Indian Journal of Animal Sciences **92** (11): 1296–1299, November 2022/Article
https://doi.org/10.56093/ijans.v92i11.125939

Indigenous pig genetic resources: Preliminary documentation of current status and population trend of Tswana pigs in three districts of Botswana

KETSHEPHAONE THUTWA[1]✉, RICKS GALETSENE CHABO[1], PATRICK MONAMETSI KGWATALALA[1] and SHALAULANI JAMES NSOSO[1]

Botswana University of Agriculture and Natural Resources, Private Bag 0027, Gaborone, Botswana

Received: 22 July 2022; Accepted: 23 September 2022

ABSTRACT

This study aimed to assess the status, population and population trend of Tswana pigs in three districts of Botswana. A survey was conducted for three consecutive years from 2018 to 2020 in three districts to establish the status of indigenous Tswana pigs in the country in terms of their population. The three districts were Kgatleng, Kweneng and South-East. These districts were purposely chosen because they are the ones which have a considerable number of indigenous Tswana pigs. A structured questionnaire was administered to 71 farmers in 2018, 50 farmers in 2019 and 71 farmers in 2020. The population of indigenous Tswana pigs declined over the three years of study. South-East district had the highest number of indigenous pigs and Kweneng district had the least number during the three years of study. Sows and gilts were more than boars. The average herd size ranged from 3.5 to 20 over the three years. According to risk status classification by FAO, the status of indigenous Tswana breed in the southern districts of Botswana is 'endangered' and the estimated population growth rate is less than one. There is a strong positive and significant difference between the total number of pigs and the number of female pigs. The regression analysis indicated a positive impact of adult female pig numbers on the total number of Tswana pigs.

Keywords: Animal genetic resources, Birth rate, Conservation, Death rate, Population trend, Tswana pigs

Documenting and monitoring the status of animal genetic resources is one of the vital factors for their sustainable use, development, and conservation (FAO 2011, Cao *et al*. 2021). Indigenous Tswana pigs, just like other indigenous livestock species, are not highly regarded in commercial production system (Halimani 2020). The main reason for that is the slow growth rate compared to the exotic commercial pigs (Wang *et al*. 2021). Farmers prefer exotic and crossbred pigs due to their large body frame and fast growth rate which makes the pig production enterprise profitable (Silva *et al*. 2016, Wang *et al*. 2021). The same scenario was reported by Krishnan *et al*. (2020) in India. This limits the indigenous pig rearing by the small-holder resource-poor farmers for home consumption and occasional sales (Silva *et al*. 2016).

The preference of exotic breeds over indigenous breeds and indiscriminate crossbreeding practices leaves the indigenous breeds in danger of becoming extinct (Rege and Gibson 2003). It should be noted that even though the indigenous breeds are slow growing and have smaller body frames, they have other good characteristics that may be of benefit to farmers and consumers now and in future. The good characteristics include tolerance to heat, high resistance to diseases and parasites, the ability to utilize low quality feeds and crop residues (Madzimure *et al*. 2013) and high fertility and longevity. They are adapted to scavenging and backyard systems (Thutwa *et al*. 2020). Indigenous pigs have also been reported to have tender meat, more fat, good meat (flavour) taste and colour (Madzimure *et al*. 2013, Wang *et al*. 2021).

Previous studies (Madzimure *et al*. 2013, Thutwa *et al*. 2020, Bharati *et al*. 2022) have shown that indigenous pigs are mostly reared by women. Looking at the favourable attributes of Tswana pigs, efforts must be made to conserve this breed. To ensure sustainable utilisation of the indigenous pigs, their slow growth can be complemented by breeding programmes such as well-planned crossbreeding (Huyen *et al*. 2005). Madzimure *et al*. (2013) reported that there is high potential to utilize indigenous pigs for crossbreeding with exotic breeds for market-oriented production systems in South Africa.

The status of the population can be determined by measuring factors such as population size, mortality and birth rate (Tarsi and Tuff 2012, Singh and Sharma 2017). Therefore, the aim of this study was to determine the population trends, risk status, births, deaths and off-take rates of indigenous Tswana pigs in Kgatleng, Kweneng and South-East districts of Botswana.

Present address: [1]Department of Animal Sciences, Botswana University of Agriculture and Natural Resources, Private Bag 0027, Gaborone, Botswana.✉Corresponding author email: kthutwa@buan.ac.bw

MATERIALS AND METHODS

Sampling sites: A survey was conducted for three consecutive years from 2018 to 2020 in Kgatleng, Kweneng and South-East districts of Botswana to establish the status of indigenous Tswana pigs in Botswana in terms of the population. These districts were chosen because they have considerable number of indigenous Tswana pigs. Kgatleng District lies between Latitude 23.88°S–24.51°S and Longitude 25.89°E–26.82°E (Tshireletso *et al*. 2018), Kweneng district lies between Latitude 21°31'44.54'' S and Longitude 23°12'14.32'' E while South-East district lies between Latitude 24.9366°S and Longitude 25.8049°E. Annual rainfall in Kgatleng District ranges between 450 mm and 550 mm. The ambient temperatures range between 6°C and 20°C in winter and 22°C and 30°C in summer (Bhalotra 1987). Kweneng district is situated in a semi-arid climate, with mainly sparse bush savannah vegetation. The rainy season is typically between October and April and the driest months are June to August (Schiess-Meier *et al*. 2007).

Data collection and analysis: A structured questionnaire was administered to 71 farmers in 2018, 50 farmers in 2019 and 71 farmers in 2020. In 2018, the baseline data were collected including demographic parameters of the farmers and the purpose of keeping indigenous pigs (data not included in this paper) while in 2019 and 2020, more variables were added. These data include birth rate, number of pigs sold (off-take) and mortality rate, and these were compared between 2018/2019 and 2019/2020. The data were analysed using Statistical Package for the Social Sciences (IBM. Corp. SPSS 2017). Most of the data were not normally distributed and transformation of data could not be possible, therefore non-parametric Kruskal-Wallis test was used for the differences of total numbers of pigs among three districts and three years. The differences in the per cent causes of death in pigs among districts and through three years was tested using chi-square. Pearson correlation and regression were done to check the relationship between the number of pigs and the number of adult females and males.

The population growth rate was estimated using the equation used in FAO (2013) report:

$$r = \text{anti-log}[(\log N2 - \log N1)/t]$$

Where, r, rate of growth per year; N1 and N2, respectively, the number of breeding females from the first (2018) and the last (2020) census; and t, time interval in years between the two censuses.

RESULTS AND DISCUSSION

Population of indigenous Tswana pigs: There was a decline in the number of indigenous Tswana pigs in the studied districts of Botswana from 2018 to 2020. The numbers declined from 620 to 457. This is a cause of concern because the studied districts are known to have more indigenous Tswana pigs. This breed is rarely available in other districts of the country. The declining population of indigenous pigs agrees with the report of Nidup *et al.* (2011) and De *et al*. (2019) in indigenous pigs of Bhutan and India, respectively. However, the results of the current study are contrary to the report of Grittner *et al.* (2021) which indicated the increasing trend in the population of different indigenous breeds of Serbia. The low numbers of indigenous pigs in the districts of Botswana are contrary to Indian numbers where indigenous pigs are reported to be 76.14% of the total pig population and different regions of the country have more than 600,000 indigenous pigs (Behl *et al*. 2020). This discrepancy in the number of pigs in the regions of India and districts of Botswana may be attributed to the huge differences in human populations and the underutilisation of the indigenous pigs in Botswana. The numbers in this study are also lower than those reported in different provinces in South Africa in 2010 (Meissner *et al*. 2013). The current Tswana pigs' population put this breed under endangered status according to FAO risk status classification (FAO 2013).

Distribution of Tswana pigs in the three districts: More pigs were found in the South-East district in all the three years of study, followed by Kgatleng and lastly Kweneng district (Table 1). This might be due to South-East district's tribe(s) preference for indigenous pigs' meat. The findings concur with Sah *et al*. (2018), who reported that pig farming was most prevalent in the central and eastern regions of Nepal. Nidup *et al*. (2011) and Sulabh *et al*. (2017) also reported varying numbers of indigenous pigs in different regions of Bhutan and India, respectively.

Table 1. Population of indigenous Tswana pigs in three districts

Year	Kgatleng district	Kweneng district	South-East district	Total
2018	128	7	485	620
2019	165	80	353	598
2020	153	40	264	457

Age and sex structure of Tswana pigs: Generally, number of sows was higher than that of boars and a similar pattern applied to young males and gilts (Supplementary Table 1). Similarly, Ayalew *et al*. (2011) reported more number of sows than boars while the male growers were more than the female growers in Papua New Guinea. Contrary to this study, Nidup *et al*. (2011) reported more males than females in indigenous pigs in Bhutan.

Herd size of Tswana pigs and mean number of different ages and sex per household in three districts: The average herd size differed between districts and the years of study ranging from 3.5 to 20 (Supplementary Table 2). Mean number of pigs of different age and sex per household in three districts over three years are shown in Table 2. The differing herd size between districts concurs with Ayalew *et al.* (2011) who reported varying herd size in different sampling sites. The average herd sizes according to districts in the current study are slightly higher than those reported by researchers in other countries. Sah *et al*. (2018) reported that average pigs per household was 2.5 in two districts of Nepal while Chiduwa *et al*. (2008) reported

average pig herd size of 3.3 per household in Zimbabwe. The lower herd sizes in countries with higher population of indigenous breeds than Botswana implies that there are more farmers with pigs compared to Botswana where the households with indigenous pigs were less than 100.

Table 2. Mean number of pigs with different age and sex per household in three districts over three years

Pig category/ Group	District			Significance
	Kgatleng	Kweneng	South-East	
Boars				
2018	1.41±0.31	0.5±0.5	0.92±0.2	0.054
2019	2.75±1.1[a]	0.00±0.00	0.97±0.3	
2020	0.68±0.24[b]	2.50±0.96	1.29±0.38	
Sows				
2018	2.00±0.45	0.5±0.5	1.81±0.3	NS
2019	3.17±0.97	1.5±0.5	1.84±0.36	
2020	2.00±0.8	3.50±1.5	2.29±0.53	
Young males				
2018	0.59±0.3[a]	0.00±0.00	1.38±0.35	NS
2019	2.42±0.86	0.00±0.00	0.59±0.33	
2020	2.63±0.83[b]	1.25±0.75	1.18±0.33	
Gilts				
2018	0.71±0.4	0.00±0.00	1.65±0.32[b]	NS
2019	1.75±0.71	0.00±0.00	0.53±0.22[a]	
2020	2.21±1.31	1.75±1.44	1.24±0.47	
Piglets				
2018	2.82±1.6	0.5±0.5	3.56±0.99	NS
2019	3.75±1.24	0.5±0.5	5.55±1.14[c]	
2020	0.79±0.48	1.0±1.0	1.79±0.5[b]	

NS, not significant between districts; [abc]Means with different letters are significantly different between years within a district.

Birth rate, off-take and mortality rate: The number of Tswana pigs that were born, that died and that were sold varied between the years of study (Supplementary Table 3). The fluctuations of number of pigs born, died and sold was also reported by Lubungu (2016) in Zambia. In 2020, more pigs were removed through death rather than being sold while in 2019 the mean number of sold pigs were similar to died pigs. On the contrary, Silva *et al*. (2016) reported that more removal of indigenous pigs in Vietnam and Sri Lanka were due to sales, instead of mortality.

Causes of pig death: The farmers who knew the causes of mortality of their pigs reported various causes such as cold stress (8%), dog bites (7%) and poisoning (5%). Mutua *et al*. (2011) and Abonyi *et al*. (2012) also reported hypothermia as a major cause of piglets' death in Kenya and Nigeria. Other causes of death such as drowning in water, high temperatures, diseases and parasites, hit by car, starvation, predation, killed by neighbours, side effects of castration, piglets crushed by sows and boars accounted for 2% and less. Our report was not consistent with other reports where crushing by sows was the major cause of piglet death (Mashatise *et al*. 2005, Abonyi *et al*. 2012). This discrepancy might be due to differences in production systems between the current study and previous studies or better maternal instincts of indigenous Tswana pigs. Most of the causes of piglets' mortality reported here are consistent with the reports of piglets mortality causes in India (Roy *et al*. 2014).

Estimation of population growth rate: The growth rate was calculated as given here.

$$r = \text{antilog}\,[(\log 129 - \log 130)/2] = 0.996.$$

The growth rate was less than 1. Based on this growth rate, the population size after 10 years can be estimated as $129*(0.996^{10}) = 123$. This suggests that the population is declining, and conservation measures need to be put in place.

Correlation analysis between total number of pigs and the number of females and males: There was a high positive and statistically significant correlation between total number of pigs and the number of females (P=0.00), and low positive correlation between total number of pigs and number of males (Table 3).

Table 3. Correlation analysis

	Total pigs	Number of adult males	Number of adult females
Total pigs	1		
Number of adult males	0.423**	1	
Number of adult females	0.718**	0.486**	1

Regression analysis: Regression analysis was done to confirm if number of adult female pigs carry a significant impact on total number of pigs (population). The dependent variable (total number of pigs) was regressed on predicting variable (adult female pigs' numbers). Female pigs number significantly predicted pigs' total, $F = 93.492$, $p<0.001$, indicating that female pigs play significant role in increasing population of pigs ($b=0.670$, $p<0.001$). These results confirm the positive effect of the adult female pig number on the population of Tswana pigs. Furthermore, $R^2 = 0.522$ depicts that the model explains 52.2% of the variance in number of pigs.

The population of indigenous Tswana pigs declined over the three years of study. Only a few farmers are keeping the indigenous pigs, making the population to remain low compared to other countries. The population growth rate was less than one. Tswana pigs are currently in the endangered status. If conservation strategies for indigenous pigs are not put in place in Botswana, this breed might reach 'critical' status. There is a strong positive relationship between the number of adult female pigs and the population of Tswana pigs. More research needs to be done to characterise this breed and document its performance ability. The breed needs to be conserved through utilisation and cryopreservation.

ACKNOWLEDGEMENT

The authors would like to thank Botswana University of Agriculture and Natural Resources (BUAN) for funding this study. The farmers are also appreciated for participating in this study.

REFERENCES

Abonyi F O, Omeh C V O and Machebe N S. 2012. Neonatal mortality of pigs in Nsukka, Southeast, Nigeria. *African Journal of Biotechnology* **11**(68): 13228–34.

Ayalew W, Danbaro G, Dom M, Amben S, Besari F, Moran C and Nidup K. 2011. Genetic and cultural significance of indigenous pigs in Papua New Guinea and their phenotypic characteristics. *Animal Genetic Resources* **48**: 37–46.

Behl R, Vij P K, Niranjan S K, Behl J and Vijh R K. 2020. Indigenous pig genetic resources of India: Distribution, types and their characteristics. *Indian Journal of Animal Sciences* **90**(2): 127–33.

Bhalotra Y P R. 1987. Climate of Botswana, part II: Elements of climate: 1. Rainfall. Department of Meteorological Services, Botswana.

Bharati J, De K, Paul S, Kumar S, Yadav A K, Doley J, Mohan N H and Das B C. 2022. Mobilizing pig resources for capacity development and livelihood security. *Agriculture, Livestock Production and Aquaculture (Springer, Cham.)*: 219–42.

Cao J, Baumung R, Boettcher P, Scherf B, Besbes B and Leroy G. 2021. Monitoring and progress in the implementation of the global plan of action on animal genetic resources. *Sustainability* **13**: 775.

Chiduwa G, Chimonyo M, Haliman T E, Chisambara S R and Dzama K. 2008. Herd dynamics and contribution of indigenous pigs to the livelihoods of rural farmers in a semi-arid area of Zimbabwe. *Tropical Animal Health and Production* **40**(2): 125–36.

De A K, Ponraj P, Kundu M S, Muthiyan R, Muniswamy K, Kundu A, Malakar D, Sunder J, George Z and Bhattacharya D. 2019. Mitochondrial landscape of indigenous pig germplasm of Andaman and Nicobar Islands. *Mitochondrial DNA Part B* **4**(2): 2808–10.

FAO. 2011. *Surveying and Monitoring of Animal Genetic Resources.* FAO Animal Production and Health Guidelines. No. 7. Rome.

FAO. 2013. *In vivo Conservation of Animal Genetic Resources*. FAO Animal Production and Health Guidelines. No. 14. Rome.

Grittner N, Mandic R and Urošsevič M. 2021. Animal genetic resources of Serbia: Situation and perspectives. *Pakistan Journal of Zoology* **53**(3): 1131–47.

Halimani T E, Mapiye O, Marandure T, Januarie D, Imbayarwo-Chikosi V E and Dzama K. 2020. Domestic free – range pig genetic resources in southern africa: progress and prospects. *Diversity* **12**: 68.

Huyen L T T, Roessler R, Lemke U and Zarate A V. 2005. Impact of the use of exotic compared to local pig breeds on socio-economic development and biodiversity in Vietnam. Verlag Grouer, Beuren, Stuttgart. University of Hohenheim, Institute of Animal Production in the Tropics and Subtropics.

IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. IBM Corp., Armonk., New York.

Krishnan A, Kumar G S, Venkataramanan R, Balasubramanyam D, Thirunavukkarasu P and Devendran P. 2020. Factors influencing mortality of pigs under hot and humid conditions of Tamil Nadu, India. *International Journal of Livestock Research* **10**(8): 82–88.

Lubungu M. 2016. Zambian Smallholder Livestock Herd Dynamics: What are the Policy Implications?. Indaba Agricultural Policy Research Institute, Lusaka, Zambia. Policy Brief No. 86. (Downloadable at http://wwwaec.msu.edu/agecon/fs2/zambia/index.htm and http://www.iapri.org.zm)

Madzimure J, Chimonyo M, Zander K K and Dzama K. 2013. Potential for using indigenous pigs in subsistence-oriented and market-oriented small-scale farming systems of Southern Africa. *Tropical Animal Health and Production* **45**: 135–42.

Mashatise E, Hamudikuwanda H, Dzama K, Chimonyo M and Kanengoni A. 2005. Socio-economic roles, traditional management systems and reproductive patterns of Mukota pigs in semi-arid North-Eastern Zimbabwe. *Bunda Journal of Agriculture, Environmental Science and Technology* **3**: 97–105.

Meissner H H, Scholtz M M and Palmer A R. 2013. Sustainability of the South African Livestock Sector towards 2050 Part 1: Worth and impact of the sector. *South African Journal of Animal Science* **43**(3): 282–97.

Mutua F K, Dewey C E, Arimi S M, Ogara W O, Githigia S M, Levy M and Schelling E. 2011. Indigenous pig management practices in rural villages of Western Kenya. *Livestock Research for Rural Development* **23**(7).

Nidup K, Tshering D, Wangdi S, Gyeltshen C, Phuntsho T and Moran C. 2011. Farming and biodiversity of pigs in Bhutan. *Animal Genetic Resources* **48**: 47–61.

Rege J E O and Gibson J P. 2003. Animal genetic resources and economic development: Issues in relation to economic evaluation. *Ecological Economics* **45**: 319–30.

Roy B, Kumar A, Lakhani G P and Jain A. 2014. Causes of pre-weaning pig mortality in India. *Scholarly Journal of Agricultural Science* **4**(9): 485–93.

Sah R P, Jha S K and Karki S. 2018. Management System including health care and marketing of pigs adopted by farmers in Dhankuta and Terhathum districts. *Nepalese Veterinary Journal* **33**: 90–97.

Schiess-Meier M, Ramsuer S, Gabanapelo T and König B. 2007. Livestock predation insights from problem animal control registers in Botswana. *Journal of Wildlife Management* **71**(4): 1267–74.

Silva G L L P, Thuy L T, Abeykoon N D, Hanh N T H, Bett R C, Okeyo M and Ibrahim M N M. 2016. Comparative study of indigenous pig production in Vietnam and Sri Lanka. *International Journal of Livestock Production* **7**(10): 83–84.

Singh P K and Sharma A. 2017. Assessment of degree of endangerment of livestock breeds in India. *Indian Journal of Animal Sciences* **87**(3): 316–23.

Sulabh S, Shivhare P, Kumari A, Kumar M and Nimmanapalli R. 2017. Status of pig rearing in India. *International Journal of Veterinary Sciences and Animal Husbandry* **2**(3): 30–32.

Tarsi K and Tuff T. 2012. Introduction to Population Demographics. *Nature Education Knowledge* **3**(11): 3.

Thutwa K, Chabo R, Nsoso S J, Mareko M, Kgwatalala P M and Owusu-Sekyere E. 2020. Indigenous Tswana pig production characteristics and management practices in southern districts of Botswana. *Tropical Animal Health and Production* **52**: 517–24.

Tshireletso K, Makhabu S W, Nsinamwa M, Kgosiesele E, Setlalekgomo M R, Seletlo Z, Majaga S and Legwatagwata B. 2018. Diversity patterns of woody vegetation of Kgatleng District, Botswana, pp 416–23. *Climate Change and Adaptive Land Management in Southern Africa – Assessments, Changes, Challenges and Solutions*. (Eds) Revermann R, Krewenka K M, Schmiedel U, Olwoch, J M, Helmschrot J and Jürgens N. Biodiversity and Ecology 6, Klaus Hess Publishers, Göttingen & Windhoek.

Wang Y, Thakali K, Morse P, Shelby S, Chen J, Apple J and Huang Y. 2021. Comparison of growth, performance and meat quality traits of commercial cross-bred pigs versus large black pig breed. *Animals* **11**: 200.