CHARACTERISTICS OF SMALL-HOLDER DAIRY GOAT PRODUCTION IN THREE DISTRICTS OF BOTSWANA

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ABSTRACT

Small-holder dairy goat production systems are potentially important among the avenues of food production and provides a regular income and work for the less resourced households. Dairy goat production in Botswana has not gained much popularity due to the fact that dairy goats and goat milk has not been the subject of much research and development and is not among the local milk production improvement schemes. The objectives of this study were to describe the smallholder dairy goat production in Central, Kgatleng and Kweneng districts of Botswana, identify their production challenges and marketing opportunities; and suggest strategies that can be used to increase local dairy goat milk yield. Data were collected using structured questionnaires and through direct observations. There were only 12 dairy goat farmers in the study area. The results showed that majority of dairy goat farmers held a junior degree qualification (9/12) and had less than five years keeping dairy goats. Fifty-two per cent (52%) of the 100 dairy goat breeds kept by farmers were the Saanen, 30% indigenous x exotic crosses, 12% Toggenburg and 6% British Alpine. Dairy goat farmers practised a semi-intensive production system with average milk production estimated to be 2kg/d milk per goat at peak lactation. Insufficient quality feeds, unavailability of breeding stock, and lack of financial assistance to dairy goat farming were the major constraints to dairy goat farmers. The opportunities that were available to dairy goat farmers included the high local milk demand, potentials for dairy goat stud breeding and fodder production. In conclusion, local dairy goat farmers should be up skilled on the management principles of dairy goat production. They should also adopt proper breeding strategies and feed local affordable quality feeds in order to increase the productivity of dairy goats in Botswana. We recommend the government to promote dairy goat production and consider it as an economic diversification derive by including goat milk production in local milk production improvement schemes.

***Key words**: Botswana, characteristics, dairy goat, production, smallholder.*

INTRODUCTION

Small-scale dairying is an important agricultural activity in developing world including sub Saharan Africa, producing a valuable food product and providing a regular income and work for the less resourced households (Bryant, 2001). Dairy goat farming is suitable for either small-scale or part-time operation (Van Saun *et al*., 2008), because dairy goats can be easily handled by women and children and produce milk for household consumption (Donkin, 1997). They can also easily acclimatize to intensive production systems, and convert quality feed into highly nutritious milk very efficiently (Ogola and Kosgey, 2012). FAO (2002) stated that the strongest growth in demand for milk and milk products is anticipated to come from the developing countries because of the rapid increase of the population and large proportion of people with small incomes. Dairy goat production also has been gaining popularity in many African countries among the small-scale farmers, because dairy goats do not require large areas to keep them, as well as the increasing demand for goat milk due to its "therapeutic properties", since it can be recommended in cases of dyspepsia, peptic ulcer, and to those intolerant/ allergic to cow milk especially infants and growing children (Kipserem *et al*., 2011).

PROBLEM STATEMENT

The greatest challenge facing smallholder farmers in Botswana is to increase milk production, reduce milk imports and by so doing, improve food security and rural employment (CSO, 2013). Milk production in Botswana generally comes from exotic dairy cattle breeds and their crosses, despite the availability of some goat breeds that have the genetic potential for producing milk. Milk in Botswana, including goat milk is imported from neighbouring countries at high cost to the economy (Mpapho, 2010). This is compounded by the low levels of milk production from indigenous goats (Agrinews, May 2012). Moreover, dairy goat production in Botswana has not gained much popularity due to issues perceived as lack of information on production, marketing and goat milk consumption (Mpapho, 2010) which is exacerbated by the fact that dairy goats and goat milk has not been the subject of much research and development and milk production improvement schemes. There is lack of information and knowledge on dairy goat production in Botswana. Research done on dairy goat production and performance in Botswana has been carried out under controlled conditions at research stations,

where the results may not reflect the actual situation of dairy goat performance of smallholder farmers. Therefore, the main aim of this study was to identify the characteristics of small-holder dairy goat production in Central, Kgatleng and Kweneng districts of Botswana.

OBJECTIVES

The objectives of this study were to:

- Describe the smallholder dairy goat production in Central, Kgatleng and Kweneng districts of Botswana.
- Identify the production challenges and marketing opportunities of smallholder dairy goat production in Central, Kgatleng and Kweneng districts of Botswana.
- Suggest strategies that can be used to increase local dairy goat milk yield as a way of increasing income and food security to smallholder farmers.

MATERIALS AND METHODS

The study population comprised of farmers which were engaged in dairy goat rearing in Tonota, Palapye, Mahalapye villages (Central district), Mochudi and Oodi villages (Kgatleng district), Sebele, Molepolole, Kopong, Boatlaname and Ngware villages (Kweneng district) in Botswana from November to December 2013 (Figure 1). There were only twelve dairy goat farmers in Central, Kgatleng and Kweneng districts of Botswana at the time of this study. Data on demographic characteristics, ownership period of dairy goat, finance to start up dairy goat farming and dairy goat breeds and production was collected using structured questionnaires administered to dairy goat farmers in the study area. Direct observations on animal husbandry and management practices were also recorded. Secondary data that were also used in this research included the dairy annual reports from Ministry of Agriculture (2008); Agrinews (May, 2012) published by Ministry of Agriculture, and trade statistics on dairy goat milk imports from Central Statistical Office (2013) under the Ministry of Trade and Industry, Botswana.

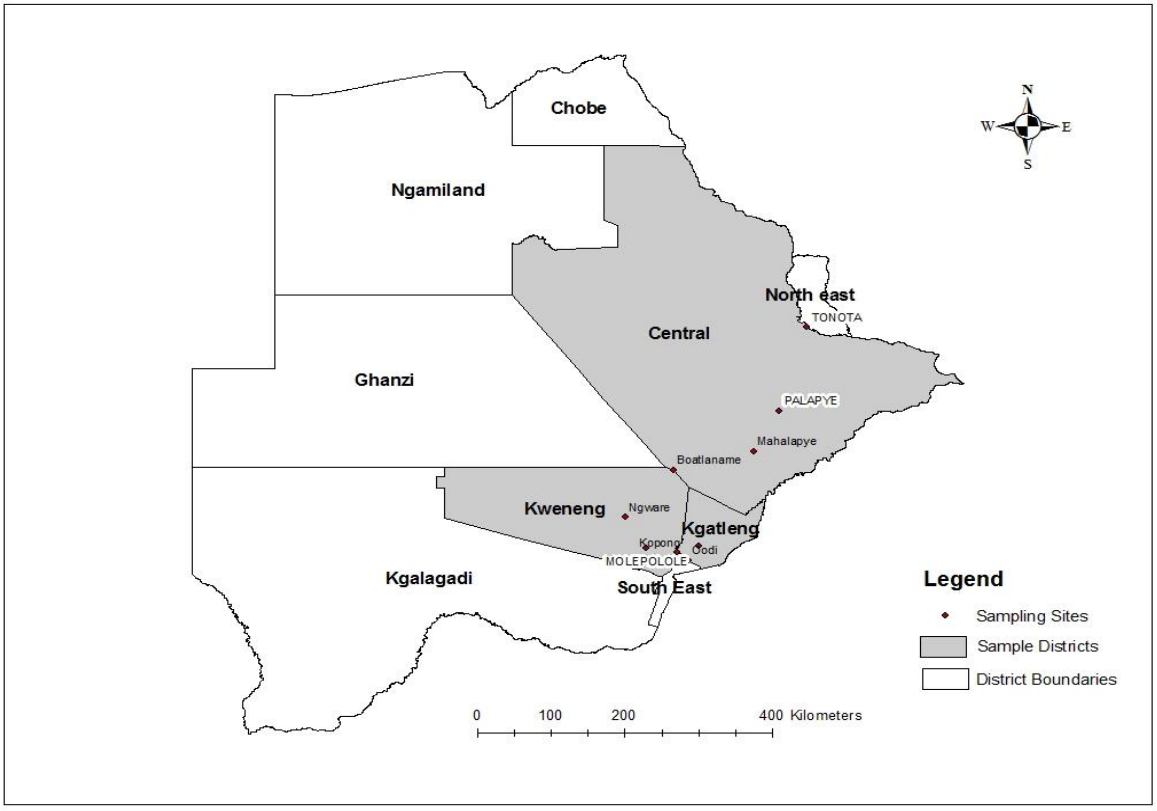

Figure 1: A map of Botswana showing Central, Kgatleng and Kweneng districts where survey of Dairy goat farmers was done.

Statistical Data analysis

Data were analysed using the procedure for Statistical Package for Social Sciences (SPSS, 2008).

RESULTS AND DISCUSSION

Demographic characteristics of respondents

Males were the predominant owners and carers of dairy goats, constituting 75% (9/12) while females contributed the remaining 25% (3/12) of the surveyed farmers. All the farmers were married, but husbands were more actively involved in milking the goats than their wives and children (Table 1). Njuki and Sanginga (2013) indicated that in Kenya women had a strong preference for dairy goats because the dairy goat multiplication programme in Kenya mainly targeted women (Ogola *et al*., 2010). Eight out of the 12 farmers were aged below 35 years while the remaining four farmers were adults of ages ranging between 36-50 years (Table 1). Nine out of the 12 farmers had a first degree qualification and the remaining three farmers had a secondary certificate. These findings showed that dairy goat production in Botswana was at that time

carried out by literate farmers, who if given appropriate support, can be able to understand and adopt advanced technologies involved in the dairy industry such as the use of milking machines and milk products processing. Aganga and Nsoso (2011) stated that appropriate support and intervention strategies should focus on empowering process which would enable smallholder farmers to have easy access to animal production training and extension services. Furthermore, Mwangi (2013) mentioned that dairy goat farming in Kenya has been hit hard by lack of training for farmers and this may have contributed to the reduced dairy goat milk production.

Seven out of the 12 farmers were employed full time (4 in government institutions and 3 in private sector) whereas only five of them were unemployed (2 were self-employed) (Table 1). Even though most of the farmers were literate, they stated that they had inadequate knowledge about the general care and management of dairy goats, they were not aware of short courses that were being offered at Botswana University of Agriculture and Natural Resources annually such as Dairy Goat Production and Fodder Production. This information should be available to all extension offices so that farmers can easily access it well in time since not all farmers have access to the internet and newspapers in which these short courses were advertised. A sound knowledge plays a key role in improving goat farming practices to derive maximum output from the farm. It was found that the lack of knowledge about improved goat farming and goat diseases were some of the important constraints faced by the goat farmers of Mathura district in Uttar Pradesh (Chethan *et al*., 2015).

Ownership period of dairy goat farming

Out of the 12 farmers, nine of them said they had been keeping dairy goats for less than five years, while the remaining three farmers had been keeping dairy goats for more than five years (Table 1). In contrast, Jackson *et al*. (2012) mentioned that in Tanzania dairy goat farming at community level dated back to the 1980s, and it was promoted by development agents in the area. The introduction of dairy goats increased goat productivity, improved nutrition and income of the small-scale farmers in Tanzania (Jackson, 2013).

Table 1: Demographic parameters of farmers with dairy goats in Central, Kgatleng and Kweneng districts of Botswana.

Variable n= 12		Respondents	
Variables	Category	N	%
Gender	Male	9	75
	Female	3	25
Marital status	Single	0	0
	Married	12	100
	Divorced	0	0
	Widowed	0	0
Age range	Below 35 years	8	66.7
	36-50 years	4	33.3
	51-60 years	0	0
	Over 60 years	0	0
Education	None	0	0
	Can read and write	0	0
	Primary	0	0
	Secondary	3	25
	Certificate	0	0
	Diploma	0	0
	First degree	9	75
Employment	None	5	41.7
	Fulltime	7	58.5
	Part time	0	0
Ownership period	0-5 years	9	75
	More than 5 years	3	25

Financial assistance to start up dairy goat farming

The majority of dairy goat farmers (7/12) surveyed in Central, Kweneng and Kgatleng districts of Botswana mentioned that they started dairy goat farming using their monthly income (salary). Three were government based farms which depended on government annual financial budget for financing; one said she utilized bank loans, while one farmer mentioned that he sold his property to buy dairy goats (Figure 2). In Kenya, a non-governmental organization FARM-Africa, initiated a community-based dairy goat multiplication programme to improve the nutrition and incomes of smallholder farmers (Donkin and Boyazoglu, 2001). The most successful of these projects has been the one based in Meru District in Kenya because it has benefited from the experiences gained from other similar projects (Ojango *et al*., 2010). The adoption of this practice in Botswana would help empower smallholder farmers with a hands-on knowledge about keeping and management of dairy goats.

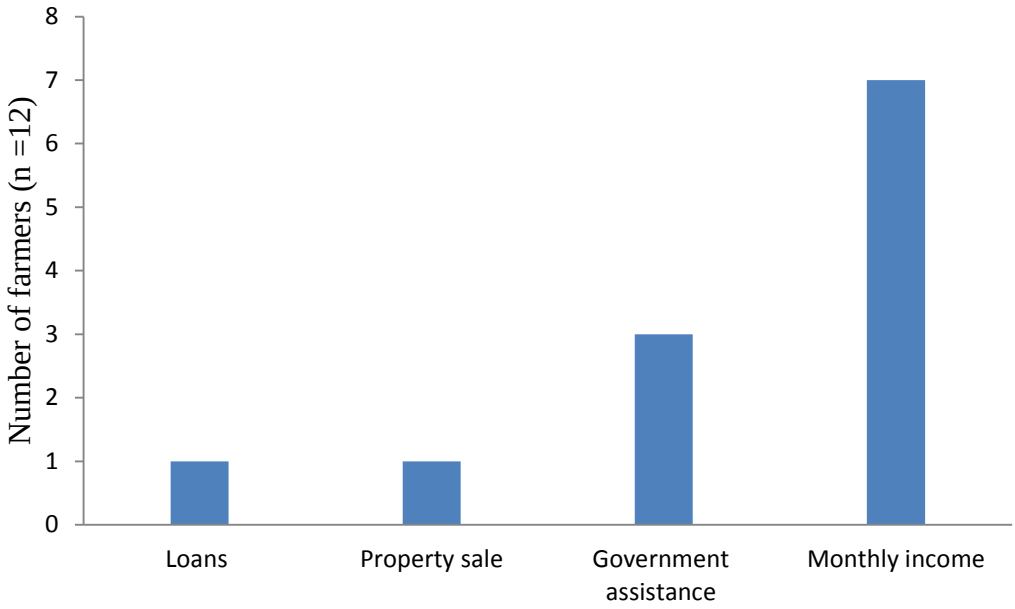

Figure 2: Financial support used to establish dairy goat farming by farmers in Central, Kgatleng and Kweneng districts of Botswana.

Dairy goat breeds in Botswana

A total of 100 dairy goats and crosses were kept in Central, Kgatleng and Kweneng districts of Botswana, with fifty-two (52) being Saanen, thirty (30) crosses (indigenous x exotic breeds), twelve (12) Toggenburg and six (6) British Alpine goats (Figure 3). Majority of these goats (70%) were from government owned dairy goat farms. Smallholder farmers in Botswana with dairy goats kept from two to ten adult milking goats, and milked them for household milk consumption. Saanen goats were the dominant breed since farmers preferred the breed because of its high milk production potential. According to the Ministry of Agriculture (MoA) annual report (2014), there were 2.4 million goats in Botswana. These statistics does not include dairy goats because they were very few at that time. Lack of statistics of dairy goats is due to the fact that a management system of small-scale household dairy goat production is not well established in Botswana. Indigenous goats in Botswana were mainly kept for meat with some farmers milking them only for household milk consumption (Moreki *et al*., 2011).

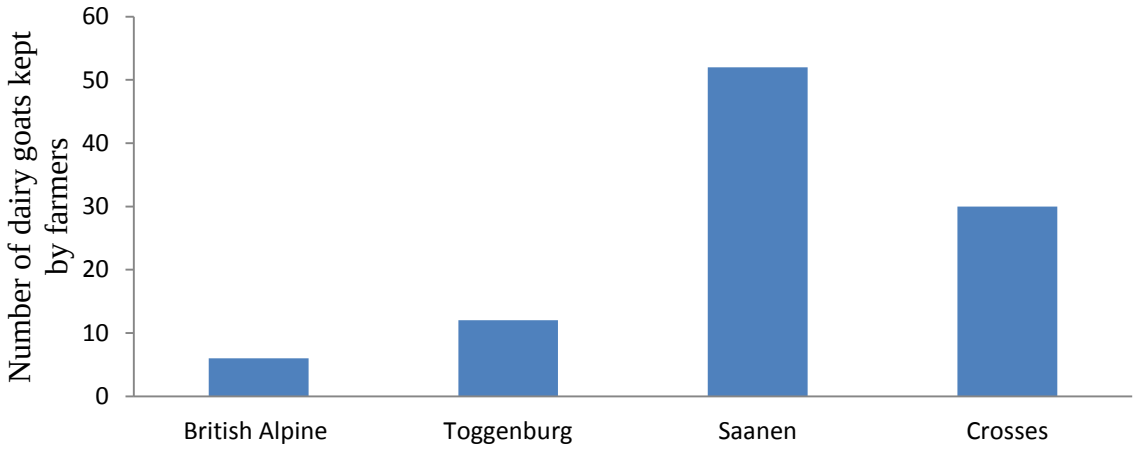

Figure 3: Breeds of dairy goats kept by farmers in Central, Kgatleng and Kweneng districts of Botswana.

Housing

Dairy goat farmers in Botswana provide shelter for their dairy goats. Five respondents constructed their goat kraals with mesh wire and gum poles with corrugated iron roofs, four with mesh wire and corrugated iron roofs, while only three used indigenous tree poles and mesh wire without any roofing (Figure 4). Ace (1993) stated that housing for dairy goats must satisfy the health and comfort of the animals. As such, the building should be adequately ventilated but not drafty; with relatively dry and clean bedding. The shelter generally provided to dairy goats in Botswana were just simple structures which basically protected the animals from heat of the sun but not from rain.

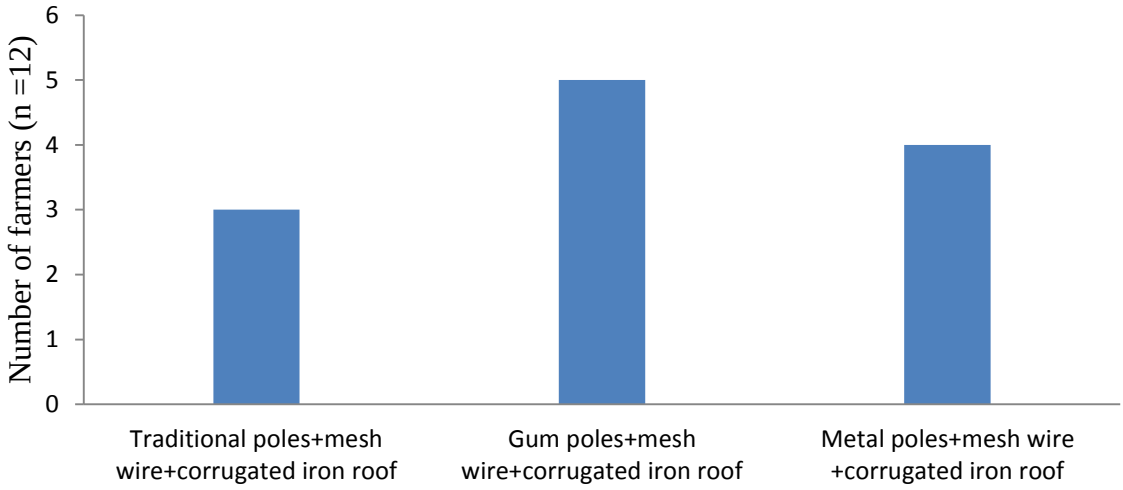

Figure 4: Type of shelter provided to dairy goats by farmers in Central, Kgatleng and Kweneng districts of Botswana.

Since most of the farmers did not remove kraal manure from their goat kraals, they mentioned that their goats were more susceptible to foot-rot during the rainy season. Negligence in housing is one of the factors responsible for low milk production in dairy goats. Shivairo *et al*. (2013) stated that maitaining good hygiene and keeping dairy goats in proper housing is critical since dairy goats prefer to live in a dry and clean place. According to Shivairo *et al*. (2013), shelters built with a raised slattered floor made of timbers to allow urine and droppings to pass through the spaces is important because it leaves the floor clean and dry. Government dairy goat farms were the only where goat kraals were constructed with gum poles and mesh wire, and the type of shelter was able to protect the animals from the heat of the sun and from rain. Adpoting this type of shelter by other dairy goat farmers in Botswana will help them to maitain a dry and clean environment for their animals hence lowering the risks of infections and diseases.

Feeding

Ten of the twelve (10/12) farmers in Central, Kgateleng and Kweneng districts of Botswana practised semi-intensive production system. During the day, dairy goats were allowed to roam around the farms browsing and they were brought back to their kraals in the afternoon to be fed with lucerne or lablab hay, available supplements such as maize and sorhum bran, salt blocks, and dicalcium phosphate, especially during the dry season (Figure 7). Water was provided *ad libutum.* Dairy goats fed on natural veld comprising of Tree Savanna to SemiArid Shrub Savanna. The shrubs consisted of Acacia e.g. *A*. *mellifera, A. giraffae, A. haematoxylon* in the south and towards north *Boscia albitrunca, Dichrostachys cineria, Terminalia sericea* also occur. Abate *et al*. (1993) indicated that permanent pasture in Botswana occupies 73% of the total land area, majority of which are not developed. Eight of the 12 farmers said that their animals depended on browsing the Tree Savanna and SemiArid Shrub Savanna for maintenance but they also bought lucerne and lablab hays and locally available commercial concentrates during the dry season to feed their animals. Two of the farmers indicated that their animals depended on browsing the Tree Savanna and SemiArid Shrub Savanna only without any supplementation. According to Omore (2005), ruminant production in the rangelands is wholly dependent on natural grasslands, where extreme weather conditions such as droughts have serious adverse effects on feed resources and production.

One farmer fed dairy goats with lucerne hay and local commercial concentrates. Dairy goats that were fed with only lucerne hay and locally available commercial concentrates were those in goverment institutions and they were intesively kept. In Kenya Shivairo *et al*. (2013) highlited that smallholder farmers depended on home grown forage (e.g Napier grass) for feeding dairy goats. Local farmers should also be encouraged to grow fodder for their dairy goats because as compared to a cow a goat eats less, occupies a small area and can produce enough milk for the average family consumption (Aziz, 2010).

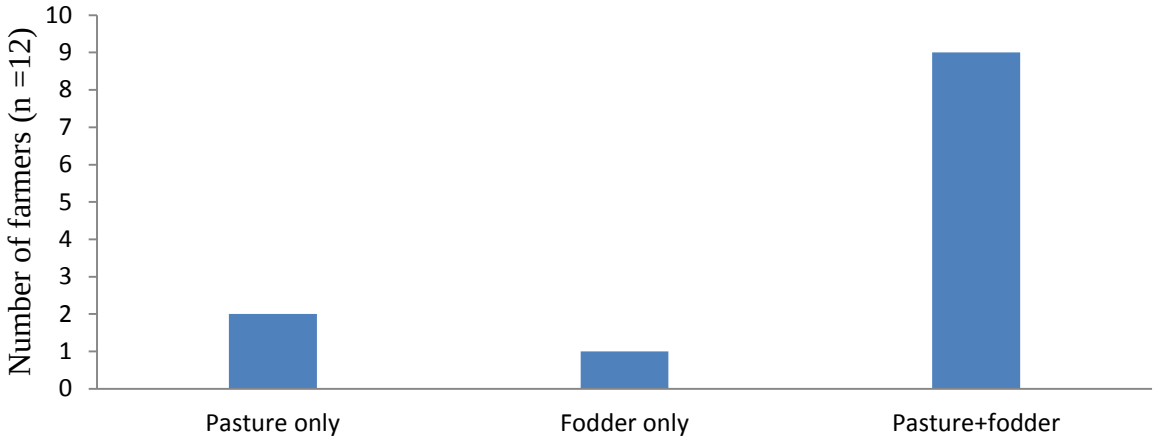

Figure 7: Kinds of feeds provided to dairy goats by farmers in Central, Kgatleng and Kweneng districts of Botswana.

Milk production

Four of the 12 farmers mentioned that the estimated milk yield produced by each goat at peak lactation averaged 2.0 kg/day (Figure 9). Milk yield was estimated at peak of lactation because farmers were not regularly measuring milk yield throughout the whole lactation; rather they depended on the highest milk production estimates of each goat which probably is at peak lactation. Milk production from dairy goats is suitable for small-scale farmers because they are less expensive to keep, eat less and can produce milk for household consumption as compared to dairy cows (Donkin, 1997). Four of the farmers indicated that they never bothered to take note of how much on average their goats were producing (Figure 9). Taking into consideration the fact that in most of the farms these animals depended on natural pasture for their maintenance, their ability to produce on average 2 kg of milk per day at peak lactation period is an opportunity to take advantage of and start producing goat milk in Botswana to help reduce the local milk imports. According to Shivairo *et al*. (2013), goat milk is generally used for

household consumption in developing countries, unlike cow milk which has organised, regulated production and marketing system.

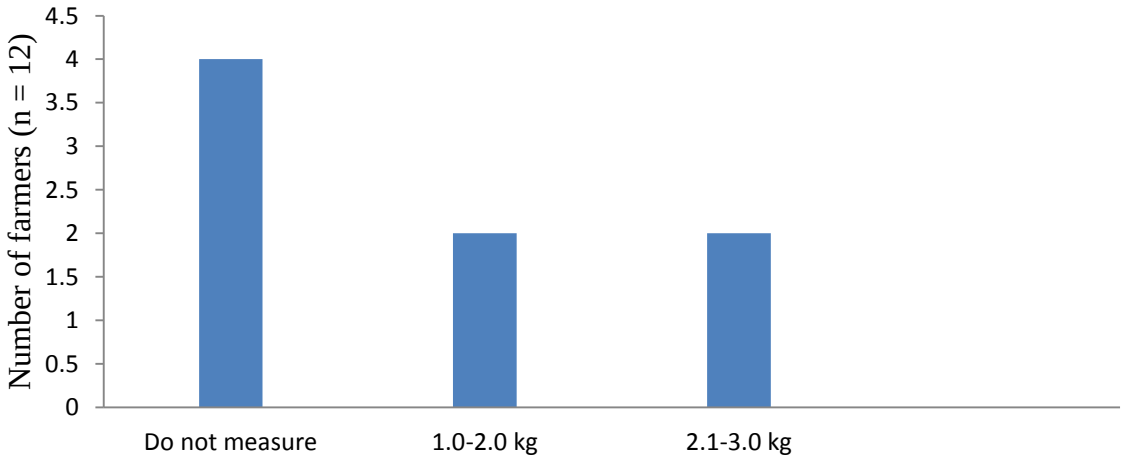

Figure 9: Estimated average milk yield per goat at peak (kg) of dairy goats owned by farmers in Central, Kgatleng and Kweneng districts of Botswana.

Constraints of dairy goat production in Botswana

The performance of dairy goats in Botswana is affected by a number of factors, as indicated below (Figure 10):

- Unavailability of breeding stock: six farmers mentioned that unavailability of dairy goats breeding stock was a major problem to dairy goat industry in Botswana. Ogola and Kosgey (2012) stated that having a proper breeding strategy in place can address both short and long-term concerns of dairy goat breeding.
- Lack of financial assistance: three farmers indicated that lack of funds from both government and private sectors contributed to low dairy goat production. According to Peter (2016), under-funding from the government has affected the Dairy Development Authority's capacity to put the required infrastructure to regulate and strengthen Uganda dairy goat industry.
- Low acclimatisation of exotic breeds: one farmer attributed the low dairy goat performance to low acclimatisation of exotic breeds. Moreki *et al*. (2011) mentioned that majority of dairy breeds used in Botswana are imported from neighbouring countries and are usually not of the best quality. Furthermore, they are hardly suitable for local climatic conditions, hence their unsatisfactory performance.
- Insufficient feed: one farmer mentioned that shortage of feed (quantity and quality) is one of the major constraints to dairy goat production to sustain milk production, particularly during the dry

season. This is attributable to unreliable rainfall and recurring droughts which result in seasonal pasture variations which are not able to sustain the livestock sector throughout the year (Moreki *et al*., 2011).

- Inadequate knowledge about the care and management of dairy goats: one farmer indicated that few dairy goat experts locally have a bearing on the provision of technical knowledge to the farming communities. Ahuya *et al*. (2005) indicated that availability of dairy goat's experts from the district to the village level is beneficial because staff will provide extension services upon the available dairy goat farming community.
- Loss of animals due to diseases such as heart-water: One farmer stated that dairy goats are susceptible to diseases as compared to indigenous and meat goats. Donkin and Boyazoglu (2004) highlighted that in most cases the high mortality of dairy goats usually occurs in kids caused by coccidiosis and pneumonia.

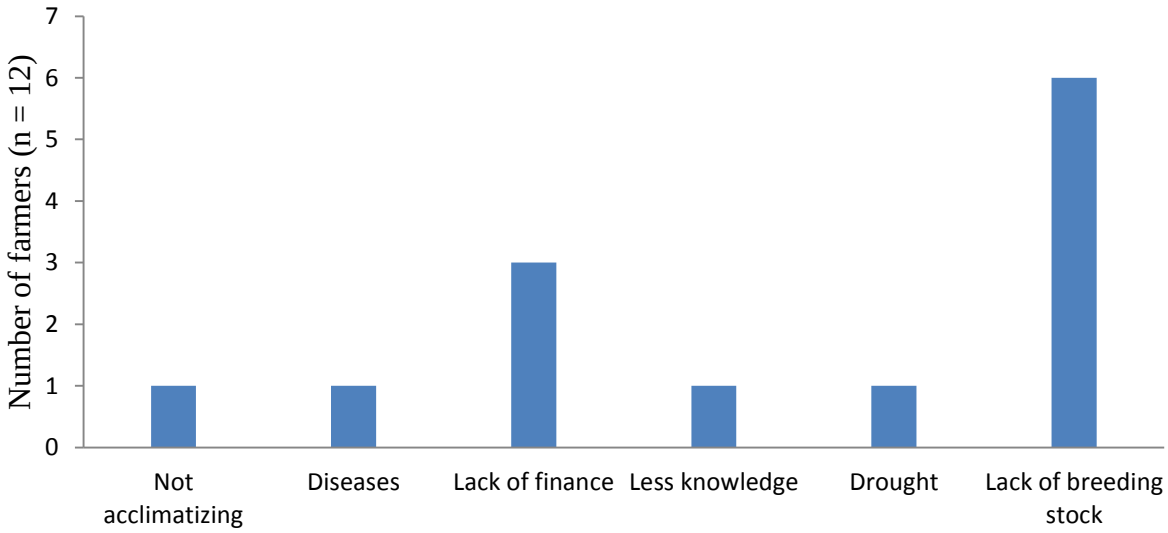

Figure 10: Challenges of dairy goat production as perceived by farmers in Central, Kgatleng and Kweneng districts of Botswana.

Opportunities for smallholder dairy goat farmers in Botswana

The dairy goat industry in Botswana has great potential for further growth. Some opportunities (Figure 11) that exist in the dairy goat industry include:

- High demand for goat milk: six farmers indicated that high demand for goat milk locally was an opportunity for farmers to invest and produce goat milk and milk products. Such findings are consistent with those of Moreki *et al*. (2011) who reported that low milk

production locally presents an opportunity to farmers to expand existing dairy farms or to start new ones. In addition, the existence of robust milk processing plants should encourage milk production in the country. Ngambi (2008) mentioned that goat milk can be processed into marketable products such as cheese, sour milk (*madila)*, and yoghurt. Goat milk can be of value to adults and babies unable to digest cow milk, therefore, has a niche market. However, in Botswana marketing of goat milk and its products is not well established. To date, there has been no local goat milk marketing efforts attempted, rather goat milk is imported from neighbouring countries and sold at high prices in big supermarkets at around P16/kg (approximately US$2.30/kg at the time of the study).

- Dairy goat stud breeding: three of the farmers mentioned that starting a dairy goat stud breeding operation in Botswana was one of the possible opportunities that farmers could start to supply local people with breeding animals. The success of any dairy goat flock often depends on the planning and preparations made during breeding season (Grossman, 2013).
- Fodder production: two farmers mentioned that producing fodder for dairy goat feed in the country could be a lucrative business. Fodder crops provide a valuable feed supplement for dairy goats, especially during the dry season. They contain much more protein than grasses and crop residues, and this makes them able to produce more milk when fed to dairy goats (Wambugu *et al*., 2006).

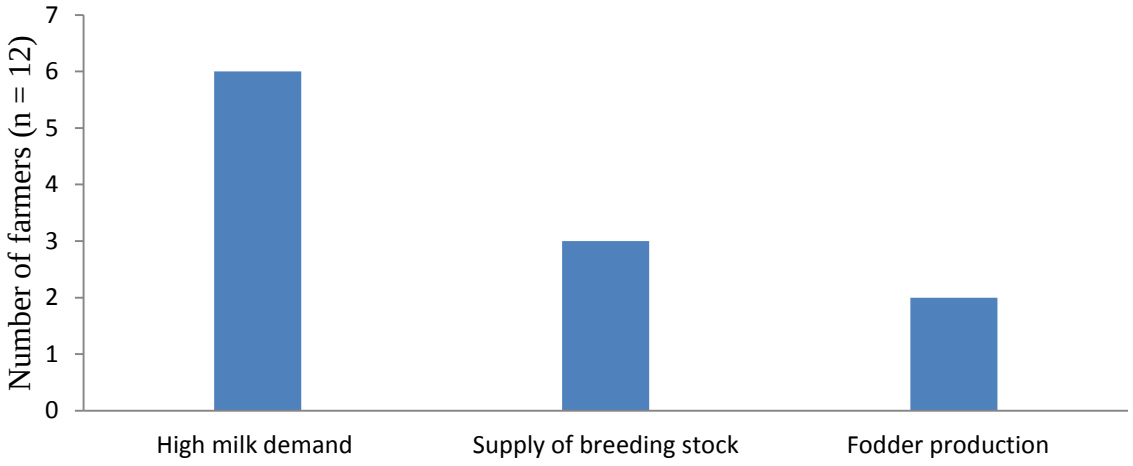

Figure 11: Opportunities of dairy goat production as perceived by farmers in Central, Kgatleng and Kweneng districts of Botswana.

CONCLUSIONS

There were only twelve farmers keeping a total of 100 dairy goats of different breeds in Central, Kgatleng and Kweneng districts of Botswana at the time this study was conducted. Dairy goat production in Central, Kgatleng and Kweneng districts of Botswana was dominated by middle aged farmers with less than five years keeping dairy goats. Farmers were keeping less than ten goats which were exotic and managed in a semi-intensive system (except government owned dairy goat farms which kept more than 20 goats intensively) with an estimated average milk production of 2.0 kg/d at peak lactation. The unavailability of affordable breeding stock and good quality feeds, lack of financial assistance to dairy goat farming, inadequate knowledge of farmers about the management of dairy goats and diseases such as heart-water disease were perceived to be the main constraints for dairy goat farmers in Botswana. However, high local milk demand and the nutritional importance of goat milk was an advantage that local farmers can regard as a marketing opportunity to produce more milk from dairy goats. Moreover, fodder production and stud breeding of dairy goats were opportunities that local dairy goat farmers can invest on.

RECOMMENDATIONS

Local farmers should be encouraged to take up dairy goat farming as a business and refrain from visiting their farms only during the week-ends and public holidays. They also need to be up skilled on the management principles of dairy goat production. Future research on management and production of dairy goats should involve collaboration with dairy goat farmers, on-farm rather than on-station. This could give farmers hands-on experience and be able to understand the challenges that are encountered during management of dairy goats. Adopting proper breeding management principles and feeding affordable local quality feeds should be encouraged to dairy goat farmers in order to increase the productivity of their flocks in Botswana. The government of Botswana should start promoting dairy goat production by considering it as an economic diversification derive and include goat milk in local milk production improvement schemes.

LITERATURE CITED

Abate, A., Dzowela, B. H., and Kategile, J. A. (1993). Intensive animal feeding practices for optimum feed utilization. (Ed). Kategile, J.A and Mubi, S. (1992) in Future of livestock industries in East and Southern Africa. Proceedings of the workshop held at Kadoma Ranch Hotel, Zimbabwe.

Ace, D. L. (1993). Feeding and Housing Dairy goats. Curators of the University of Missouri Extension. Whitten Hall, Columbia.

Aganga., A. A. and Nsoso, S. J. (2011). Gender distribution in ownership of livestock and poultry in the animal industry in Botswana. *UNISWA Journal of Agriculture* 15 (1): 93-98.

Agrinews. (May 2012). Dairy Goat Research Projects. Botswana Ministry of Agriculture farmer's monthly magazine. 22 (2). Ministry of Agriculture, Gaborone, Botswana.

Ahuya., C. O, Okeyo., A. M., and Hendy, C. (2005). Community Based Livestock Improvement: A case study of FARM-AFRICA's goat improvement in Meru, Kenya. Department for International Development. Oxford, United Kingdom.

Aziz, M. A. (2010). Present status of the world goat populations and their productivity. *Lohmann information* 45 (2): 42-52.

Bryant, M. (2001). Milk production in smallholder dairy farms in Tanzania: the quality and safety of milk. Southern Highlands Dairy Development Programme (SHDDP), Tanzania.

Central Statistics Office CSO. (2013). Botswana Agricultural Survey Report 2013. Ministry of Finance and Development Planning. Printing and Publishing Services, Gaborone, Botswana.

Chethan., G. N, Senthil., K. R., Rajkamal., P. J., and Chandra, M. B. (2015). Knowledge and attributes of the beneficiaries of livestock development for livelihood support (Ldls) programme in Goat farming in Wayanad district of Kerala, India. *International Journal of Social Sciences* 4 (3): 1-6.

Donkin, F. E. (1997). Productivity and diseases of Saanen, indigenous and crossbred goats on zero grazing. Unpublished PhD thesis, Medical University of Southern Africa.

Donkin, E. F., and Boyazoglu, P. A. (2001). Milk production from goats for households and small-scale farmers in South Africa. Faculty of Veterinary Science, University of Pretoria, Onderstepoort, South Africa. www.nda.agric.za/docs/AAPS/Articles/goats. 6/09/14.

Donkin, E. F., and Boyazoglu, P. A. (2004). Diseases and mortality of goat kids in a South African milk goat herd. *South African Journal of Animal Science* 34: 258-261.

Peter, M (2016). Opportunities and challenges in Uganda's dairy industry. East Africa Agribusiness Magazine, (January 2016). (6). Kampala, Uganda.

Food and Agriculture Organisation, (2002). Medium Term Projections for Meat and Dairy Products to 2010. Committee on Commodity Problems. Rome, 27-29 August 2002. FAO/IFAD Cooperative Programme, United Nations, Rome.

Grossman, M. (2013). Planning ahead: Breeding season affects the year to come. Dairy Goat Journal. Swift Communications, Inc. Medford.

Jackson, M. (2013). Production performance and the contribution of dairy goats to income of small-scale farmers in Babati and Kongwa districts, Tanzania. Unpublished MSc thesis. Sokoine University of Agriculture, Morogoro, Tanzania.

Jackson, M., Chenyambuga, S. W., Komwihangilo., D. M., and Ndemanisho, E. E. (2012). Production performance and contribution of dairy goats in to income of small-scale farmers: A case of Babati and Kongwa districts in Tanzania. Third RUFORUM Biennial meeting 24-30 September 2012, Entebbe, Uganda.

Kipserem, J., Sulo, T., Chepngeno, W., and Karrir, M. (2011). Analysis of factors affecting dairy goat farming in Keiyo North and Keiyo South Districts of Kenya. *Journal of Development and Agricultural Economics* 3(11): 555-560.

Ministry of Agriculture (2008). Dairy Section Annual Report. Department of Animal Health and Production. Division of Animal Production. Ministry of Agriculture, Gaborone, Botswana.

Ministry of Agriculture, (MoA) (2014). Dairy Annual Report, 2014. Department of Animal Production, Government printing, Gaborone, Botswana.

Moreki, J. C., Koloka, O., Nthoyiwa, L., Moloi, I. P., and Palai, G. (2011). A critical review of the performance of the dairy industry in Botswana. *Livestock Research for Rural Development* 23 (3).

Mpapho, G. S. (2010). Establishing a dairy goat milking enterprise in Botswana: Challenges and prospects. 2nd Animal Agriculture Conference. Botswana College of Agriculture, Gaborone, Botswana.

Mwangi, B. (2013). Shortage of extension services hurts goat milk production. Business Daily Magazine Nation Centre. Nairobi, Kenya.

Ngambi, J. W. (2008). The role of goats in food supply, poverty alleviation and prosperity in Sub-Saharan Africa. Department of Agriculture and Animal Health. College of Agriculture and Environmental Sciences. South Africa.

Njuki, J., and Sanginga, P. C. (2013). Women Livestock Ownership and Markets: Bridging the gender gap in East and Southern Africa. International Livestock Research Institute and the International Development Research Centre, Canada, United States of America.

Ogola, T. D. O., and Kosgey, S. I. (2012). Breeding and development of dairy goats: Eastern African experience. *Livestock Research for Rural Development* 24 (1).

Ogola, T.D.O., Nguyo, W.K. and Kosgey, S.I. (2010). Dairy goat production practices in Kenya: Implications for a breeding programme. Livestock Research for Rural Development 22 (1).

Ojango, J. M. K, Ahuya., C, Okeyo., A. M., and Rege, J. E. O. (2010). The FARM-Africa dairy goat improvement project in Kenya: A case study. Animal Genetics Training Resource, International Livestock Research Institute, Swedish University of Agricultural Sciences. Nairobi, Kenya.

Omore, A. (2005). Livestock Production and Feed Resources in Kenya. AGRIPPA Country profile. International Livestock Research Institute, Nairobi, Kenya.

Shivairo, R. S., Matofari, J., Muleke, C. I., Migwi, P. K., and Lugairi, E. (2013). Production Challenges and Socio Economic Impact of dairy goat farming amongst Smallholder farmers in Kenya. *Food Science and Quality Management* 17:54-61.

Van-Saun, R. J. (2008). Dairy goat nutrition: Feeding for two: How to properly feed the goat and her rumen. Pennstate.

Wambugu, C., Franzel, S., Cordero, J., and Stewart, J. (2013). Fodder shrubs for dairy farmers in East Africa: Making extensive decisions and putting them into practice. World Agroforestry Institute, Nairobi, Kenya and Oxford Forestry Institute, Oxford, United Kingdom.