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Camels in Botswana: Herd dynamics and future development implications

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ES; conceived idea, designed the study, collected data, analyzed data, prepared the manuscript, ORM; design of the study, collected data, reviewed the manuscript, DT; design of the study and reviewed the manuscript.

ABSTRACT

This study was conducted to assess the current status of camels kept at the Tsabong Ecotourism Camel Park (TECP) and to make recommendations for improvement of their productivity. A semi-structured questionnaire was prepared and all park workers and the park manager were interviewed on various issues related to the camel park. In addition, field observations were made by touring the entire park in order to identify browse species consumed by the camels. Also, the overall conditions of the camel herd were assessed by visiting them at the kraal. The results showed that the camel park is currently facing a wide range of problems and the Tsabong camel herd is underutilized and performing well below its potential. The camels are currently used only for tourism (riding) purposes. However, the main reason for keeping camels elsewhere in the world is for food production, mainly for milk production. Thus, due emphasis should be given to milk production from camels alongside camel tourism (camel safari). If appropriate interventions are taken to improve the productivity of the camels, they would significantly contribute towards achieving food security and economic prosperity in Kgalagadi District, Botswana.

Keywords: Challenges, Dromedaries, productivity, Tsabong Ecotourism Camel Park
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INTRODUCTION

One-humped camels (*Camelus dromedarius*) play an important role as a primary source of subsistence in the Middle East as well as north and eastern Africa. They live in arid and semi-arid areas, which are not suitable for crop production and where few other livestock species thrive. The primary reason for keeping camels in these areas is milk production, although transportation and meat production are also important goods and services provided by camels. In arid and hot environments, camels are the preferred dairy animals and they produce more milk for a longer period of time, even during the dry season, than local cattle (Bekele et al., 2002).

The number of camels in the world is reported at 24 million, of which 89% are one-humped (*Camelus dromedarius*) and the remaining 11% are two-humped (*Camelus bactrianus*) camels (FAOSTAT, 2010). Due to their unique physiological characteristics, one-humped camels have adapted to challenging environments in arid and semi-arid regions (Wilson, 1998). Over 80% of the world's camel population is found in Africa (Faye, 2015) with about 63% of these being in north east Africa (FAO, 2008). Three eastern African countries, namely Somalia, Sudan and Ethiopia possess the highest dromedary camel populations in the world (Faye, 2015).

Dromedaries are multipurpose domestic animal species. They provide milk and meat, and are also used for riding, and as baggage and work animals (Wilson, 1998). Camel milk is the main component of human diets in hot regions and arid countries where they are found (Wilson, 1998), but also in many other parts of the world (Yagil, 1982). Dromedaries can produce up to 10 litres of milk per day during a lactation period of 12-18 months (Farah et al., 2007). Annually, about 5.4 million tonnes of camel milk is produced in the world (UNDP, 2012) and Somalia is the leading camel milk producer in the world followed by Ethiopia (FAOSTAT, 2010). Camel milk has a potential market of a minimum of 200 million people in the Arab world and many millions more in Africa, Europe and the Americas (UNDP, 2012). It is reported that camel milk has a potential world market worth of 10 billion US dollars per year (UNDP, 2012). Camel milk has therapeutic properties and is used to treat diabetes, tuberculosis, dropsy, jaundice, anemia, asthma, cancer, hepatitis, hypertension and autism (Yagil, 1982; Agrawal et al., 2005; Hashim et al., 2009; Mullaicharam, 2014; Sharma and Singh, 2014; Shori, 2015;

Yadav et al., 2015; Dubey et al., 2016). Because of its purported medicinal values, interest is growing in camel milk among specific consumer groups in North America and Europe (Al Haj and Al Kanhal, 2010; Mullaicharam, 2014; Sharma and Singh, 2014) and fresh camel milk fetches 22 US dollar per 16 ounce bottles (≈ 0.5 litre) in American supermarkets (Weinstein, 2016).

Camels are well-adapted to dry and hot environments, and among domesticated animals, have the physical and physiological capacity to cope with the impeding climate change. The majority of the land area of Botswana has an arid climate and ideally suited to camel production. Camels were imported into Botswana in the beginning of the twentieth century, mainly from the Cape of Good Hope (Wilson, 2013). These animals were used by the police for regular patrols in the sandy Kgalagadi Desert and for postal deliveries. The police force continued to use camels on patrols up to the 1970s and retained them until 2001 (Wilson, 2013). In 2001, the camels were handed over to local communities with the intention of developing a tourism industry based on camel safaris.

The Tsabong Ecotourism Camel Park was established in 2003. The camels are kept in an enclosed park known as Tsabong Ecotourism Camel Park (TECP), which is located in Kgalagadi District. They are under the care of the local community (Tsabong, Maubelo and Maleshe Villages; Tsamama Trust) where Botswana Tourism Organization oversees the overall management of the park.

Currently, camels are being used for ecotourism in Botswana. Similarly, camel safari is becoming a major tourism attraction in the world. In the Thar Desert of India, camel safaris have become an important attraction of tourists and are generating a considerable amount of income which sustains the economy of Jaisalmar, a city in Rajasthan state of north-west India (Shackey, 1996; Sindhu and Singh, 2014). Camel desert safari is the main attraction for tourists. This form of tourism provides income to local residents, tour operators and camel owners in Jaisalmer District.

Use of camels for tourism activities is also practiced in Tanzania, where a cultural tourism initiative run by the Maasai community of Mkuru at the foot of Mount Meru generates income for the community and created employment opportunities for the people in the area (Mukuru Camel Safari, 2017). Camels are also used for tourism in the Arabian Peninsula (Breulmann et al., 2007). Khalaf (1999) indicated that camel races are a major traditional heritage sport in the Arab region. It should be noted that only a limited number of camels can be bred and kept for camel safaris. Therefore, concurrent to ecotourism, there is a need to explore the use of camels for milk production.

Botswana has a population of 2 million people and approximately 40% of the country's population live in rural areas and derive most of their livelihood by practicing one or more forms of agriculture (Marumo et al., 2012). There is a high incidence of poverty in the country, particularly in rural areas whereby according to Marumo et al. (2012), the numbers of persons living below the poverty line was estimated at 499,467 in 2002/03 which represents a national poverty head count of 30.6%. The cities and towns of Botswana also experienced an increase in poverty incidence from a poverty headcount of 10.6% in 2002/03 to 14% in 2009/10 (Marumo et al., 2012). Lately, it was reported that an estimated 1.1 million people are food insecure in Botswana and, therefore, in need of humanitarian assistance (Mokwena, 2016).

Camels are important milk producing animals in dry and arid environments like Botswana. They produce more milk for a longer period of time as compared to other domestic animals such as local cattle under harsh environmental conditions. Given Botswana's agro-ecology, which is suitable for camel husbandry, there is huge potential to develop camel dairy in the country and substantially contribute towards the national milk supply and produce diverse dairy products based on camel milk. Moreover, Botswana is well known for its beef sector which contributes to the economy of the country. Camels can serve as an additional source of meat and will positively contribute to the development of the meat industry in the country.

The Tsabong camel herd is underutilized and performing well below its potential. The camels are currently used only for tourism purposes where 20 Botswana Pula (P20.00) per person is charged for riding a camel. However, the main reason for keeping camels elsewhere in the world is for food production, especially milk production. Thus, camels have a great potential to contribute to food security, national economic growth and poverty alleviation in Botswana if appropriate interventions are made to improve their productivity.

The objectives of this study were to assess the current status of camels kept in TECP and make recommendations for improvement of their productivity.

METHODOLOGY

Study area

The study was conducted in TECP, which is located in Kgalagadi South District in south-western Botswana. The study site is located at a distance of 520 km from the capital city Gaborone and 10 km north of Tsabong village, and comprises a fenced area of 4 x 4 km (Figure 1). The area has sparsely distributed vegetation dominated by *Grewia, Senegalia* and *Vachellia* species and some species of grasses (Kgaudi, 2014).

Tsabong is the capital of the Kgalagadi South District. A large proportion (31.6%) of the human population of Kgalagadi South District is found in Tsabong village. Tsabong has a total human population of 9,471, of which 4,719 are males and 4,752 are females (Statistics Botswana, 2015). The annual population growth rate of Tsabong village between 2001 and 2011 was 3.1%, and the overall literacy rate in Tsabong during this period was 85.6% (Statistics Botswana, 2015). The demographic structure of Tsabong village shows that the population is characterized by a high proportion of young people. According to the 2011 population and housing census of Tsabong, children of school age (0-14 years), the youth (18-35 years) and active labour force (15-64 years) accounted for 32.4, 34.2 and

64.3%, respectively, of the total population (Statistics Botswana, 2015).

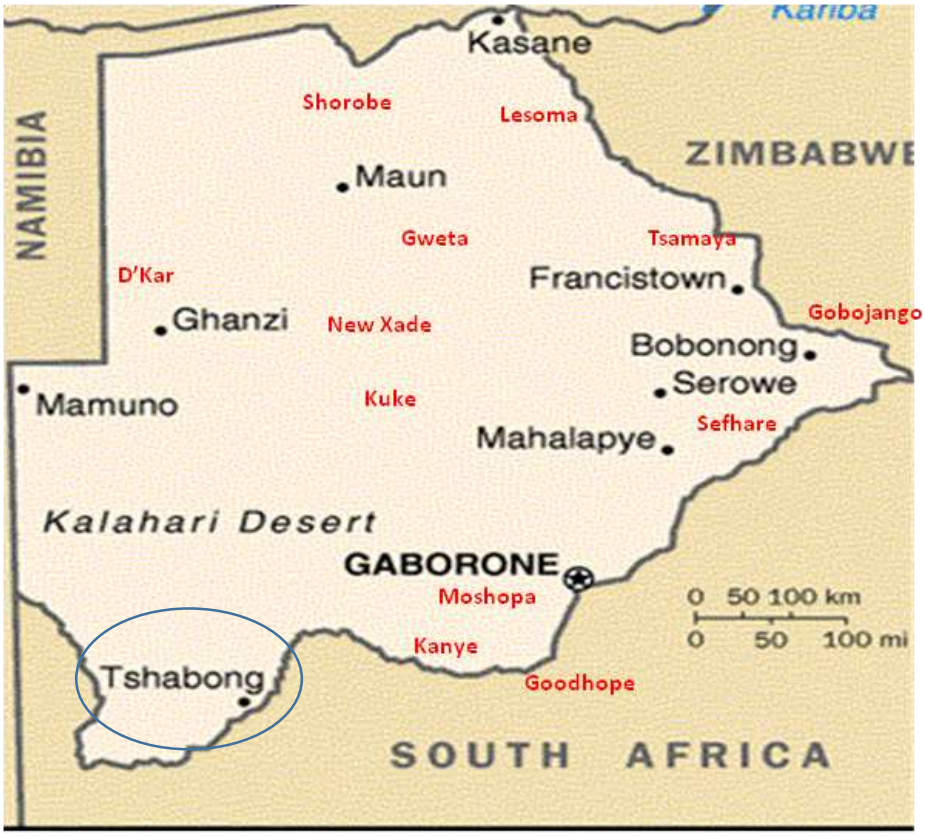

Figure 1. Botswana map showing the location of Tsabong village

The region has a hot and dry climate with summer temperatures ranging from 28.5 to 35 °C and winter temperatures ranging from 1 to 12 °C. Rainfall occurs in summer (November – March) and averages at 146.2 mm per annum (Mphale et al 2013), ranging from 0.6 to 61 mm monthly (Zweistra, 2012). The area is an inland plateau of relatively flat savannah woodland and grassland with an average altitude of 1,000 m. Agriculture, in the form of cattle and game (wildlife) farming, and hunting have historically been the main economic activities of the area (Zweistra, 2012). The Kalahari Desert that covers nearly 70% of the country's land area is found in this region, and the soil is generally sandy and infertile (Batisani, 2010) and, hence, arable agriculture is limited.

Methods

A survey was conducted in January 2016 by interviewing all employees and the manager of TECP. A semi-structured questionnaire was developed and used for the interview. The questionnaire was designed to generate information on herd size, herd composition, productive and reproductive performance of the camels, feeds and feed-resource base, health of the camels, and assess problems related to camel husbandry and infrastructure in the park. In addition, field observation was carried out throughout the park in order to identify the plant species being browsed by the camels, assess the status of the vegetation and the environment, the camel herd while roaming in the park and during milking, sources of water as well as the structures of the kraals used to keep and handle the camels. Moreover, secondary data (Kgaudi, 2014; Statistics Botswana, 2015) about camels and the TECP were used as inputs for the study. Data generated through survey were analysed using descriptive statistics.

RESULTS AND DISCUSSION

Herd size and composition

The Tsabong Camel Park has a total of 370 dromedaries, of which 210 were female and 160 were male (Table 1). The camels consist mainly of one type; the Dromedary camel which is mostly tan in colour (Figure 2). However, in recent times a black dromedary bull (Figure 3) was received from Libya and his progeny can be observed in the herd. The ratio of male to female camels in the herd is very high. The common ratio of male to female animals in a camel herd is 1:30-50 (Mukasa-Mugerwa, 1981). Abdelhadi et al. (2011) reported that the ratio between breeding males and females in camel herds in North Kordofan State in Sudan is one male to 25 females. Major factors that determine male to female ratio in a camel herd include management practices, level of nutrition, the condition and stamina of the males and their libido and the fertility level of the females (Mukasa-Mugerwa, 1981).

Figure 2. Part of the camel herd at Tsabong Eco-Tourism Camel Park – camels while roaming and browsing and resting

Figure 3. The black Libyan bull camel that was recently introduced into the herd

The information below shows that there are excess males in the herd than required. Considering a ratio of one male to 25 females, only six breeding males are needed and the rest should be culled/sold or slaughtered after selecting and retaining some for riding. If a very conservative ratio of male to female camels of 1:11 as suggested by Elmi (1989) is used, 14 breeding male camels can be retained in the herd. However, it should be noted that the above mentioned male to female ratio in the camel herd is recommended provided that the major breeding objective of the camels is milk production.

The higher number of male camels in the study herd may be attributed to the lack of clear management and breeding objectives and the emphasis the Park places on tourism rather than milk production. Future interventions aimed at improving the productivity of camels in the Park should consider setting clear management and breeding goals as well as maintaining the recommended ratio of male to female animals in the herd. Because of lack of controlled breeding, there is a high rate of inbreeding in the herd, which is evidenced by the frequent encounter of calves born with deformities and low productivity of the herd as reported by the respondents. So far, limited attempts have been made to introduce new breeding camels into the herd since the initial importation of these animals into the country.

Thus, there is a dire need to solve the problem of inbreeding by introducing new blood into the herd.

Table 1. Herd size and composition of camels kept in Tsabong Ecotourism Camel Park

Category	Total number	Proportion (%)
Lactating camels	47	13
Dry camels	108	29
Heifers	30	8
Bulls	138	37
Female calves	25	7
Male calves	22	6
Total herd size	**370**	**100**

Productive and reproductive parameters

The average daily milk yield *per* camel in Tsabong at the time of this study was 1.7 litres (Table 2), which is similar to the amount (1.9 litres) observed by Field and Gitao (2011) for this herd but much lower than milk yield of camels reported elsewhere in the world. The camels in Tsabong produce this amount of milk daily throughout the lactation period (10 months) and they are milked only once a day. Milk yield of dromedary camels varies depending on management, feeding, stage of lactation, parity, season of calving, breed, frequency of milking and presence of the calf (Bekele et al., 2002). Knoess (1977) reported that milk yield of dromedary camels in Ethiopia was 6.6 litres *per* day. Similarly, Jemmali et al. (2016) reported that Maghrebi camels in Tunisia produce 6.7 litres of milk *per* day. Raziq et al. (2011) also reported that Raigi camels, one-humped dromedary, reared by Pashtoon pastoral people in Pakistan and Afghanistan produce 6-10 litres of milk *per* day *per* camel. Nagy et al. (2013)

reported an average daily milk yield of 6 kg for dromedary camels kept under intensive management in the United Arab Emirates.

It is reported by Breulmann et al. (2007) that with improved feed, availability of water, improved management and veterinary care, daily milk yields of camels could increase to 20 litres *per* day *per* dromedary. Khan and Igbal (2001) reported that well-fed and managed dromedaries produce 9 to 14 litres of milk daily. This suggest that with improved management, camels at Tsabong park may produce more than what they are currently producing. Camels are very reliable milk producers during dry seasons and drought years when milk from cattle, sheep, and goats is scarce. Therefore, improved milk production by Tsabong camels will go a long way in improving household nutrition of local communities, throughout the year. In drought-stricken areas of the world, where continuous drought decimates cattle, sheep and goat populations, only the camel survives and continues to produce milk. In arid and semiarid zones where camels are reared, their milk yield is four times higher than that of indigenous zebu cattle (Breulmann et al., 2007). This has a positive implication for diversification of milk production from cattle and will probably help meet local milk demands.

The camels kept in Tsabong have neither been selected for milk production nor are given supplementary feed. Although the milk yield of camels kept in the study area is low, there is a good potential to increase milk yield through provision of supplementary feed, selective breeding for milk production and proper health care of the camels. Hence, concerted efforts are required from Park management to improve the feeding system of the camels and select camels for milk production. The milk yield reported in this study is based on information obtained from respondents. Thus, there is a need to measure the daily milk yield of the camels throughout the lactation period in order to establish the actual milk yield of the camels in the study area both under the existing and later on under improved feeding regimes

The average lactation length of camels is 12 months, but it may vary from 9 to 18 months (Mukasa-Megerwa, 1981). The variations for this trait depend mostly on management and environment (season, temperature and feed supply). The average lactation length of camels and weaning age of calves at Tsabong Park is 10 months (Table 2). This is in line with reports of other studies

Table 2. Productive and reproductive performance of camels kept in Tsabong Ecotourism Camel Park

Parameter	Value
Average daily milk yield per camel (litres)*	1.7
Lactation length (months)	10
Weaning age (months)	10
Calving interval (years)	2
Dry period (days)	60
Age at puberty females (years)	3
Age at puberty males (years)	6
Gestation period (months)	12
Mating season	Summer (June to August)

* Daily milk yield from milking once a day. However, camels are milked twice a day when there is ample supply of feed.

Raziq et al. (2011) reported a lactation length of 10-12 months and a weaning age of 9 months for Raigi camels in Pakistan and Afghanistan. Similarly, Kayastha and Dutta (2012) reported a lactation length of 9-18 months and a weaning age of 12 months for dromedary camels in India. Also, Mahamed et al. (2015) reported a weaning age of 6-18 months for camels in Jigjiga District of eastern Ethiopia, and this depended on the availability of feed, milk production of the dam and growth of the calf.

Calving interval, gestation period and age at puberty of female camels kept at Tsabong Camel Park are reported to be 2 years, 12 months and 3 years, respectively (Table 2). This is in line with earlier reports. Razik et al. (2012) reported a calving interval of 2-3 years, a gestation period of 375-386 days and age at puberty (females) of 3 years for Raigi camels in Pakistan and Afghanistan. Similarly, Kayastha and Dutta (2012) reported a calving interval of 2 years, gestation period of 365-400 days and age at puberty (females) of 3-4 years for Indian camels. Babiker and El-Zubeir (2014) reported gestation period and calving interval of 12 and 24 months, respectively, of camels in Sudan. It would seem that these discrepancies for calving interval between research reports may be due to level of management, which affects reproduction.

Length of the dry period of the Tsabong camels was reported to be 2 months and this is in line with the findings of Babiker and El-Zubeir (2014) who reported a dry period of 2-3 months for camels kept under an intensive farming system in Sudan.

Major problems identified

One of the most important factors affecting productivity of camels, besides nutrition and disease, is the low reproductive efficiency of camels (Mukasa-Mugerwa, 1981). Improvement of reproductive efficiency in camels is essential for profitable production and to provide ample opportunities for selection and genetic improvement.

There are two methods to achieve genetic improvement in farm animals: selection from within the herd or introduction of new genes from known quality animals (other herds), which can be done through importation of either superior bulls or genetically superior semen and inseminating the camels using artificial insemination (AI) technique. Both systems can be used for genetic improvement of the Tsabong camel herd. Selection of superior males and females from the existing herd can be used as a long-term strategy to improve the productive performance of the camels. However, this will be a slow process and will not bring about significant improvement within a short period of time. Thus, introduction of new gene pool into the herd can be used as a short-term strategy to bring about genetic progress in the Tsabong camel herd. Studies (Hermas, 1998; Ali et al., 1999; Eknah, 2000; Marai and Zeidan, 2007; Skidmore et al., 2013) elsewhere have indicated the possibility of using AI for camel breeding AI is a proven technique for rapid genetic improvement. Camels are induced ovulators (ovulate only when mated) and are sexually receptive at all times and, thus, they have an advantage over other livestock for the use of AI techniques (Ali et al., 1999; Eknah, 2000). Since females demonstrate continuous estrous, they can be inseminated coinciding with induced ovulation. Induced ovulation if combined with estrous synchronization using prescribed drugs offers better prospects of AI in camels than in other domestic animals (Ali et al., 1999).

In Tsabong, camels are bred by indiscriminate natural mating, and AI has never been used. Use of AI technique offers a number of advantages compared with natural mating. It allows more efficient use of genetically superior males by inseminating more than one female with a single ejaculate, thereby reducing the number of females that the male has to mate and increasing his number of offspring. Also, the use of AI would eliminate the need to transport the male or female animal to the stud, as it is much easier to transport semen. This would reduce the costs and risks of transporting valuable animals, which might expose them to injury. It would also reduce the risk of disease and infection since contact between male and female is prevented. AI also helps to eliminate behavioral problems since, often, a male camel may refuse to mate or be aggressive towards a particular female. Hence, AI would eliminate the risks of injury due to fighting. In addition, AI allows preservation of semen either for 24 hours by chilling, which enables the semen to be transported between farms/countries for insemination in other breeding herds, or for many years by deep freezing, which could extend the reproductive lifespan of the camel even beyond its death (Skidmore et al., 2013).

The major problems identified at TECP were:

- serious problem of feed shortage in the park;
- camels not given supplementary feed and depending only on natural grass and browse;
- absence of rotational grazing;
- poor condition of the vegetation in the park, which is unable to sustain the number of camels and meet their nutrient requirements;
- overgrazing of the park, which often is compounded by drought;
- absence of controlled breeding and indiscriminate breeding of camels;
- absence of AI for breeding camels;
- serious problem of inbreeding in the camel herd;
- absence of selection of bulls and replacement of heifers (females);
- absence of culling policy of unproductive camels;
- absence of production and health records;
- more male animals in the herd than ideally recommended for a camel herd;
- prevalence of diseases: most commonly encountered health problems are mastitis, tick infestation and internal parasites;
- absence of quarantine for sick camels (sick camels are kept with the rest of the herd);
- problems of dystocia (sometimes);
- strip cup not used to detect mastitis before milking;
- milking of camels in the open kraal exposing milk to manure and dirt;
- hand milking of camels, and the milk is collected in unclean plastic containers;
- presence of camels with blind teats in the herd;
- lack of medical assistance for camels from veterinarians;
- claims of veterinarians being unfamiliar with the health problems of camels;

- absence of clear breeding objective for the camels;
- camel milk not sold to the community (no set price for the milk);
- absence of information about the carrying capacity of the park; and
- lack of professional employees trained on the management of camels.

It was observed that no production and health records of camels are kept in the Tsabong Camel Park. Moreover, there is no culling policy, and therefore unproductive camels are allowed to remain in the herd indefinitely. For a dairy farm to show improvement in productivity, regular culling of inferior animals and replacing them with superior animals should be carried out in addition to selective breeding. For a modern dairy farm, record keeping is very important, and it can determine the success or failure of a particular farm because many management decisions are made based on information obtained from records.

Disease is one of the problems encountered in the camel herd in Tsabong. The respondents indicated incidence of different diseases in the camel herd, in particular mastitis, tick infestation and internal parasites. Camels are affected by different diseases, and various viral, fungal, bacterial and parasitic microorganisms have been associated with disease outbreaks in camels (Harrak et al., 2011). Some of the major health problems in dromedary camels include viral diseases, such as camel pox, camel contagious ecthyma and papillomatosis; bacterial diseases such as brucellosis, mastitis, enterotoxemia and salmonellosis as well as parasitic and fungal diseases, such as trypanosomosis, mange, dermatophytosis, gastrointestinal parasites and tick infestation (Harrak et al., 2011). Investigation of the major diseases that affect camels in Tsabong park is important in order to devise appropriate preventive and control measures.

The respondents also mentioned that sick camels are not quarantined and/or separated from the herd. Rather, sick and healthy animals are kept together in the same kraal, which is risky and a dangerous practice that should be avoided. Construction of an isolation unit (separate kraal) for keeping sick animals is needed. Moreover, the park workers reported that they have never received veterinary support from Tsabong Department of Veterinary Services. This calls for the need to make necessary arrangements with the Department of Veterinary Services so that the veterinarians regularly visit the camels and attend to them when needed.

Camels in Tsabong are hand milked in an open kraal (Figure 4) exposing milk to manure and dirt. Milk is collected in unsanitised plastic containers, which may pose a health risk to the public consuming unpasteurized milk. Milking in an area which is full of dust and dung, and without shade could have a negative impact on the quality of the milk produced in terms of presence of foreign objects and pathogenic micro-organisms. Thus, education of the park workers about the importance of sanitary milking practices would help solve the problem in the future. Washing of the udder and teats of the camels before milking is not practiced in the park. Besides, it was observed that the milkers do not wash their hands or the milking vessels prior to milking. Unhygienic milking procedure is one of the factors which predispose dairy animals to mastitis infection. The prevalence of mastitis in the camel herds reported by the respondents could perhaps be attributed to the unhygienic milking practiced in the park. Thus, hygienic milking procedures and hygienic production systems should be followed in order to increase milk production and improve the quality and safety of camel milk in Tsabong Camel Park. Moreover, having a separate paved milking bay/shed for the camels will contribute towards hygienic milking and improved milk quality.

The major constraint that hinders the productivity of camels in Tsabong is feed shortage especially during the dry season. The study area experiences low rainfall. This results in the area having poor pasture, making it difficult to meet nutrient requirements for camels to survive or remain in good condition for most of the year. The area is characterized by high ambient temperatures and the vegetation is dominated by sparsely distributed shrubs and trees in particular *Vachellia* species (Figure 5). Some plant species produce pods which are a valuable feed resource for camels while other species have the ability to produce green shoots during the dry period (Figure 6).

Introduction of improved feeding systems, such as provision of quality supplementary feeds, and introduction of drought resistant, palatable and nutritious shrub/tree species as alternative sources of feed for camels may help to solve the problem of feed shortage in the park

Limitation of grazing land and lack of paddocking of the park so as to practice rotational grazing is another factor that exacerbates the problem of feed shortage. The major plant species preferred and consumed by camels in the area are *Vachellia* spp, *Boscia albitrunca* (Burch.) Gilg & Benedict and *Grewia flava* DC (Table 3 and Figure 5). The natural browse species found in the area hardly meet the nutrient requirements of camels for production and in the dry period are insufficient for maintenance.

However, during the rainy season, it seems vegetation is sufficient (Figure 7) as observed during a field tour of the park in March 2015.

Figure 4. Hand milking of camels in an open kraal using plastic containers

Figure 5. Common browse trees at Tsabong Eco-Tourism Camel Park: *Boscia albitrunca* (left), *Vachellia erioloba* (right)

Figure 6. *Vachellia erioloba* with pods and *Senegalia mellifera* with new green shoots during the dry season

Figure 7. State of the vegetation (trees and grass) during the rainy season; March 2015

Table 3. Plant species browsed by camels in Tsabong Ecotourism Camel Park

Scientific name	Setswana name	English name
Vachellia erioloba E. Mey.	Mogotlho	Camel Thorn
Senegalia galpinii Burtt Davy or *A. luederitzii* Engl.	Mokala	Monkey Thorn
Vachellia hebeclada DC.	Sekhi	Candle-pod Acacia
Vachellia karroo Hayne	Mokha	Sweet Thorn
Senegalia mellifera (Vahl) Benth.	Mongana	Black Thorn
Boscia albitrunca (Burch.) Gilg & Benedict	Motlopi	Shepherd's Tree
Grewia flava DC.	Moretlwa	Brandy Bush
Rhus tenuinervis Engl.	Modupaphiri	Kalahari currant
Rhigozum trichotomum Burch.	Mokurubane	Driedoring, Threethorn
Schmidtia kalahariensis Stent	-	Kalahari sour grass
Tribulus terrestris L.	Mosetlho	Devil's thorn

Studies by Dereje and Ud´en (2005) and Chibsa et al. (2014) show that provision of supplementary feed to camels significantly improves their productivity. Dereje and Ud´en (2005) reported that supplementing lactating dromedary camels with protein and energy concentrate significantly increased milk yield in camels. Similarly, Chibsa et al. (2014) reported that supplementation with concentrate helped to wean camel calves at an early age and resulted in good post weaning growth rate and survival of calves.

In camel rearing societies, camels are kept mainly for food production in particular for milk production. However, camels in the TECP are kept mainly for tourism (riding) purposes. Milk and meat production from camels has not been given any attention. Although the camels are milked and occasionally slaughtered for meat, these camel products are only consumed by the park workers and have not, as yet, been supplied to the market for sale. Elsewhere in the world, several successful commercial camel dairies are operating in different countries in the Middle East, Africa, Europe and America, and produce thousands of litres of milk daily. Some of the commercial camel dairy farms and/or camel milk processing plants include Camelicious of Dubai, Tivkisi Dairy of Mauritania, Vital Camel Milk of Kenya, Kamelenmelkerij of the Netherlands, and Oasis Camel Dairy of the USA. Camel milk is highly valued for its supposedly medicinal properties and, hence, its demand has increased in recent years. It is now possible to find camel milk in supermarkets of Europe and North America where it fetches a premium price.

Therefore, in addition to being used for tourism, camels kept in TECP could be used for milk production and it would be possible to generate income from sales of camel milk and milk products. Thus, there is a need to redefine the breeding objective of the Tsabong camel herd and use the herd for food production in addition to their current use as tourist attraction. The camels can also be used for meat production; however, given the current low camel population, it would not be feasible to have camel meat production as an objective. Nevertheless, excess male camels and camels culled for various reasons can still be used for meat production.

Lack of knowledge on camel husbandry is one of the problems reported by the respondents. Knowledge and skills on camel husbandry by the communities in Botswana is non-existent and, as such, productivity and interest in camels as sources of food are limited. Most of the local people who are taking care of camels have never been trained on camel husbandry. The people managing camels mostly rely on limited personal experiences. Moreover, camel husbandry is not included in the agricultural curricula of schools nor at tertiary level. Therefore, it is very important to create awareness about the importance of camels and train camel herders and development agents on camel husbandry, disease control and hygiene, processing of camel milk and meat, feed management and production of feed from alternative fodder species. This will help them to raise camels properly and help in the development of the camel sector in Botswana. With anticipation that camel production in Botswana may become a source of milk, meat and tourism, it is recommended that Botswana University of Agriculture and Natural Resources (BUAN) embark on short courses in camel production. Long-term planning should include camel production courses as part of the BSc degree in Animal Science and Production. In addition to knowledge, the following is the infrastructure needed at Tsabong Ecotourism Camel Park.

Infrastructure/Facilities needed

Facilities that need to be put in place in the TECP are:

- milking parlour/milking bay for lactating camels
- milk cooling facility (milk cooling tank);
- milk pasteurization unit with the necessary accessories;
- solar-powered water pump in order to pump water from the borehole;
- feed storage room;
- isolation (quarantine) room for sick animals;
- partitioning the park into paddocks;
- maternity (parturition) room in the park;
- separate pen for calves;
- weighing balance to measure the weight of camels; and
- changing room for the park workers where they can store their personal belongings when they go to work and take shower afterwards.

One of the infrastructure related problems in the park is lack of changing rooms for the park workers. This is important for storing their personal belongings when they go to work and to take a shower after work. Personal hygiene of employees working in dairy farms is important, and it has a direct effect on the quality and safety of milk produced in the farm. Contamination of milk with dirt and pathogens occurs not only from the cows and milk utensils but also from the milkers and workers on a dairy farm. The workers also need regular

health checkups at least every six months, so as not to contaminate the milk, animals and farm products with dangerous communicable diseases and also to avoid being infected by disease from animals, such as tuberculosis and contagious abortion.

According to the respondents, water shortage is one of the constraints in the camel park. The park owns a borehole, which supplies camels with water. However, the water tank is small, resulting in frequent shortage of water in the park. For a dairy farm, ample supply of clean potable water is essential because water is needed for washing milk utensils and all equipment, which come in contact with milk. Water is needed for cleaning the barns, drinking by animals and cleaning by farm workers. Thus, the water problem needs immediate remedial action(s).

CONCLUSIONS AND RECOMMENDATIONS

Camels kept in Tsabong are mainly used for tourism activities. Despite their potential other uses, so far no attempt has been made to use camels in Tsabong for food production or other non-food purposes. Thus, based on our observations and the results of this study we recommend the following interventions to be made in the future in order to improve the productivity of the Tsabong camel herd and develop the camel sector, which has a great potential to contribute significantly to food security, national economic growth and, hence, poverty alleviation in Botswana.

Management related strategies

- The camel park needs to have clear objectives. Thus, the objectives of the park need to be revised and articulated clearly to the community trust and workers.
- To match the carrying capacity of the park with animals and to maintain the required male:female ratio of breeding animals, excess male camels and unproductive females should be culled.
- Feed shortage is one of the problems identified in the camel park. The productivity of camels kept in TECP can be increased through improved feeding, such as provision of quality supplementary feeds, and introduction of drought tolerant, palatable and nutritious browse species into the park. The potential of supplementary feed and improved management on milk and meat quantity and quality should be investigated.
- The camels in TECP are neither bred for milk nor for meat production. Moreover, there is a high rate of inbreeding in the camel herd. Thus, there is a need to select camels for milk production and introduce a controlled breeding programme in the herd. Also, there is a need to introduce new blood (gene pool) into the herd in order to prevent the problem of inbreeding.
- For breeding the camels, either AI services should be sought or bulls of superior genetic potential should be purchased from a known camel farm with a good record keeping system.
- Disease and parasites are among the problems encountered in the Tsabong camel herd. To date, no study has been carried out on the occurrence and prevalence of camel diseases and parasites in the area. Thus, there is an urgent need to study the major diseases in the camel herd and provide proper health care to the animals. The Tsabong camel herd has never been visited by veterinarians and, thus, there is a need to make arrangements with the Tsabong Department of Veterinary Services so that veterinarians can be assigned to regularly visit the camel herd.
- Currently, the camels in Tsabong are mainly used for riding by tourists. Although the camels are milked, the milk is consumed only by the park workers and has not yet been supplied to the market. The quality of the milk has never been analysed and no attempt has been made to make dairy products from camel milk. Thus, this calls for the need to assess the quality of the milk and apply appropriate processing treatments, such as pasteurization to ensure the safety of the milk. Moreover, value addition to camel milk through the production of various camel milk-based products deserves proper attention.
- Similarly, meat production potential of the camels, characteristics of the carcass and production of value-added camel meat products need to be assessed.
- Less productive animals as well as those with poor genetic potential and/or undesirable traits, reproductive problems, and two or more blind teats, and aged animals need to be culled from the herd. A culling policy should be set out and animals should be culled based on the set criteria.

- The camel park needs to have an up-to-date, complete and easily understandable record keeping system.
- For proper park management, the park needs to be partitioned into paddocks and the carrying capacity of the park needs to be determined. This should be followed by water reticulation.
- Training and education: One of the constraints to camel production in Botswana is lack of awareness and know-how about camel husbandry. Thus, there is a need to create awareness in the general public, of the benefits of camel husbandry and provide training on various aspects of camel production and product processing to stakeholders. Botswana University of Agriculture and Natural Resources should be encouraged to embark on short courses in camel husbandry at the Center for In-Service and Continuing Education (CICE) and provide a new course in Camel Production as part of the BSc degree in Animal Science and Production.

Infrastructure related strategies

- There is a need to construct feed storage and staff changing rooms with showers and toilets where the park workers can store their personal belongings.
- A shaded milking bay/shed with a concrete floor and separate calf rearing pens need to be constructed.
- It is important to construct an isolation (quarantine) room for sick animals.
- In the long-term, it is essential to establish a small-scale milk pasteurization unit in the park to ensure the quality and safety of camel milk produced in the park and generate income from the sale of this milk. In addition to the pasteurizer, a milk cooling system and a system for aseptic packaging of the milk should be put in place.
- It is recommended to have a heavy-duty weighing balance on the camel park, which can be used to weigh camels intended for sale and for growth monitoring.
- There is a need for a solar-powered water pump in order to pump water from the borehole.
- There is an urgent need to provide the camel park with stainless steel milking cans (buckets), milk measuring cylinders, strip cup for detecting mastitis and simple milk quality monitoring devices, such as pH meters, thermometers, etc.
- In the long-run, the park could buy milking machines, in which case construction of proper milking parlour would be needed.

Tourism

- The use of the park for tourism and recreation should continue. However, to provide education to the general public, students and tourists, the park should generate information about camels, their habitat (vegetation, soil and climate) and the ecology of the Kgalagadi eco-system. This can be achieved through collaboration with interested stakeholders.

Collaboration

- Potential collaborators include the Ministry of Tertiary Education, Research, Science & Technology, Departments of Animal Production and Veterinary Services, Forestry and Range Resources, and BUAN. Collaborating with these organisations would initiate education on camel husbandry, their economic importance and their environmental compatibility. The park should be open for research to generate information and knowledge for enhancement of quality services to the park's clients.

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CONFLICT OF INTEREST

When this article was submitted in 2017, ORM was the Chief Editor of BOJAAS.

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