

Production, health and marketing in Botswana

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Monitoring production, health and marketing of indigenous Tswana pigs in Ramotswa village of Botswana

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Abstract

The purpose of this study was to monitor the production, health and marketing of indigenous Tswana pigs in Ramotswa village of Botswana over a 12-month period. Farmers who rear indigenous Tswana pigs were identified by conducting a random survey throughout the village. These farmers were then interviewed using a formal questionnaire. Information was collected on demographic parameters, management system, herd composition, reproduction parameters, shelter, marketing, monthly stock movements and incidences of external and internal parasites from December 2004 to December 2005 except during April and May 2005. The data was analysed using Frequency and General Linear Model Procedures in Statistical Analysis System.

Eight (8) farmers were identified, who kept a total of 67 pigs comprised of 38.8, 22.4, 19.4, 17.9 and 1.5% piglets, gilts, sows, castrates and boars, respectively. It was found that elderly females (75%) in male-headed households (62.5%) with either primary or no education (75%) farmed pigs in Ramotswa village. All the pigs used in the study were managed extensively. The majority of the farmers (75%) did not control the reproduction of their stock but the pigs were able to farrow and raise their piglets with very little assistance. All farmers did not keep any form of records. The pigs were mostly scavengers supplemented with mainly brewers grains. They were provided with shelter made from locally available materials to protect them from inclement weather and predators. Half of the farmers (50%) did not clean the shelters, but those that did clean did so by removing manure with shovels without sanitation. The pigs were mainly marketed for their meat to the local community and Chinese expatriates. During the study, 68 animals were slaughtered, while 70 births were recorded, 9 pigs were either killed by cars or stray dogs and 2 were given away as gifts. External parasites identified were

Rhipicephalas evertsi evertsi

and

Amblyomma hebraeum

ticks and

Haematopinus suis

lice and

Ascaris suum

and

Trichuris suis

internal parasites. Generally, the level of infestation of both external and internal parasites did not differ significantly ($p > 0.05$) between farms and months throughout the study period. There were no incidences of diseases reported throughout the study period.

Farmers should be encouraged to improve management, husbandry practices and productivity of Tswana pigs. More research should be done to improve the overall productivity of indigenous Tswana pigs in order to conserve them through utilisation.

Keywords:

Botswana, health, marketing, pigs, production

Introduction

There is very little reliable information on indigenous Tswana pigs (Podisi 2001) as compared to other indigenous domestic animals such as beef cattle, sheep and goats in Botswana. The latest Annual Agricultural Survey Report of 1999 (Botswana Government 2003) show that the population of pigs was 4 000, which is far less than over 10 000 in the 1980-1990s. This figure does not mention the number of indigenous pigs within that population. Most of the indigenous Tswana pig population is found in the southeast district of Botswana at a village called Ramotswa. These pigs are raised under traditional management system, characterised by low inputs coupled with poor management (Nsoso et al 2004a). The animals are primarily scavengers, utilising food scraps thrown away by people around homesteads. However, there are some farmers who buy pig feeds, which are based on bran and provide them with tap water (Nsoso et al 2004a). Pigs raised under this system are susceptible to parasites and diseases and they are also carriers of diseases such as hog cholera (Eusebio 1988). Similar to all indigenous animals in Botswana, Tswana pigs are an adapted genetic resource that can be used for food security, income generation and poverty alleviation (Nsoso et al 2004b) by resource poor farmers. The objective of this study was to monitor the production, health and marketing of indigenous Tswana pigs in Ramotswa over a 12-month period.

Materials and methods

Data collection

The study was conducted in Ramotswa village of Botswana. The farmers that participated in this study were strictly those that only reared indigenous Tswana pigs. They were identified by conducting a random survey throughout the village. The farmers were then interviewed using a formal questionnaire. Information was collected on:

- Demographic parameters for each farmer: gender, gender of head of household, marital status, age, level of education, occupation, main source of income and other livestock kept
- Management system of pigs including type of feed provided, source of feed, frequency of feeding, person(s) responsible for feeding, source of water.
- Herd composition: number of boars, sows, castrates, gilts and piglets
- Reproduction parameters of pigs: mating system used, mating season, birth frequency, litter size, age at weaning
- Pig shelter: type of shelter provided, frequency of cleaning and standard of hygiene maintained
- Pig marketing, buyers of pigs, products, records kept, prices, age at sale

From each farm the following pig data was also collected monthly from December 2004 to December 2005 except during April and May 2005 on:

- Number of births
- Number of deaths,
- Number of pigs slaughtered, sold, lost, bartered and/or given away

- Incidences of diseases in the herd during the first 6 months only
- Ticks, lice and faecal samples during the first 6 months only

Faecal collection and analysis

The fresh faecal samples were collected from the ground and placed in a clean sampling bottle for each farm. In the laboratory, standard methods were used to prepare individual samples, eggs of internal parasites and oocysts were counted using the modified McMaster method.

Data analysis

The data except on faecal oocysts/egg counts was analysed using the Procedure Frequency in Statistical Analysis System (SAS 1999-2000). The data on faecal oocysts/worm egg counts (fec) were transformed to $\log(\text{fec} + 1)$ because the original data were not normal, then analysed using the General linear Model (GLM) in Statistical Analysis System (SAS 1999-2000) and the reported least squares means separated using *t-test*.

Results and discussion

A total of 8 farmers were identified, comprised of mostly married females (75%) in male-headed households (62.5%) aged over 41 years of age with either primary or no formal education (75%). Most of these farmers were unemployed depending on the sale of traditional beer, odd jobs and keeping poultry (Table 1).

Table 1.

Demographic characteristics of the farmers keeping indigenous Tswana pigs in Ramotswa village of Botswana

Parameter	Frequency	Percentage
Gender		
Female	6	75
Male	2	25
Gender of head of household		
Female	3	37.5
Male	5	62.5
Marital status		
Single	2	25
Married	4	50

Divorced	1	12.5
Widow/er	1	12.5
Age (years)		
31-40	3	37.5
41-50	1	12.5
51-60	3	37.5
More than 61	1	12.5
Level of education		
No formal education	2	25
Primary	4	50
Secondary	2	25
Occupation		
Farmer	3	37.5
Civil servant	3	37.5
Unemployed	2	25
Main source of income		
Farming	1	12.5
Salary	1	12.5
Business	2	25
Odd jobs	1	12.5
Sale of traditional beer	3	37.5
Other livestock kept		
Poultry	5	62.5
Cattle	2	25
Sheep and goats	1	12.5

This is consistent with the surveys of Nsoso et al (2004a) for pigs and Nsoso and Rabasima (2004) for beef cattle where the majority of the farmers were males (76-87%). This contrasts with surveys of Nsoso et al (2004c) where there was nearly equal participation in farming sheep and goats by males (52%) and females (48%) and Nsoso et al (2005) where there were more female (84%) indigenous chicken farmers than males (16%). These findings could be attributed to the fact that pigs are larger in size hence not easy to raise in terms of day to day management compared to smaller animals such as chickens, sheep and goats, therefore, fewer women are keeping them. More research should be conducted to elucidate this issue because of its importance to improve welfare of rural communities and reduce poverty in rural areas. Only 25% of secondary school leavers participated in pig farming (Table 1). These findings are consistent with those of Nsoso and Rabasima (2004) and Nsoso et al (2004a and b and 2005), where similar phenomena are reported. In agreement with these studies, young people i.e. those less than 40 years of age and secondary school leavers should be attracted into farming because the former are potential future farmers and the latter has education and skills, both attributes are required to increase agricultural production, improve community welfare and reduce poverty in the country.

All the farmers (100%) managed their pigs extensively (Table 2).

Table 2. Management and feeding of indigenous Tswana pigs in Ramotswa village of Botswana

Parameter	Frequency	Percentage
Type of management		
Extensive/traditional	8	100
Type of feeds		
Kitchen left overs	1	12.5
Bran	1	12.5
Brewers brewers grains	6	75
Sources of feed		
Household materials	4	50
Local breweries	3	37.5
Milling plants	1	12.5
Frequency of feeding per day		
Once	1	12.5
Twice	7	87.5
Who feeds the pigs?		
Owner	6	75
Other members of the family	1	12.5
Hired labour	1	12.5
Sources of water		
Tap at home	5	62.5
Domestic waste water	1	12.5
Fend for themselves	2	25

Pigs were fed mostly with brewers grains from the local brewing industry and domestic kitchen waste in addition to scavenging. This is consistent with the surveys of Nsoso et al (2004a) for pigs where a similar phenomenon is reported. Despite the high fibre content (15 %), low protein and great variety, brewing by-products are widely used in small-scale pig production systems, especially in Africa (Holness 1999). The majority of the farmers (87.5%) provided feed twice a day, with very little assistance from other members of the family. Some even employed caretakers, which is a clear indication that there is very little or no interest in pig rearing by younger people. Pigs were provided with clean tap water, with some having to fend for themselves (Table 2). This is also consistent with the findings of Nsoso et al (2004a) for pigs where a similar phenomenon is reported and points to the fact that farming with indigenous pigs is subsistence and also a hobby in some cases.

The majority of the farmers (75%) did not control mating of the pigs since they were extensively farmed (Table 3).

Table 3. Reproduction management in indigenous Tswana pigs in Ramotswa village of Botswana		
Parameter	Frequency	Percentage

<i>Mating system used</i>		
Controlled	2	25
Uncontrolled	6	75
<i>Mating season</i>		
September to December	2	25
All year round	6	75
<i>Frequency of farrowing</i>		
Once per year	4	50
Twice per year	4	50
<i>Average litter size (piglets/sow farrowing)</i>		
1 to 4	2	25
5 to 8	5	62.5
9 to 14	1	12.5
<i>Average age at weaning (months)</i>		
2	1	12.5
4	5	62.5
6	2	25

This is typical of traditional farming in Botswana where animals mix freely and any entire male animal may mate any female animal on heat, since the grazing areas are not fenced (Nsoso and Morake 1999). This resulted in piglets being born through out the year and all the pigs farrowing once or twice a year. According to farmers, the most common litter size was 5 to 8 piglets per sow farrowing (Table 3). According to Holness (1999), productivity of the unimproved breeds in Africa is influenced by their environment, which in this case is the traditional management system in place. Most of the farmers claimed that the piglets were weaned by the age of 4 months (Table 3). However, this was very difficult to confirm, as the pigs were not easy to observe because they

were not confined and thus the farmers only speculated.

Most of the farmers (62.5%) provided some form of shelter, with only 12.5% not providing any. The shelters were either built from concrete or a combination of wood and corrugated iron sheets (Table 4).

Parameter	Frequency	Percentage
Type of shelter		
Concrete	5	62.5
Wood and corrugated iron sheets	1	12.5
None	2	25
Time pigs spent in shelter		
All night	4	50
All day and night	2	25
None	2	25
Is the shelter cleaned?		
Yes	4	50
No	4	50
Frequency of cleaning		
Weekly	1	12.5
Monthly	1	12.5
Occasionally after rains	2	25
Never	4	50
What do you use to clean shelter?		
Shovel to remove manure	3	37.5
Through cleaning with disinfectant	1	12.5
Nothing	4	50

Most of the farmers reported that they provided shelter during the night for the pigs to escape low night temperatures and attacks from dogs. Fifty percent of the respondents did not clean the shelters. The other 50% that did clean, mostly cleaned after rains and not as regularly as they should to maintain reasonable standards of hygiene (Table 4). The most common way of cleaning was the use of shovels to remove manure, without any disinfection to kill off disease causing pathogens and parasites. According to Kassai (1999), the most relevant general measure is careful mechanical cleaning: removal of faecal materials and bedding contaminated with parasite eggs, hosing of the floors and walls of feeding-troughs.

Most of the farmers (62.5%) marketed their pigs at puberty (Table 5).

Parameter	Frequency	Percentage
Age at sale		
Soon after weaning	1	12.5
At puberty	5	62.5

After first litter of piglets	1	12.5
Not for sale	1	12.5
Buyers of pigs		
Local community for meat	4	50
Local community for farming	1	12.5
Chinese nationals for meat	3	37.5
Products sold		
Piglets	2	25
Meat/slaughter animals	5	62.5
Lard/soap from made from lard	1	12.5
Do you keep any records?		
No	8	100
How much do you sell a mature pig for slaughter? (US\$/head)		
5 to 10	2	25
10 to 50	2	25
More than 50	2	25
Not for sale	2	25
How much do you sell a piglet? (US\$/head)		
2 to 10	7	87.5
More than 10	1	12.5

The reason for this could be that at puberty, they would have not laid a lot of fat, which is why some people dislike indigenous pig meat. Pigs destined for fresh meat trade are usually slaughtered at younger ages and lower weights (porkers) than those used for processing (Holness 1999). The other reason could be that, at puberty they can be selected for traits of economic importance as either breeding or cull animals. The main consumers of slaughter pigs and meat in Ramotswa were the local community (50%) and Chinese expatriates (37.5%) who have an acquired taste for the animals' meat. Only 12.5% of the pigs were sold as replacement stock to other farmers (Table 5). Meat was the most priced product of the indigenous pigs, with piglets and lard coming in second and third place respectively (Table 5). The lard was used to make soap for domestic use or sold for extra cash. This is supported by the findings of Nsoso et al (2004a) who reported a variety of uses of pig fat such as in traditional leather rope making, traditional medicine and seed preservation.

None of the farmers kept either sale records or any other records (Table 5), which is typical of the traditional management of any other livestock in Botswana. Mature pigs were sold at prices ranging from USA\$10.00 to more than \$50.00 depending on the size of the animal and the reason for which it was being sold for. Piglets on the other hand were mostly sold at prices ranging from \$2.00 to 10.00. Prices that exceed \$10.00 were rare (Table 5). This is supported by Holness (1999), who reported that in Zimbabwe marketing of traditionally farmed indigenous pigs is largely indiscriminate and is dictated by the immediate financial needs of the owner. Although the selling price was generally low for the different classes of pigs, at least there was discrimination between mature and young stock. This is consistent with the marketing of sheep and goats in Kweneng district of Botswana where Nsoso et al (2004c) reported that the price of small stock in the market ranged from \$20 (young stock) to \$80 (mature stock) with most people selling castrated males

while breeding stock sold for \$40-\$60. This shows that farmers understand that for the industry to be sustainable it should be treated as a business by selling different classes of pigs at appropriate prices.

At the beginning of the study the total number of pigs was 67. Most of the pigs were piglets that had not yet reached puberty (38.8%) followed by gilts (22.4%), sows (19.4%), castrates (17.9%) and boars (1.5%). Such herd structures could be in cognisance that farmers require productive animals, which are provided by females that are easy to control compared to entire males which are difficult to control during mating times. Keeping few entire males is typical of traditional farming in Botswana where animals mix freely and any entire male animal may mate any female animal on heat, since the grazing areas are not fenced (Nsoso and Morake 1999). The low number of boars could also be attributed to them being undesirable as meat animals because of their "boar taint", which get stronger as the animal matures. However, the problem does not occur if entire males destined for slaughter are grown out fast enough to allow them to be slaughtered at less than six months of age (Holness 1999). Castrates do not demonstrate this, and thus are kept longer in the herd and result in larger animals that produce more meat.

Stock movements recorded during the study period were predominantly due to births, slaughter and death from either car accidents or stray dogs (Table 6).

Table 6. Stock movement of indigenous Tswana pigs recorded over the

duration of the study for all the farmers on a monthly basis in Ramotswa village of Botswana?

? - Data was not collected in April and May 2005 due to labour shortage

There were 70 additions to the total sampled herd in the form of piglets born. There were no pigs bought, received as gifts or bartered. The 68 pigs that were slaughtered was nearly equal to those added. This shows a stable population. However, a more comprehensive study should be carried out to elucidate this issue given that these pigs could become extinct if not properly maintained and utilized (Nsoso et al 2004a). To ensure that this breed does not get extinct there is need to conserve it using both

in situ

and

ex situ

methods. There is also an urgent need to assess the production potential of this breed both as a pure breed and in crossbreeding work. Following Ramsay et al (2000) and Jaume and Alfonso (2000), the concept of adding value to indigenous breeds conservation through promotion and

utilisation of unique products and traits should be applied to this breed. This would ensure its survival because farmers would be more willing to conserve a breed that has got present value or future perceived value.

Rhipicephalus evertsi evertsi

and

Amblyomma hebraeum

ticks were identified in all farms. The number of these external parasites were generally low, ranging from 1.44 ± 0.35 to 2.69 ± 0.35 ticks per animal and was not significantly ($p > 0.05$) different between farms (Table 7) and months (Table 8). This may seem like an insignificant infection but ticks transmit tick borne diseases like

anaplasmosis

and

babesiosis

in pigs. Ticks are easily controlled by spraying or dipping with suitable acaricides, and they are only a problem in scavenging or more extensive systems of pig production (Holness 1999).

Table 7.

Ticks, lice and worm egg counts load in indigenous Tswana pigs on different farms in Ramotswa village of Botswana

Farm	Ticks	<i>Haematopinus suis</i>	<i>Ascaris suum</i>	<i>Trichuris suis</i>
A	$2.42 \pm 0.35a$	$1.28 \pm 0.36ab$	$1.64 \pm 0.33a$	$1.64 \pm 0.42 a$
B	$2.11 \pm 0.35 a$	$1.67 \pm 0.36 ab$	$2.03 \pm 0.33 a$	$1.05 \pm 0.42 a$
C	$1.71 \pm 0.35 a$	$1.34 \pm 0.36 ab$	$1.44 \pm 0.33 a$	$1.43 \pm 0.42 a$
D	$2.19 \pm 0.35 a$	$1.43 \pm 0.36 ab$	$1.39 \pm 0.33 a$	$1.06 \pm 0.42 a$
E	$2.69 \pm 0.35 a$	$1.64 \pm 0.36 ab$	$3.15 \pm 0.33b$	$2.24 \pm 0.42 a$
F	$1.44 \pm 0.35 a$	$1.63 \pm 0.36 ab$	$1.42 \pm 0.33 a$	$1.34 \pm 0.42 a$
G	$1.77 \pm 0.35 a$	$2.39 \pm 0.36a$	$2.08 \pm 0.33 a$	$1.44 \pm 0.42 a$
H	$1.76 \pm 0.35 a$	$0.71 \pm 0.36b$	$2.48 \pm 0.33 a$	$1.39 \pm 0.42 a$

ab means in the same column for each parameter with different superscripts are significantly different ($p < 0.05$)

Table 8.

Ticks, lice and worm egg counts load in Tswana pigs during different months in Ramotswa village of Botswana

Months	Ticks	<i>Haematopinus suis</i>	<i>Ascaris suum</i>	<i>Trichuris suis</i>
December	2.01 ± 0.25a	1.66 ± 0.25 a	1.40 ± 0.23 a	1.26 ± 0.30 a
January	1.93 ± 0.25 a	1.53 ± 0.25 a	2.05 ± 0.23 a	1.18 ± 0.30 a
February	2.45 ± 0.25 a	1.61 ± 0.25 a	2.27 ± 0.23 a	1.16 ± 0.30 a
March	1.65 ± 0.25 a	1.25 ± 0.25 a	1.95 ± 0.23 a	1.75 ± 0.30 a

ab means in the same column for each parameter with different superscripts are significantly different (p < 0.05)

The other external parasites identified were

Haematopinus suis

lice in all farms. The lice infestation ranged from 0.71 ± 0.36 to 2.39 ± 0.36 lice per pig with generally no significant differences between farms (Table 7) and months (Table 8). Ditschup (1995) found a high infestation rate of 76% and a mean load of 10.2 lice/pig in the Southeast district of Botswana. According to Holness (1999), lice become a problem in dirty and unhygienic conditions, as they live on the skin surface but particular attention should be paid to the ears. Among other things lice suck blood hence they may transmit diseases, cause anaemia and cause irritation hence reduced animal productivity.

The internal parasites identified were

Ascaris suum

and

Trichuris suis

eggs from faecal samples. Their level of infection ranged from 1.39 ± 0.33 to 3.15 ± 0.33 and, 1.05 ± 0.42 to 2.24 ± 0.42 worm egg counts per sample for

Ascaris suum

and

Trichuris suis

, respectively. The level of infestation did not differ significantly between farms (Table 7) and months (Table 8). These are all mild infections and show that nematode parasites are not of significant importance in this indigenous pig population. Kgaswane (1998) found that

Ascaris suum

tends to be the most prevalent endoparasite of indigenous pigs, with an infestation rate of 86% in the 40 samples collected from pigs in the Southeast parts of Botswana. According to Kassai (1999),

ascariasis

is very common in swine and its clinical signs depend on the severity of the infection. New born piglets show signs of pneumonia characterized by coughing and exudates in the lungs, diarrhoea and stunted growth (Soulsby 1982).

Trichuris suis

mostly affects pigs of 8 - 14 weeks of age, and affected pigs show signs of anaemia, dehydration, anorexia, dysentery and loss of condition (Kassai 1999). Internal parasites are known to cause clinical diseases and to predispose animal to other diseases hence they should be controlled.

Conclusions

- The indigenous Tswana pig farmers in Ramotswa village of Botswana were mostly elderly females in predominantly male headed households who were above 40 years of age.
- Most of these farmers were illiterate and unemployed, depending on subsistence farming for their survival.
- At the beginning of the study there were 67 pigs made up of 26, 15, 13, 12 and 1 piglets, gilts, sows, castrates and boars kept under traditional management system.
- Most farmers kept Tswana pigs for meat and lard production. Pigs were sold alive to other farmers and there were no organised markets. Even though the selling price per pig was generally low, at least there was differentiation between the different age classes of pigs, with mature animals fetching a higher price than young animals.
- The most pronounced cause of changes in population dynamics of the sample population was the slaughter of pigs for the sale and consumption of their meat, and the birth of piglets. Nine pigs were either killed by cars or stray dogs.
- The average number of piglets weaned per litter was found to be between 5 and 8, and they were mostly weaned at an average age of 4 months.
- There were no incidences of diseases reported, but there were external (ticks and lice) and internal parasites identified in all farms. The level of infection for both external and internal parasites generally did not differ significantly between farms and months throughout the study period.
- Farmers should be encouraged to improve management, husbandry practices and productivity of Tswana pigs. More research should be done to improve the overall productivity of indigenous Tswana pigs in order to conserve them through utilisation.

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References

1.
Botswana Government 2003
1999 Annual Agricultural Survey Report. Ministry of Agriculture, Gaborone, Botswana.
2.
Ditshupo T T 1995
Ectoparasites of indigenous pigs in the Southeast District. Unpublished. Diploma in Animal health and Production Research Project. Department of Animal Science and Production, Botswana College of Agriculture/ University of Botswana.

3.

Eusebio J A 1988

Pig production in the tropics. Longman scientific and technical. Longman Group UK limited, Longman House, Burnt Mill Harlow. Essex CM20 2JE, England.

4.

Holness D H 1999

Pigs. The tropical agriculturalist. G P Maisonneuve et Larose, 15 rue Victor-Cousin, 75005 Paris, France.

5.

Jaume J and Alfonso L 2000

The Majorcan Black pig. Animal Genetic Resources Information 27:53-58.

6.

Kassai T 1999

Veterinary Helminthology. Butter worth- Heinemann. Linarce house, Jordan Hill. Oxford OX2 8DP. UK

7.

Kgaswane I 1998

The prevalence of endoparasites in pigs in the Southeast parts of Botswana (Ramotswa, Boatlé and Gaborone). Unpublished. Diploma in Animal health and Production Research Project. Department of Animal Science and Production, Botswana College of Agriculture/ University of Botswana.

8.

Nsoso S J, Monkhei M and Modise O M 2005

A survey of indigenous Tswana chicken farmers in Kgatleng Agricultural District in Botswana. Botswana Journal of Agriculture and Applied Sciences1(1): 10-18.

9.

Nsoso S J, Monkhei M and Tlhwaafalo B E 2004c

A survey of traditional small stock farmers in Molepolole North, Kweneng district, Botswana: Demographic parameters, market practices and marketing channels. Livestock Research for Rural Development. Volume 16 Article #100. Retrieved 10, May 2004, from <http://www.cipav.org.co/lrrd/lrrd16/12/nsos16100.htm>

10.

Nsoso S J and Morake G T 1999

A critical look at the use of exotic bulls and a proposed breeding strategy under traditional farming in Botswana. South African Journal of Animal Science 29: 100-104.

11.

Nsoso S J, Mosweu S, Malela L and Podisi B 2004a

A survey on population, distribution, management and utilisation of indigenous Tswana pigs in Southern Botswana. Animal Genetic Resources Information 34: 83-96. <http://www.fao.org/docrep/007/y5303t/y5303t0c.htm>

12.

Nsoso S J, Podisi B, Otsogile E, Mokhutshwane BS and Ahmadu B 2004b

Phenotypic characterisation of indigenous Tswana goats and sheep breeds in Botswana: Continuous Traits. Tropical Animal Health and Production 36: 789-800.

13.

Nsoso S J and Rabasima MC 2004

A survey of traditional beef cattle farmers in southern Botswana: Demographic parameters and adoption of certain improved management practices

South African Journal of Agricultural Extension 33: 11-19.

14.

Podisi B 2001

Management of farm animal resources in Botswana. In S H B Lebie and Kamau L (Editors). Proceedings of planning and priority setting. Workshop on animal genetic resources in the SADC region held in Gaborone, Botswana. 19-22 February 2001, 13-21.

15.

Ramsay K, Smuts M and Els HC 2000

Adding value to South African landrace breeds conservation through utilisation. *Animal Genetic Resources Information* 27:1-7.

16.

SAS Institute 1999-2000

SAS® User's Guide Version 8.1. SAS Institute Inc., Cary, NC. USA.

17.

Soulsby E J L 1982

Helminths, arthropods and protozoan of domestic animals, 7th Edition. Bailliere Tindall, a division of Casell Ltd. Greycoat House, 10 Greycoat Place, London. UK

Citation



Oui