

A survey on rabbit production in the city of Gaborone, Botswana

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ABSTRACT: This study was conducted to provide information on rabbit production in 20 operations in the City of Gaborone, Botswana. Data were collected from individual rabbit breeders and educational institutions (5) using a structured questionnaire and through direct observation. Rabbit farming in Botswana is only carried out at subsistence level. Results showed that 55% of male respondents were involved in rabbit production compared to 45% for females. Rabbits were kept mainly as a source of meat for families, income generation and educational purposes. Fifty percent of the rabbit stock was sourced from local breeders, 25% from South Africa and the remainder from local breeders and other countries. The predominant rabbit breeds reared were Californian (60%) and New Zealand (60%) followed by Chinchilla, Dutch and Rex with 20% each. Ninety percent of the breeders kept rabbits in cages while 3% confined them at night and let them out during the day to scavenge for feed. Fifteen percent of the respondents fed commercial rabbit pellets, 5% vegetables only while 80% fed both rabbit pellets and vegetables. The number of rabbits kept by an individual breeder ranged from 7 to 140 with mean stock size of 20.85 ± 13.21 . Litter size per doe ranged from 6 to 10 kits with 5 to 6 litters per year. Rabbits were marketed at 8 to 12 weeks of age and each rabbit was sold for Botswana Pula (BWP)150 to 250 (equivalent to USD14.30 to USD23.80). On average the ratio of a breeding buck to doe was 1:5.4 (1:1 to 1:10). The major challenges in rabbit production were lack of feed resources, lack of research support, inadequate breeding stock and lack of technical support from Government extension services. These results suggest that rabbit production has the potential to contribute to food and nutrition security and poverty alleviation.

Keywords: Botswana, challenges, food security, poverty alleviation, rabbits, rabbit farming.

INTRODUCTION

Agriculture provides food, income and employment for the majority of people in Botswana, especially the rural dwellers. It has potential for growth and creation of employment opportunities particularly for the unskilled and semi-skilled people (Statistics Botswana, 2019). As is the case with other developing countries, urban and peri-urban agriculture (UPA) is practised in Botswana. Urban and peri-urban agriculture refers not only to food crops and fruit trees grown in urban centres, but also to different kinds of livestock, medicinal plants and ornamental plants (Mosha, 2016). The majority of UPA farmers are low to

medium-income-earners who grow food for their own consumption or income generation. Commercial UPA is limited to areas such as Greater Gaborone, Francistown or Lobatse. Four main types of UPA are practised in Botswana and these are backyard gardening, bee keeping, poultry and rabbit production; demarcated plots along dams and rivers; intensive activities in tribal peri-urban areas such as Kazungula, Tlokweng and Mogoditshane; and institutional agricultural programmes/projects (e.g., schools, prisons, Botswana Defence Force). Men tend to dominate commercial urban food production

while women dominate certain components of urban cultivation including backyard gardening, poultry and rabbit production (Moshia, 2016).

Small livestock such as rabbits have a number of characteristics that might be advantageous in the smallholder, subsistence-type integrated farming and gardening food production systems in developing countries (Cheeke 1986). The domestic rabbit (*Oryctolagus cuniculus*) is one of the few species commonly kept as companion animals and who are also farmed for their meat and fur and also used for research (Oxley et al., 2018). Collin and Lebas (1996) identified three types of rabbit farms as traditional (smallholder), intermediary and commercial. In traditional production, less than 8 does are reared and 8 to 100 does in intermediary farms. For commercial production, over 100 does are kept and feeding is based mainly on complete feeds.

Although rabbits are farmed mainly for food, they are also raised for pets, show and laboratory use in cosmetic, medical and pharmaceutical research (Fanatico and Green, 2012). Rabbit manure can be used to fertilize crops and gardens (Cheeke 1986; Schiere, 2004). Rabbits can be successfully raised on grain-free diets, based on forages and agro-by-products. Acceptable performance can be obtained using greens such as weeds, tree leaves, tropical legume and grass forage, vegetable tops, waste fruits and vegetables (Cheeke 1986). However, complete diets are available in the markets which most of the time are used with non-conventional feedstuffs.

Domestic rabbits are recommended as an alternative source of dietary protein for the increasing human population in developing countries, where animal protein is in short supply (El-Raffa, 2004). Compared to other livestock, rabbit meat is richer in protein, vitamins and minerals (Lebas et al., 1997; Kunnath, 2017). Rabbit meat is white and has desirable attributes which include low fat, sodium and cholesterol contents but high protein content when compared with other meats (Bodnàr and Bodnàr, 2014). Furthermore, rabbit fat has less stearic and oleic acids and high proportions of essential polyunsaturated linolenic and linoleic acids (Kunnath, 2017). These attributes make rabbit meat superior to other meats, thus making it appeal to the health conscious market. No studies on rabbit production systems in Botswana could be found in literature due to overemphasis on larger livestock such as cattle; hence there is limited information on rabbit production in Botswana. Therefore, this study investigated the status of rabbit production in the city of Gaborone, the capital of Botswana.

MATERIALS AND METHODS

Study site

A survey was conducted in the city of Gaborone, the

capital of Botswana from January to February 2018. The geographical coordinates of Gaborone are 24° 38' 47" South and 25° 54' 43" East. The human population of Gaborone is estimated to be 234 775, which is about 10.9% of the country's population (Statistics Botswana, 2018a). The Botswana Multi-Topic household survey estimated poor people in Gaborone to be 18,395, representing about 8% of the city's population (Statistics Botswana, 2018b). Average annual temperature in Gaborone is 20.3°C; the warmest and coldest months of the year are January and July with average temperatures of 25.6 and 12.5°C, respectively. Throughout the year temperatures vary by 13.1°C while total annual rainfall for Gaborone is 311.5 mm (Statistics Botswana, 2016).

Data collection

A list of rabbit breeders was obtained from the Department of Animal Production in the Ministry of Agricultural Development and Food Security from which 20 breeders in Gaborone were randomly selected for data collection. In addition, data were collected from five educational institutions. Data were collected using a structured questionnaire and through direct observation. The breeders were interviewed either early in the morning or in the evening to avoid interfering with their daily activities. The following data were collected: respondents occupation, age, sex, level of education, source of stock, total number of rabbits (breeders + growing rabbits), rabbit breeds, housing type, age at weaning, the ratio of breeding buck to does, feeds, frequency of feeding and watering rabbits, type of equipment used, health management, marketing and use of money from rabbit sales.

Data management and analysis

Data were captured in the computer using Microsoft Excel and analysed using Statistical Package for Social Sciences (SPSS) software, version 15 (SPSS Inc., Chicago, USA). Descriptive statistics were analysed with frequency distribution, means and percentages.

RESULTS AND DISCUSSION

Socioeconomic data

The respondents' socioeconomic data are given in Table 1. Sixty-five percent (65%) of rabbit breeders were aged over 35 years followed by 26 to 35 years (25%) and lastly 21 to 25 years (10%), indicating that rabbit farming is carried out by all age groups. This finding is consistent with Hungu et al. (2013) who found that rabbit farming in Kenya cuts across all age groups. Fifty-five percent (55%) of the respondents in this study were males while the remainder

Table 1. Socioeconomic data of the respondents.

Category	Frequency (n=20)	Percentage
Age		
21 to 25 years	2	10
26 to 35 years	5	25
Over 35 years	13	65
Gender		
Male	11	55
Female	9	45
Occupation		
Teacher	5	25
Farmer	6	35
Manager	1	5
Secretary	3	15
Pensioner	1	5
Field assistant	1	5
Student	1	5
Self employed	1	5
Education level		
Senior school	2	10
Junior school	1	5
Tertiary school	15	75
Non formal education	2	10
Marital status		
Married	5	25
Single	14	70
Widow	1	5

were females. In addition, 85% of the respondents were employed in either the public or private sector followed by 15% that comprised students, pensioners and those that were self-employed. These results indicate that most of the respondents raised rabbits as a sideline activity. All the respondents in this study were literate with 75% of them having tertiary education (Table 1). This implies that most of the respondents could comprehend technical messages from extension services. The educational status of the respondents in this study is higher than that reported by Tembachako et al. (2014) in Zimbabwe. Additionally, 70% of the respondents were single followed by married (25%) and widowed (5%).

Source of rabbit stock

Fifty-five percent (55%) of rabbit breeders sourced their breeding stock locally from other breeders, 25% from South Africa while the remainder sourced rabbits from local breeders and outside the country. Similarly, Hungu

et al. (2013) found that 64% of farmers sourced their breeding stock from other farmers while Kale et al. (2016) reported a higher value of 76.9%. In the opinion of Hungu et al. (2013), sourcing breeding rabbits from fellow farmers could lead to inbreeding if not done properly. Oseni et al. (2008) observed that the practice of acquiring rabbit stock from other farmers in Ghana has disadvantages because of lack of reliable and steady supply of rabbit stock. In this study, rabbits were obtained outside the country in order to access a wide range of genetic materials and also to avoid inbreeding. In disagreement with the present results, Dairo et al. (2012) reported that 74% of the respondents in Ekiti State of South-Western Nigeria obtained foundation stock as gifts from friends while the remainder purchased stock from the open market. The authors attributed farmers' failure to import foundation stock to lack of credit facilities.

Reasons for rearing rabbits and rearing experience

In the present study, rabbits provided a source of income (47%) and food (44%) to the breeders and were also kept as pets (9%). The educational institutions kept rabbits mainly for educational purposes though sales occasionally occurred after the rabbit population had risen significantly. In addition, the educational institutions donated some rabbits to other institutions as a way of encouraging rabbit farming among students. In Kenya, Kale et al. (2016) found that farmers valued rabbits as a source of food (46.2%) and income generating enterprise (53.8%). Similar observations were made by Tembachako and Mrema (2016) who found that in Mt Darwin District of Zimbabwe rabbits were mainly kept for consumption with a few being sold.

Forty percent (40%) of the respondents said they had been rearing rabbits for 3 to 4 years followed by over 4 years (25%), 1 to 2 years (20%) and less than a year (10%), indicating that rabbit farming is still in its infancy in the study area. Tembachako and Mrema (2016) opined that more experience in rabbit farming implies that farmers have more and better information and the ability to improve rabbit production. This indicates that technical support is needed to raise the knowledge level of rabbit breeders.

Breeds and reproductive performance of rabbits

As shown in Table 2, six breeds of rabbits were reared in this study. These included Angora, Californian, Chinchilla, Dutch, New Zealand and Mini Rex. The predominant breeds were Californian (60%) and New Zealand (60%) followed by Chinchilla, Dutch and Rex. The total number of rabbits (breeders + growing rabbits) kept by an individual breeder ranged from 7 to 140 rabbits. On average, the number of rabbits kept by an individual breeder was 20.85 ± 13.21 (SD), whereas the number of

Table 2. Rabbit breeds and the time farmers have been keeping rabbits.

Category	Frequency (n=20)	Percentage
Breeds of rabbits kept		
Angora	1	5
New Zealand	12	60
Chinchilla	1	5
Californian	12	60
Dutch	4	20
Rex	4	20
Time farmers have been keeping rabbits		
<1 year	2	10
1 to 2 years	4	20
3 to 4 years	9	45
>4 years	5	25

Table 3. Rabbit production performance in the city of Gaborone.

Category	Frequency (n=20)	Percentage
Gestation period		
31 days	11	55
31-33 days	5	25
26-30 days	4	20
Average litter size		
1-6 kits	4	20
6-10 kits	8	40
>10 kits	8	40
Number of litters/doe/year		
5	13	65%
6	7	35
Buck to does ratio		
1:1	3	15
1:5	1	5
1:10	11	55
1:3	3	15
1:8	2	10

rabbits reared by educational institutions ranged from 2 to 60.

Fifty-five percent (55%) of the respondents mentioned that the gestation period of a rabbit was 31 days (Table 3). This finding is consistent with Lukefahr (1998), Kpodekon et al. (2004) and Schiere (2004). A doe produced a litter size of 6 to 10 kits with 5 to 6 litters per year (Table 3). The finding on the number of litters produced by a doe per year is similar to 6.98 reported by Lebas (2009), 6.52 ± 0.53 (Xiccato, 2010) and 5 to 6 litters (Kunnath, 2017). On the

other hand, Yadav (2014) reported 3 to 4 litters per doe per year in Kenya.

Table 3 shows that 55% of the respondents said that the ratio of breeding buck to does was 1:10 (1 male to 10 females), followed by 1:1 and 1:3 with 15% each, 1:8 (10%) and 1:5 (5%). On average the ratio of breeding buck to does in this study was 1:5.4 (with a range of 1:1 to 1:10). Previous study by Gono et al. (2013) in Zimbabwe reported the average buck to doe ratio of 1:6. The buck to doe ratio of 1 to 10 respectively in this study is consistent with Sicwaten and Stahl (1982). According to Lebas et al. (1997), in intensive system a buck can serve 7 to 8 does and 10 to 15 does in the extensive system.

Housing and equipment

Seventy percent of the respondents caged their rabbits, 20% kept them in shelters with solid floors and bedded with Lucerne or lablab (*Lablab purpureus*) while 10% allowed rabbits to free range but confined them at night. Furthermore, 90% of the respondents constructed rabbit shelters (hutches) using locally available materials such as wood, mesh wire, metal rods, bricks and corrugated iron sheets. The finding on types of materials used to construct rabbit shelters in this study is in agreement with Moreki and Seabo (2012). Rabbit houses in this study were constructed using locally available materials (Figures 1 and 2) due to inadequacy of funds or technical support provided by the Ministry of Agricultural Development and Food Security (MoA) extension services. Hungu et al. (2013) attributed the poor design and construction of rabbit hutches to farmers' limited access to technical information.

Feeds and nutrition

Three types of feeds were used including commercial rabbit pellets (15%), vegetables only (5%) and a combination of rabbit pellets and vegetables (80%) (Table 4). Similarly, Hungu et al. (2013) found that 11% of farmers used pellets, 19% vegetables while 70% used vegetable and pellet mixtures. In a related study, Borter and Mwanza (2011) reported that rabbit feeding in Kenya is based on locally available feed materials with little supplementation using commercial rabbit pellets. The study by Mailafia et al. (2010) in Nigeria showed that rabbit production can be integrated into small farming systems, with the rabbits being fed on crop residues, weeds, waste fruits, vegetables and poultry droppings. In a related study, Abu et al. (2008) in Nigeria reported that the diets of rabbits in Nigeria are primarily forages, grasses and legumes supplemented with kitchen wastes and agricultural by-products such as dried cassava peels and wet milled cereal by-products. Samkol and Lukefahr (2008) stated that a balanced diet containing adequate crude fibre (20-25%), minimal starch and optimum protein concentration



Figure 1. Poorly designed self-built cages.



Figure 2. A cage lacking manure collection system.

Table 4. Feeds and frequency of feeding and watering rabbits.

Category	Frequency (n=20)	Percentage
Type of feeds		
Pellets	3	15
Green vegetables	1	5
Pellets and green vegetables	16	80
Feeding and watering frequency		
<i>Ad libitum</i>	7	35
Once a day	10	50
Twice a day	3	15

is important to prevent gastro-intestinal distress and to improve rabbit production.

In the present study, 50% of the respondents fed and watered their rabbits once a day, i.e., early in the morning, followed by *ad libitum* (35%) and twice a day, i.e., morning and late afternoon (15%). Similarly, Ogbonna (2015) in the Enugu state of Nigeria reported that 62.55% respondents fed their rabbits twice a day. Lukefahr and Cheeke (1990) observed that there is limited data on feeding systems and programmes in backyard production.

Health management

Thirty percent (30%) of the respondents said their rabbits experienced diseases and parasites, and 40% of them cited ear canker (psoroptic mange) as a common parasitic infection in rabbits. Low disease incidence (30%) could imply that the breeders were knowledgeable in disease prevention and therefore were likely to have undertaken disease prevention measures. In agreement with this finding, Moreki et al. (2011) reported that ear canker was the most prevalent parasitic infection of rabbits in Botswana. Ear canker results from poor hygiene and mite attack on ears (Borter and Mwanza, 2011). In this study, ear canker infection was treated by rubbing rabbits' ears with cooking oil. Similarly, Gono et al. (2013) reported that farmers treated ear canker by rubbing the affected rabbit skin with used automobile oil and *Aloe vera* juice. Furthermore, Lebas et al. (1997) mentioned that glycerine, iodized oil or cresyl oil are effective against ear canker when applied frequently. The present and previous results indicate the predominance of ethnoveterinary medicine in the treatment of ear canker. Ivermectin is effective against ear canker (Bowman et al., 1992).

Fifty-five percent (55%) of the respondents said that they were able to identify signs/symptoms of rabbit diseases such as discharges around the eyes, ears, nose or anal area; loss of appetite; depression; diarrhoea; head tilt; loss of balance and laboured breathing. However, the respondents could not match the signs/symptoms with any specific disease. In spite of the respondents' ability to

identify signs/symptoms of diseases only about 27% of them sought assistance from animal health practitioners. This confirms that breeders' knowledge of disease control using modern medicine was limited. In agreement with the present results, Hungu et al. (2013) observed that despite the fact that the majority (83%) of farmers had reported disease and recognized their symptoms/signs only 69% sought treatment for their rabbits.

Extension/technical support

Seventy-five percent (75%) of the respondents said they obtained information on rabbit production from other breeders and Internet; 5% from MoA extension services, whereas the remainder said they obtained information from a combination of fellow breeders, Internet and MoA extension services. The fact that only 5% of the respondents obtained technical information from MoA extension service indicates that extension service is inadequate and not technically equipped to promote rabbit production. Forty percent (40%) of breeders indicated that they were visited by the Government extension staff once a month to count and record rabbit numbers. Only 10% of the respondents said they were trained in rabbit production. These findings indicate inadequacy of technical support and lack of access to information on rabbit production which have influence on production performance. Similar observations were made by Lukefahr and Cheeke (1990) and Oseni et al. (2008) in Western Nigeria.

Marketing and pricing of rabbits

Data on marketing and pricing of rabbits are presented in Table 5. Fifty percent (50%) of the respondents said they marketed their rabbits through word of mouth and flyers followed by flyers only (25%) and word of mouth only (5%). Rabbits were only sold when there was the need for money. Tembachako et al. (2017) reported that three methods are used to market rabbits in Zimbabwe and these are advertising through posters, waiting for customers and door to door marketing. Previous studies by Karikari and Asare (2009) and Osei et al. (2012) in Ghana reported that rabbits are mostly sold when there is a willing buyer or a strong need for a farmer to raise money. According to Lebas (2009), rabbits are slaughtered at 74 days of age. For Peace Corps (2014), rabbits are marketed at 3 to 4 months of age.

Forty-five percent (45%) of the respondents said they used age and weight to set prices for their rabbits followed by 25% who used a combination of age, sex and weight and 10% who used age only. Heavy rabbits fetched a better price than lighter rabbits. The educational institutions said they occasionally sold rabbits but donated them to other educational institutions and destitutes. In Botswana, destitutes are individuals without assets, people

Table 5. Marketing and pricing of rabbits in the city of Gaborone.

Category	Frequency (n=20)	Percentage
Marketing strategies		
Word of mouth	1	5.0
Advertising using flyers	5	25.0
Word of mouth and flyers	10	50.0
No response	4	20.0
Pricing strategies		
Age	2	10.0
Age, sex and weight (size)	5	25.0
Age and weight (size)	9	45.0
No response	4	20.0
Clients		
Individuals and restaurants	7	35.0
Individuals and restaurants/supermarkets	7	35.0
Individuals only	3	15.0
No response	3	15.0

with mental and physical disabilities, minor children without family support and those who are rendered helpless by natural disasters or temporary hardships (Government of Botswana, 2002).

Forty-six percent (46%) of the respondents said their clients were restaurants, hotels and supermarkets, individuals (39%) and government institutions (5%) such as schools. Rabbits were sold live or dressed. As there are no rabbit slaughter facilities in Botswana, rabbits were slaughtered and dressed in home kitchens prior to delivery to retailers, hotels and individual buyers. This finding is consistent with Bodnár (2009) in Hungary who reported that clients bought live rabbits, whole carcasses or different rabbit meat cuts. In the present study, rabbits were sold from six weeks of age and a rabbit was sold for BWP150 to 250 (equivalent to USD14.30 to 23.80). This implies that rabbit farming contributes to family revenue generation, economic empowerment, household food security and nutrition security. Data from MoA show that 20 tonnes of rabbit meat was imported into Botswana in 2018/19, indicating that market for rabbit meat exists in the country.

Breeders' use of money from rabbit sales

The respondents indicated that rabbits contribute towards household food supply and quality. The respondents said that they used money from rabbit sales to purchase food, clothing and to pay electricity and water bills. The money was also used to buy additional rabbit stock, equipment (i.e., cages, drinkers, feeders, nest boxes) and rabbit feed. Previous study of Osei et al. (2012) in Ghana reported eight main uses of income from the sale of rabbits which

included school fees, utilities, health care, clothing, food, hired labour, general household expenses and expansion of rabbitry. The authors mentioned that rabbit keepers who used the income generated mainly for paying school fees operated only backyard and small-scale commercial enterprises.

Challenges in rabbit production

Previous study by Kumar et al. (2010) in India categorized challenges in rabbit farming into production, financial, marketing and institutional problems. Challenges in rabbit production in this study are summarised in Table 6. The four major challenges are unreliable market, limited technical information, lack of Government support and high feed expenses. In agreement with the current study, Soyebó (2006), Dairo et al. (2012), Moreki and Seabo (2012), Ogbonna (2015) and Roy (2015) reported lack of foundation stock, lack of Government support, lack of research support and inadequate extension/technical support to be challenges in rabbit production.

Other challenges included lack of access to credit and feeds (Moreki and Seabo, 2012; Ogbonna, 2015; Tembchako and Mrema, 2016), diseases/pest infestation (notably mange) and inability to purchase good quality feed (Dairo et al., 2012). In consonance with the current study, Ouertani et al. (2016) reported high feed expense and quality of feeds to be major challenges in the development of the rabbit subsector in Tunisia. Previous studies identified challenges faced by rabbit keepers to be diseases, environmental conditions, skills deficiency, predation (Baruwa, 2014; Kale et al., 2016), lack of access to market (Baruwa, 2014; Kale et al., 2016; Tembchako

Table 6. Challenges in rabbit production in the city of Gaborone.

Category	Frequency (n=20)	Percentage
Predation	1	5
Unreliable market	10	50
Diseases	4	20
Limited availability of technical information	10	50
Inadequate stock and breeds replacement	4	20
Lack of technical support	10	50
Medication for rabbits not readily available	4	20
Delays in government procurement	4	20
High expense of rabbit feeds	10	50

et al., 2017), some religious beliefs (Tembachako et al., 2017), lack of interest in the enterprise, lack of proper awareness, poor marketing channels (Odinwa et al., 2016) and soldier's attack (Baruwa, 2014).

Borter and Mwanza (2011) observed that rabbit production in Kenya is not structured resulting in farmers not able to ascertain the number of rabbits they can make available to the market at any given time. The authors also reported that market is not clearly defined as many people do not know that rabbit meat can adequately replace other protein sources.

For Oseni and Lukefahr (2014), the key challenges to the development of a viable rabbit industry in Africa range from institutional and policy limitations to critical environmental conditions such as heat stress, poor stock and poor diet quality. The challenges reported in the present and previous studies show that rabbit farming in Botswana and most African countries faces myriad challenges that must be addressed if productivity levels are to be raised.

Conclusion

Rabbit farming is at its infancy and is a source of protein and income to smallholder farmers. The nutritive attributes of rabbit meat suggest that rabbit production has the potential to significantly contribute to food and nutrition security in Botswana. This study identified unreliable market, limited technical information on rabbit production, lack of support from MoA and high feed expenses as the major challenges in the development of rabbit industry in Botswana. The present results suggest that rabbit production can contribute to increased protein supply of families in both rural and urban and peri-urban areas thereby playing an important role in nutrition security.

Recommendations

Based on the present findings, the following recommendations are made:

1. Technical information on rabbit farming should be generated by MoA extension services and made available to rabbit farmers. Digitalization will play a key role in the dissemination of technical information to farmers quickly.
2. Extension activities should be intensified in order to mobilise more farmers to venture into rabbit production.
3. There is need to establish a Rabbit Association which together with extension service will promote rabbit farming and consumption in Botswana. In an effort to popularize rabbit farming, countrywide road show campaigns focusing on the nutritional attributes of rabbit meat should be mounted.
4. Further research in rabbit production covering a wider area and a large number of breeders is recommended.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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