**JWPR**
**Journal of World's Poultry Research**

**2023, Scienceline Publication**

*J. World Poult. Res.* 13(4): 426-439, December 25, 2023

*Research Paper,* PII: S2322455X2300045-13
*License:* CC BY 4.0

DOI: https://dx.doi.org/10.36380/jwpr.2023.45

# Quail Farming in Villages of Mogoditshane-Thamaga and Tlokweng Districts, Botswana

Shame Bhawa[1*], John Cassius Moreki [1], and Freddy Manyeula[2]

[1]*Department of Animal Science, Faculty of Animal and Veterinary Sciences, Botswana University of Agriculture and Natural Resources, Private Bag 0027, Content Farm, Sebele, Gaborone, Botswana*
[2] *Department of Agriculture and Animal Health, College of Agriculture and Environmental Sciences, University of South Africa, Florida 1710, South Africa*

*****Corresponding author's E-mail: shame.bhawa@yahoo.com

Received: 10 October 2023
Accepted: 28 November 2023

## ABSTRACT

The interest in quail farming has been increasing over the years due to the quail's many productive and financial benefits over other poultry species. Quail farming is still in its infancy in Botswana. This study investigated the current status, challenges, and prospects of Japanese quail farming in Mogoditshane, Gabane, and Tlokweng districts, Botswana. A total of 64 quail farmers were interviewed using a structured questionnaire from June 2022 to April 2023. Data were collected on the respondents' demographic characteristics (age, educational status, and sex), quail management aspects (feeding, housing, and health), ownership of quail, challenges in quail farming, and the use of quail products in the study area. Results showed that 67% of male respondents were involved in quail rearing. The youth (≤35 years) dominated the rearing of quails, followed by respondents aged 41-50 years (22%), 36-40 years (16%), and above 50 years (9%). In addition, 48% of the respondents reared ≤100 quails, followed by 39% and 13% who reared 101-500 and 500 quails, respectively. Furthermore, 81% of respondents reared quails in cages, 17% in conventional structures, and 2% in residential houses. Bobwhite, Jumbo, and Japanese quail were the three quail varieties reared in the study area. It was found that 55% of the respondents had less than one year of experience in quail farming. Moreover, 86% of the respondents used crushed maize or sorghum to feed quails, while 14% used commercial chicken diets. Finally, 92% of the respondents mentioned that quail eggs were used to treat various human diseases. Effective challenges in quail farming included external parasites (36%), diseases (30%), predation (13%), lack of commercial quail diets (12%), escaping (6%), and theft (3%). Quail farming should be considered for inclusion in government support programs as it has the potential to contribute to income generation and food and nutrition security.

**Keywords:** Food security, Job creation, Nutrition, Quail farming, Therapeutic properties

## INTRODUCTION

The Japanese quail (*Coturnix cortunis japonica*) was domesticated over 700 years ago and is now the most frequently farmed species for its egg production and meat (Mondry, 2016). Recently, quail production has gained relevance due to its usage as a laboratory bird for poultry and biomedical research, as well as its commercial use in the production of meat and eggs (Berterchini, 2012). As quails have many productive and financial benefits over other bird species, quail breeding has recently been effectively developed in many African countries, including Botswana, Ghana, Nigeria, South Africa, and Zimbabwe (Minvielle, 2009). Japanese quails are tiny birds of the Galliformes order that are widely distributed throughout the Palaearctic (Khaleel et al., 2021). Japanese quails have a strong genetic capacity for productivity; they may produce 310 eggs annually, with 12.5 g as the average egg weight (Katerynych and Pankova, 2020), and the bird's life expectancy is 2-2½ years (Bakoji et al., 2013).

Despite their small size, quails are not inferior to chickens when it comes to vitamin content and other beneficial components, including calcium, iron, zinc, and protein. Quails generally represent a distinctive protein-vitamin-mineral complex (Priti and Satish, 2014; Ali and Abd El-Aziz, 2019). For example, one gram of quail egg contains 2.5 times as much vitamin A, 2.8 times as much vitamin B1, and 2.2 times as much vitamin B2 as a

To cite this paper: Bhawa S, Moreki JC, and Manyeula F (2023). Quail Farming in Villages of Mogoditshane-Thamaga and Tlokweng Districts, Botswana. *J. World Poult. Res.*, 13(4): 426-439. DOI: https://dx.doi.org/10.36380/jwpr.2023.45

chicken egg. Five quail eggs, weighing the same as one chicken egg, have five times the amount of phosphorus and potassium and 4½ times the amount of iron (Nepomuceno et al., 2014). Quail eggs are extremely beneficial not just as foodstuffs but also as a wonderful therapeutic agent due to the high amount of vital nutrients such as protein, calcium, and vitamins A, B, K, and D (Mnisi et al., 2021), that medical professionals across the world strongly advise using (Arthur and Bejaei, 2017). In addition, quail eggs are richer than chicken eggs in essential amino acids such as tyrosine, threonine, lysine, glycine, and histidine (Genchev, 2012). These essential amino acids give the quail egg its antibacterial, immune-modulating, anticancer, and normalizing effects on the cardiovascular, gastrointestinal, and other systems. In Japan, the egg is known to eliminate radionuclides from the body (Katerynych and Pankova, 2020).

Quail meat outperforms all other types of farm fowl in terms of nutritional value and flavor. It is also succulent, savory, and tender (Mnisi et al., 2021). Along with treating chronic conditions and disorders of the heart, stomach, liver, lungs, and kidneys, quail meat also strengthens bones and enhances tone (Costăchescu et al., 2018). Quail meat has a hypotensive effect due to the large amount of potassium, which is necessary for the brain's function (Katerynych and Pankova, 2020). Additionally, quail meat is a great way to prevent gout because it contains vitamin PP (nicotinamide), which helps to improve blood microcirculation, as well as being a source of sulfur and phosphorus that are essential for restoring normal metabolism (Katerynych and Pankova, 2020). Quail meat also contains significantly more vitamins A, B1, and B2 than chicken, along with vitamin D, making it an effective way to prevent rickets (Santhi and Kalaikannan, 2017).

As Africans consume the least protein daily per person compared to other continents (Illgner and Nel, 2000), the use of quail meat as an alternative protein source will undoubtedly increase in the near future, especially for those in the developing World (Mnisi et al., 2021). Considering the numerous uses of quail as food and medicine, the quail industry's global expansion is likely to be determined by these uses. In Botswana, quail farming is a relatively uncommon form of agricultural activity, but those who have adopted it are not only benefiting financially from it but are also reaping its nutritional and health benefits. Data on quail farming in Botswana is limited. Therefore, this study endeavors to investigate the status, challenges, and prospects of Japanese quail farming in the selected villages of Mogoditshane-Thamaga, and Tlokweng Districts of Botswana.

## MATERIALS AND METHODS

### Study area

The study was conducted in three villages (Gabane, Mogoditshane, and Tlokweng) of Mogoditshane-Thamaga and Tlokweng districts of Botswana (Figure 1). The geographical positions of the study sites are Gabane (24.6641$^{o}$ S, 25.7836$^{o}$ E), Mogoditshane (24.6072$^{o}$ S, 25.8540$^{o}$ E), and Tlokweng (24.6680$^{o}$ S, 25.9764$^{o}$ E). The human populations of Gabane, Tlokweng, and Mogoditshane are estimated to be 20010, 55508, and 88006, respectively (Statistics Botswana, 2022). Gabane and Mogoditshane are located west of Gaborone, and Tlokweng is in the eastern part of Gaborone (the capital city of Botswana). Mogoditshane and Tlokweng share a boundary with Gaborone, while Gabane is approximately 15 km away from Gaborone.

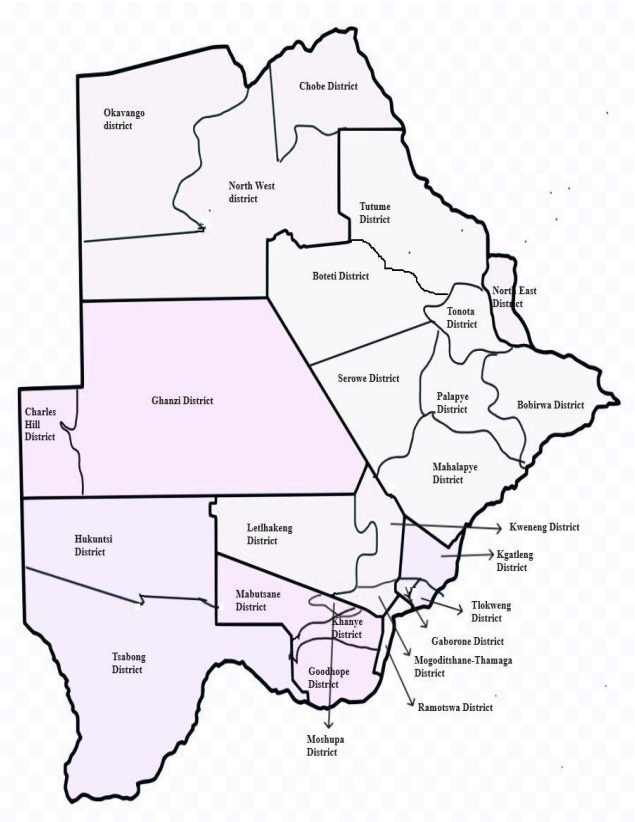


**Figure 1.** A map of Botswana showing Mogoditshane-Thamaga and Tlokweng districts of *Botswana* among others. Source: Ministry of Local Government and Rural Development (2023)

**Selection of the study sites and sampling techniques**

In this study, the sample size was determined by the human population in the villages and the availability of rearers. A total of 64 quail rearers were identified in the Mogoditshane-Thamaga and Tlokweng districts utilizing a cluster random selection technique described by Gabanakgosi et al. (2014). A total of 24 respondents were identified in Mogoditshane, followed by 21 respondents in Tlokweng, and 19 respondents were from Gabane village.

**Data collection**

Data on management techniques, consumption, and contribution of quail towards income and nutrition in the selected villages were acquired through a structured questionnaire and direct observation from June 2022 to April 2023. Data were collected on socio-economic characteristics (sex, age, and education level of the respondents), the economic value of quail, management practices, production systems, and production challenges. Participants were asked, among others, to give reasons for keeping quails. Secondary sources of data were also reviewed. Only one member of the household was interviewed by reading and interpreting the questions in the local language, while responses were recorded in English.

**Statistical analysis**

Quantitative and qualitative data were analyzed using IBM SPSS version 25. The means were separated using the Chi-square ($X^2$) mean separation test was used to determine the statistically significant differences and the significance was declared at $P < 0.05$.

## RESULTS AND DISCUSSIONS

**Socio-economic characteristics**

Males operated 67% of farms, and quail farming was the primary occupation for 42.2% of farm holders. The results revealed that there was no significant difference (p > 0.05) in respondents' sex (Table 1). Similarly, Nasar et al. (2016) and Ekpo et al. (2020) reported that the quail farming business was mainly operated by males in Bangladesh and Benin, respectively. About seven percent of women in this study were involved in quail rearing compared to 55.6% for Uganda (Nasaka et al., 2017) and 68% for Zimbabwe (Majoni et al., 2018).

Fifty-three percent of the respondents in the present study were under the age of 35 years, 16% were between the ages of 36 and 40 years, 22% were between the ages of 41 and 50 years, and 9% were adults between the ages of 51 and 60 years (Table 1). The results showed no significant difference (p > 0.05) in age of respondents. Results show no significant differences in the age of the respondents, as reported by Muthoni (2014) and Ekpo et al. (2020) in Kenya and Benin, respectively. The results of the current study indicated that the respondents aged 40 years and below were more active in quail farming than other age groups. This might be attributable to the fact that young and middle-aged people are more likely to take risks in investing in a new venture such as quail farming than the elderly, who are risk averse. Additionally, this age group is active and better able to handle the physical strain associated with quail production.

Only 8% of the respondents were illiterate, 17% dropped out at the primary level, 44% completed their secondary education, and 31% attended tertiary education. This finding indicates that the majority of the respondents were likely to understand extension messages and try new technologies. The results revealed that there was no significant difference in the educational level of respondents (P > 0.05). The respondents who never attended school were above 60 years old. The current results supported the findings of Aliyu (2016) and Muhammad-Lawal et al. (2017) but differed with those of Oksana (2016), who reported that 59% of small-scale quail farmers in the Kaduna State of Nigeria lacked formal education. The scenario in Botswana is encouraging since education is essential for adopting novel ideas, experiencing new things, and managing some of the difficulties that may occur from quail production to marketing. Heads of households were mostly females (47%).

Fifty-two percent of the respondents relied on livestock sales, 16% operated family tuck shops, 13% depended on proceeds from vegetable and crop sales, 11% depended on children who were working, and 2% depended on pension (Table 2). The present study revealed that 23.4% of respondents were formally employed compared to 34.4% who were informally employed. Setlalekgomo (2012) found that 90.7% of women who reared chickens in Lentsweletau village in the Kweneng District of Botswana were unemployed.

**Table 1.** Socio-economic characteristics of respondents in Gabane, Mogoditshane, and Tlokweng of Botswana from 2022 to 2023

| Respondent number (%) / Variable (n = 64) | Category | Gabane | Mogoditshane | Tlokweng | Overall | $X^2$ | P value |
|---|---|---|---|---|---|---|---|
| Gender | Male | 13(62) | 16(73) | 14(67) | 43(67) | 0.959 | 0.619 |
| | Female | 8(38) | 6(27) | 7(33) | 21(33) | | |
| Age (years) | ≤ 40 | 18(82) | 11(50) | 15(71) | 44(69) | 11.734 | 0.068 |
| | 41-50 | 2(10) | 7(32) | 5(24) | 14(22) | | |
| | 51-60 | 1(8) | 4(18) | 1(5) | 6(9) | | |
| | ≥ 60 | 0 | 0 | 0 | 0 | | |
| Educational level | Illiterate | 1(5) | 3(14) | 1(5) | 5(8) | 3.828 | 0.700 |
| | Primary | 3(14) | 3(14) | 5(24) | 11(17) | | |
| | Secondary | 8(38) | 10(45) | 10(48) | 28(44) | | |
| | Tertiary | 9(43) | 6(27) | 5(24) | 20(31) | | |
| Marital status | Married | 7(33) | 4(14) | 2(10) | 12(19) | 9.402 | 0.052 |
| | Single | 9(43) | 16(73) | 12(57) | 37(58) | | |
| | Widowed | 5(24) | 2(13) | 7(33) | 14(22) | | |
| Head of household | Husband | 3(17) | 7(32) | 2(9) | 12(19) | 4.257 | 0.372 |
| | Single father | 7(33) | 6(27) | 9(43) | 22(34) | | |
| | Single mother | 11(50) | 9(41) | 10(48) | 30(47) | | |
| Position in household | Father | 3(14) | 7(32) | 8(38) | 18(28) | 9.669 | 0.139 |
| | Mother | 8(38) | 6(27) | 6(29) | 20(31) | | |
| | Son | 6(29) | 5(23) | 4(19) | 15(24) | | |
| | Daughter | 4(19) | 4(18) | 3(14) | 11(17) | | |
| Household size by sex | Male | 26 | 52 | 25 | 103 | | |
| | Female | 30 | 68 | 55 | 153 | | |
| Occupation | Formal | 4(19) | 7(32) | 5(24) | 15(23.4) | 5.544 | 0.244 |
| | Informal | 8(38) | 4(18) | 9(43) | 21(34.4) | | |
| | Unemployed | 9(43) | 11(50) | 7(33) | 27(42.2) | | |

**Table 2.** The sources of income in selected villages without considering the quail farming in Botswana from 2022 to 2023

| Respondent number (%) / Source of income | Gabane | Mogoditshane | Tlokweng | Overall |
|---|---|---|---|---|
| Livestock sales | 10(48) | 12(55) | 11(52) | 33(52) |
| Children working | 3(14) | 2(9) | 2(10) | 7(11) |
| Relative working | 0 | 1(5) | 0 | 0 |
| Pension | 1(5) | 0 | 0 | 1(2) |
| Vegetable and crop sales | 3(14) | 2(9) | 3(14) | 8(13) |
| Tuck shop | 2(10) | 4(18) | 4(19) | 24(16) |
| Renting a house in Gaborone | 2(9) | 1(5) | 1(5) | 4(6) |

**Training and record-keeping**

Eighty-three percent of the respondents across the villages did not have poultry management training or experience in quail farming. Gabane had 90% of quail farmers who were not trained in quail farming, followed by Tlokweng (86%) and Mogoditshane (73%, Table 3). The results revealed no significant difference ($p > 0.05$) in poultry training. The current results are in line with Nasar et al. (2016), who found that 67.3% of farmholders did not receive any training in poultry farming. All respondents in the current study agreed that training is critical for the long-term viability of quail production. This information might explain why farmers in Botswana are not actively involved in quail farming. The current results point to the inadequacy of technical support from the government extension services in supporting farmers who are involved in small-scale quail farming. Similarly, Siddique and

Mandal (1996) reported that quail farmers in Dhaka lack training in quail husbandry.

Eighty-six percent of the respondents did not keep quail business records (Table 3). Ninety-five percent of the respondents in Gabane mentioned that they did not keep records, followed by Tlokweng (86%) and Mogoditshane (77%). The results showed no significant difference ($p > 0.05$) in record keeping among respondents, indicating that most respondents did not keep records. A minority of the respondents who kept records were those who had tertiary education. This finding indicates that extension support to quail rearers is lacking. The majority of farmers who kept farm records had tertiary education. On the contrary, Akarikiya (2021) reported that more than half of respondents retained records in Ghana. The present study revealed that 41% of the respondents considered monitoring production as a reason for keeping records, implying that many farmers need training in record keeping. Thirty-six percent of the respondents mentioned that they monitored profit and loss using financial records that they keep, 17% mentioned that they used records to check the flock's health status, whereas 4% did not see any usefulness in keeping records. The results revealed no significant difference ($p > 0.05$) in the reasons for record keeping.

**Livestock species reared in the study area**

Livestock species reared in the study area are summarised in Table 4. The main livestock species reared include goats (35.3%), indigenous chickens (also referred to as traditional or family chickens, 21.8%), cattle (16%), sheep (12.6%), pigs (2.5%), and others (donkeys, ducks, and guinea fowl) that accounted for 11.8% (Table 4). A previous study by Gabanakgosi et al. (2013) in four areas of Botswana (Lobatse, Mokubelo, Khudumelapye, and Serowe) reported that the main livestock species reared were indigenous chickens (42%), followed by goats (32%), and cattle (16%). Furthermore, Simainga et al. (2011) in Zambia reported that chickens (50.7%) were the most reared livestock species, followed by cattle (35.4%), pigs (7.76%), and goats (6.08%).

About 45% of the respondents had ≤1 year of experience in quail farming, 31.3% had two years, 11% had three years, and 13% had ≥4 years of experience. Mogoditshane had a greater percentage of new farmers (55%) who had ≤1 year of experience in quail business, followed by Gabane (43%) and Tlokweng (38%). This means that quail farming is gaining recognition among poultry farmers in the surveyed villages. A minority of farmers with more than four years of experience in the quail business were found to be 14% in Mogoditshane, 10% in Tlokweng, and 5% in Gabane. This finding validates the past study that indicated quail farming is new in Africa (Akarikiya, 2021). Respondents in the present study stated the main reasons for starting quail farming were lower production costs, the nutritional benefits of quail eggs and meat, and the quails' tolerance to diseases. In another study, Ojo et al. (2014) in Nigeria reported that farmers enter the quail business due to the bird's hardiness, short generation intervals, and lower production costs of the quail enterprise.

**Table 3.** Training and record keeping of quail production in Gabane, Mogoditshane, and Tlokweng of Botswana from 2022 to 2023.

| Variable n = 64 | Category | Respondents number (%) | | | Overall | $X^2$ | P-*value* |
|---|---|---|---|---|---|---|---|
| | | Gabane | Mogoditshane | Tlokweng | | | |
| Poultry training | Trained | 2(10) | 6(27) | 3(14) | 11(17) | 4.664 | 0.097 |
| | Not trained | 19(90) | 16(73) | 18(86) | 53(83) | | |
| Training useful | Useful | 21(100) | 22(100) | 21(100) | 64(100) | | |
| | Not useful | 0 | 0 | 0 | 0 | | |
| Do you keep records | Yes | 1(5) | 5(23) | 3(14) | 9(14) | 3.399 | 0.183 |
| | No | 20(95) | 17(77) | 18(86) | 55(86) | | |
| Reasons for record-keeping | Monitor profit and loss | 2(10) | 6(27) | 15(71) | 23(36) | 0.774 | 0.679 |
| | Monitor production | 2(10) | 12(55) | 12(57) | 26(41) | 0.889 | 0.641 |
| | Identify health status | 3(14) | 12(55) | 13(62) | 11(17) | 1.588 | 0.452 |
| | Not useful | 3(14) | 1(5) | 0 | 4(6) | 2.087 | 0.352 |

**Table 4.** Ownership of livestock by respondents in three selected villages of Mogoditshane-Thamaga and Tlokweng districts Botswana from 2022 to 2023

| Variable \ Number of respondents | Animal | Gabane | Mogoditshane | Tlokweng | Overall |
|---|---|---|---|---|---|
| Species of livestock | Cattle | 8 | 5 | 6 | 19 |
| | Goats | 10 | 19 | 15 | 44 |
| | Chickens | 8 | 8 | 9 | 25 |
| | Sheep | 7 | 5 | 3 | 15 |
| | Pigs | 1 | 0 | 2 | 3 |
| | Others | 11 | 1 | 0 | 12 |

**Table 5.** Status of quail farming in selected villages of Botswana from 2022 to 2023

| Variable n=64 | Breed | Respondents number (%) | | | Overall |
|---|---|---|---|---|---|
| | | Gabane | Mogoditshane | Tlokweng | |
| Farm type | Layer | 2(10) | 3(14) | 1(5) | 6(9) |
| | Broiler or meat type | 1(5) | 4(18) | 2(10) | 7(11) |
| | Mixed type | 18(85) | 15(68) | 18(85) | 51(80) |
| Farm size | <100 | 12(57) | 11(50) | 8(38) | 31(48) |
| | 101-500 | 7(33) | 9(41) | 9(43) | 25(39) |
| | >500 | 2(10) | 2(9) | 4(19) | 8(13) |
| Number of breeds | One variety | 1(5) | 2(9) | 3(14) | 6(9) |
| | Two varieties | 11(52) | 7(32) | 8(38) | 26(41) |
| | Three varieties | 9(43) | 13(59) | 10(48) | 32(50) |
| Reared with other poultry | Yes | 1(5) | 4(18) | 0 | 5(8) |
| | No | 20(95) | 18(82) | 21(100) | 59(92) |

**Status of quail farming**

Eighty percent of the respondents were involved in mixed-type quail farming (eggs and meat), 11% reared quails for meat only, while 9% reared quails for egg production only. In Gabane, 85% of respondents were involved in mixed-type quail farming, laying quail (eggs) production (10%), and quail broiler production (5%). In Tlokweng, 85% of the respondents participated in mixed-type quail farming, 10% in broiler quail production, and 5% in layer quail production. Similarly, the majority of farmers in Mogoditshane (85%) were involved in mixed-type quail farming, followed by quail broiler farming (10%), and layer quail farming (5%, Table 5). The current results are consistent with Nasar et al. (2016), who found that 63.4% of the respondents in Bangladesh practiced mixed-type quail farming. Egbeyale et al. (2013) mentioned that Japanese quails are well suited for commercial egg and meat production under intensive management and that mixed-type quail farming is used globally. This is due to their resilience and capacity to live in small cages (Odunsi et al., 2007); the relatively short generation interval, and lower production costs (Ojo et al., 2014).

Approximately 92% of quail farmers in this study rear quail alone. Most of the farmers (48%) had ≤100 birds, 39% reared between 101-500 quails, while only 13% reared over 500 quails with 2-3 quail varieties reared in cages separately from other poultry species (Table 5). El-Sheikh et al. (2016) found that egg production for quails raised in battery cages was higher than that for quails reared in deep litter. However, Arumugam et al. (2014) observed that the fertility level of Japanese quails was unaffected by the rearing techniques.

**Housing and management**

All respondents in the study area provided shelter to quails during the day and at night. Eighty-one percent of the respondents kept quails in cages as they indicated that quails can easily fly away, followed by 17% that used open-sided houses, and one percent used the owner's house (Table 6). Monika et al. (2018) argued that as quails are small birds, they may readily be kept in restricted spaces inside multitier colony cages. Eighty-four percent of the respondents in this study said they cleaned quail shelters weekly, followed by 14% that cleaned monthly, while 2% only cleaned the shelters when there was too much feces (Table 6). The results revealed no significant

difference ($p > 0.05$) in the type of housing and the frequency of cleaning quail shelters. The quail shelters were swept by family members using locally purchased brooms, and no disinfectants were used, indicating lack of biosecurity. Similarly, Gabanakgosi et al. (2014) reported that family chicken houses were cleaned using locally-made brooms without applying disinfectants. All the respondents mentioned that they used quail droppings to fertilize vegetable gardens. In agreement with the current results, Dikinya and Mufwanzala (2010) reported that quail manure was used to fertilize the gardens, as it is a potential source of plant nutrients and chemical conditioner.

**Nutrition and water provision**

Feeds such as crushed yellow maize and drinking water were provided mainly by family members. Quails in the current study were given portable water. The respondents also mentioned that field crops were the major sources of feed for quail. Similarly, Gabanakgosi et al. (2014) reported field crops as the major feed resources available to poultry. Akarikiya (2021) asserted that in backyard quail farming, the birds could be fed any available agro-by-products, household leftover food grains, and commercial chicken feed. Eighty-six percent of the respondents in this study used crushed maize or sorghum to feed quails, while 14% used commercial chicken diets predominantly laying chicken mash as there are no quail feeds locally. The results revealed no significant difference ($p > 0.05$) in feed type (Table 7). Sixty-three percent of the respondents provided feed and water to quail at *ad libitum*. The results showed a significant difference ($p < 0.05$) in the frequency of water and feed provision among the villages. About 28% of the respondents provided feed and water only in the morning (once a day), followed by 9% that provided feed twice a day (before going to work in the morning and upon return from work in the evening).

Fifty-five percent of the respondents stated they provided quail feed *ad libitum*, while 34% mentioned they gave limited feed for survival only, 6% of the respondents had no idea of how much feed they offered to quail daily while 5% provided kitchen wastes (bread crumbs, rice, and maize meal (Table 7). Similarly, Gabanakgosi et al. (2014) in Botswana and Akarikiya (2021) in Ghana reported that respondents provided poultry with kitchen leftovers. The results revealed a significant difference ($P < 0.05$) in the feed type used by quail farmers.

**Table 6.** Quail housing by the respondents in three selected villages of Mogoditshane-Thamaga and Tlokweng districts of Botswana from 2022 to 2023

| Respondents number (%) / Variable (n=64) | Category | Gabane | Mogoditshane | Tlokweng | Overall | $X^2$ | P-value |
|---|---|---|---|---|---|---|---|
| Type of housing | Owner's house | 1(5) | 0 | 0 | 1(2) | 2.324 | 0.676 |
| | Cage | 16(76) | 18(82) | 18(86) | 52(81) | | |
| | Conventional structure | 4(19) | 4(18) | 3(14) | 11(17) | | |
| Frequency of cleaning | Daily | 0 | 0 | 0 | 0 | 2.871 | 0.238 |
| | Weekly | 19(90) | 15(68) | 20(95) | 54(84) | | |
| | Monthly | 2(10) | 6(27) | 1(5) | 9(14) | | |
| | When droppings accumulate | 0 | 1(5) | 0 | 4(2) | | |

**Table 7.** Feed and water provision of quail by respondents in the selected villages of Botswana (2022 to 2023)

| Respondents number (%) / Variable n=64 | Category | Gabane | Mogoditshane | Tlokweng | Overall | $X^2$ | P value |
|---|---|---|---|---|---|---|---|
| Feed type | Crushed maize/sorghum | 19(90) | 19(86) | 17(81) | 55(86) | 0.793 | 0.693 |
| | Commercial feeds | 2(10) | 3(14) | 4(9) | 9(14) | | |
| | Others | 0 | 0 | 0 | 0 | | |
| Quantity | Do not know | 0 | 1(4) | 3(14) | 4(6) | 7.074 | 0.314 |
| | Just a little | 0 | 2(9) | 1(5) | 3(5) | | |
| | Just on average | 4(19) | 12(55) | 6(29) | 22(34) | | |
| | *Ad libitum* | 17(81) | 7(32) | 11(52) | 35(55) | | |
| Frequency of feeding water provision | Morning | 3(14) | 6(27) | 9(43) | 18(28) | 11.901 | 0.018 |
| | Morning and afternoon | 1(5) | 4(18) | 1(5) | 6(9) | | |
| | *Ad libitum* | 17(81) | 12(55) | 11(52) | 40(63) | | |

**Meat and eggs**

Quail eggs were used mainly for hatching, consumption, and sale (61%); hatching only (58%), consumption (53%); and hatching and sales (31%, Figure 2). Respondents who did not consume quail eggs (6%) stated that they wanted to allow their flocks to increase as consuming eggs would affect their flock sizes. Egg consumption happens when egg production is very high or in summer when low hatchability is experienced due to heat stress. The respondents also mentioned they did not consume eggs because they wanted to make a living out of the sale of quail eggs, which are claimed to have health benefits. In contrast to the current findings, Ogunwole et al. (2015) in Oyo state, Nigeria, reported that the majority of respondents (55%) suggested eating more quail eggs because they thought the eggs were a very healthy and rich source of protein.

Seventy-seven percent of the respondents mentioned that they slaughtered quail for family consumption and to honor guests (23%). This finding agrees with Moreki (2006), who reported that family chickens were usually slaughtered to honor guests. Quail meat is recommended as a low-fat meat as it contains low fat and cholesterol contents due to its thin skin and low-fat accumulation between its tissues (Faraq et al., 2021). Quails are valuable for the high nutritional content of their eggs and meat (Wen et al., 2017).

Quail eggs provide essential nutrients for maintaining human health (Jeke et al., 2018). The present results revealed that 94% of respondents consumed quail eggs and that 92% of respondents in this study agreed that quail eggs have nutritional benefits. The present results appear to support Akarikiya (2021), who reported that less than half of the survey participants stated that their primary motivation for quail breeding was to take advantage of the alleged nutritional and therapeutic benefits of quail meat and eggs.

It has been proven that quail meat and eggs contain high-quality protein of high biological importance, little fat content, and less low-density lipoprotein (Tolik et al., 2014). To supplement their diets, many of the respondents in this study acknowledged that they shared part of the quail meat and eggs with their family members and friends. Mnisi et al. (2021) posited that regular consumption of quail eggs aids in the prevention of numerous diseases and acts as a natural remedy for conditions of the digestive tract, such as stomach ulcers. According to Tunsaringkarn et al. (2013), quail eggs boost the immune system, support healthy memory, stimulate the brain, and calm the nervous system by boosting the body's hemoglobin levels and eliminating toxins and heavy metals. Quail eggs also aid in the treatment of anemia.

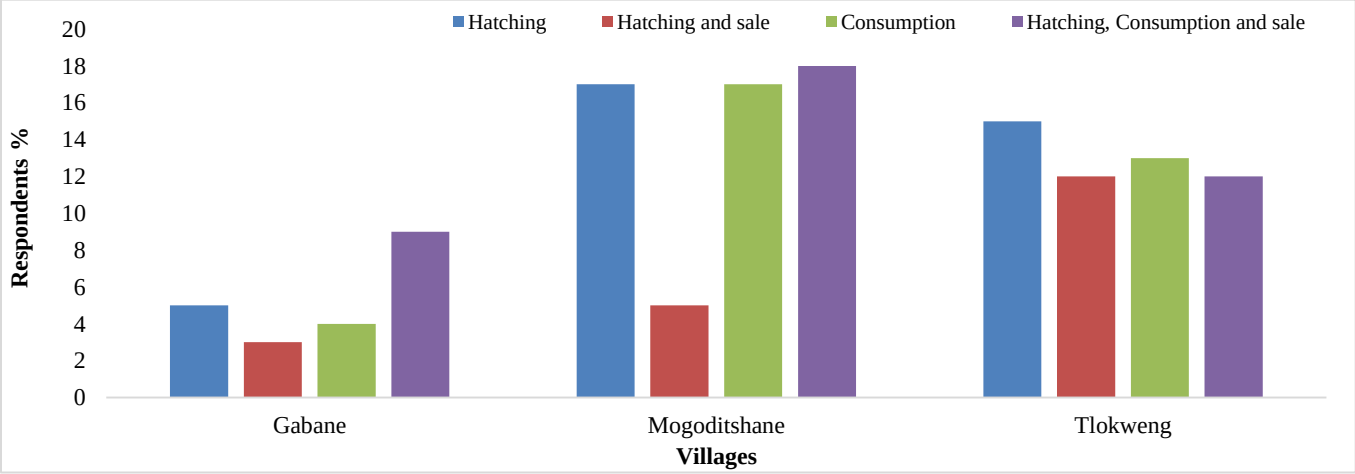


**Figure 2.** Uses of quail eggs in Mogoditshane-Thamaga and Tlokweng districts of Botswana, from 2022 to 2023

**Marketing**

Ninety-five percent of respondents mentioned that they sell quails to meet immediate family needs, while the remainder stated that they did not sell quail as they were still building their flock sizes (Table 8). Fifty-six percent of the respondents marketed quail at 28-35 days of age followed by 17% (above 35 days old), 14% (14-28 days), 10% (7-14 days), and 3% (below 7 days of age). The average price for a quail chick at 2 weeks and 5 weeks of age was P20.00 (USD 1.49) and P40.00 (USD 2.90),

respectively. Quail meat was sold at P150.00 (USD 10.90)/pack of 5 carcasses. According to Nasar et al. (2016), domestic quail grows quickly and reaches sexual maturity at 5-6 weeks of age. Modern meat-type (broiler) quail strains undergo slaughter at 5 weeks of age and weigh 160–250 g (Ophir et al., 2005; Jatoi et al., 2013). Seventy percent of respondents in the current study stated that they sell quail often, 16% rarely sold quail, whereas 14% sold quail only when the need arose to meet their immediate family needs. Ninety-seven percent of the respondents mentioned that they sell quail when they need money while only 3% sold quails to avoid overcrowding. All the respondents in Gabane village indicated that they sold quail eggs when they needed money to cover household expenses.

Seventy-five percent of the respondents mentioned that the market for quails was satisfactory as quails could be sold throughout the year, while the remainder stated it was unsatisfactory. The main buyers of quails were individuals (95%), followed by retailers (3%) and some organizations such as schools (2%). The average price of an egg was P3.00 (USD 0.23). Eggs were sold as fresh eggs and some as pickled eggs. The pickled eggs were sold at P70.00 (USD 5.09) per bottle. In addition, respondents stated eggs were sold as per customer preferences, as some wanted them cooked and others uncooked.

**Table 8.** Quail marketing in selected villages of the two districts Mogoditshane –Thamaga and Tlokweng districts of Botswana from 2022 to 2023

| Variable n=64 | Category | Respondents number (%) | | | Overall | $X^2$ | P - value |
|---|---|---|---|---|---|---|---|
| | | Gabane | Mogoditshane | Tlokweng | | | |
| Do you sell quail? | Yes | 21(100) | 20(91) | 20(95) | 61(95) | 2.133 | 0.344 |
| | No | 0 | 1(9) | 2(5) | 3(5) | | |
| Marketing age (days) | <7 | 1(5) | 1(4) | 0 | 2(3) | | |
| | 7-14 | 3(14) | 2(9) | 2(10) | 7(10) | | |
| | 14-28 | 1(5) | 4(18) | 3(14) | 8(14) | | |
| | 28-35 | 13(62) | 12(55) | 11(48) | 36(56) | | |
| | >35 | 3(14) | 3(14) | 5(24) | 11(17) | | |
| Frequency of selling quail | Rarely | 2(10) | 3(14) | 5(24) | 10(16) | 4.625 | 0.328 |
| | Often | 18(86) | 15(68) | 12(57) | 44(70) | | |
| | At times | 1(4) | 4(18) | 4(19) | 10(14) | | |
| Reason for selling | Limited housing | 0 | 1(5) | 2(10) | 2(3) | 3.256 | 0.516 |
| | Money | 21(100) | 21(95) | 19(90) | 62(97) | | |
| Quail market satisfactory | Yes | 14(67) | 19(86) | 15(71) | 39(75) | 1.600 | 0.449 |
| | No | 7(33) | 3(14) | 6(29) | 16(25) | | |
| Main buyers | Individuals | 21(100) | 21(95) | 19(90) | 61(95) | 2.087 | 0.352 |
| | Retailers | 0 | 1(5) | 1(5)0 | 2(3) | | |
| | Organisations | 0 | 0 | 1(5) | 1(2) | | |

**Challenges in quail farming**

Figure 3 illustrates that parasites were a major challenge (36%), followed by diseases (31%), predation (13%), lack of quail diets (11%), escaping (6%), and theft (3%). Parasites were the major cause of losses in Tlokweng, followed by Mogoditshane and Gabane, respectively. This could be attributable to the failure of farmers to clean and disinfect the cages. Figure 3 also shows that Tlokweng, Mogoditshane, and Gabane had the highest disease incidences, indicating a lack of health management by the rearers. Siddique and Mandal (1996) reported that high feed expense, inadequate institutional credit, lack of veterinary services and medicine, lack of training on quail husbandry, and inadequate product marketing facilities are major challenges in quail farming in Dhaka, Bangladesh.

Figure 4 shows the common diseases of quail in the study area. In order of prevalence, the three major diseases that affected the productivity of quail were sudden death, fowl pox, and bumble foot. Across the villages, predation ranked second after diseases. The respondents stated that predation occurred in the first week of age and that they suspected rodents could be responsible for killing quail chicks. In addition, the respondents claim that high chick mortalities occurred during the brooding phase due to inadequacy of heat. The study by El-Demerdash et al. (2013) found that respiratory diseases may be to blame for the high mortality rate among day-old quail chicks during the first week of age. However, this problem may be resolved after the first week with adequate management techniques.

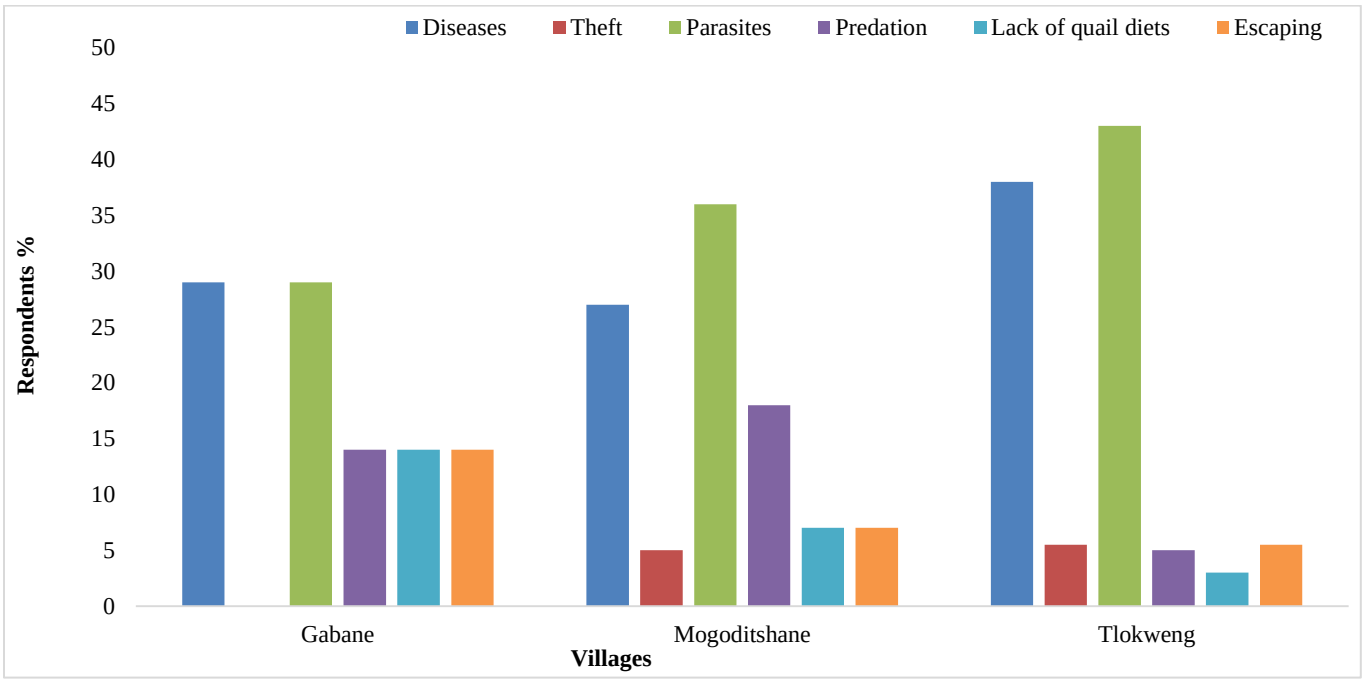


**Figure 3.** Challenges in quail production faced by respondents in the selected villages of Botswana, from 2022 to 2023

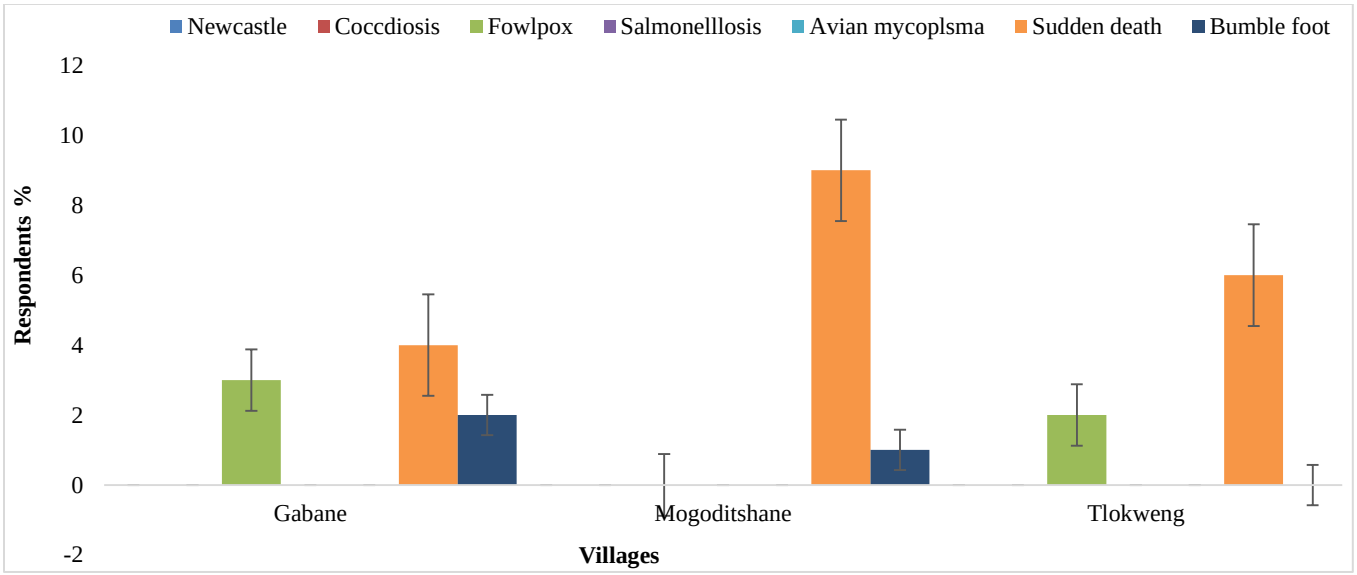


**Figure 4.** Disease prevalence in the selected villages of Botswana from 2022 to 2023.

**Table 9.** Veterinary or extension service used by respondents in three villages of Botswana from 2022 to 2023

| Variable / Respondents number (%) | Gabane | Mogoditshane | Tlokweng | Overall |
|---|---|---|---|---|
| Rarely | 5(24) | 6(27) | 5(24) | 16(25) |
| Often | 6(29) | 10(45) | 5(24) | 21(33) |
| At times | 10(47) | 6(28) | 11(52) | 27(42) |
| No access | 0 | 0 | 0 | 0 |

None of the farmers in this study recorded any diseases of economic importance. This finding is in line with Nasar et al. (2016) and Akarikiya (2021), who reported that most of the farmers did not experience any form of disease or parasite on their farms. Across the villages, sudden death (30%) was a major problem, especially during brooding, followed by fowl pox (8%), and bumble foot condition (5%, Figure 4). This study supported the claims made by Chakrabarti et al. (2014) that quails are less susceptible to most poultry diseases and parasites. Contrary to a study by Nasar et al. (2016) in Bangladesh, diarrhea (21.4%) was found to be the most common problem, followed by pneumonia (19.4%), infectious coryza (16.5%), Newcastle disease (15.5%), dysentery (5.8%), and avian influenza (4.9%). Most respondents in the present study were concerned about the inadequacy of biosecurity measures which could easily expose their flocks to diseases. Forty-two percent of the respondents received advice from animal health experts, 33% visited the veterinary office to seek help, while 25% rarely engaged veterinary technicians (Table 9). Similarly, Nasar et al. (2016) reported that 52% of the respondents received veterinary advice when needed. Forty-two percent of the respondents in this study obtained veterinary knowledge online, explaining a high percentage of the respondents engaged in self-medication for the treatment of diseases and parasites. The present results support Akarikiya (2021), who found that respondents sourced veterinary information from the Internet to medicate their quails without the assistance of trained animal health experts.

Across the villages, the respondents used modern and traditional medicines to control ectoparasites. On average, 28% of the respondents used traditional medicine alone to control diseases and parasites, 20% used modern medicine alone, whereas 52% used a combination of modern medicine and traditional medicine. The use of modern medicine was high in Mogoditshane (22%) compared to Gabane (19%) and Tlokweng (19%). Tlokweng had the highest percentage of respondents who used traditional medicine (33%), followed by Gabane and Mogoditshane, with 29% and 22%, respectively. On the other hand, Mogoditshane had the highest percentage of respondents (56%) who used modern and traditional medicines, followed by Gabane (52%) and Tlokweng (48%). Similarly, Gabanakgosi et al. (2014) reported that 65% of rearers of family poultry used modern medicines, 10% used traditional medicines, and 25% used traditional medicine and modern medicine. The high use of modern and traditional medicine is attributable to the fact that farmers are using internet solutions to poultry problems in places close to the city, such as Mogoditshane and Tlokweng. In Namibia, Petrus et al. (2011) observed that ethnoveterinary medicine was culturally acceptable and economically viable. In another study, Sadr et al. (2022) in Iran reported that a mixture of three herbal plants (*Quercus infectoria*, *Allium sativum,* and *Artemisia annua*) was useful in the reduction of the pathogenic effects of *Trichomonas* spp. The authors concluded that the mixture can be used as an alternative to chemotherapeutic drugs in trichomoniasis treatment.

**External parasites**

One of the main factors that might cause the poultry business to suffer significant economic losses is parasitism (Hassan et al., 2020). Twenty-eight percent of the respondents in the present study cited mosquitoes as a major problem, followed by fleas, mites, and fowl ticks (22%), fleas and fowl ticks (19%), mites (16%), fleas and mites (8%), and fowl ticks (7%). In another study, Ranwedzi (2002) found that mites (77%) and fleas (9.3%) were the major parasites in family chicken production in South Africa. Similarly, Moreki and Radikara (2013) found that the most problematic parasites in chickens in Botswana were tampans, mites, fowl lice, and ticks. Since family chickens and quail are kept in the backyards and usually in the same shelter, it is possible that chicken mites and lice can easily migrate to quails. As indicated earlier, mosquitoes were the most prevalent parasites in this study, perhaps explaining the high incidences of fowl pox in Gabane and Tlokweng. The study by Mazyad et al. (1999) showed that 31 species of mites were recovered from quail. Studies by Monte et al. (2018) and Yu et al. (2022) showed that quails that suffer from parasitism experience stunted growth, poor productivity, increased susceptibility to various infections, and eventually high mortalities.

Thirty-eight percent of the respondents used Karba dust (Carbaryl) and Blue death powder (Permethrin and Carbaryl), 17% Blue death powder (Permethrin and Carbaryl), 14% Jeyes fluid (Tar Acids), 13% wood ash, and 13% wood ash and Karba dust, whereas only 5% used paraffin to control external parasites (Table 10). Similarly, Ranwedzi (2002) in Port Elizabeth (South Africa) reported that respondents used wood ashes (19.4%), Jeyes fluid (0.9%), Blue death powder (0.9%), hot water (6.5%) and paraffin (6.5%) to control external parasites. Moyo (2009) in the Eastern Cape of South Africa also reported that wood ash (28%), Jeyes fluid (10%), paraffin (8.4%), used

engine oil (2.8%) and Karba dust (4.2%) were used to control ectoparasites. According to the respondents, these chemicals and remedies are cheap to buy or access, and do not need any prescription; hence their wide use.

**Table 10.** Control of external parasites of quails by respondents in the selected villages of Botswana from 2022 to 2023

| Control method | Gabane | Mogoditshane | Tlokweng | Overall |
|---|---|---|---|---|
| Wood ash | 3 | 4 | 1 | 13 |
| Karba dust and wood ash | 2 | 4 | 2 | 13 |
| Jeyes fluid | 1 | 3 | 5 | 14 |
| Blue death | 3 | 6 | 2 | 17 |
| Karba dust and blue death | 8 | 7 | 9 | 38 |
| Use of paraffin | 0 | 1 | 2 | 5 |

## CONCLUSION

Quail farming in the study area is practiced only at a small-scale level, with 55% of farmers having less than one year of experience in the business. Most of the farmers (48%) reared ≤100 quails and 39% reared between 101-500 quails. External parasites were a major challenge (36%), followed by diseases (30%), predation (13%), escaping (6%), and theft (3%). Twenty-eight percent of the respondents used traditional medicine alone to control diseases and parasites, 20% used modern medicine alone, whereas 52% used a combination of modern medicine and traditional medicine. Forty-two percent of the respondents received advice from animal health experts, indicating that technical support for quail rearers was lacking. Quail farming has the potential to contribute to job creation and additional revenue. It is recommended that quail farmers establish active farmers' associations to enable them to support one another in marketing, advertising, and raising awareness of their products. The Government should consider incorporating quail production in support programs such as Livestock Management and Infrastructure Development since quails are highly prolific and can contribute to food and nutrition security.

## DECLARATIONS

### Acknowledgments

The authors would like to thank farmers from Mogoditshane-Thamaga and Tlokweng districts for sharing their experiences in quail farming.

### Funding

This study is not financially supported by any organization.

### Authors' contribution

Shame Bhawa conducted the survey, analyzed data, and wrote the manuscript. John C. Moreki conceptualized the study, and reviewed and edited the manuscript. Freddy Manyeula reviewed and edited the manuscript. All authors have reviewed and agreed with the final version of the manuscript for publishing in the Journal of World's Poultry Research.

### Competing interests

The authors declare no conflicting interests.

### Ethical consideration

Each author has reviewed this work for ethical problems, such as plagiarism, consent for publication, misconduct, data manipulation and/or deceit, and duplication of work.

### Availability of data and materials

Data will be available upon request to the corresponding author.

## REFERENCES

Akarikiya SA (2021). Quail production systems, prospects and constraints in Ghana: BSc. Agriculture Technology Thesis. University for Development Studies, Ghana. Available at: https://www.udsspace.uds.edu.gh

Ali MA and Abd El-Aziz AA (2019). Comparative study on nutritional value of quail and chicken eggs. Journal of Research Field and Specific Education, 15(14): 39-56. DOI: http://www.doi.org/10.21608/jedu.2019.73533

Aliyu MK (2016). Adoption of recommended management practices for quail production in Gwale and Kano Municipal Local Government areas of Kano State, Nigeria. Master of Science Thesis. Ahmadu Bello University Zaria, Kaduna State Nigeria.

Arthur J and Bejaei M (2017). Quail Eggs. In: P. Y. Hester (Editor), Egg innovations and strategies for improvements. Academic Press., London, UK, pp. 13-21. DOI: http://www.doi/10.1016/B978-0-12-800879-9.00002-0

Arumugam R, Prabakaran R, and Silvakumar T (2014). Hatching performance of pure-bred Japanese quail breeders under cage and deep litter systems of rearing. Journal of Global Biosciences, 3(7): 1105-1110. Available at: https://www.mutagens.co.in/jgb/vol.03/7/18.pdf

Bakoji I, Aliyu MK, Haruna U, Jibril SA, Sani R M, and Danwanka H (2013). Economic analysis of quail's bird (*Cortunix cortunix*)

production in Bauchi local government area, Bauchi state, Nigeria. Research Journal of Agriculture and Environmental Management, 2(12): 420-425. Available at: B2n.ir/d86464

Berterchini AG (2012). The quail production. XXIV World's Poultry Congress. Poultry Welfare and Environment. Salvador, Bahia, Brazil. pp. 1-4. Available at: http://www.facta.org.br/wpc2012-cd/pdfs/plenary/Antonio_Gilberto_Bertechini_.pdf

Chakrabarti A, Kumar P, Dayal S, Gupta JJ, Dey A, Kumari R, and Barari SK (2014). Backyard quail farming- A new venture for rural farmers. Available at: https://www.researchgate.net/publication/264567163

Costăchescu DFI, Boiteanu PC, Costăchescu E, and Hoha GV (2018). Physico-chemical and sensory characteristics of quail meat, meat line. Lucrări Ştiinţifice. Seria Zootehnie, 70(23): 144-149. Available at: https://www.uaiasi.ro/firaa/Pdf/Pdf_Vol_70/D_Costachescu1.pdf

Dikinya O and Mufwanzala N (2010). Chicken manure enhanced soil fertility and productivity: Effects of application rates. Journal of Science and Environmental Management, 1(3): 46-54. Available at: https://academicjournals.org/article/article1380013842_Dikinya%20and%20Mufwanzala.pdf

Egbeyale LT, Fatoki HO, and Adeyemi OA (2013). Effect of egg weight and oviposition time on hatchability and post hatch performance of Japanese quail (*Coturnix coturnix japonica*). Nigerian Journal of Animal Production, 40(1): 102-110. DOI: https://www.doi.org/10.51791/njap.v40i1.652

Ekpo KJ, Oke OE, Osseyi GE, Dossou J, and Chrysostome CAAM (2020). Characterization of quail (*Coturnix japonica*) production in Benin Republic. International Journal of Poultry Science, 19(11): 531-538. DOI: https://www.doi.org/10.3923/ijps.2020.531.538

El-Demerdash MZ, Hanan MFA, and Asmaa EA (2013). Studies on mortalities in baby quail chicks. Proceedings of the 6th Scientific Conference of Animal Wealth Research in the Middle East and North Africa, Hurghada, Egypt, pp. 63-7. Available at: https://www.cabdirect.org/cabdirect/abstract/20133391338

El-Sheikh TM, Essa NM, Abdel-Kareem AAA, and Elsagheer MA (2016). Evaluation of productive and reproductive performance of Japanese quails in floor pens and conventional cages with different stocking densities. Egyptian Poultry Science Journal, 36(3): 669-683. DOI: https://www.doi.org/10.21608/epsj.2016.168800

Faraq MM, Abd-El-Aziz NA, and Ali AA (2021). Preparing and evaluation of new products from quail meat. Food and Nutrition Sciences, 12(9): 889-898. DOI: https://www.doi.org/10.4236/fns.2021.129066

Gabanakgosi K, Moreki JC, Tsopito CM, and Nsoso SJ (2013). Impact of family chickens on the livelihoods of people living with HIV and AIDS in four villages of Botswana. Journal of World's Poultry Research, 3(2): 43-53. Available at: https://www.jwpr.science-line.com/attachments/article/18/J.%20World's%20Poult.%20Res.%203(2)%2043-53,%202013.pdf

Genchev A (2012). Quality and composition of Japanese quail eggs (*Coturnix japonica*). Trakia Journal of Sciences, 10(2): 91-101. Available at: http://tru.uni-sz.bg/tsj/Vol10N2_%202012/At.Gen4ev.pdf

Hassan KA, Naeem VE, and Soliman MA (2020). Investigation the prevalence of common parasitic infections in farmed quails in Upper Egypt. SVU- International Journal of Veterinary Sciences, 3(2): 38-50. DOI: https://www.doi.org/10.21608/svu.2020.31915.1058

Illgner P and Nel E (2000). The geography of edible insects in sub-Saharan Africa: A study of the mophane caterpillar. Geography Journal, 166: 336-351. DOI: https://www.doi/org/10.1111/j.1475-4959. 2000.tb000 35.x

Jatoi AS, Sahota AW, Akram A, Javed K, Hussain J, Mehmood S, and Jaspal MH (2013). Hatching traits as influenced by different body weight categories in four close-bred flocks of Japanese quails (*Coturnix coturnix japonica*). Pakistan Journal of Zoology, 45(5): 1215-1220. Available at: https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=6c3c0ee1534cc7bee900b328f4675d158380a3bc

Jeke A, Phiri C, Chitindingu K, and Taru P (2018). Nutritional compositions of Japanese quail (*Coturnix coturnix japonica*) breed lines raised on a basal poultry ration under farm conditions in Ruwa, Zimbabwe. Cogent Food & Agriculture, 4(1): 1473009. DOI: https://www.doi.org/10.1080/23311932.2018.1473009

Katerynych O and Pankova S (2020). Development of quail growing in Ukraine. UDC, 636. 5(1): 1-6. DOI: https://www.doi.org/10.31073/agrovisnyk202004-06

Khaleel AG, Shuaibu IM, Nasir M, Abdullahi AY, Zango MH, Madaki S, Ibrahim U, Tamburawa MS, Ashiru RM, and Kamarudin AS (2021). Growth performance and carcass merit of Japanese quails (*coturnix japonica*) fed with sorghum as an energy source substitute for maize in North Western Nigeria. Journal of Agrobiotechnology, 12(1): 23-30. DOI: http://www.doi.org/10.37231/jab.2021.12.1.220

Majoni C, Tembachako D, and Katanha A (2018). Appraising the viability of quail (chihuta) farming. Prospects and challenges. A case of Bindura urban farmers in Zimbabwe. Journal of Agribusiness and Rural Development, 47(1): 49-55. DOI: http://www.doi.org/10.17306/J.JARD.2018.00338

Mazyad SA, Morsy TA, Fekry AA, and Farrag AM (1999). Mites infesting two migratory birds, *Coturnix c. coturnix* (quail or Simmaan) and *Sturnus v. vulgaris* (starling or zarzuur) with reference to avian zoonosis. Journal of Egyptian Society of Parasitology, 29(3): 745-761. Available at: https://pubmed.ncbi.nlm.nih.gov/12561915/

Ministry of Local Government and Rural Development (2023). Adminstrative districts of Botswana. Gaborone, Botswana.

Minvielle F (2009). What are quail good for in a chicken-focused world? World's Poultry Science Journal, 65(4): 601-608. DOI: http://www.doi/10.1017/S0043933909000415

Mnisi CM, Marareni M, Manyeula F, and Madibana MJ (2021). A way forward for the South African quail sector as a potential contributor to food and nutrition security following the aftermath of COVID-19: A Review. Agriculture and Food Security, 10: 48. DOI: https://www.doi.org/10.1186/s40066-021-00331-8

Mnisi CM, Mlambo V, Kumanda C, and Crafford A (2021). Effect of graded levels of red grape pomace (*Vitis vinifera* L.) powder on physiological and meat quality responses of Japanese quail. Acta Agriculturae Scandinavica. Section A – Animal Science, 70(2): 100-106. DOI: https://www.doi.org/10.1080/09064702.2021.1923796

Mondry R (2016). Quail farming in tropical regions, pp. 5-29. Available at: https://publications.cta.int/media/publications/downloads/1934_PDF.pdf

Monika M, Rokade JJ, Gopi M, Dinesh M, Gireesh SS, and Jose J (2018). Japanese quail: Status, Production and Management. A Magazine of Agriculture and Allied Sciences, 1(5): 13-18.

Monte GLS, Cavalcante DG, and Oliveira JBS (2018). Parasitic profiling of Japanese quails (*Coturnix japonica*) on two farms with conventional production system in the Amazon region. Pesquisa Veterinária Brasileira, 38(5): 847-851. DOI: https://www.doi.org/10.1590/1678-5150-PVB-5274

Moreki JC and Radikara MV (2013). Challenges to commercialisation of guinea fowl in Africa. International Journal of Science and Research, 2(11): 436-440. Available at: https://www.ijsr.net/archive/v2i11/MDIwMTM1MjY=.pdf

Moreki JC (2006). Family poultry production, Poultry today. Ministry of Agriculture, Gaborone, Botswana, pp. 1-11.

Moyo S (2009). Alternative practices used by resource-limited farmers to control fleas in free-range chickens in the Eastern Cape province, South Africa. Master Thesis, University of Fort Hare, Alice Campus, South Africa.

Muhammad-Lawal A, Amolegbe KB, and Abdulsalam OA (2017). Economics of quail production in Ilorin, Kwara State, Nigeria.

Journal of Agricultural Extension, 21(2): 44-53. DOI: https://www.doi.org/10.4314/jae.v21i2.4

Muthoni CL (2014). Factors influencing quail farming in Nyeri Central Constituency, Nyeri County, Kenya. Research of Master degree, University of Nairobi, Kenya.

Nasaka J, Nizeyi JB, Okello S, and Katongole CB (2017). Characterisation of feeding management practices of quail in urban areas of Uganda. Tropical Agriculture, 99(2): 166-176. DOI: https://journals.sta.uwi.edu/ojs/index.php/ta/article/view/7786

Nasar A, Rahman A, Hoque N, Kumar Talukder A, and Das ZC (2016). A survey of Japanese quail (*Coturnix coturnix japonica*) farming in selected areas of Bangladesh. Veterinary World, 9(9): 940-947. DOI: https://www.doi.org/10.14202/vetworld.2016.940-947

Nepomuceno RC, Watanabe PH, Freitas ER, Cruz CEB, Peixoto MSM, and Sousa ML de (2014). Quality of quail eggs at different times of storage. Ciência Animal Brasileira, 15(4): 409-413. DOI: http://www.doi/10.1590/1089-6891v15i424107

Odunsi AA, Rotimi AA, and Amao EA (2007). Effect of different vegetable protein sources on growth and laying performance of Japanese quails (*Coturnix coturnix japonica*) in a derived savannah zone of Nigeria. World Applied Sciences Journal, 3(5): 567-571. Available at: http://www.idosi.org/wjas/wjas3%285%29/2.pdf

Ogunwole OA, Agboola AF, Mapayi TG, and Babayemi OJ (2015). Consumers' perception and preference for Japanese quail and the commercial chicken eggs in Akinyele local government area of Oyo State, Nigeria. Tropical Animal Production Investigation. 18(2): 108-119. Available at: https://tapianimalsci.ui.edu.ng/index.php/journal/article/view/93

Ojo V, Fayeye TR, Ayorinde KL, and Olojede H (2014). Relationship between body weight and linear body measurements in Japanese quail (*Coturnix coturnix japonica*). Journal of Scientific Research, 6(1): 175-183. DOI: http://www.doi.org/10.3329/jsr.v6i1.16368

Okusaga A H (2013). Economic analysis of quail production among small holder farmers in Kaduna Metropolis – Kaduna state, Nigeria. MSc. Thesis, Ahmadu Bello University, Zaria, Nigeria.

Ophir AG, Persaud KN, and Galef BG Jr (2005). Avoidance of relatively aggressive male Japanese quail (*Coturnix coturnix japonica*) by sexually experienced conspecific females. Journal of Comparative Psychology, 119(1): 3-7. DOI: https://psycnet.apa.org/doi/10.1037/0735-7036.119.1.3

Petrus NP, Mpofu I, and Lutaaya E (2011). The care and management of indigenous chicken in Northern communal areas of Namibia. Livestock Research for Rural Development, 23(12): 253. Available at: https://www.lrrd.org/lrrd23/12petr23253.htm

Priti M and Satish S (2014). Quail farming: An introduction. International Journal of Life Sciences, 2(2): 190-193. Available at: https://oaji.net/articles/2014/736-1404212860.pdf

Ranwedzi NE (2002). An evaluation of family poultry production systems in the Northern region. Thesis. Department of Agricultural Management, Technikon Port Elizabeth, George Campus, South Africa.

Sadr S, Ghafouri SA, Ghaniei A, Jami Moharreri D, Zeinali M, Qaemifar N, Poorjafari Jafroodi P, Hajiannezhad Z, and Atazade AH (2022). Treatment of Avian Trichomoniasis by Tannin-based Herbal mixture *(Artemisia Annua*, *Quercus infectoria*, and *Allium Sativum)*. Journal of World's Poultry Science, 1(2): 32-39. https://www.doi.org/10.58803/JWPS.2022.1.2.01

Santhi D and Kalaikannan A (2017). Japanese quail (*Coturnix coturnix japonica*) meat: Characteristics and value addition. World's Poultry Science Journal, 73(2): 337-344. DOI: http://www.doi/10.1017/S004393391700006X

Sathiya R, Pazhanisamy C, and Banumathy V (2017). Economics of quail farming: A case study. Research Journal of Animal Husbandry and Dairy Science, 8(1): 74-78. Available at: https://www.ipindexing.com/journal-article-file/10124/Economicsofquailfarming

Setlalekgomo MR (2012). Limitations to Tswana chicken farming among women in Lentsweletau village in Kweneng District, Botswana. Journal of Animal Production Advances, 2(11): 473-476. Available at: https://journals.indexcopernicus.com/search/article?articleId=904516

Siddique SA and Mandal MAS (1996). Economics of Japanese quail farming in Dhaka Metropolitan city. The Bangladesh Journal of Agricultural Economics, 19(1-2): 71-84 DOI: http://www.doi.org/10.22004/ag.econ.202550

Simainga S, Moreki JC, Banda F, and Sakuya N (2011). Socio-economic study of family poultry in Mongu and Kalabo Districts of Zambia. Livestock Research for Rural Development, 23(2): 31. Available at: http://www.lrrd.org/lrrd23/2/sima23031.htm

Statistics Botswana (2022). Population and Housing Census 2022. Population of cities, towns, and villages. Version 2. pp. 13-15. Available at: https://www.statsbots.org.bw/sites/default/files/publications/Population%20of%20Cities%20Towns%20and%20Villages%20%202022.pdf

Tolik D, Polawska E, Charuta A, Nowaczewski S, and Cooper R (2014). Characteristics of egg parts, chemical composition and nutritive value of Japanese quail egg - A review. Folia Biologica, 62(4): 287-292. DOI: https://www.doi.org/10.3409/fb62_4.287

Tunsaringkarn T, Wanna Tungjaroenchai W, and Siriwong W (2013). Nutrient benefits of quail (*Coturnix coturnix japonica*) eggs. International Journal of Scientific and Research Publications, 3(5): 1-8. Available at: https://www.ijsrp.org/research-paper-0513.php?rp=P171147

Umera AE, Ejezie FE, Ibegbu MD, Ikekpeazu JE, Onyekwelu KC, and Ejezie CS (2018). Effects of quail (*Coturnix japonica*) egg diet on both the blood sugar and the lipid profile of alloxan induced diabetic albino rats. Biomedical Research, 29(19): 3599-3604. DOI: http://www.doi.org/10.4066/biomedicalresearch.29-18-989

Wen ZG, Du YK, Xie M, Li XM, Wang JD, and Yang PL (2017). Effects of low-protein diets on growth performance and carcass yields of growing French meat quails (France *Coturnix Coturnix*). Poultry Science, 96(5): 1364-1369. DOI: https://www.doi.org/10.3382/ps/pew321

Yu H, Wang P, Wang C, Wang B, He J, Sun W, and Pan B (2022). A new method using quail (*Coturnix coturnix*) as a suitable host for laboratory rearing of *Dermanyssus gallinae*. Experimental Parasitology, 243: 108422. DOI: https://www.doi.org/10.1016/j.exppara.2022.108422