production and found that stock theft, mortality due to diseases, difficulty to get herders, and lack of enough grazing areas were the major constraints. Some of the constraints were diseases (mainly pneumonia and Helminthiasis) and shortage of water for livestock. It was also observed that overgrazing was a constraint. Nuti *et al.*, (2003) alluded that forage conditions of domestic goat production make it difficult to adjust parturition, weaning, and growth cycles to match periods of high consumer demand.

Fianu *et al.*, (1994) investigated problems and prospects of rearing sheep under tree crop plantation. Common health problems were Helminthiasis, foot rot, skin disorders, coughs, fractures and cuts. The other problem unearthed was that some farmers never consulted veterinarians while others did consultation during crises. It was found that mortality for both young and old was high in those flocks that did not consult the veterinarian. Okeyo *et al.*, (1994) studied the reproductive performance and level of gastro-intestinal parasite infestation in East African goats. The most prevalent helminth was *Haemonchus contortus*. The most common diseases were pneumonia, mange, Heartwater, Helminthiasis, ectoparasitism (fleas & ticks) and orf. Reproductive parameters examined were kidding interval, breeding, abortions pre-weaning mortalities and udder problems. Other aspects included feed and water availability. Farmers did not control breeding and selection for breeding was based on visual appraisal. In the farms studied, abortions were common (75%) and udder problems followed at (42%).

Nuti *et al.*, (2003), observed that production costs are another factor influencing the relative value of goats while Mrema and Rannobe (1994) investigated the factors affecting goat production in Botswana and found that high cost of veterinary services, poor housing and hygiene, poor nutrition due to overstocking in communal grazing areas, insufficient family labour and long distances to dams resulting in use of municipal sewage ponds. Steele (2006) argued that in addition to feeding and general management, a number of factors affect smallstock

health; intensity of production, age of animals, breed, weather/climate and contact with other animals. The dying of goats represented losses, and large economic losses may occur due to chronic problems affecting optimal breeding and growth such as diseases and internal parasites. Singh *et al.*, (1996) found that mortality varied with flock size and age. Mortality reported in adults was 5.38% and 10.78 % in kids. The highest mortality was on kids and the lowest was in adults, the highest mortality was in large flocks.

London and Weniger (1996) found that mortalities in smallstock differed according to the environment, management and season. The pre-weaning mortalities were found to be higher in lambs kept in the free range system and in wet season and highest in the semi-tethered system. Age also played a role in the mortality of small stock. Dibanzilua *et al.*, (1995) found that 60 % of mortalities were in young animals and 26.6% were still-born and those found dead were less than a day old. Gongnet *et al.*, (1996) confirmed that mortalities were influenced by birth weight, year and season of lambing, strain and the sex of the lamb and the type of birth (multiples/singles). Ramabu and Segwagwe (1999) studied the causes of mortalities in small stock in Botswana, the major causes of sheep mortalities were helminthiasis/coccidiosis (43.9%) and Heartwater (14.6%). For goats the major causes were helminthiasis/coccidiosis (40.1%) and Heartwater (18.1 %). Pasteurellosis was reported to cause high mortalities in both species. Mortalities due to rabies were 14.7% in goats and 7.3% in sheep. Singh *et al.*, (1996) found that mortality was high in large flocks; the higher the number of animals kept the higher the mortality.

2.2 Marketing Constraints and channels

Nsoso *et al.*, (2004) investigated market practices and marketing channels used by goat farmers in Molepolole and found that most farmers (88%) did not keep any records and weighing before selling was not done (0%). Most farmers (96%) rather preferred using subjective conformation assessment to bargain for prices. Selling was largely through both individual sales (92%) and butchers (34%), which were the most favoured markets because they are relatively cheap and easily accessible. Botswana Meat Commission (BMC) was almost not utilized (4%). Some marketing channels such as co-operatives and auction sales were not used at all (0%). The majority of small stock farmers (76%) had little knowledge about market forces and quality of

their livestock and this limited their ability to choose the right marketing channel based on sound economic decisions which would increase their income.

Singh *et al.*, (1996) studied some fundamental and economic aspects of goat rearing and reported. The aspects studied were productivity levels; annual milk production, manure production, kidding rate, mortality levels, manure production as well as animals sold and retained. It was found that 76% of goat keepers maintained small flock sizes. Most of the milk was for consumption and the remainder was for sale. Selling of surplus goats was done under crucial circumstances and few female kids were retained as replacement stock. Mrema and Rannobe (1994) found that farmers see BMC prices as low compared to private agents who do not look at the grade of the animal. Long distances to abattoirs, poor roads and lack of transport were also identified as constraints; most farmers especially women did not own trucks that could ease their transport problems. The type of transport owned (donkey carts) was inappropriate for transporting goats. Hiring of trucks was not viable for smallholder farmers. The lack of transport reduced the possible number of trips that could be made to the market. Glimp (1995) found that meat goat marketing was highly unstructured in the United States, yet prices are generally higher per unit of weight basis than other red meat-producing species. Efforts to organize marketing had only limited success.

2.3 Profitability

Several studies have stated that meat goats could be profitable to produce and that the apparent market demand for goat meats in the United States exceeded the current supply (Mercado *et al.*, 1991). The productivity and income contribution of small ruminant production to rural household in Africa was studied in Botswana. It was found that small ruminant production was both profitable and economically viable. It contributed 15% to household income, (Panin 1994). In the United States, goats were becoming increasingly important income contributors to many producers, Glimp (2009). In Ethiopia, goats contributed significantly to households' income, especially to the rural poor (Demeke, 2004). In Kenya goats constituted an important national productive asset that generated a flow of income and employment throughout the year, (Rege *et al.*, 2001).

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CHAPTER THREE

The performance of goats in Oodi extension area supplemented with Molasses Urea Block (MUB).

Abstract

The study was conducted during the wet season to investigate how supplementing with molasses urea block (MUB) affects the growth rate of adult and weaner goats as well as the to find the effect of MUB on the egg worm count (EPG) in both adult and weaner goats.

Supplemented weaner males (SWM) grew at a fast rate ($P<0.05$) than control weaners (CWM), as such they had heavier weights at the end of season than CWM. Supplemented weaner females (SWF) had higher mean weights ($P < 0.05$) than control weaners (CWF) as they also experienced fast growth rate than CWF. A similar trend was observed for supplemented adult males (SAM) while contrarily the supplemented adult females (SAF) did not differ ($P > 0.05$) from the control female adults (CAF) at the end of the wet season.

Egg per gram count (EPG) was high before the wet season, from the beginning to the end there was gradual decline in EPG for all goats with increasing weight gain. All supplemented weaners had a lower ($P<0.05$), EPG than control weaners. at the end of wet season SWM (225) and SWF (288.46±86.03) had significantly ($P < 0.05$) reduced EPG than CWM (296.42±82.90) and CWF (308.33±147.78).

Although all adult goats experienced a general decline in (EPG) from beginning of season to the end, the supplemented adult goats had lower ($P<0.05$) EPG than control adults at the end of the season. Supplemented adult females (SAF) had an EPG of 212 ±29.56 while CAF had 238.89±39.67. Egg worm count for SAM was 216±48.59 while CAM had EPG of 338.89±28.10 at the end. Supplementation therefore reduced egg worm count leading fast growth rate.

3.1 Introduction

El-Hassan *et al.*, (2010), described goats as one of the first farm animals to be domesticated and used for human consumption. They possess unique ability to survive in various environments upon which they provide food, fibre and hides. In Botswana goat rearing is an integral part of the extensive farming systems wherein they play an important role in the economy among small holder farmers, thus they provide ready income through the sale of live animals (Aganga, *et al*, 2005). Mareko *et al.*, (2006), stated that Tswana goat was a native breed which was well adapted to climatic regions of Botswana. They were an important source of protein for developing regions, mainly situated in the tropics. The primary reason for keeping goats was to produce meat; hence meat goats constitute a major proportion of the world goat population. They played a significant role in the livelihoods of the poor rural households where they were mostly raised by poor women and their children.

Goat management implies interventions put in place to improve the overall productive performance of these animals. Such interventions can either be nutritional or health based. The effectiveness of nutritional interventions is measured through live weights, which have a direct positive correlation to improved nutrition. Improved nutrition greatly increases the growth rate of indigenous animals (Wilson, 1982). Animals which have continuous access to quality diet are less susceptible to diseases, whereas unhealthy and dying goats represent large economic losses (Steele, 2006).

The scarcity and fluctuating quantity and quality of the year-round feed supply is a major constraint to livestock production in developing countries. Provision of sufficient and good quality feed to livestock in order to maintain and improve their productivity is, and continues to be, a grave challenge to farmers, agricultural scientists and policy makers all over the world. In developing countries, livestock are fed mainly on low quality roughages, including natural grazing and agro-industrial by-products, such as cereal straws/stovers, sugarcane by-products and other similar feeds, all of which contain large quantities of ligno-cellulosic material. These feeds are deficient in protein, energy, minerals and vitamins. In addition, at certain times of the year, the quality of grazing and browse deteriorates substantially due to seasonal changes leading

to decline in livestock productivity unless supplements are offered, Smith (2006). The main objective of this study therefore was to determine how the nutritional management intervention influences the performance of extensively raised goats.

Specific objectives were;

3.1.1 To investigate the effect of feeding molasses urea block (MUB) on the growth of weaner and adult goats during the wet season.

3.1.2 To determine if feeding molasses urea block (MUB) would have an anthelmintic effect on the faecal egg worm count in adult and weaner goats during the wet season.

3.2 Hypothesis

- **Ha**; Feeding molasses urea block will **not** improve the growth of goats or reduce the egg worm count.

- **Ho**; Feeding molasses urea block will improve the growth of goats and reduce the egg worm count.

3.3 Methodology

3.3.1 Study area

The study was carried at Oodi extension area in the Kgatleng district. This location was chosen due to its proximity to the institution of study; Botswana College of Agriculture. Kgatleng is located in the south-eastern part of the Botswana and the selected villages were almost 10-15 kilometres from the capital city of Botswana, Gaborone. The rainfall distribution of the study area is varied with an annual mean ranging from 400-500 mm. The vegetation of the area is tree savannah.

3.3.2 Identification of the study animals

Nine (9) farmers with more than thirty (30) animals and practicing extensive management were randomly selected for this study. In each kraal nine adults and nine weaners of different sex and almost equal weight were chosen as experimental animals. The mean body weight of weaners averaged 11 kg and adults weighed an average of 26.5 kg. They were tagged for identification purposes.

3.3.3 Live weight measurements

Growth rate was determined monthly for all treatments by weighing the animals using a smallstock step-in mobile scale. The scale dimensions were 1250 x 500mm. A salter gauge was calibrated from 0-200 kg was used to read weights. Goats were weighed in the morning before being released for grazing. The weights were recorded against the identification tags.

3.3.4 Faecal sampling

Faecal samples were collected from adult goats and weaners monthly by collecting fresh faeces from the rectum into faecal bottles. They were kept on ice and then refrigerated before examination to avoid larval development.

3.3.5 Egg Worm counting

A modified McMaster technique (MAFF, 1978) was used to determine the number of worm eggs per gram of faeces. A sample faeces weighing two (2) grams were crushed with a spoon. Forty five (45) glass balls were placed together with crushed faeces into a faecal bottle. Twenty eight (28) ml of tap water was added to the mixture which was then shaken thoroughly after tightly

closing the bottle. The mixture was then poured through a two (2) mm sieve to collect the fluid. The fluid was then poured into a centrifuge tube up to its brim. The fluid was then centrifuged for two (2) minutes at approximately one thousand revolutions per minute (1000 rpm). The supernatant was poured off. Saturated sodium chloride solution was poured to fill the centrifuge tube. The sediments were then mixed with salt solution using the wooden applicator stick. The contents were then thoroughly mixed by tilting or inverting the tube 5 to 6 times. A sufficient amount of mixture enough to fill the one half of the McMaster slide was taken. The mixture was shaken and again enough of it taken to fill the remaining half of the slide. All the nematode eggs occurring on and within the engraved lines in both halves of the slide were counted. The total number of eggs counted was multiplied by fifty (50) and the result recorded as eggs per gram, (Uruqhart *et al.*, 1996).

3.3.6 Experimental Design

The experimental animals were blocked according to age (adults and weaners) and allocated to two (2) treatments as stated below; each treatment had three (3) replicates in a randomised complete block design (RCBD), thus a 2 x 2 x 3 factorial in RCBD.

3.3.7 Treatments

Treatment 1:

Adult and weaner smallstock were managed according to the traditional management system where no modern management intervention was introduced. This treatment was taken as the control.

Treatment 2:

Adult and weaner smallstock were supplemented with molasses-urea block (MUB) daily for 12 weeks of the wet season with unrestricted (*ad lib*) access to MUB.

3.3.8 Experimental Model

$Y_{ijk} = \mu_{ij} + A_i + T_j + S_k + e_{ijk}$

Y_{ijk} = observation

μ_{ij} = general mean

A_i = age effects

T_j = treatment effects

S_k = sex effects

e_{ijk} = random error

3.3.9 Chemical Analysis

The browsed and grazed pasture (range) was sampled monthly. This was done by clipping the browse (leaves and twigs) using secateurs. Proximate analysis was used on the samples to determine moisture content, crude protein and ash. Moisture content was determined by the air drying method as described by Association Official Analytical Chemistry (AOAC) [1997] in which the feed sample was dried at 70°C over 48 hours. The wet clippings were weighed to get their wet mass and then oven dried at 70 °C for 48 hours to remove moisture. The dried samples were removed from the oven dried to obtain the dry mass. The difference between the dry mass and the wet mass was the moisture content. The dry mass represents the dry matter of the sample. Nitrogen was determined using the Kjeldahl method from (AOAC) [1997]. Neutral and acid detergent fibre was analyzed by Ankom Technology (2000).

Calcium, copper, magnesium, manganese, zinc and iron were determined using Atomic Absorption Spectrophotometer; phosphorus was determined using Ultra Violet Spectrophotometer while sodium and potassium was determined using a flame photometer. The molasses urea block was also put through the same procedures as above to find its nutrient content.

3.4 Statistical Analysis

The data were subjected to Analysis of Variance (ANOVA) using the General Linear Model of SAS (2002). Treatment means were tested for significant differences using the Least square means.

The percentage nutrient composition of the range samples (browsed & grazed pasture) is shown in Table 3.1 below:

Table 3.1: Percentage (%) chemical composition and macro-mineral content of range samples

	Sample Period	DM	N	CP	NDF	ADF	CF	K	P	Mg	Na	Ca
End of dry season	October	97.9	1.66	10.38	67.2	41.02	4.1	0.74	0.07	0.33	0.01	0.70
Beginning	Nov-Dec	97.7	1.96	12.25	61.7	28.7	5.0	1.01	0.23	0.53	0.01	1.44
Mid	Jan-Feb	97.1	1.96	12.25	65.4	31.5	9.3	1.07	0.31	0.33	0.04	1.74
End	March-April	98.8	1.86	11.63	71.02	48.4	6.4	1.31	0.30	0.30	0.021	0.97

ADF: Acid detergent fibre CP: Crude protein; NDF: Neutral detergent fibre

The mineral content in parts per million (ppm) of the browsed and grazed samples is shown in Table 3.2 below.

Table 3.2: Micro-mineral composition of range samples (browsed & grazed) in parts per million (ppm)

Sample period	Months	Fe(iron)	Mn(manganese)	Zn(zinc)
Before wet season	October	103	19.1	72.8
Beginning of wet season	Nov-Dec	189	22.3	72.5
Mid-season	Jan-Feb	186	18.4	73.7
End of wet season	March-April	174	14.8	74.0

Table 3.3: Percentage (%) chemical composition and macro-mineral content of the Molasses urea block (MUB).

DM	N	CP	NDF	ADF	K	P	Mg	Na	Ca
87.5	5.33	33.31	26.83	11.99	0.2	0.328	4.89	0.95	4.16

ADF: Acid detergent fibre CP: Crude protein; NDF: Neutral detergent fibre, DM: dry matter

Table 3.4: Micro-mineral composition of the Molasses urea block in parts per million (ppm)

Mineral	Fe(iron)	Mn(manganese)	Zn(zinc)
Ppm	0.067	0.064	0.01

3.5 Results

The least square means and standard errors for weaner goats are shown in Table 3.5 below. The weaner goats were supplemented with MUB to observe growth performance. Even though all treatment and control weaner animals gained weight at the beginning of the wet season, the treatment effect were apparent ($P < 0.05$) on supplemented male weaners (SWM) till the end of the wet season. SWM attained weights that were heavier ($P < 0.05$) than control weaner males (CWM). At the end of the season the SWM had gained a 9.57 kg which was heavier ($P < 0.05$) than 6.78 kg gained by control weaner males (CWM). The SWM gained 0.106 kg/day, which was almost twice the amount of weight gained by CWM (0.075kg/day).

A similar trend was observed for weaner females, the mean weights of supplemented weaner females (SWF) were heavier ($P < 0.05$) than those of control weaner females (CWF) throughout the experimental period. At the end of the season SWF were 6.32 kg heavier ($P < 0.05$) than CWF. The total weight gain by the SWF was 8.82 kg, thus heavier ($P < 0.05$) than the CWF with a total gain of 5.18 kg. The average daily gain (ADG) attained by SWF was 0.098 kg/day which was almost double ($P < 0.05$) that of the CWF's growth rate of 0.058 kg/day.

Table 3.5: Body weight means (kilograms) and Average daily gains (kg) of weaner goats supplemented with molasses urea block.

Sex		Male		Female	
Treatment		Control	Supplement	Control	Supplement
Before the wet season	October	11.04±0.93	13.05 ±0.89	10.86 ± 0.86	13.54±0.92
Beginning	Nov -Dec	12.71± 0.95^{b}	17.58 ±0.909^{a}	11.88 ±0.88^{b}	18.55±0.99^{a}
Mid-season	Jan-Feb	16.64±1.32^{b}	20.46±1.21^{a}	14.62 ±1.21^{b}	22.18±1.32^{a}
End	March –April	17.82±1.23^{b}	22.62 ±1.13^{a}	16.04 ±1.31^{b}	22.36 ±1.23^{a}
ADG (Kg/day)		0.075	0.106	0.058	0.098

Means with the same superscript in a row are not significantly different (P < 0.05). Means with different superscripts (a and b) are significantly different.

The least square means (kilograms) of adult goats supplemented with MUB are shown in Table 3.6 below. All the adult goats showed weight gains, thus both control and treatment animals. The supplemented adult males (SAM) gained 7.78 kg at the end of the study while control adult males (CAM) gained almost 8.54 kg. At the end of the study the SAM (37.78±2.49 were still heavier (P < 0.05) than the CAM (35.46±2.16).

A totally different scenario was observed with female adult goats, the supplemented adult females (SAF) gained 4.15 kg by the end of study compared to CAF that had gained 9.12 kg. At the end of the study CAF accumulated 0.101 kg/day (P < 0.05) while SAF's ADG was a 0.046 kg/day. At the end of the study CAF were significantly heavier than the SAF group. At the end of the season SAM (37.78±2.49) were similar (P > 0.05) to SAF (36.94±1.81). However, the ADG of the control groups showed a similar trend of better performance than the supplemented groups.

Table 3.6: Body weight means (kilograms) and Average Daily Gains (kg) of adult goats of supplemented with MUB.

Sex		Male		Female	
	Treatment:	Control	Supplement	Control	Supplement
Before the wet season	October	26.92±1.98	30.00 ±1.73	33.46 ±1.91	32.79 ±1.72
Beginning of the wet	Nov-Dec	29.69±1.74^{b}	34.39± 2.10^{a}	35.57 ±1.69^{a}	35.97 ±1.53^{a}
Mid-season	Jan-Feb	34.50±1.97^{b}	36.99 ±2.27^{a}	40.13±1.97^{a}	38.06 ±1.70^{b}
End	March-April	35.46 ±2.16^{b}	37.78±2.49^{a}	42.58 ±2.15^{a}	36.94±1.81^{b}
ADG (kg/day)		0.095	0.086	0.101	0.046

Means with the same superscript in the same row are not significantly different ($P < 0.05$).

The least square means of egg per gram count (EPG) in adult goats is shown in Table 3.7 below. All the adult control animals (male and female) showed an increase in their EPG before the wet season to the beginning of wet season with CAM increasing by 18.7% while CAF increased by 8.8%. It was also evident that females in both groups had greater EPGs than their male counterparts. However, the EPGs of both groups decreased with increasing body weight gains until the end of the study period. Contrastingly, the supplemented groups (males and females) decreased their EPGs as from before the wet season to the end of the wet season when study was terminated as depicted by Figure 3.1.

Table 3.7: Egg per gram count in adult goats supplemented with Molasses Urea Block during the wet season.

Sex	Male		Female	
Treatment	Control	Supplement	Control	Supplement
Before the wet season	361.11±135.96	493.75±144.21	580.56±96.14	535.29±98.93
Beginning of the season	444.44±131.93[a]	441.67±161.57[a]	636.67±102.19[a]	446.88± 98.95[b]
Mid of season	227.78±53.19[a]	256.25±56.41[a]	316.67±37.61[a]	266.67±41.19[b]
End of season	238.89±39.67[a]	216.67±48.59[a]	338.89±28.10[a]	212.50±29.56[b]

Means in the same row with same superscript do not differ significantly, (P<0.05).

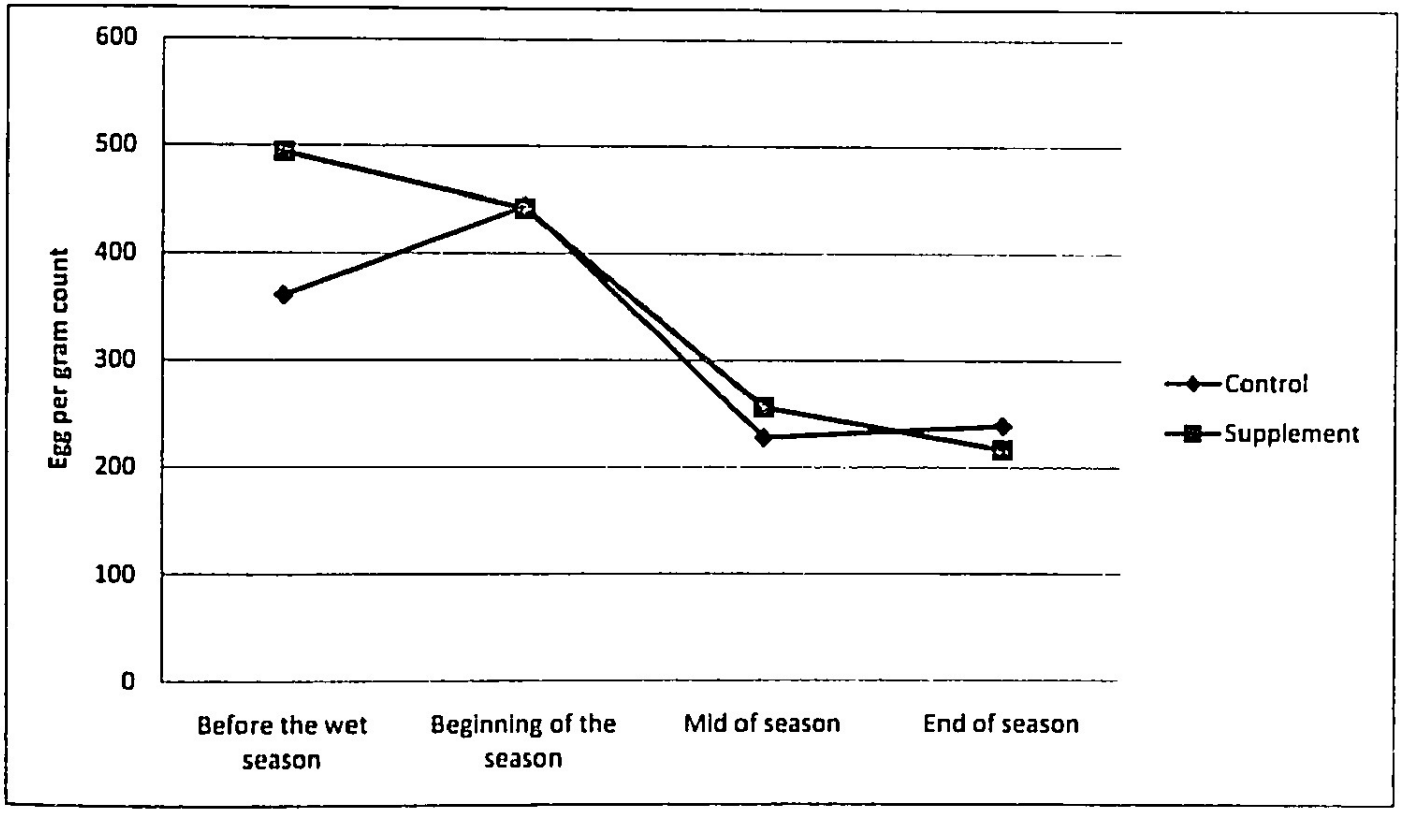

Figure 3.1: Egg per gram count in male adult goats supplemented with Molasses Urea Block

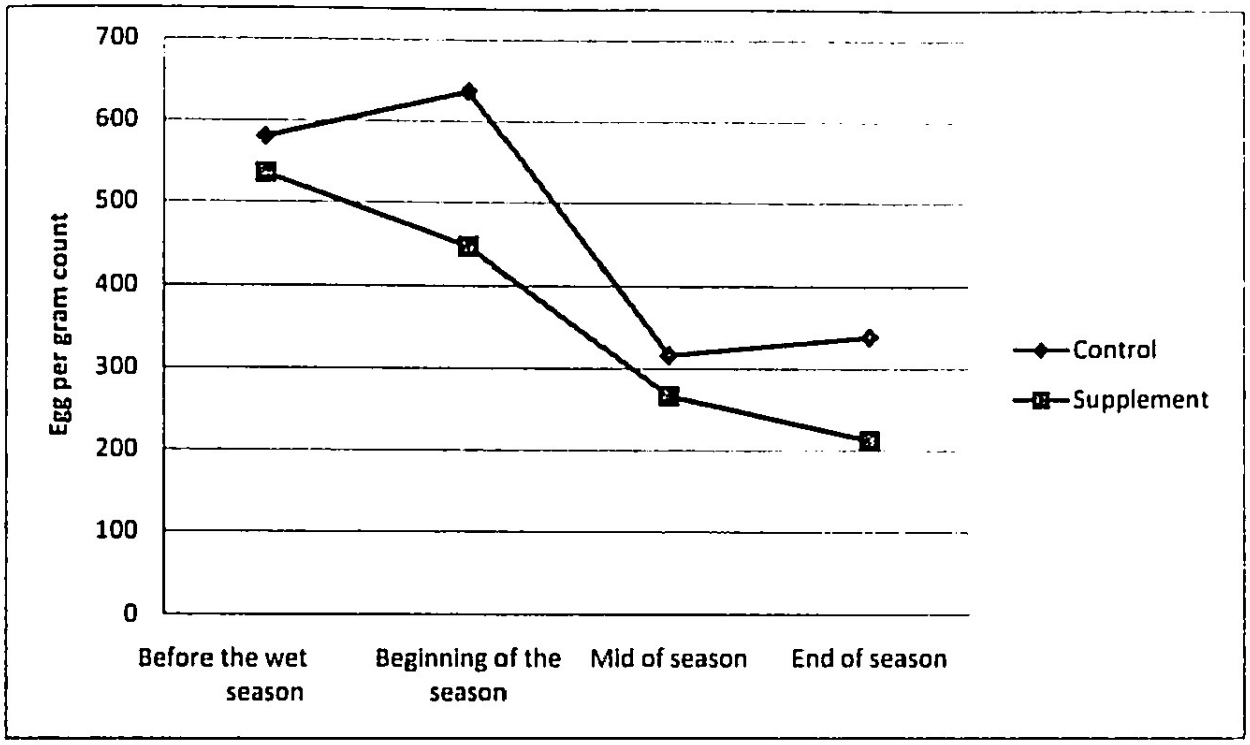

Figure 3.2: Egg per gram count in female adult goats supplemented with Molasses Urea Block

The EPG square means for weaner goats are shown in Table 3.8 below. As the wet season started the EPG for all weaners decreased. There were significant treatment effects as SWM's EPG was lower ($P<0.05$) than CWM by an EPG of 128.57 at the beginning of the wet season while SWF's EPG was than CWF by 156.46. The difference between supplemented weaners persisted through the mid-season. At the end of the wet season the SWM and SWF still had lower EPGs than their control counterparts, ($P < 0.05$).

Table 3.8: Egg per gram count in weaner goats supplemented with Molasses Urea Block during the wet season.

Sex	Males		Females	
Treatment	Control	Supplement	Control	Supplement
Before the wet season	1025±372.90	625.00±91.50	650.003±89.47	750.00±84.71
Beginning	453.57±84.71[a]	325.00±147.78[b]	573.08±141.99[a]	416.67±89.54[b]
Mid of season	422.73±154.36[a]	266.67±372.90[b]	354.17±91.50[a]	320.83±372.90[b]
End of season	296.42±82.90[a]	225.00±89.54[b]	308.33±147.78[a]	288.46±86.03[b]

Means in the same row with same superscript in a row do not differ significantly, (P<0.05).

Figure 3.3 below shows a graphical line presentation of egg per gram count (EPG) in male weaner goats supplemented with MUB. At the beginning of the experiment till the end, the egg per gram count of supplemented animals was lower ($P < 0.05$) than that of control groups. The EPG of both supplemented and control animals were dropping as the season progressed.

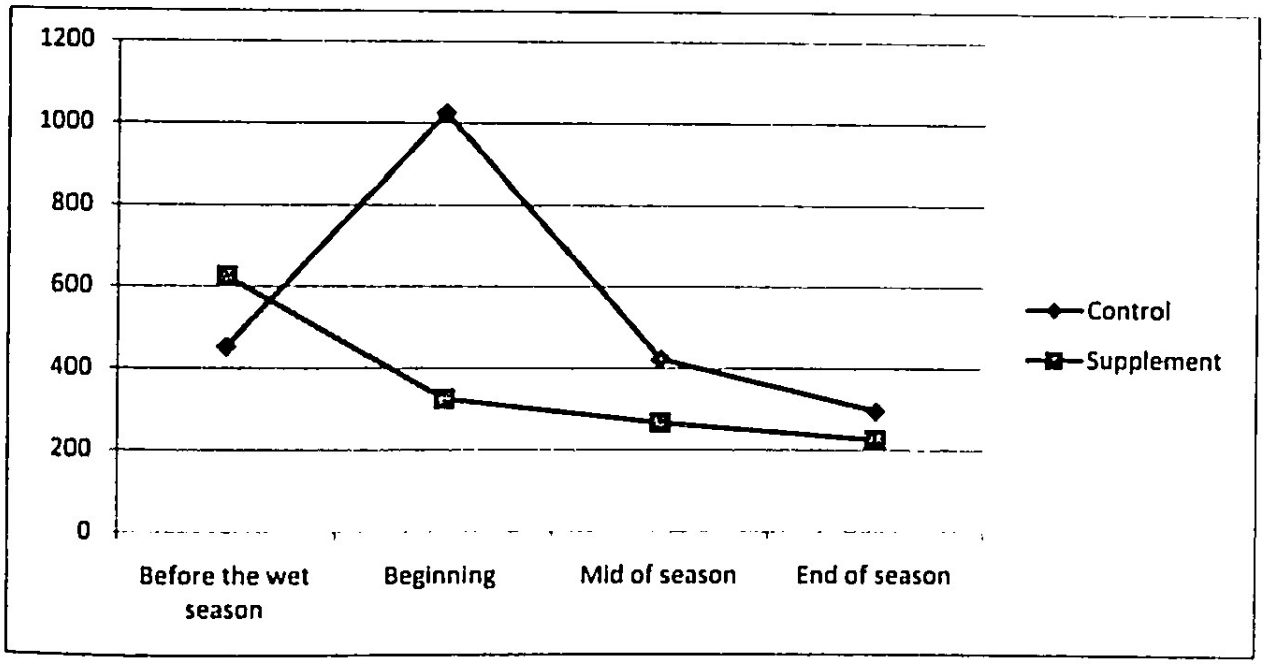

Figure 3.3: Egg per gram count in male weaner goats supplemented with Molasses Urea Block

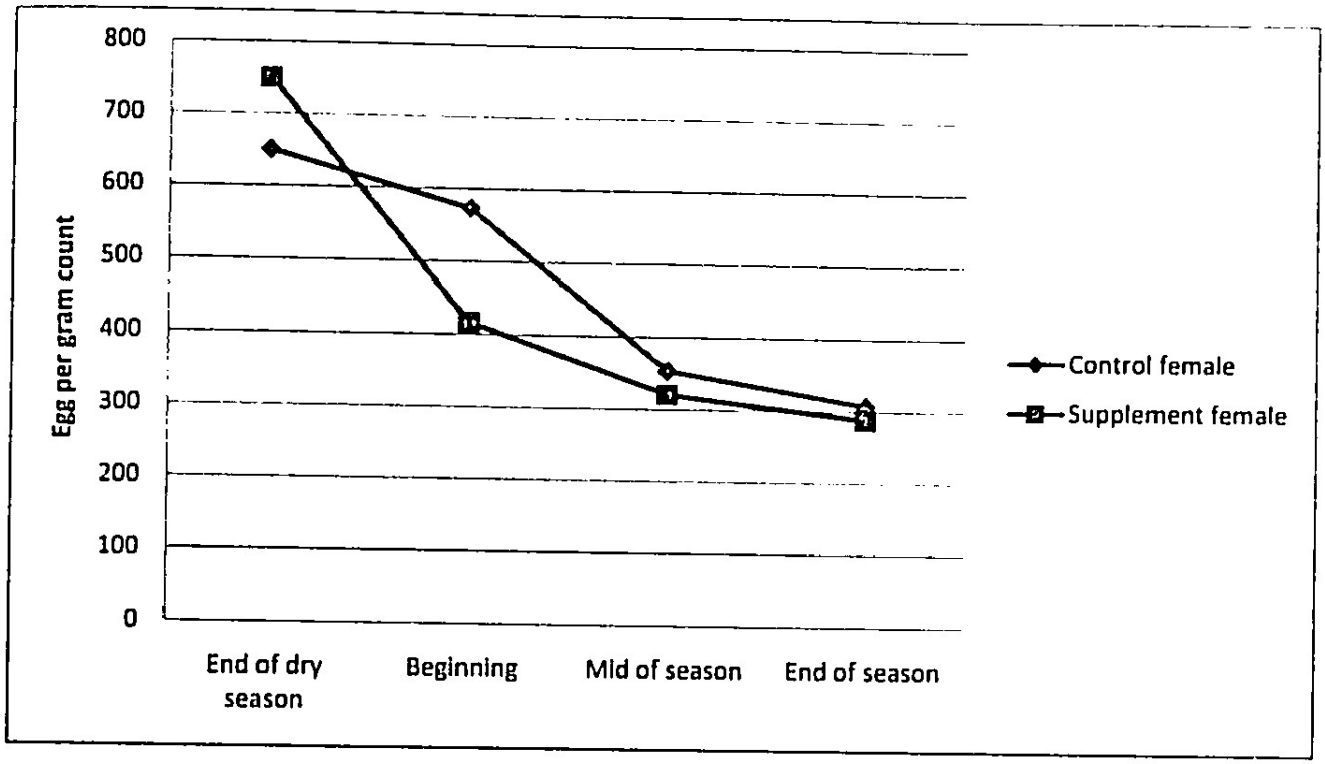

Figure 3.4: Egg per gram count in female weaner goats supplemented with Molasses Urea Block

3.6 Discussion

3.6.1 Weight gains

In this study it was apparent that all treatment and control goats from the beginning to the end of the experiment, were gaining weight. The gaining of weight by goats could be attributed to the good range conditions as it was during the course of the wet season. However, from the beginning to the end of the wet season, supplemented male weaner males (SWM) fed MUB were heavier (22.62kg) ($P<0.05$) than the CWM (17.82kg), thus a difference of almost 5kg in growth. The SWM gained heavier ($P<0.05$) weight and almost double (0.106 kg/day) that of the CWM (0.075 kg/day).This agrees with (Olafadehan and Adewumi. 2009), who found that average daily gains (ADG) and body condition scores (BCS) of supplemented cows were significantly better than the non-supplemented cows. Tswana goats were reported to have a potential to grow faster on a good diet but when the diet was poor such as the native rangelands, this potential could not be attained (Aganga and Sera 2010). This trend was also observed in the treatment weaner females which were significantly heavier ($P < 0.05$) at the end of the wet season. The SWF gained a total of 8.82 kg (65% mass accumulated) while the CWF gained 5.18 kg (almost 48% mass accumulated) in total. The ADG for SWF (0.098kg/day) was higher ($P< 0.05$) than that of CWF (0.058kg/day) by the end of the wet season. This phenomenon agrees with Idris *et al.*, (2011) who found that supplementation had a significant effect on lambs' growth rate after weaning.

The MUB effect on was apparent in adult goats. Supplemented adult males (SAM) were heavier ($P < 0.05$) than CAM at the end of season. However, the treatment effect did not surface in SAF. At the end of the season the SAF were losing weight (-1.12 kg) while CAF gained (2.42 kg), which was in disagreement with Olafadehan and Adewumi, (2009) who found that unsupplemented cows had a more pronounced weight loss than the supplemented cows. The aspect of gaining less weight in the mid-season and subsequent weight loss at the end of wet season by SAF could be attributed to reduced grazing activity as previously reported by Milne *et al.*,(1981) above that supplementary feeding had impact on grazing of the animal. It was reported that grazing activity in lactating ewes decreased as the level of supplementary feeding was increased, which also explained the why SAM responded well to supplementation as they were

not lactating. Cisse *et al.*, (2002) also indicated that goats provided no supplement ate more forage in the pasture than those that received supplement; this also explained the parallel growth experienced by control goats. Yurtman *et al.*, (2005) also found supplemented goats showed 52 % less grazing than those in control. The reduced grazing by supplemented female adults (SAF) led to the lowered weights at the end of the wet season. The loss could also be attributed to the urea in MUB. Urea was a non-protein compound that hydrolysed rapidly to ammonia [NH_3 (aq)] when it entered the rumen. In order for ammonia $NH_{3\,(aq)}$ to be efficiently incorporated into microbial protein, its concentration must be below optimum or otherwise at its peak it will be simply absorbed into the ruminal wall and lost from the animal resulting in low protein synthesis and poor growth rate (Mc Donald *et al.*, 1996).

At the end of the wet season SAM were heavier ($P<0.05$) than SAF. This was also the case with weaner goats, whereby SWM were heavier ($P < 0.05$) than SWF (22.36 ±1.23 kg). This above finding was reported by Aganga and Sera (2010), where it was found that sex had a greater influence on the growth rate of kids, where males gained more weight (2.9 kg) than females (1.9 kg) under semi-intensive management. This effect of MUB supplementation was also found by Tiwari *et al.*, (2008) where the MUB supplemented buffalo calves that ate rice straw as basal diet were heavier than those which were fed rice straw only. Jinjun *et al.*, (2006) also found a significant difference in live-weight gain between control and MUB treatment ($P <0.01$). By the end of the experiment, the live-weight gain of animals fed with MUB was 17.6 kg greater ($P<0.05$) than those without MUB after the 45 day fattening period.

Akbar *et al.*, (2006) found that feeding MUB to smallholder dairy cows improved their live-weight and condition score and milk yield was increased by 32–33%. Supplemented animals' higher average daily gains could also be attributed to the block's character of improving the nutritional plane as found by Nguyen van Thu (2001), that there were improvements ($P < 0.01$) in *in vivo* dry matter, organic matter and neutral detergent fiber digestibility in the MUB supplemented diets of buffaloes. Feed digestibility was enhanced by MUB supplementation. Supplementation with the urea-molasses-mineral mixture improved ruminal NH_3-N, rumen microbial populations and feed digestion of swamp buffaloes. This implied that MUB supplemented goats utilised the pasture more effectively than non-supplemented ones. The

difference in feed digestibility could be seen as the fibre values (NDF & ADF) were higher in range than in the MUB. All goats supplemented on MUB were on good nutritional plane than those fed on range due to the superior quality of the MUB (table 3.3) compared to the range (table 3.1 and 3.2), except for the SAF group.

3.6.2 Egg per gram counts (EPG)

It was observed that all treatments and control goats' EPG decreased from the beginning of the wet season. This could be attributed to the good nutrition available in the form of pasture. However, at the end of season whereby SAF's EPG (212.50±29.56) was significantly lower ($P<0.05$) than the CAF (338.89±28.10) This was supported by Sikosana *et al.*, (2004) who found that goats supplemented with browse pods had lower EPG than the non-supplemented ones. Even though there was no treatment effect for most part of the wet season, there was a gradual decrease in egg per gram count for the supplemented animals. Males had a lower egg per gram count at the end of the wet season than females in both control and treatment, (Fig 3.1, 3.2, 3.3 and 3.4).

The egg worm count between supplemented and control weaner goats was not statistically different, ($P > 0.05$). The SWM depicted a gradual decrease ($P<0.05$) in egg per gram count as the season progressed while the SWF goats had lower ($P< 0.05$) egg worm count (288.46±86.03) than control female weaners (416.67±89.54) at the end of the season. The SWM (225.00±89.54) and CWM (296.42±82.90) had lowest egg per gram count than female weaners at the end of the wet season. Adult goats had significantly lower EPG than weaners by virtue of being more tolerant to worm infestation than the less resistant younger animals.

This agrees with Vatta *et al.*, (2007), that the molasses urea block supplementation appeared to reduce the faecal egg counts in communally grazed goats at Kwazulu Natal. Akbar *et al.*, (2006) also found that the animals fed MUB showed lower egg counts ($P <0.05$) than those offered the unsupplemented control diet by the end of experimentation. The findings of this study coincided with studies by Waruiru *et al.*, (2004) where it was found that kids in group on MUB had faecal egg counts differing with those were not given MUB. The mean worm counts for the MUB group was 482 ± 299 and were ($P<0.05$) lower than that of the pasture fed (1 302 ± 410). The

results indicated that MUB had significant effects in the control of gastro intestinal nematode parasitism and enhanced growth of the young goats.

3.7 Conclusions

One of the major factors that affected the livestock performance is nutrition. An adequately provided nutrition, supplementation included, alleviated the effects of the harsh environment and poor management hence enabling animals to reach their genetic potential. As per the result of this study, the nutritional interventions of supplementing adult and weaner goats with molasses urea block (MUB) during the wet season improved their health regarding reduction in faecal egg worm count. The feeding of MUB also improved their growth rates. The MUB had higher nitrogen content hence it elevated ammonia concentration in the rumen which is very crucial to microbial degradation and protein synthesis. Ruminal microbial growth was fast in supplemented goats than control animals. The breakdown of carbohydrates in the ingested feed resulted in high growth rates of supplemented weaner and adult goats, respectively. A protein deficient diet; (the feed available to unsupplemented goats) resulted in the low concentration of rumen ammonia and the slow growth of rumen microbes. The breakdown of carbohydrates got retarded resulting in poor growth rate.

Even though all the goats showed some positive weight changes and the reduction in EPG from the beginning of the wet season till the end the season, goats supplemented with MUB had higher ($P<0.05$) weight means and significantly lower EPG. Molasses urea block (MUB) improved the growth rate of adult and weaner goats during the wet season. It was inferred that MUB supplementation economically improved the feed efficiency in extensively grazed goats. Its low fibre content improves the bioavailability of nutrients which was reflected in improvement in growth and health performance of the goats.

Therefore this implied that it was necessary to have in place a feeding plan during the wet season for the communally managed smallstock flocks. Feeding the MUB also reduced the egg worm load in both adult and weaner goats, as such it acted as a good anthelmintic by improving the health of goats. It was clear that feeding molasses urea block had a positive impact on the growth and health of both adult weaner goats. This therefore implied that MUB was both a good nutritional and health intervention for the extensively reared goats during the wet season, unlike the anthelmintic for which the internal parasites can develop resistance against. It was therefore concluded that MUB was economically advantageous to use as a supplement since it can relieve

he farmer the pressure to buy both feed supplements and dewormers due to its nutritional :ontribution and anthelmintic nature as shown by reduction faecal egg worm and weight gains in ;upplemented goats.

3.8 Recommendations

a) Albeit the common practice of feeding MUB during the dry season, it can also be fed during the wet season to ward off the pressure of buying anthelmintic and supplements for goats.

b) It is advisable to have a feeding plan for the extensively managed goats during the wet season, because the rainy season may commence at a time when the vegetation is still dry and indigestible.

c) Farmers should be aware of the poisonous state that MUB assumes when it gets wet due to its urea content. MUB should not be left in the rain; hence it should be removed from feeding troughs if it has had contact with water.

d) MUB is also very effective during the wet season for it improves the digestibility of the dry pasture that is prevalent at the beginning of the wet season before re-sprouting.

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CHAPTER FOUR

THE EFFECT OF IVERMECTIN ADMINISTRATION ON THE PERFORMANCE OF GOATS IN OODI EXTENSION AREA: KGATLENG DISTRICT, BOTSWANA.

Abstract

The aim of this study was to determine the effect of anthelmintic administration on the goat growth and egg per gram count. Following deworming at the beginning of the wet season there was a significant treatment effect as weaner goats (IWF and IWM) were heavier ($P < 0.05$) than their control counterparts. This treatment effect persisted till the end of the wet season. The growth rate (ADG) of IWF and IWM was different ($P < 0.05$) from the CWF and CWM, respectively, at the end of the wet season. The treatment effect was also observed in the worm egg counts of dewormed (injection) weaner goats, with IWF and IWM experiencing lower ($P<0.05$) egg per gram count (EPG) than the control weaners over the same experimental period. The dewormed weaner goats (IWF & IWM) egg load reduced with progression of the season and their EPG was lower ($P<0.05$) than control weaners (CWF & CWM) at the end of the wet season. The IMW had the lower ($P<0.05$) EPG than IWF. The IWM also had lower ($P<0.05$) EPG than CWF at the end of the wet season. The impact of the treatment was also exhibited by adult goats (IAF and IAM) which were heavier ($P<0.05$) than control adult goats (CAF & CAM) at wet season's end. The ADG of the IAF and IAM was higher ($P<0.05$) than their control counterparts. The EPG also showed significant treatment effect between treated adult goats and control animals. The IAF had lower ($P<0.05$) EPG than CAF, similarly IAM had lower ($P<0.05$) EPG than CAM, at the end of the wet season. The EPG of treated adults reduced as the season progressed. At the end of season IAM had lower ($P<0.05$) EPG than IAF. The anthelmintic treatment administered reduced the worm load in all classes of goats treated.

4.1 Introduction

Goats are hardy and well-adapted to harsh climates. Due to their grazing habits and physiological characteristics, they are able to browse on plants that would normally not be eaten by other livestock species. Thus, the presence of goats in mixed species grazing systems can lead to a more efficient use of the natural resource base and add flexibility to the management of livestock. Sheep and goats contribute to a broad range of production systems. The most common system throughout the developing countries involve either the extensive system with large herds and/or flocks grazing on arid and semi-arid rangelands or the intensive system with smaller herds and/or flocks kept in confinement, mostly in the humid tropics. Both systems are characterized by low input use (Banerjee *et al.*, 2000).

Sheep and goats are important in development because of their ability to convert forages and crops and household residues into meat, fibre, skins and milk. The economic importance of each of the products varies between regions, especially in the developing countries. In terms of total output, sheep and goat products are the most important in developing countries where 45% of all sheep meat, 54% of all sheep milk, 93% of all goat meat, and 73% of all goat milk are produced (Timon, 1985). In the last decade, small ruminants in developing countries were less productive than those in developed countries. However, the total product from small ruminants increased in developing countries because their numbers increased. This indicates that if developing countries could increase herd productivity, they could increase production (Winrock International, 1983).

Shearer 2003; Mobini, 2002) stated that *coccidia* and various nematodes (worms) are major internal parasites of importance in young growing kids, particularly *haemonchus* species. Coccidiosis can affect kids and lambs as early as two weeks of age with diarrhoea as the most consistent sign. Kids and lambs become weak dehydrated and may demonstrate signs of abdominal discomfort. Rapid detection, isolation, and prompt treatment of affected lambs and kids are important for reducing kid losses. Reducing exposure to faeces is of prime importance in controlling this disease. Thus feed bunks and hay mangers should be constructed in such a way that kids and lambs are kept out. The nematodes of goats which cause the majority of problems are the large stomach worms (*haemonchus*), although lungworms and tapeworms can be important in some herds. Stomach worms suck blood and will cause profound anaemia, weight loss and weakness in severely affected animals. A vigorous sanitation and deworming program

may be the best advice for controls at the present time. The external parasites are equally important in parasitism problems of small ruminants. They can likewise result in anaemia, weight loss and gradual debilitation. Deworming should be performed routinely (every two to three months). Deworming programs should be designed to include a deworming treatment for does 30 days prior to and again at kidding. This is advised because information in recent years suggests that the immune response to parasitic infection is suppressed in the doe near kidding time. (Shearer 2003; Mobini 2002). The aims of undertaking this study were to determine the effect of anthelmintic administration on the egg worm count and growth of extensively reared goats.

4.2 Objectives

The specific objectives were;

i) To determine the effect of anthelmintic administration on the growth of adults and weaner goats.

ii) To determine the effect of anthelmintic administration on egg per gram count of adults and weaner goats.

4.3 Hypothesis

Ha; Administration of anthelmintic will **not** reduce the egg per gram counts and improve growth rate in adult goats and weaner goats.

Ho; Administration of anthelmintic will reduce the egg per gram counts and improve growth rate in adult goats and weaner goats.

4.4 Methodology

4.4.1 Study area

The study was carried in Oodi extension area, Kgatleng district. This location was chosen due to its proximity to the institution of study, Botswana College of Agriculture. Kgatleng district is located in the south-eastern part of the Botswana and the selected villages are almost 10-15 kilometers from the capital city of Botswana, Gaborone. The rainfall distribution of the study area is varied with an annual mean ranging from 400-500 mm. The vegetation of the area is tree savannah.

4.4.2 Identification of the study animals

Nine (9) farmers with more than thirty (30) animals and practicing extensive management were randomly selected for this study. In each kraal nine adults and nine weaners of different sex and almost equal weight were chosen as experimental animals. The mean body weight of the chosen weaners was 11 kg while those of adults were 26.5 kg. All animals were tagged for identification purposes.

4.4.3 Live weight measurement

Growth rate was determined monthly from all treatments by weighing the animals using a 1250 X500 mm, step-in mobile scale with salter gauge calibrated form 0 to 200 kg. Goats were weighed in the morning before being released for grazing. The weights were recorded against the identification tags.

4.4.4 Faecal sampling

Faecal samples from adult goats and weaners were collected monthly by collecting fresh faeces from the rectum into the faecal bottles. The faecal samples were kept on ice and then refrigerated before examination to stop larval development.

4.4.5 Egg Worm counting

A modified McMaster technique (MAFF, 1978) was used to determine the number of worm eggs per gram of faeces. Dry faeces weighing two (2) grams were crushed with a spoon. Forty five (45) glass balls were placed together with crushed faeces into a faecal bottle. Twenty eight (28) ml of tap water was added to the mixture and which was shaken thoroughly after tightly closing the bottle. The mixture was then poured through a sieve to collect the fluid. The fluid was then poured into a centrifuge tube up to its brim. It was then centrifuged for two (2) minutes at approximately one thousand revolutions per minute (1000 rpm). The supernatant was poured off and in it saturated salt solution was poured to fill the centrifuge tube. The sediments were then mixed with salt solution using the wooden applicator stick. The contents were then thoroughly mixed by tilting or inverting the tube 5 to 6 times. A sufficient amount of mixture enough to fill the one half of the McMaster slide was taken. The mixture was shaken and again enough of it taken to fill the remaining half of the slide. All the nematode eggs occurring on and within the engraved lines in both halves of the slide were counted. The total number of eggs counted was multiplied by a factor of 50 and the results recorded as egg per gram (Uruqhart *et al.*, 1996).

4.4.6 Experimental Design

The experimental animals were grouped according to age (adults and weaners) and allocated to two (2) treatments as stated below; each treatment had three (3) replicates in a randomised complete block design (RCBD), thus a 2 x 2 x 3 factorial design in RCBD.

4.4.7 Treatments

Control: Adult and weaner smallstock were managed according to the traditional management system whereby no injection management intervention was introduced. This treatment was the control.

Anthelmintic: Every adult and weaner smallstock received one subcutaneous injection of 10mg/kg of Ivermectin (an anthelmintic) per week for two weeks. Every month animals received one shot (10mg/kg) of Long Acting Terramycin for three months to block for Heartwater.

4.4.8 Experimental Model

$Y_{ijk} = \mu_{ij} + A_I + T_j + S_k + e_{ijk}$

Y_{ijk} = observation
μ_{ij} = general mean
A_i = age effects
T_i = treatment effects
S_k = sex effects
e_{ijk} = random error

4.4.9 Statistical Analysis

The data were subjected to Analysis of Variance (ANOVA) using the General Linear Model of SAS (2002). Treatment means were tested for significance at 5 % using the Least square means.

4.5 Results

Weight increase is a great indicator of growth. All weaners were growing from the beginning of the wet season till the end of season as illustrated by changes from initial weights, Table 4.1 below; however the significant difference ($P < 0.05$) was apparent between treated (injection) weaners and control weaners at the end of study. The dewormed weaner males (IWM) were heavier ($P<0.05$), with 18.55kg than control weaner males (CWM) at 12.71kg. The dewormed weaner (IWF) females also weighed heavier ($P<0.05$) with17.67 kg than control weaner females (CWF) at 11.88 kg, Table 4.1. The difference in weight gain between treatment weaners and control weaners was also illustrated in the ADG. The ADG of IWM (114 g/day) was higher ($P<0.05$) than CWM's ADG (75 g/day). The IWF also gained (129 g/day) which was a high ($P<0.05$) growth rate than CWF with an ADG of 58 g/day.

Table 4.1: Body weight means (kilograms ± standard errors) and Average daily gain (kg) of dewormed and control weaner.

	Sex	Male		Female	
	Treatment	Control	Ivermectin	Control	Ivermectin
Before the wet season	October	11.04±0.59	11.85 ±0.62	10.86± 0.55	10.27± 0.53
Beginning	Nov -Dec	12.71± 1.64^{b}	18.55 ±1.21^{a}	11.88 ±1.08^{b}	17.67± 1.04^{a}
Mid-season	Jan-Feb	16.64± 1.17^{b}	20.70± 1.23^{a}	14.62 ±1.07^{b}	17.57± 1.03^{a}
End	March -April	17.82± 0.97^{b}	22.10 ±1.02^{a}	16.04 ±0.89^{b}	21.93 ±0.86^{a}
ADG (Kg/day)		0.075	0.114	0.058	0.129

Means with the same letters and on the same row are not significantly different, $P < 0.05$.

Below are the Least square weight means (kilograms) and standard errors and their Average daily gain ADG (kg/day) and standard errors of adult goats in Table 4.2. The difference in growth became apparent during the course of the wet season whereby treated adult males (IAM)

were heavier (P<0.05), 44.63kg than control adult males (CAM) at 29.69 kg. The difference was observed until the end of the wet season even though the CAM were gaining weight progressively while the IAM seemed to gradually lose weight from the mid-season till the end of the wet season. The ADG of IAM was lower (P>0.05) [3.7 g/day] than CAM (64 g/day). An almost similar trend was observed between the treated adult females (IAF) and control adult females (CAF). The CAF were gaining weight progressively till the end of the wet season but they weighed lower (P < 0.05) weights than IAF. On daily basis the IAF grew faster (P<0.05), [144 g/day] than CAF at 101 g/day.

Table 4.2: Body weight means (kilograms ± standard errors) and Average daily gain (kilograms) in dewormed and control adult goats

	Sex	Male		Female	
	Treatment:	Control	Injections	Control	Injections
Before the wet season	October	26.92±1.82	44.00 ±3.27	33.46 ±1.75	32.14 ±1.42
Beginning of the wet	Nov-Dec	29.69±1.72^{b}	44.63± 3.10^{a}	35.57 ±1.65^{b}	39.66 ±1.35^{a}
Mid-season	Jan-Feb	34.50±2.38^{b}	44.50 ±4.77^{a}	40.13±2.38^{b}	42.62 ±1.80^{a}
End	March-April	35.46 ±2.62^{b}	43.67±5.24^{a}	42.58 ±2.62^{b}	45.06±2.19^{a}
ADG (kg/day)		0.064	0.0037	0.101	0.144

Means with the same superscript and on the same row are not significantly different (P< 0.05).

The Least square means egg per gram (EPG) count and standard error of worm eggs in adult goats are shown in Table 4.3, figure 4.1 & figure 4.2 below. At the beginning of the wet season the EPG of control adult goats increased sharply while it drastically decreased (P<0.05) for treated adult goats. The CAM experienced an increase of 83 in EPG while CAF egg worm count increased by only 56.11. At the beginning of the wet season there was significant treatment effect as dewormed male adult goats (IAM) had lower (P<0.05), [121.42] EPG than the control male adults (CAM) at 444.4. This was also the case for dewormed female adults (IAF) which had a lower EPG (P<0.05) of 232.35 than the control female adults with 636.67. The EPG for

treated (dewormed) animals were lower ($P < 0.05$) than those of the control animals. Egg per gram count (EPG) of treated animals reduced ($P < 0.05$) substantially from the beginning of the season till the end while that of the control adult goats tend to increase as illustrated pictorially by the line graphs; **Figure** 4.1 and 4.2 respectively. Males had lower ($P<0.05$) egg counts than the females at the end of the season.

Table 4.3: Egg per gram count means in dewormed and control adult goats

Sex		Male		Female	
	Treatment	Control	Injection	Control	Injection
Before the wet season	October	361.11±124.93	521.42±141.66	580.56±88.34	444.74±85.99
Beginning	Nov -Dec	444.44±109.50[a]	121.42±124.17[b]	636.67±84.82[a]	232.35±79.68[b]
Mid-season	Jan-Feb	227.78± 45.62[a]	100.00± 55.88[b]	316.67±32.26[a]	112.50±34.22[b]
End	March - April	238.89± 36.65[a]	57.14 ±41.56[b]	338.89±25.91[a]	96.88 ±27.49[b]

Means with the same superscript are not significantly different (P< 0.05).

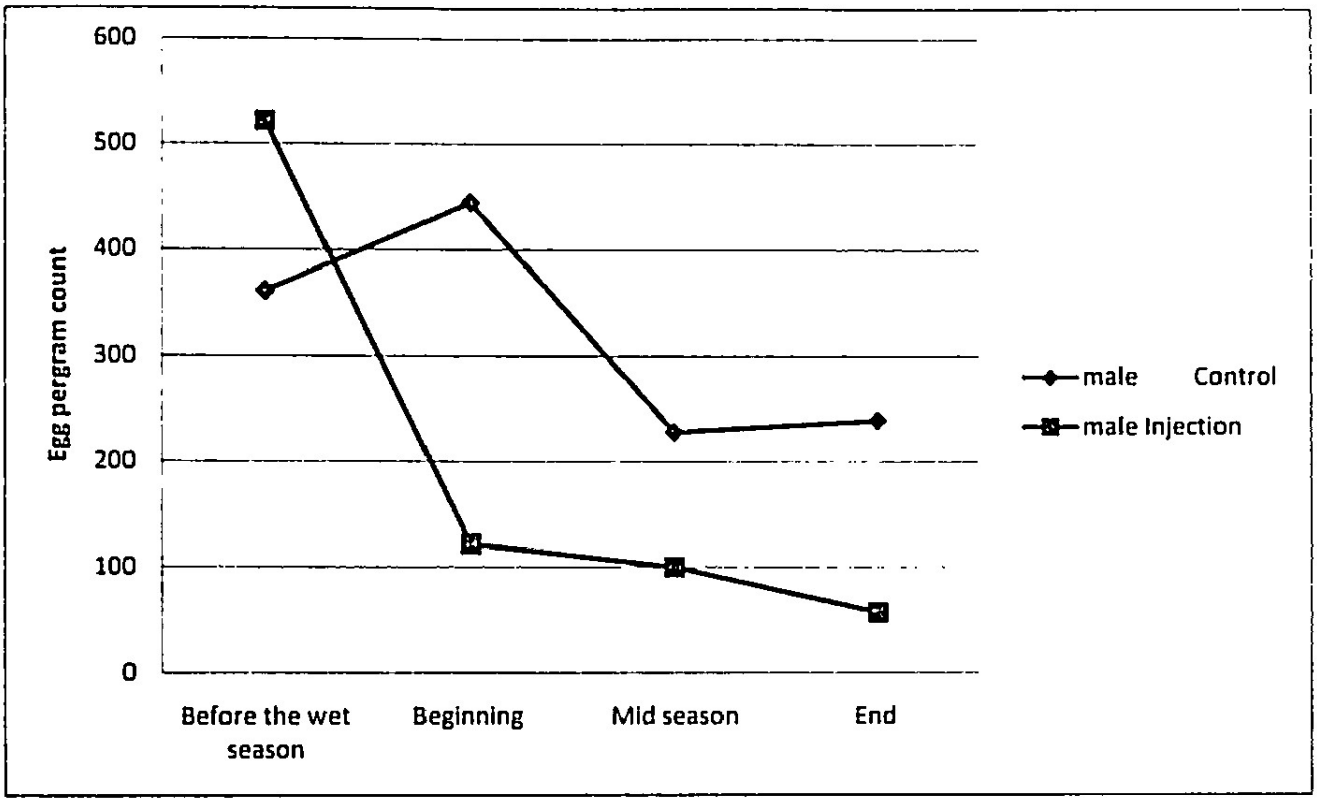

Figure 4.1: Egg per gram count means in dewormed and control male adult goats

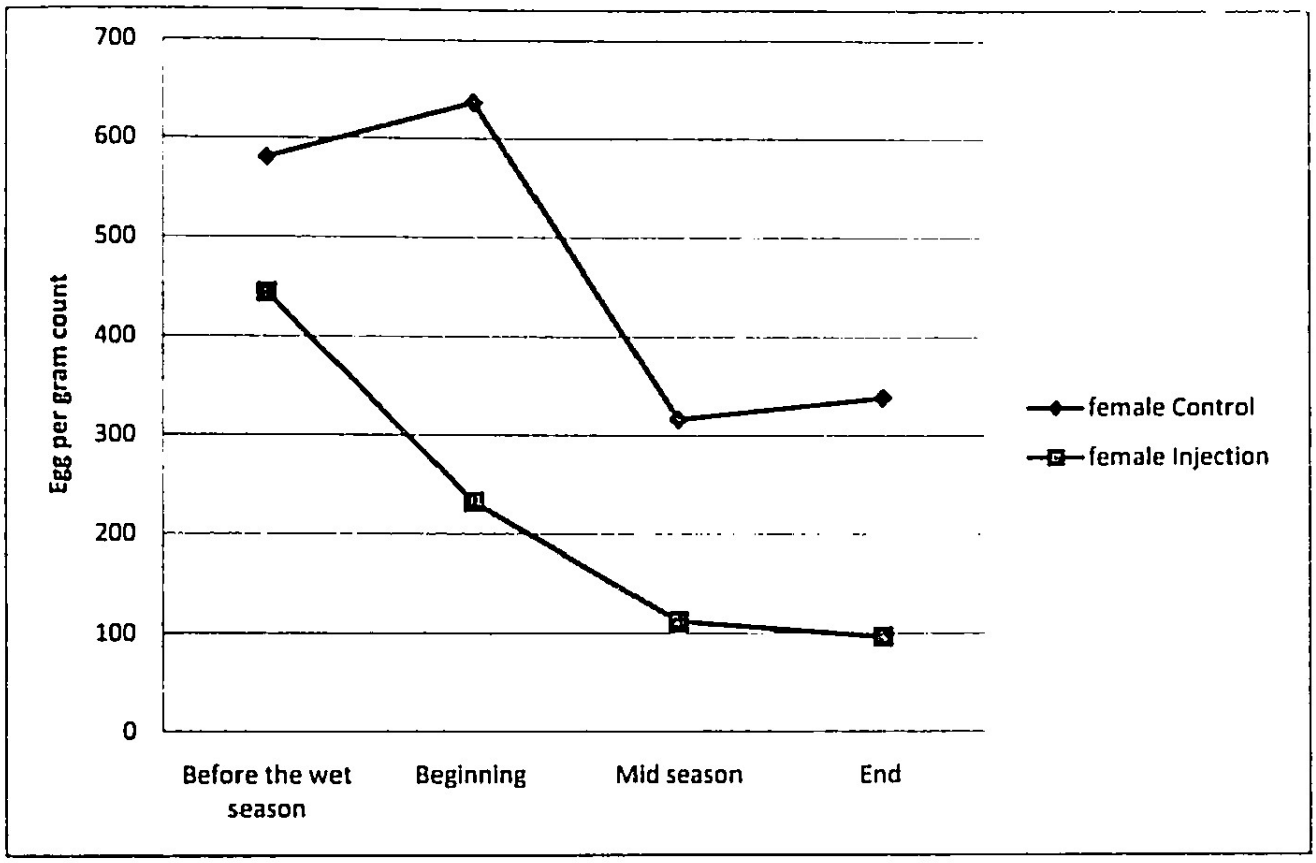

Figure 4.2: Egg per gram count means of in dewormed female and control adult goats.

Below are the least square egg per gram (EPG) count means and standard error of worm eggs in weaner goats, in Table 4.4, figure 4.3 and figure 4.4. At the beginning of the wet season EPG for CWM had increased by 586 from the initial count while the IWM drastically reduced ($P < 0.05$) by a count of 687.50 hence a pronounced difference, ($P < 0.05$). The dewormed female weaners (IWF) also had a higher ($P < 0.05$) EPG (1521.43±645.19) than the control female weaners (1200±727.87). The IWF attained an abrupt increase in EPG while the CWF experienced a reduction ($P < 0.05$) in EPG but at mid-season the IAF attained (1159) reduction ($P<0.05$) in EPG than 421 reduction attained by the CAF. Control adult males (CAM) also experienced a higher ($P < 0.05$) reduction (755) than IWM (211.11), however, the IAM had lower ($P<0.05$), [488] EPG than CWM at 1183.38. At the end of the wet season the IAF and IAM had highest ($P<0.05$) EPG reduction of 88% and 85% respectively than CWM (63%) and CWF (67%). IWF and CWF had the lowest ($P<0.05$) EPG means than IWM and CWM weaners.

Table 4.4: Egg per gram count means in dewormed and control weaner goats

Sex		Male		Female	
Treatment		Control	Injection	Control	Injection
Before the wet season	October	1353.57±81.99	1387.50±88.56	1391.67±88.56	1343.33±79.21
Beginning	Nov -Dec	1939.29±645.19^{a}	700±727.87^{b}	1200±727.87^{a}	1521.43±645.19^{b}
Mid-season	Jan-Feb	1183.33±143.87^{a}	488.89±166.13^{b}	787.50±143.87^{a}	361.54±138.22^{b}
End	March - April	503.57±94.03^{a}	212.50±101.56^{b}	454.17±101.56^{a}	160.71±94.03^{b}

Means with the same superscript and on the same row are not significantly different (P< 0.05).

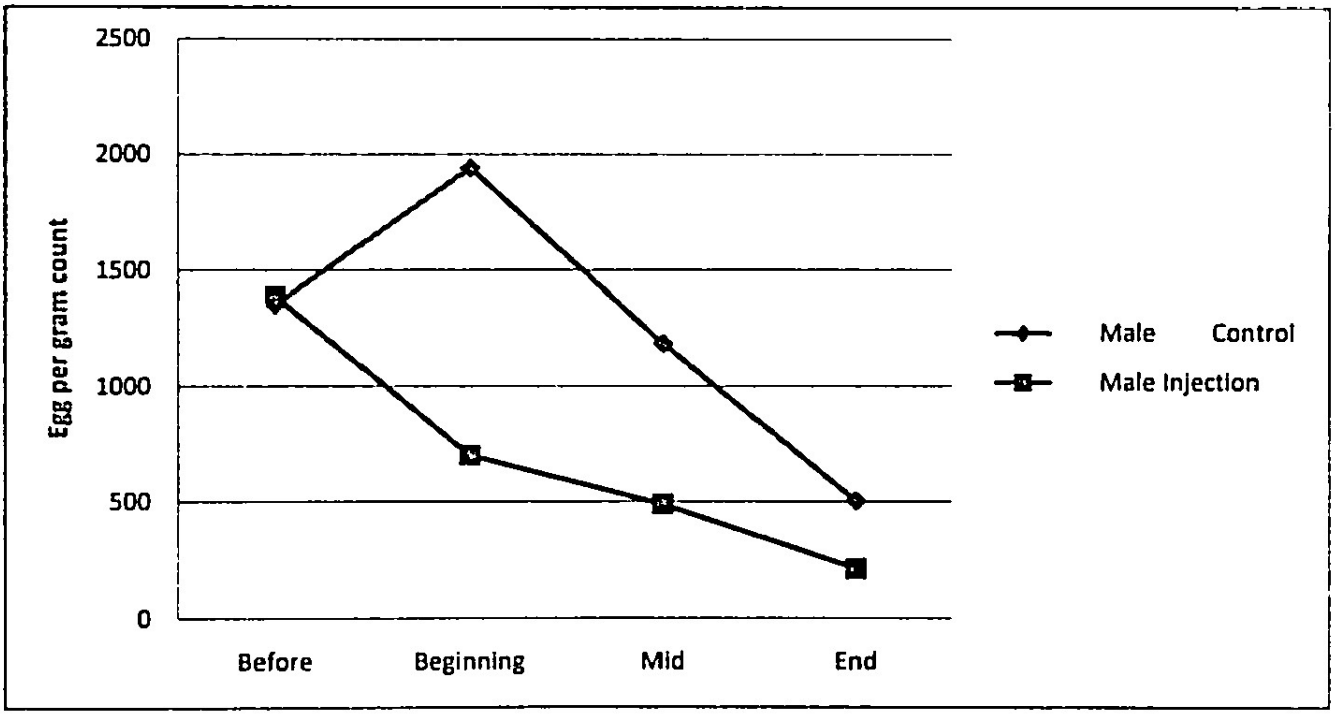

Figure 4.3: Egg per gram count means in dewormed (injection) and control male weaner goats.

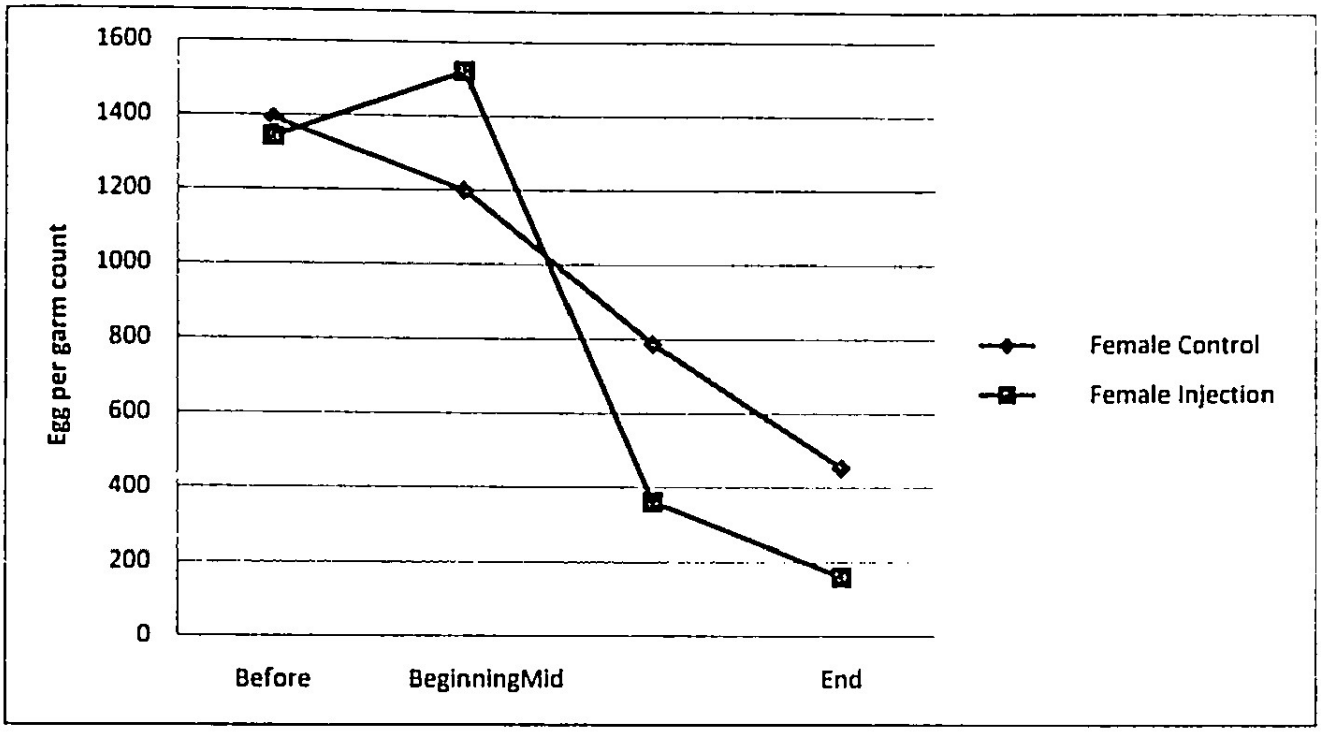

Figure 4.4: Egg per gram count means in dewormed (injection) and control female weaner goats

4.6 Discussions

4.6.1 Growth

At the beginning of the wet season till the end of the season there was significant treatment effect as the dewormed male weaners were heavier ($P < 0.05$) than the control male weaners. The injection female weaners were heavier than control male weaners. The other significant difference was apparent between the ADG of the treatment weaner goats and the control weaner goats. Better nutrition from nutritious wet season grazing of better quality lead to reduced worm load as observed in the previous experiment (chapter 3) and contributed to good ADG for treated animals as opposed to untreated ones.

Internal parasites have been described as a potential problem to most goat herds especially those that graze continuously. They tend to be infested with most common worms such as trichostrongylus, Mowlem (1992). It was found that controlling of internal parasites amongst other husbandry practices has the potential of substantially improving the weight gain rate of weaned Small East African goats, (Korir *et al.*, 2010).

The body weight means of dewormed adults were different ($P<0.05$) from the control adult males at the beginning of the wet season. The ADG for treated adult females was significantly different from control adult females. In the mid-season the treatment effect was still apparent as dewormed adult males ADG and body weight means differed from the control male animals but it was not the case with dewormed adult females as they lost weight. The loss of weight could be attributed to probable resistance development to anthelmintic by the endoparasites as reported by (Prichard, 1994).The emergence and spread of gastrointestinal nematode populations that are resistant to anthelmintic treatments have been found to contribute significantly to poor productivity in small ruminants particularly those reared in tropical and subtropical environments (Waller, 1999).

At the end of the season the treatment effects were insignificant ($P > 0.05$) as the treatment and control adult males' ADG and weight means were the same. This was also the case with treated adult females and control adult females.

There were several studies undertaken that have proved the importance of deworming which are consistent with this study. Dawo *et al.*, (2005) also observed that use plant; *Halothamnus somalensis* as anthelmintic improved body condition score in goats. The live weight change was also observed even though it was not significant.

Gatongi *et al.*, (1997) undertook a similar study to this one in order to evaluate the effects of anthelmintic treatment using Ivermectin before or during the rains, on performance of mixed sheep and goat flocks, birth weights and growth rates of offspring were significantly improved by the treatment administered before the rains.

4.6.2 Egg per gram count (EPG)

Before the beginning of wet season (before injections) the EPG of the weaner goats was relatively similar. This was also the case with adult goats. The counts were very high before the beginning of the wet season. After treatment administration (injections), the EPG for the treated adult goats and treated weaners decreased as compared to control groups till the end. The dewormed animals' EPG decreased gradually ($P < 0.05$) from beginning to the end of wet season and were lower than at the beginning of the wet season, Fig 4.3 & Fig 4.4. The treatment effect allowed the animals to gradually gain weight because of the reduced worm load while the control gained weight slowly since they were affected by a greater worm load. This finding coincides with findings by Dawo *et al.*, (2005) who found that anthelmintic effect of *Halothamnus somalensis* induced 50% reduction in EPG on goats under experimental conditions. In the same study the reduction of EPG increased with time after treatment. Biffa *et al.*, (2004) in Ethiopia also reported 52% reduction in EPG using water extract of *Albizziz gummifera* as anthelmintic. Gatongi *et al.*, (1997) found that treatment using Ivermectin, either before or during the rains, significantly reduced the faecal egg output on smallstock raised extensively.

4.7 Conclusion

There is no doubt that the anthelmintic administration has a substantial impact in improving the growth and health of goats through faecal egg worm count reduction. The administration of anthelmintic showed an improvement in the performance of adult goats and weaner goats, thus with regard to improving their health and subsequently growth. This was shown by a significant difference in weight gains and worm load of the goats. Dewormed goats had higher weight means, fast growth rate and low egg per gram count. Untreated goats had lower weight means, slower growth rate than treated goats.

Faecal egg worm count was high in young animals than in adult animals throughout the season. This implies young goats are less resistant to parasitic infestations. Adults' highest faecal count mean was 630 eggs while the young ones had the highest of 1939 eggs which was almost three times the amount of worms in adults. At the end the adult females has 96 eggs per count while weaners had 160 eggs per gram count. This therefore implied age played a significant role in the parasite load, with weaners experiencing the highest EPG.

4.8 Recommendations

i) Deworming should be performed routinely, following health programs/schedules and production stages of goats.
ii) It's advisable for farmers to administer Ivermectin during the wet season as it reduces egg worm counts in goats which lead to effective nutrients utilisation by the animals and consequent growth.
iii) Like other dewormers, farmers are advised to use Ivermectin interchangeably with other dewormers to avoid building Ivermectin resistant worms.
iv) Adherence to instructions with regard to administration and dosage rate is crucial to an effective Ivermectin usage.

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CHAPTER FIVE

THE EFFECT OF MANAGEMENT PRACTICES ON THE PROFITABILITY OF SMALLSTOCK ENTERPRISES IN BOTSWANA: THE CASE OF OODI EXTENSION AREA, KGATLENG DISTRICT

Abstract

The study was carried out at Oodi extension area in which 32 smallstock farmers assisted in providing the information through a questionnaire. The main objectives of the study were to; identify marketing channels used by producers in the Oodi extension area; determine the impact of management practices on profitability of smallstock in the Oodi extension area; as well as to determine the demographic characteristics of smallstock farmers in Oodi extension area. It was found that smallstock owners identified butcheries and individual people as the only marketing channels available in their extension area. Fifty six percent (56 %) of the respondents sold their goats to individuals and 9% sold to butcheries. The problems experienced when selling goats were lack of organized markets, and that the respondents did not sell goat products such as milk, skins and manure. Only 5 % of young able bodied people (21-30 years) were engaged in smallstock production hence age was also a constraint as most of the respondent who own smallstock were old (51-60 years). Education was also a constraint, with 31 % illiteracy among the respondents. Record keeping was not satisfactorily practiced, 97% of the respondents did not keep records. Poor and irregular feeding was prominent, whereby 63% of the respondents fed their smallstock but not regularly, mentioning high costs of feed as an impediment. Respondents did not have any vaccination schedule or health management program in place hence the prevalence of diseases and parasites. High costs of hired labour (41%) compared to self-employment (22%). The management practices also affected profit, respondents who spent less on inputs (e.g. labour, feeds) and sold their goats made profit unlike those who spent more on inputs and did not sell their goats. Those respondents who fed their animals also made profit as their animals reached market weight relatively over a shorter time. Thus, management practices had potential to increase the profitability of smallstock enterprises.

5.1 Introduction

The importance of livestock in Botswana's economy has long been recognised as a major source of income and employment for most of the rural dwellers (Ministry of Agriculture [MoA], 1991). The beef export in Botswana was one of the main sources of foreign exchange generated by the agricultural sector than smallstock sector (MoA 1989). While the cattle industry was the main source of foreign exchange, Seleka (1999) argued that smallstock was one possible avenue to improve welfare of rural communities, reduce their level of poverty, reduce and further diversify the economy of Botswana because the smallholder farmers make more investments in the small stock sector than in other enterprises, (Whiteside 1997). The populations of small stock in Botswana was estimated to be slightly fewer than 0.4 and 2 million sheep and goats, respectively, of which over 93% of each species were reared in the traditional sector (Botswana Agricultural Census Report, 2003). Over 80% of smallstock in communal areas is owned by traditional farmers, 70% of which were goats (MoA, 1991).

Steele (1996) described smallstock in the tropical countries as mostly owned by smallholder farmers who are rural area dwellers. These animals play a major role in the lives of rural populations as a source of protein and security. Goats are normally perceived as the poor man's cow due to their ability to provide sufficient products (meat, milk & fibre) to small holder farmers. That is why small ruminant production in general, sheep and goat production in particular, has in recent years gained increasing popularity in most of the developing countries. Apart from the social and economic functions that small ruminants play in developing societies, they also provide most of the meat supply for human consumption. Goat meat provides potential economic advantages to small ruminant farmers over large ruminant farmers (Cross, 1974; McDowell and Bove, 1977).

Aganga *et al.*, (2005) indicated that goat rearing is an integral part of the extensive farming systems in Botswana, playing an important role in the economy, especially among the smallholder farmers. Farmers get ready income through the sale of live animals. The income earnings imply livestock production in Botswana is a very important socio-economic activity. The semi-arid nature of Botswana climate and low human population density provide a great

opportunity for smallstock production. Also lack of alternative investment opportunities in rural areas has promoted investment in smallstock, (MFDP 1991).

5.2 Objectives

The objectives of this study were to:

1. Identify the existing management constraints faced by smallstock farmers in the Oodi extension area in Kgatleng District.
2. Identify marketing channels used by in the Oodi extension area.
3. Determine the impact of management practices on profitability of smallstock in the Oodi extension area.
4. Determine the demographic characteristics of smallstock farmers in Oodi Extension area

5.3.4 Statistical Analysis

Statistical Package for Social Sciences (SPSS, 2010) was used to analyze questionnaire data. Frequencies and percentages were used to describe the data. Profitability was determined using the budgetary analysis method. This method compares returns to costs;

Profit = Income - Expenditure

5.4 Results

The frequencies and the percentages of the respondents' demographic traits are shown in Table 5.1 below. A total of 81% males dominate ownership of smallstock while only 19% of respondents were females. Sixty nine percent of the repondents were literate while 31% were illetrate. The percentage of respondents who went to Primary and tertiary attendence was the same at 25%. About 13% of respondents went through Junior Certificate. The least attended level of education achieved was the upper secondery school at 6%. Apart fom owning smallstock, the respondents had other occupations. Fifty three percent (53.1%) of respondents practiced arable farming, followed by full time employees at 31%. A total of 9.4% of the responedents owned cattle while three (3%) percent of the respondents which were into part time jobs and owned other buisinesses respectively.

Table 5.1: Demographic characteristics of the smallstock owners

	No of persons interviewed	No of respondents (%)
Gender		
Male	26	81.3
Female	6	18.8
Level of education		
Primary	8	25.0
J.C	4	12.5
S secondary	2	6.3
Tertiary	8	25.0
None	10	31.3
Other sources of living		
Full time job	10	31.3
Part time job	1	3.1
Arable farming	17	53.1
Cattle	3	9.4
Others(own business)	1	3.1

Figure 5.1 shows the age distribution and corresponding percentages of respondents who own smallstock owners in the Oodi extension area. Forty four percent (43.8%) of the respondents were aged 51-60 years and dominated smallstock rearing followed by the thirty one percent (31%) of respondents aged 41-50 years. The oldest respondents were aged between over 61years at 6.3%, but the lowest were the young people at 3.1% aged between 21 and 30 years.

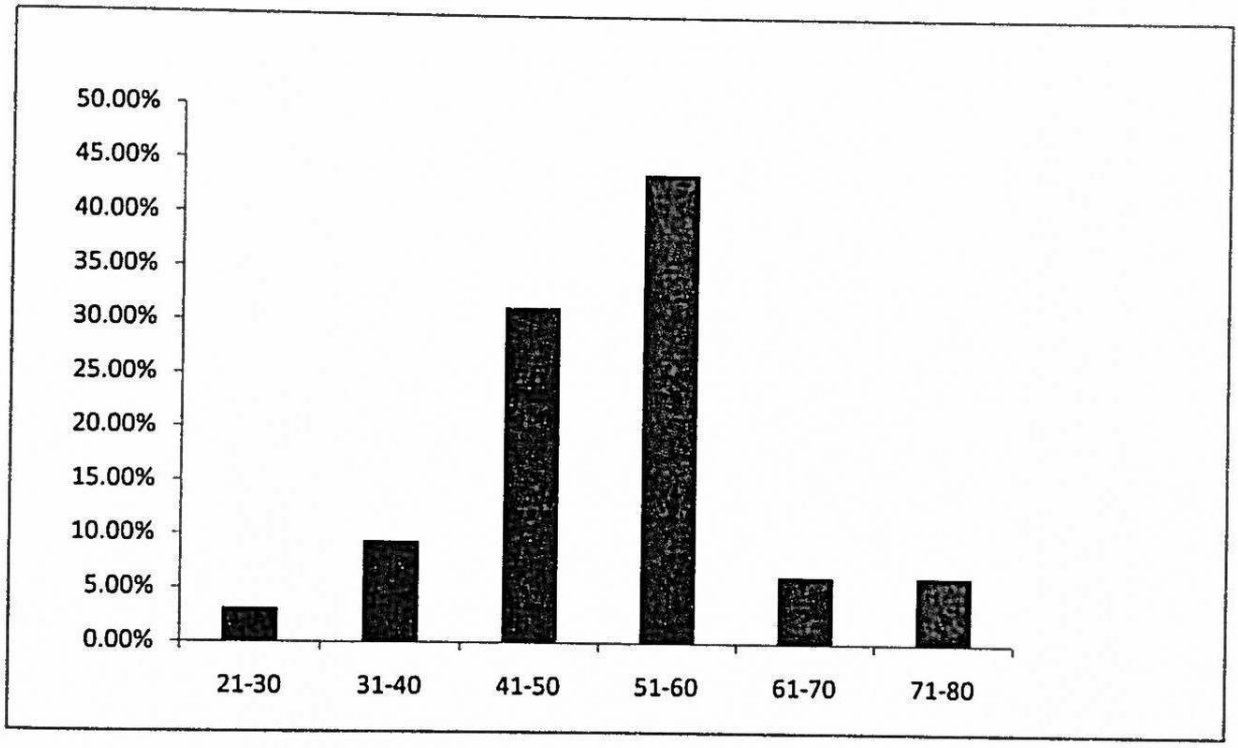

Figure 5.1: Age distribution of smallstock owners in the Oodi extension area

Table 5.2 below shows the management practices implemented by farmers in the Oodi exension area. Goats were owned by 78% of the respodents while 22% of the respondents had both sheep and goats. Goats were the preferred smallstock in the area.

Table 5.2: Management practices in Oodi extension area.

Type of smallstock	Goats	78%	Sheep & goats	22%
Record keeping	Yes	3%	No	97%
Knowledge of supplements	Yes	(23)72%	No	(9)28%
Usage	Yes	(20) 63%	No	(12)37%
Goat health plan	Yes	(17) 53%	No	15(47%)
Labour	**No of respondents**		**Percentage (%)**	
Self	7		22%	
Family	12		37%	
Hired	13		41%	

This could be attributed to their tasty meat and high adaptability traits as well as resitstance to diseases and parasites.

The practice of record keeping was a grave concern in the Oodi extension area, with almost all farmers not keeping records (97%) and very few (3%) of them keeping records.seventy two percent (72%) of the respondents had knowledge about supplements while 28% did not know anything about supplements, implying that the majority of the respondednts were aware of supplements. There was ample knowledge of supplements among the respondents. Sixty three percent (63%) of the respondents used supplements. Only 37% of the respondents did not use supplements. The respodents opined that supplements such as blocks and dicalcium phosphate were expensive.

The other factor examined was the health managemnt. It was found that 53% of the farmers had a health plan/vaccination schedule which ran concurrently with that of the extension office. Labour was very important in smallstock like other livestock endevours. Hired labour at 41% tops the types of labour used to run small stock, followed by family labour at 37% while the lowest was self employment (22%). The use of family labour and self employment by

respondents was percieved as a cost reduction measure because they did not pay herdbboy fees monthly as it was the case with hired labour.

Figure 5.2 below shows the types of housing used for goats in the Oodi extension area. There were three types of housing commonly used for smallsotck; thorn bush enclosures, fence + wood poles and fence + metal poles. The respondents preferred fence wire and wood pole kraals (59%), followed by thorn bush enclosure (38%) and lastly the kraal made of fence wire and metallic poles (3%).

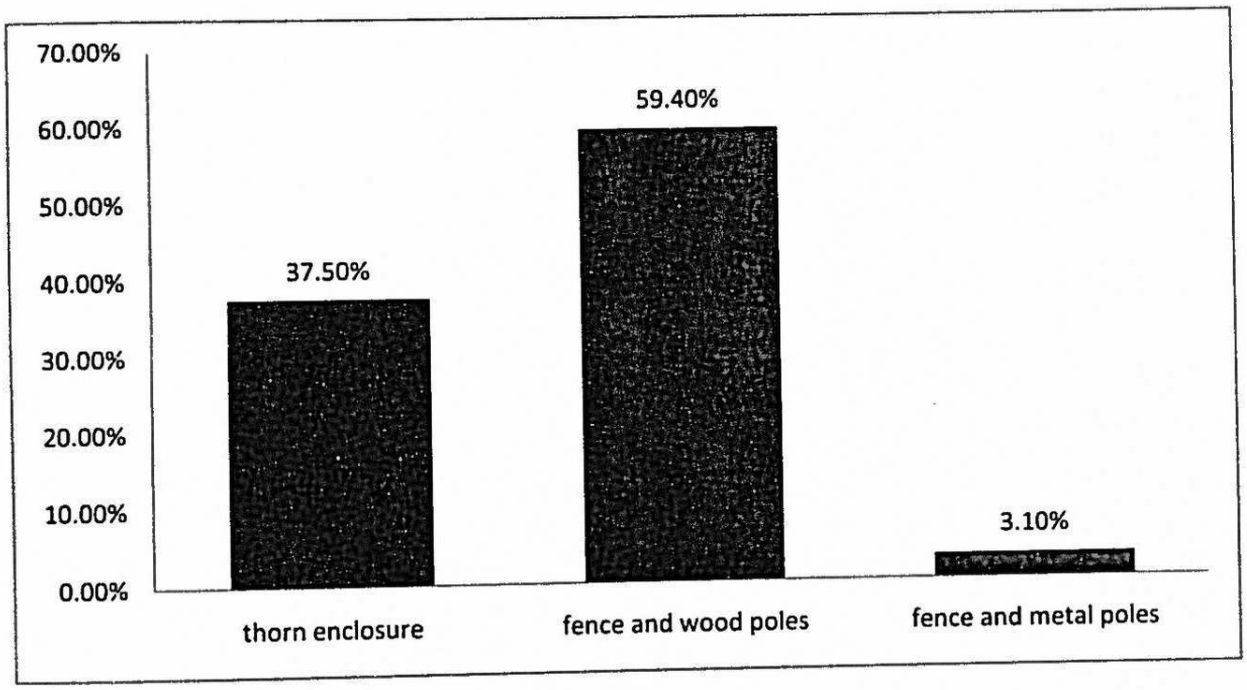

Figure 5.2: Types of housing for smallstock in Oodi extension area

Figure 5.3 below shows the reasons for keeping smallstock in the Oodi extension area. The respondents reared smallstock for various reasons; hobby, consumption and to make money. Sixty six percent (66%) of respondents reared smallstock for consumption and sixty three percent (63%) of the respondents kept them for profit making purposes. Respondents who were into smallstock production as hobby are few (3%).

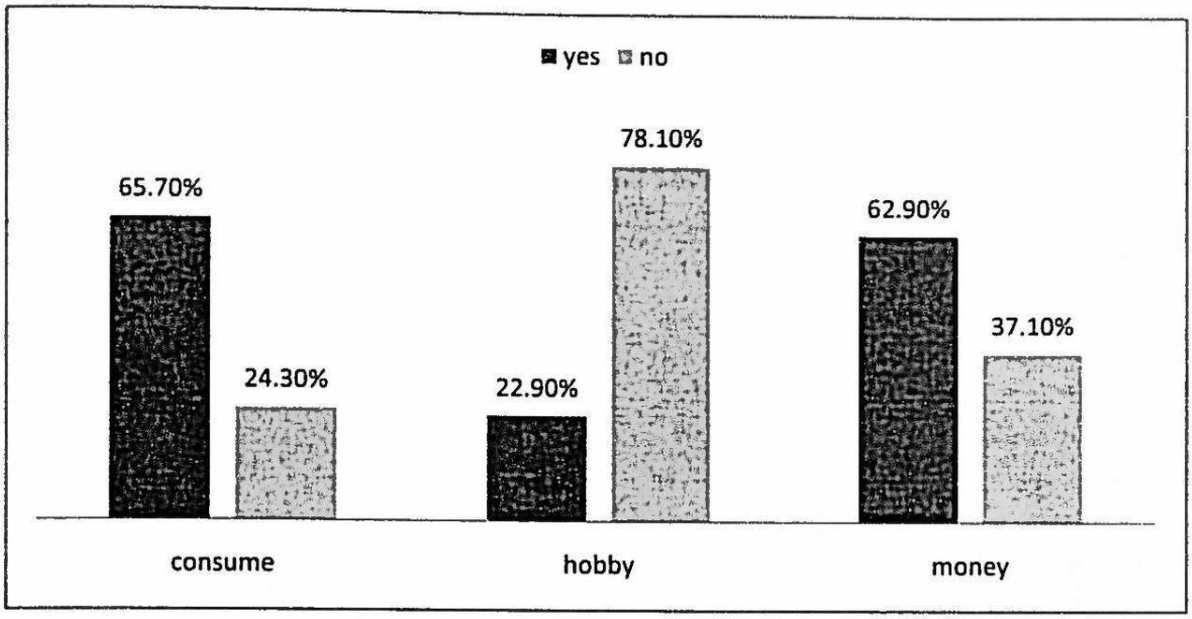

Figure 5.3: Reasons for rearing smallstock in the Oodi extension area

Table 5.3 below shows the level of education and the correspondeming practice of record keeping. Three percent (3.1%) who had gone through tertiaty education kept records, thus ninety seven percent(97 %) of repondents did not keep records.

Table 5.3: Level of education and Record keeping by smallstock farmers in Oodi extension area

	Record keeping		Percent (%)
Level of education	Yes	No	
Primary education	0	8	0
Junior certificate	0	4	0
Senior secondary	0	2	0
Tertiary education	1	7	3.1
None	0	10	0
Total	1	31	3.1

The number of respondents who practiced record keeping in relation to their age is shown in Table 5.4 below.

Table 5.4: Age and Record keeping practice of smallstock farmers in Oodi extension area

Age of farmers	Yes	No
21-30	1	0
31-40	0	3
41-50	0	10
51-60	0	14
61-70	0	2
71-80	0	2
Total	1	31

Record keeping was only practiced by one respondent aged 21 years. Respondents aged between 31- 80 years did not practice record keeping. The majority of respondents aged between 41-50 years and 51-60 years did not keep records.

Figure 5.4 shows the frequency of farm visits by the extension officers. "None" means no farm visit at all, "weekly" means each week the extension officers do make a farm visit, "office call" means the respondents visits the extension office, "when contacted" means the extension officer only makes a farm visit when the respondent contacts them, "once in a while" means the extension officers make a farm visit after a long time and when least expected and in most cases the respondents did not know the date of the previous farm visits.

Sixty three percent (62.5%) of the respondents were visited "once in a while." by extension officers while 15.6 % of them did not get farm visit by the officers. Nine percent (9.4%) of respondents visited the extension offices for help, similarly 9.4% of the respondents made office calls. Only 3.1% of the respondents were visited weekly. All these was an indication that extension workers conducted farm visits

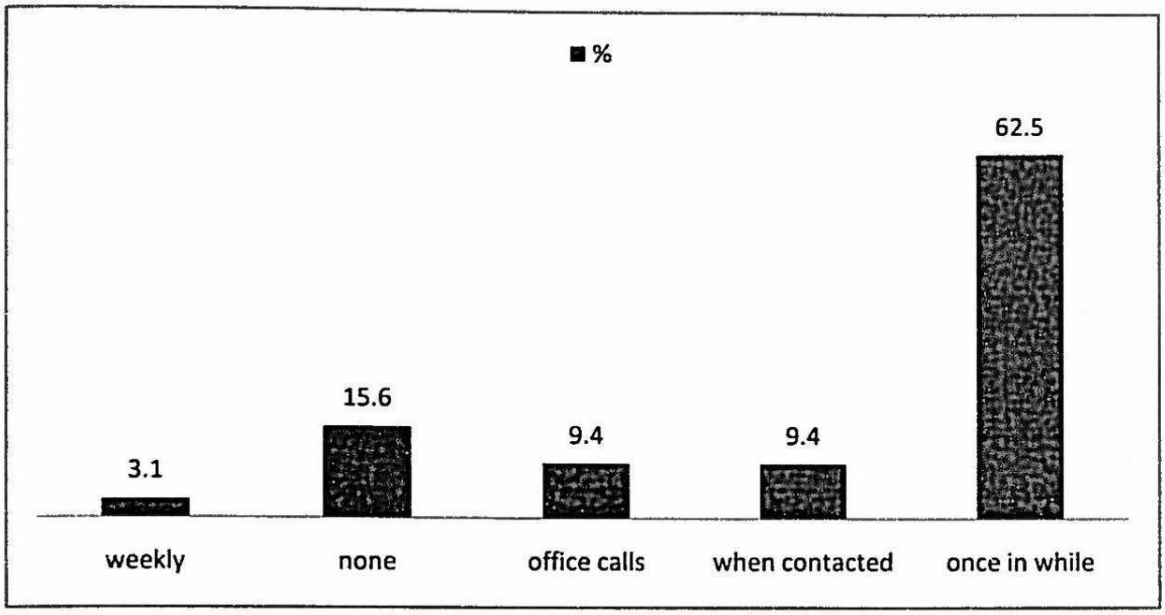

Figure 5.4: Frequency of visits by extension officers

The age of respondents and the corresponding types of smallstock they own is shown in Table 5.5 below. Eleven (11) respondents aged 51-60 owned goats and sheep respectively, while 8 respondents aged 41-50 owned goats and within the same age group only 2 respondents owned sheep. Three (3) respondents aged 31-40 owned goats only. Three respondents aged 61-80 years were very few in goat and sheep. This simply implied that age was an influential factor in smallstock farming in Oodi extension area.

Table 5.5: Age of small stock farmers and small stock species owned in Oodi extension area

Age of farmers(years)	Type of small stock		Total
	goats	Sheep & goats	
21-30	0	1	1
31-40	3	0	3
41-50	8	2	10
51-60	11	3	14
61-70	2	0	2
71-80	1	1	2

The relationship between gender and the type of livestock owned is shown in Table 5.6 below. Twenty five (25) respondents owned goats out of which twenty one (21) were men and four (4) were women. Only seven (7) respondents own both sheep and goats. There were more men (26) than women respondents (6).

Table 5.6: Gender and type of small stock owned in Oodi extension area

Gender	goats	Sheep & goats	Total
Male	21	5	26
Female	4	2	6
Total	25	7	32

The market outlets available for use by the respondents are shown in Table 19 below. The individual buyers were the preferred at 56.3%.

Table 5.7: Market outlets used by small stock farmers in Oodi extension area

Outlets	Yes	%	No	%
Individuals	18	56.3%	14	43.7%
Butcheries	3	9.4%	29	90.6%
Botswana Meat Commission	0	0	32	100%

The individual buyers could have been preferred due to the easy exchange and arrangements between the respondents (sellers) and the buyers (individuals). This could also be due to the fact that most individuals visited the respondents when buying hence it was cheap for the respondents as they did not have to carry their stock to the buyer as it was the case with butcheries. The butcheries were the second preferred outlets (9.4%) by virtue of their proximity to the respondents. It appeared that only sixty six percent (66%) of small stock farmers sold their stock. The least preferred was the Botswana Meat Commission (0%) due to the fact it has closed the small stock slaughtering line and the distance to the outlet was opined to be far. This therefore ruled out the Botswana Meat Commission as an available market for small stock.

The profitability of a small stock production operations is shown are shown in Table 5.8 below. It also depicts management practices such as; health management (vaccination schedule), selling of animals and supplementation. These practices had an influence on profitability. These were health management practices such as having a vaccination schedule.

Table 5.8: Annual Costs and Revenue of small stock farmers in the Oodi extension area

Farm	Management practices				Total cost Pula (P)	Total Income Pula (P)	Profit Pula (P)
	Marketing	Feeding	Health	Breeding Plan			
1	Y	Y	N	N	510.00	0.00	-510.00
2	N	Y	N	Y	487.00	900.00	413.00
3	Y	Y	N	N	3994.00	400.00	-3594.00
4	N	N	N	Y	2385.70	0.00	-2385.00
5	Y	Y	N	N	432.00	0.00	-432.00
6	Y	N	N	Y	1021.00	0.00	1021.00
7	Y	Y	N	Y	665.00	3600.00	-1400.00
8	N	N	N	N	0.00	0.00	0.00
9	Y	Y	Y	Y	728.00	2100.00	1372
10	Y	Y	Y	N	292.00	1500.00	1208.00
11	Y	N	N	N	0.00	12 600.00	12600.00
12	N	Y	N	N	317.00	0.00	-317.00
13	Y	Y	Y	Y	7560.00	5000.00	-2560.00
14	Y	Y	Y	N	2310.00	4200.00	1890.00
15	Y	N	N	N	0.00	600.00	600.00
16	Y	Y	Y	Y	5506.00	8000.00	2494.00
17	Y	Y	Y	Y	6606.00	7150.00	544.00
18	N	N	N	N	140.00	0.00	-140.00
19	Y	Y	Y	Y	5016.00	7000.00	2984.00
20	Y	N	N	N	140.00	600.00	460.00
21	N	Y	N	N	6140.00	0.00	-6140
22	N	Y	Y	N	8870.00	0.00	-8870.00
23	Y	N	N	N	1580.00	7200.00	5620.00
24	Y	Y	Y	N	5765.00	11 100.00	5335.00
25	N	Y	N	N	354.00	0.00	-354.00
26	Y	Y	N	Y	6364.00	500.00	-1400
27	Y	N	N	N	1900	8400.00	6500.00
28	Y	N	N	N	137.00	8400.00	8263.00
29	Y	N	N	N	140.00	3250.00	3110.00
30	N	N	N	N	6240.00	0.00	-6240.00
31	Y	Y	N	Y	0.00	4800.00	4800.00
32	Y	Y	N	Y	437.00	6700.00	6263.00

'Y' denotes a Yes and 'N' denotes a No to the management practices in the Table 2.9.

There were various inputs used by the respondents in the Oodi extension area which included; water, feed in the form of supplements, labour and medication and all these constituted costs. There were corresponding outputs such as animals; does, castrates and weaner goats which some farmers sold to make profit. Inputs were costs while outputs were income as depicted in the Table 5.8 above. The management practices that were observed were feeding, a health plan (vaccination schedule), sale of the goats and a breeding plan.

5.5 Discussion

5.5.1 Marketing channels

In Oodi extension area a few marketing channels were identified. These were individuals and butcheries. Fifty six percent (56.3%) of respondents sold their goats to individuals and 9.4% of them sold to butcheries. The most preferred marketing channel by respondents was the individual buyers, because respondents did not have to transport their animals, rather individual buyers followed them to the farm. In this way it was cheaper and easier to do business with individuals. Butcheries were their second market channel. This finding agreed with Lebbie and Mustaph (1984) in Swaziland, and the findings by Nsoso *et al.*, (2004) in the Molepolole area who found that farmers preferred to deal with individual buyers. The Botswana Meat Commission (BMC) was not a small stock marketing channel for Oodi area. This differed with observations by Nsoso *et al.*, (2004) who found that the BMC was one of the marketing channels in the Molepolole area during earlier times. The discrepancy between marketing channels used by smallstock farmers in Oodi and Molepolole could be attributed to the fact that recently the BMC has closed its smallstock line slaughter due to low supply of smallstock. Some government schemes, such as Livestock Management and Infrastructure Development (LIMID) bought smallstock from few individuals but it was not mentioned as a marketing channel due to its irregularity.

5.5.2 Marketing constraints

The marketing constraints that prevailed in the research area were that, the respondents did not have an established schedule and place where they could sell their animals when ready for sale. There was no organized market place in the Oodi extension area. This was in congruence with Lebbi and Mustaph (1984), Nsoso *et al.*, (2004) who found that there was no organized

marketing structure in Molepolole area as farmers sold as individuals instead of utilizing cooperatives and middle men. The Oodi extension area farmers sold to butcheries (9%) and individuals (56%) because they were near. The respondents did not sell animal products such as milk, skins and manure; as such they were not making money from the above mentioned saleable products. This contradicted Lebbie and Mustaph (1984) who found that (82%) eighty two per cent of respondents raised goats for skins and none of the respondents milked his goats.

5.5.3 Production constraints

Smallstock farmers in Oodi were faced with various production constraints which included the following; Age of the respondents was a major factor for any enterprise to run profitably. It was also found that the largest numbers of respondents who own smallstock was in the age of 51-60 years, whereas ages below this age (51-60) are mostly still employed. This was the least active age group to carry out all the smallstock management activities while the able bodied age group of 21-30 years was the lowest in terms of ownership of smallstock in the area.

Education was another factor that will enable a farmer to understand some innovations brought by extension agents. A large number of the respondents (31%) were illiterate, thus a constraint to understanding the extension agents. Msuya *et al.*, (2008) reported that low levels of education had a negative effect on technical efficiency.

The practice of record keeping was a serious concern in the area as 97% of the respondents did not keep records, implying that out of 32 respondents only 1 respondent kept record. Records were valuable for assessing herd performance and for making informed management decisions. They could also be vital and reliable for official reporting to extension officers; drugs used and date of use, (Marete 2011). The importance of records in livestock production have been described as continuously necessary for making decisions with regard to culling, reproductive management and animal health interventions, (Njogu 2006).

Although 72% of the respondents did have an idea of what feed supplements were, the practice of supplementing was not observed during the data collection even though 63% of usage was

reported by the respondents. This implied that supplementary feeding was not regular, rather it was erratic.

Fifty three percent (53%) of the respondents said they had a vaccination plan but failed to produce it when it was requested claiming it ran concurrently with the vaccination plan the local extension office used. Forty seven percent (47%) did not have it and did not subscribe to the extension office's vaccination schedule.

Thirty one percent (31%) of the respondents were on full time jobs meaning that smallstock production was not a priority to them. Some respondents also owned cattle which were usually given the first priority thus relegating smallstock to the second position of importance. Smallstock farmers in the Oodi had entrusted their stock to herd boys. This was depicted by forty one percent (41%) of the hired labour. The family provided labour which accounted for thirty seven percent (37%) while those who herded their own stock were few (22%).

5.5.4 Profitability

Smallstock in the Oodi extension area were profitable with 17 out 32 respondents realizing some profit. Included in this list were respondents 11, 23, 24, 27, 28 and 32 with the highest profit. These findings agreed with Panin (1993) who found that small ruminant production in Kgatleng and Kweneng was both profitable and economically viable. Profit was achieved if a respondent sold his/her goats with an income that was over and above the costs, e.g. respondents No 11's sales achieved the highest annual profit (P12600.00) by selling his/her goats but did not feed or had any vaccination schedule meaning he/she did not spent on medication. The second highest profit in a year was achieved by the respondent No 28 (P8 263.00) who also did not supplement nor followed any health management practice. The highest loss was recorded by respondent No 22 (P8 870.00) who did not sell but was supplementing and performing some health management practice, because the respondent was mostly likely starting the smallstock operation. The second highest loss was experienced by respondent No 30 who had spent on inputs but did not sell his goats but was supplementing and performing some health management practices. Some respondents did not sell their animals especially those who were starters, as such this contributed

to them not making profit because they reasoned to say they were still building a flock. Although farmers (11, 23,24,27,28 & 32) made profit, they did not have a breeding plan.

5.6 Conclusion

The Oodi respondents who owned small stock identified butcheries and individual people as the only marketing channels available in their extension area. Of all respondents, 56 % of the respondents preferred to sell to individuals rather than to the butcheries (9%). The identified marketing were almost similar to those identified in Molepolole where they found that small stock farmers' most favoured markets were individuals (92%) and butcheries (34%) because they were relatively cheap and easily accessible.

The respondents also experienced problems when selling their goats. The problems identified were; lack of organized markets which entailed no established schedule and place to sell their goats regularly. The other problem was that the respondents did not sell goat milk, skins and manure.

Old age and illiteracy was also an observed constraint as most of the respondents who owned small stock were old (51-60 years) and were less able bodied than young people. The other major constraint was education, with 31 % illiteracy within the respondents. Low levels of education had a negative effect on technical efficiency, farm people need education in order to adopt and use technologies. Record keeping was not satisfactorily practiced, 97% of the respondents did not keep records. The management decisions were affected such as weight and price relationships as well medicines to use when a health problem arose.

The respondents were aware of feeding supplements but only 63% of them reported using them but not regularly. The supplements used were lick/block supplements, drought pellets, brewer's bran, lablab, molasses and sorghum bran + salt. Diseases and parasites were reported as the major constraints as respondents do not have any vaccination schedule or health management program in place. The respondents followed the extension office's vaccination schedule and also relied on the extension office for health management interventions. Even though labour was a crucial component of small stock farming, it could also be an impediment to successful goat

production. The high level of hired labour (41%) compared to self-employment (22%) was a significant cost and had a significant impact on total profit. Family labour was a constraint as it was not paid for.

Management practices affected profit. a respondent who spent less on inputs (e.g. labour) and sold his goats made a profit as opposed to the one who spent more on inputs and did not sell his goats. Sixty three percent (63 %) of the respondents which were the majority did not have a breeding plan while 37 % did have it. The breeding did not seem to have any relationship with attaining profit as the respondents who made profit did not have it in place. Goats that were properly managed nutritionally and health wise tended to grow quickly to reach market weight and withstood diseases and parasites better than goats that were not properly managed. Therefore, keeping smallstock is potentially a profitable endeavour if management interventions were practiced

5.7 Recommendations

i. In order to realise profit, small stock farmers must try to establish an organised market and sell their animals regularly. Products such as skins, milk and manure should also be sold.

ii. Small stock farmers should also have their own health schedules and nutritional plan. These two plans must be followed as good health and nutrition enhanced reproduction, resistance to diseases and parasites. Such animals tended to grow fast to reach market weight.

iii. It was crucial for small stock farmers to keep all forms of records as it would assist them in breeding, health and nutrition practices, as well as evaluating the viability of their small stock enterprises.

iv. Labour could be costly, hence it was advisable to be self-employed where circumstances allow.

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Appendix 1: Letter to the respondents

BOTSWANA COLLEGE OF AGRICULTURE

Location: Content Farm	*Postal Address:*
Telecommunications	Private Bag 0027
Telephone: 3650100	Sebele, Gaborone
Telegrams Telefax: 392875:	AGRICOLA'
Gaborone, Botswana	Botswana

Dear respondents

This questionnaire is part of a study in which the researcher interrogates key components of goat production/ management; breeding, health and nutrition and marketing.

This survey intends to find out the profitability, production and marketing constraints of small stock in Kgatleng area. Your contribution through filling up the questionnaire and answering the oral questions will help in this research. The findings of this research will be shared with you, other small stock farmers and the concerned stakeholders for the betterment of small stock industry.

Please be informed that participation in this research is not by any means enforced upon the respondents, should any respondent withdraw from this research, the information collected from him/her will be discarded.

Your contributions are highly valued.

Yours truly

Mmoloki Moemi (Mr.)

Appendix 2: Questionnaire for the respondents

1.0 Demographic characteristics

1.1 Gender Male [ ]
Female [ ]

1.2 Age

21-30 [ ]
31-40 [ ]
41-50 [ ]
51-60 [ ]
61-70 [ ]
71-80 [ ]

1.3. Marital status

Single [ ]
Married [ ]
Widow [ ]
Divorced [ ]

1.4 Other sources of livelihood

Full time employment [ ]
Part-time employment [ ]
Casual employment [ ]
Arable farming [ ]
Livestock farming [ ]
Mixed farmer [ ]
Other (specify) _____

1.5 Level of education

Primary education [ ]
Junior certificate [ ]
Senior secondary education [ ]
Tertiary education [ ]
None [ ]
Vocational [ ]

2.0 Livestock management

2.1 What type of smallstock do you keep?

Sheep [ ]
Goats [ ]

2.2 State the number smallstock owned;

Type	Goats	Sheep
Adult females		
Adult castrates		
Bucks		
Young males		
Young females		
Male kids		
Female kids		

2.3 How long have you been in smallstock farming?

1-5 yrs [ ]
5-10 yrs [ ]
10-15 yrs [ ]
15-20yrs [ ]
0ver 20 yrs [ ]

2.4 What are the reasons for keeping smallstock?

To make money [ ]
It's a hobby [ ]
Home consumption [ ]
Make money + home consumption [ ]

2.5 Do you keep records? **Yes** [ ] **No** [ ].

2.6 If yes, what types of records do you keep?

Financial records [ ]
Sale [ ]
Mortality [ ]
Production [ ]
Sales + finance [ ]
Finance + mortality [ ]
Finance + production [ ]
Production + mortality [ ]
All records above [ ]

2.7 Do you provide housing for your livestock? **Yes** [ ] **No** [ ]

2.8 If yes, what type of housing do you provide?

Thorn Bush enclosure	[ ]
Fence with wood poles	[ ]
Fence with metallic poles	[ ]
Cement with corrugated roof	[ ]

3.0 Nutrition

3.1 do you have any knowledge about supplements? **Yes** [ ] **No** [ ]

3.2. If yes do you supplement your stock? **Yes** [ ] **No** [ ].

3.3 If yes what type of supplementary feeds do you give to your stock?

Licks/blocks	[ ]
Drought pellets	[ ]
Crop residues	[ ]
Brewer's bran	[ ]
Sorghum bran +salt	[ ]
Lucerne	[ ]
Lick, drought pellets, bran + salt	[ ]
Licks + drought pellets	[ ]

3.4. When do you supplement?

During the rainy season	[ ]
During the drought	[ ]
All year round	[ ]
When they look malnourished	[ ]
Sporadically	[ ]

3.5. At what stage of production do you supplement?

Before breeding	[ ]
During pregnancy	[ ]
After parturition	[ ]
Kids at weaning stage	[ ]
All stages/ all animals	[ ]

3.6 What are the reasons for supplementing at that stage?

Improve the body weight	[ ]
Avoid mortality	[ ]
To improve rate of conception	[ ]
To cater for the used up range	[ ]
Improve body weight & avoid mortality	[ ]
Improve body weight and conception rate	[ ]
Improve rate of conception & avoid mortality	[ ]
Control animal movement	[ ]

3.7. How much did you spend on the following as in the last 12 months?

Licks /blocks:	P_____
Drought pellets:	P_____
Brewer's bran:	P_____
Sorghum bran + salt:	P_____
Others (specify: lablab, molasses,):	P_____

3.8. If No, what are the reasons for not supplementing?

It is expensive	[ ]
It is not necessary	[ ]

Others (specify) _____

3.9 Where do you water your animals?

Small dams	[ ]
Household water	[ ]
River water	[ ]
Borehole water	[ ]

4.0. Do you pay for watering your animals? **Yes** [ ] **No** [ ]

4.1 How much do you pay for watering your animals?

Per month P _____

Per year P _____

4.2 What type of **labour** do you have and how much are they paid?

Type	Pay/month
Self	
Family	
Hired	
Others(specify)	

5.0 Health.

5.1 Do you have a vaccination schedule for your stock?

Yes [ ] **No** [ ]

5.2 If yes, what diseases do you vaccinate for?

Pasteurellosis [ ]
Abortion [ ]
Heartwater [ ]
Pulpy kidney/Enterotoxaemia [ ]
Heartwater & Pasteurella [ ]
Heartwater & pulpy kidney [ ]
Pulpy kidney & Pasteurella [ ]
Heartwater, pulpy kidney, Pasteurella & dosing [ ]
None [ ]

5.3 How often is vaccination carried out?

All year round [ ]
During the wet season [ ]
During the dry season [ ]
Beginning of the wet season [ ]
Beginning of the dry season [ ]
Beginning of both the dry & wet season [ ]

5.4 Who does the treatment/vaccinations?

Technical assistants/extension staff [ ]
Self [ ]
Self & extension stuff [ ]

5.5 Apart from the modern drugs/medicines, which traditional treatments do you use for treatment of ailments? **Yes** [ ] **No** [ ]

5.5 b, if yes state the medicines /traditional treatments used and corresponding uses.

Sebete & sekaname – Pasteurella (madi) [ ]
Mokgwapha-general [ ]
Used engine oil-wounds / dipping [ ]
Others (specify) _____

5.6 What are the external parasites that affect your flock?

Ticks [ ]
Flies [ ]
Fleas [ ]
Lice [ ]
Mange [ ]

5.7 How do you control them?

Dipping [ ]
Dosing [ ]
Others (specify) _____

5.8 Which are the common signs of internal parasites in your stock?
Stunted growth and ruffled hair [ ]
Bottle jaw [ ]
Black watery scours [ ]
Scours, stunted growth & ruffled hairs [ ]

5.9 How much did you spend in the last twelve months in controlling both parasites and diseases?

Vaccine	Price
Heartwater/ Pasteurella	
Pulpy kidney	
Parasites	
Others(specify)	

How much did you spend on treatment for diseases, parasites and other ailments?

Treatment	Price
Terramycin	
Sulphamezathine 33%	
Wound oil	
Eye infection	
Dipping	
Dosing	

6.0 Reproduction / Breeding.

6.1 What breeds do you keep?

Tswana	[ ]
Boer	[ ]
Tswana*Boer	[ ]
Tswana + Boer crosses	[ ]
Tswana + Boer	[ ]

6.2 Why keep the specified breeds

Grow fast	[ ]
Prolific	[ ]
Disease & parasites resistance (hardy)	[ ]
It is a start	[ ]
Prolific, hardy, & good body conformation	[ ]
Prolific and hardy	[ ]
Reduces the risk of owning one breed	[ ]
Preference	[ ]

6.3 Do you follow a breeding plan? **Yes** [ ] **No** [ ]

6.4 If yes, when do you breed your animals?

Wet season	[ ]
Dry season	[ ]
Others (specify)	_____

6.5 Why breed during the above chosen season?

Plenty of feed for does	[ ]
Plenty for feed at weaning	[ ]
Less prevalence of diseases & parasites	[ ]
Others (specify)	_____

6.6 How many times do they kid in a year?

Once a year	[ ]
Twice a year	[ ]
Others (specify)	_____

6.7 How many does gave you the following types of kidding?

Type of birth	No of does	No of ewes
Single		
Twins		
Triplets		
Others(specify)		

6.8 How many kids died in the last twelve months?

_____

6.9 What do you think is the cause of their death?

Diseases & Parasites [ ]
Negligence [ ]
Plant poisoning [ ]
Predation S

7.0 Do you change your buck ram? **Yes** [ ] **No** [ ]
7.1 If yes, give reasons for changing the buck.
Because of age [ ]
Because it's less effective [ ]
Improve the genetic pool [ ]
Avoid inbreeding [ ]

7.2 Where do you acquire your bucks/rams?
Locally [ ]
Import from South Africa [ ]
Breed own [ ]
None / mate in communal area [ ]

7.3 When disposing stock (selling / consumption) which animals remain as the replacement stock?

Adult does [ ]
Adult males [ ]
Male kids [ ]
Female kids [ ]
Does & female kids [ ]
Does, female kids & male kids [ ]
Weaner goats [ ]

8.0 Socio-Economic

8.1 How many animals were sold in the last twelve (12) months and their prices received?

Type of animal	Number	Price	Market outlet
Castrates			
Does			
Weaners			
Kids			
Others(specify)			

8.2 What stock products were sold in the last twelve months?

Product	Quantity	Price	Market outlet
Meat			
Milk			
Skins			
Manure			
Others(specify)			

8.3 Before you sell your animals do you ever get information on prices? Yes [ ] No [ ]

8.4 If yes, where do you get the information on prices?

Other farmers [ ]
Radio [ ]
Others (specify) _____

8.5 Who determines the price of what you sell?

Self [ ]
Buyer [ ]
Negotiation [ ]
Self & negotiation [ ]

8.6 If you determine the price, what criteria do you use?

On what farmers charge [ ]
On costs of production [ ]
Sex [ ]
Age [ ]
Size [ ]

8.7 When do you normally sell animals?

When there is drought [ ]
When wanted [ ]
When I need cash [ ]
Both when I need cash & when animals are wanted [ ]

8.8 What problems do you face when marketing smallstock?

Transport	[ ]
Prices offered by buyers	[ ]
None	[ ]

8.9 What do you think should be done to eradicate the problems mentioned above?

Transport- provision of transport by buyers	[ ]
Prices – government intervention	[ ]

9.0 Do you belong to an association/group/cooperative? Yes [ ] No [ ]

9.1 If yes, what kind of help do you get from the association?

Input sources	[ ]
Output marketing	[ ]
Others (specify) _____	

10.0 Extension Services

10.1 What areas of do you receive advice in order to improve smallstock production?

Nutrition	[ ]
Health	[ ]
Breeding	[ ]
On farm demonstrations	[ ]
Nutrition & breeding	[ ]
Health & breeding	[ ]
Nutrition, health, breeding	[ ]
None	[ ]

10.2 How often do extension officers visit your farms?

Weekly	[ ]
Monthly	[ ]
Once in a while	[ ]
Farmers visit the extension office instead	[ ]
None	[ ]
Extension officers come when contacted	[ ]

10.3 Are they any on-farm demonstrations carried by the technical assistants?

Yes [ ] No [ ]

10.4 If yes, what kind of demonstrations do extension officers carry out?

Dosing	[ ]
Castrations	[ ]
Foot trimming	[ ]
Dipping	[ ]
Vaccinations	[ ]
Dosing, dipping, vaccinations/treatment	[ ]
All	[ ]

10.5 How often do extensions officers arrange for your training?

Once every three months	[ ]
Once a year	[ ]
Once a while	[ ]
None	[ ]

10.6 Where were you trained?

BCA	[ ]
RTC	[ ]
None	[ ]

10.7 Which government schemes are you aware of which are used for small stock improvement?

LIMID	[ ]
Youth Fund	[ ]
NDB	[ ]
CEDA	[ ]
None	[ ]
Heard of them	[ ]
Youth fund & CEDA	[ ]
LIMID & NDB	[ ]
LIMID, Youth fund & CEDA	[ ]

10.8 Have you benefited from any of these schemes?

Yes [ ] **No** [ ]

10.9 If yes, (specify the scheme & how)?

Inputs	[ ]
Technical advice	[ ]
Finance	[ ]

Others (specify) _____

10.0 If not, why have you not benefited?

Not legible for the schemes	[ ]
Not aware of how to solicit help	[ ]
Unaware of the schemes	[ ]
Unaware of the benefits	[ ]
Not into commercial farming	[ ]