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Technical-Economic Diagnosis and Development Prospects of Quail Farming in Burkina Faso

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ABSTRACT: *Poultry farming is a livestock sector that encompasses various bird species, with the most well-known in Burkina Faso being chickens and guinea fowl. These two species receive support from development programs as they significantly contribute to the livelihoods of poor populations. Quails have been recently introduced, presenting technical and economic advantages that could contribute to the development of livestock farming. The study aimed to characterize the profile of stakeholders, conduct a techno-economic diagnosis, and suggest development prospects. Thirty-three farming units were surveyed in the cities of Bobo Dioulasso, Ouagadougou, and Orodara. The socio-demographic aspects of quail farmers, zootechnical aspects of quails, and challenges faced were analyzed.On the socio-economic level, the activity is predominantly practiced by young, educated men, exclusively with secondary and higher education. Zootechnically, the animal productions consist of eggs and meat. Quail production goals prioritize egg production, quail chicks (97%), fattening (76%), and breeder farming (48%).The feeding practices are inadequate, as all farmers (100%) were providing quails with feed intended for laying hens or broilers. Breeding quails reach sexual maturity at 6 weeks, with an average of 250 eggs laid per female and a high hatching rate. Quails also exhibit a high level of hardiness, easily adapting to their environment, and a high level of adaptation to climatic factors (85% of farmers).Quail housing exclusively consists of battery cages. Economically, live quail prices range from 1,500 to 3,000 Fcfa for breeders and consumption quails, and from 2,500 to 4,000 Fcfa for a tray of thirty eggs. Income levels varied from 184,470 to 28,642,945 Fcfa from quail sales. The revealed constraints primarily involve marketing, followed by the issue of inadequate feeding.*

KEYWORDS: Japanese quail, zootechnical performance, Burkina Faso, constraints, profitability.

INTRODUCTION

Livestock farming plays a crucial role in improving the livelihoods of both rural and urban populations in Burkina Faso through local consumption and income generation from sales (Pousga, 2009; Alders, 2005). It serves as the primary source of monetary income for poor households (MRA, 2011). Poultry farming is widely practiced by women and youth in both rural and urban settings, offering various social, financial, and technical advantages for small-scale producers, including low investment levels (Akarikiya, 2021).

Poultry farming encompasses various bird species, collectively referred to as poultry, with chickens and guinea fowl being the most well-known and raised in Burkina Faso. However, other bird species, recently introduced, are evolving and presenting significant potential, particularly the Japanese quail, Coturnix coturnix japonica. Quail farming, considered unconventional animal husbandry in Burkina Faso, offers enormous advantages due to its unique characteristics. Globally, quails are raised for their egg production and/or meat. Quail eggs, in particular, have recognized therapeutic importance, and quail meat is low in calories, containing 160 calories per 100 grams. Medically, quail eggs are used for treating asthma and other diseases (Orhan et al. 2003; Tolik et al. 2014). Quail eggs are rich in polyunsaturated fatty acids, some of which are not produced in significant quantities in humans due to low metabolic efficiency. Quail eggs are cholesterol-free or low in cholesterol, making them some dietary food rich in vitamins.

Moreover, quails exhibit remarkable zootechnical performances, characterized by rapid growth, strong resistance to avian diseases, and efficient feeding (Ali et al. 2012). They also have minimal space requirements for production, allowing for large-scale, cage-based farming within human living environments. The reproductive cycle is short, reaching sexual maturity at six weeks (Mnisi and Mlambo, 2019 ; Mahlake et al. 2021). Ecologically, quails are known for their adaptability. Socioreligiously, there appears to be no constraints on quail farming and consumption, with no scientific or informal sources addressing such issues. According to the United Nations, this farming practice can contribute to achieving sustainable development goals (Marareni and Mnisi, 2020). Despite these numerous advantages, quail farming remains at a primitive stage in Burkina Faso. The actors involved in this farming practice are poorly known, and information regarding its technical and economic aspects is extremely limited. This lack of information hinders an accurate assessment of the industry's performance and its potential to create jobs and income for households in peri-urban areas.

The constraints of these types of bird farming are not well understood, impeding the ability to propose tailored solutions. Quail farming is not integrated into the framework of promising animal sectors in Burkina Faso and has not yet been documented by the technical services responsible for livestock management.

The overall objective of this study is to address the knowledge gap in quail farming in Burkina Faso by conducting a diagnostic. Specifically, the study aims to: i) describe the profile of stakeholders interested in this bird species; ii) determine the conditions of quail farming practice among promoters; iii) and specify certain techno-economic indicators of its profitability animal sectors in Burkina Faso and has not yet been documented by the technical services responsible for livestock management.

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MATERIALS AND METHODS

Study area

The study was conducted in the cities of Bobo-Dioulasso, Orodara, and Ouagadougou, all located in the Sudanian climatic zone of Burkina Faso. Ouagadougou is situated in the North-Sudanian zone with an average rainfall of 740 mm of water. The mean temperature is 28.7°C, with an average relative humidity of 48.9% (Kaboré et al. 2017). On the other hand, Bobo-Dioulasso and Orodara are located in the South-Sudanian zone, with average rainfall ranging between 900 and 1,200 mm per year, mean temperatures of 27.4°C, and a relative humidity of 53.8%. The climate is characterized by two main seasons, averaging 7 months for the dry season and 5 months for the rainy season (Kaboré et al. 2017). These climatic conditions are ideal for quail farming. The performance of quail farming is closely correlated with living conditions, with significant temperature fluctuations being detrimental. Additionally, a specified duration of illumination is necessary to maintain reproductive efficiency.

In addition to favorable climatic conditions for livestock activities, these three cities present significant economic and social opportunities. Ouagadougou and Bobo-Dioulasso represent the political and economic capitals of the country, respectively. They exhibit remarkable urbanization and demographics, providing an opportunity to enhance the demand for animal products, especially poultry, with an average daily consumption of 80,000 and 50,000 heads, respectively, for these two major cities (Sidwaya, 2021). Urban and peri-urban livestock farming aligns with an economic development strategy, creating employment opportunities and reducing marketing constraints through proximity to major consumption centers (Kiendrebeogo et al. 2024).

Sampling of studied farms

The survey exclusively targeted quail farmers, utilizing a non-probabilistic snowball sampling approach. This method involves identifying quail farmers who, in turn, refer others. Currently, there is no comprehensive list or directory of all quail farming units nationwide. The initial quail farmers encountered on the field served to identify others.

This sampling method is employed in specific cases, such as the scarcity of individuals in a target population. It is widely used in opinion surveys and offers the advantage of being rapid, cost-effective, and easy to administer, as it does not require a complete sampling frame (Salganik and Heckathorn, 2004 ; Kindo, 2017).

Data collection, processing, and statistical analysis

The chosen sampling approach identified and surveyed thirty-three (33) quail farming units in the three cities of the country (Bobo-Dioulasso, Ouagadougou, and Orodara).
A survey questionnaire was utilized, structured around seven (07) sections: farm identification, structural characteristics of quail farms, feeding and reproduction characteristics, quail housing, health and prophylaxis considerations, and aspects related to the commercialization of these farms' products. The survey phase took place from April to May 2023.
The questionnaire was designed using the KoBo Toolbox software, facilitating rapid data collection and reducing time associated with data processing and analysis. Excel spreadsheet software was employed for data processing, database creation, and descriptive statistical analyses.

RESULTS AND DISCUSSION

Socio-economic and demographic characteristics of the survey respondents

The socio-economic and demographic characteristics of the respondents are described in Table 1. The majority of quail farmers are men (97%), with a high level of education. Most have received higher education (85%), while 15% have completed secondary education.

A similar trend is observed in Nigeria, where 67% are men, and over 80% have a higher level of education (Adelomo and Owoeye, 2017), as well as in Benin, with 93.3% men and 81.8% having a higher level of education (Ekpo et al. 2020). However, in sub-Saharan Africa, it has become almost customary to recognize the central role of women without formal education in traditional poultry farming (SB et al. 2013; Agbédé et al. 1995). This contradictory trend could be explained by the recent introduction and exploitation of the species in these countries, driven by the profitability that attracts men.

In contrast, in Cameroon, there seems to be gender parity in quail farming, with men representing only 56% (Katchouang et al. 2015). Regarding the age of quail farmers, the results show that quail farming is mainly conducted by relatively young individuals aged 20 to 49. This pattern is also reported in Nigeria (70% under 46 years old; Adelomo and Owoeye, 2017), in Benin (average age of 40 years; Ekpo et al. 2020), while in Cameroon, older individuals aged 45 and above are more represented (Katchouang et al. 2015). They predominantly belong to social groups such as Mossi, Bobo, and Bwaba, accounting for 61%, 12%, and 6%, respectively. The remaining 21% consist of Dioula, Siamou, Sénoufo, Peuhl, Gourounsi, Gourmantché, and Bissa groups.

Marital status of quail farmers is primarily married men (55%) and unmarried (45%). Unmarried individuals generally take care of one person, unlike married individuals who support an average of 6 people (ranging from 3 to 7 people). These results indicate that marital status has little influence on the nature of the actors promoting quail farming. Quail farming appeals to both unmarried and married individuals. However, in Benin, the activity is predominantly carried out by married individuals (73.3%), as well as in Nigeria (68.8%; Adelomo and Owoeye, 2017) and Cameroon (94%; Katchouang et al. 2015). The diverse marital status could suggest the profitability level of this type of farming, especially since it is conducted in urban areas, where urban farming is either for leisure or to meet the high demand associated with urbanization and population growth (Cesaro and Apollini, 2020) in African regions.

As for their profession, the results display three profiles. The majority are farmers (52% of respondents practice conventional species farming in general, with full-time quail farmers representing 6% of the total sample), followed by employees (39%) and traders (9%). In Cameroon, however, employees were more numerous, representing 56%, followed by farmers of other poultry species (30%; Katchouang et al. 2015). Nevertheless, our results are similar to those of Adelomo and Owoeye (2017) in Nigeria, indicating that only 11.2% were full-time quail farmers. This behavior is understandable, given that the activity seems to attract a growing number of actors.

Quail farming is a relatively recent activity in the country's animal production environment. Indeed, the majority of quail farmers (58%) have brief experience of less than or equal to 3 years, those with experience between 4 and 9 years (39%), and the most experienced with 10 years of experience constitute only 3% of the study population. Quail farmers predominantly (78% of respondents) have low experience levels ranging from 0.5 to 5 years in Burkina Faso. According to respondents, this low level is explained by a high abandonment rate among quail farmers, linked to difficulty in marketing and low appreciation of the prices of quails and their products set by the market. There is a perpetual turnover of actors in this field over the years. In Nigeria, a significant proportion of quail farmers (97.5%) had fragile experience of less than 5 years (Adelomo and Owoeye 2017). In Cameroon, 52% of respondents had experience of just 5 years (Katchouang et al. 2015).

Those involved in quail farming primarily express economic motivation (79%), meaning they engage in the activity with the goal of selling products, gaining profitability, and improving income levels. This is followed by motivations related to food and nutritional security and leisure (21%). Quail eggs and meat are sometimes withheld from sale and made available to the family for self-consumption. The same farmer may exhibit all forms of motivation leading to the establishment of their activity. Similar motivational sources are reported among quail farmers in Cameroon, particularly concerning income improvement (40% of respondents) and those related to food, nutritional, and dietary security (44% of respondents; Katchouang et al. 2015).

In terms of required qualifications, very few farmers (12%) have enhanced their capacity or undergone learning processes preparing them for proper management and success in this activity. Regarding the acquisition of technical knowledge and methods of quail farming, promoters of quail farms have done little preparation before engaging in this activity. Only 12% received training that could benefit the effective management of their activity. Although this rate is higher in Cameroon (40%), it is still lower than the average for farms starting this activity (Katchouang et al. 2015). The participation of some actors in training could explain the observed practices of quail feed production on some farms (9% of farms; Table 3). This low enthusiasm for initial training could also be explained by the level of education of quail farmers, which gives them an advantage in self-training. The livestock training structures identified are VADAE élevage, Volaille nature, Faso élevage, Amira Élevage. are VADAE élevage, Volaille nature, Faso élevage and Amira Élevage.

Table 1. Socio-demographic situation of surveyed quail farmers

Parameters	Modalities	Number of respondents	Percentage of total
City	Bobo	12	36%
	Orodara	3	9%
	Ouaga	18	55%
Age	Twenties (20-29 years)	13	39%
	Thirties (30 -39 years)	12	36%
	Forties (40 -49 years)	8	24%
Gender	Male	32	97%
	Female	1	3%
Education level	Secondary	5	15%
	Superior	28	85%
Religion	Catholic	4	12%
	Protestant	9	27%
	Muslim	20	61%
Ethnic group	Bwaba	2	6%
	Bobo	4	12%
	Mossi	20	61%
	Others	7	21%
Marital status	Single	15	45%
	Married	18	55%
Number of dependents in the household	0 person	14	42%
	1 person	1	3%
	2 people	1	3%
	3 people	1	3%
	4 people	6	18%
	5 people	5	15%
	6 people	5	15%
Main occupation	Employees	13	39%
	Breeders	17	52%
	Retailers	3	9%
Experience	0,5	1	3%
	1	6	18%
	2	4	12%
	3	8	24%

Parameters	Modalities	Number of respondents	Percentage of total
	4	3	9%
	5	4	12%
	6	1	3%
	7	2	6%
	8	3	9%
	10	1	3%
Motivation	Economical	26	79%
	Leisure and food safety	7	21%
Training	Yes	4	12%
	No	29	88%

Some structural characteristics of quail farming.

The size of quail flocks held by quail farmers varied from less than 100 to nearly 5,000 subjects, with an average of 968 ± 1,454 subjects (table 2). Farmers with a flock size of less than 100 subjects represent 45% of the surveyed farmers. The most represented category in the flock is that of breeders, accounting for 46% of the total population. Other domestic animal species are also raised by these farming units, such as cattle (9%), sheep (9%), goats (6%), rabbits (6%), and poultry (chicken, guinea fowl, duck, turkey, ranging from 12 to 91%).

There is also an interest shown by 12% of quail farmers in agricultural activities, particularly the cultivation of maize, millet, sorghum, and peanuts. These quail farmers operate agricultural areas ranging from 1 to 10 hectares.

Table 2. Structural characteristics of quail farms

Parameters	Modalities	Number of respondents	Percentage of total
Quail size	Less than 100	15	45%
	100 - 500	5	15%
	500 - 1,000	4	12%
	1,000 - 3,000	5	15%
	Over 3,000	4	12%
	Total number	31, 944	-
	Male breeding stock size	4, 404	-
	Female breeding stock size	10, 420	-
Other livestock	Cattle	3	9%
	Ovine	3	9%
	Goat	2	6%
	Rabbit	2	6%
	Chicken	30	91%
	Guinea fowl	8	24%
	Duck	10	30%
	Turkey	17	52%
	Other	4	12%
Farming practices	Yes	4	12%
	No	29	88%
Cultivated area	1 ha	1	3%
	3ha	2	6%
	10 ha	1	3%

Status of quail farming alimentation

Table 3 presents some feeding practices in quail farms in the study area. Feeding practices were characterized by a substantial supply of compound feeds to quails in the majority (97%) of farms. Ration formulation is indeed common in intensive poultry farming and aims to meet the nutritional needs of animals, allowing for the efficient utilization of production factors (housing, feed, health, labor, etc.).

Farmers source their feed from the market through formal private enterprises like VADAE élevage, Volaille nature, Faso élevage, Amira Élevage. All farmers (100%) unanimously declared that the compound feeds obtained from the market in private establishments selling zootechnical inputs are not formulated to meet the specific needs of quails but rather correspond to the physiological needs of chicken species (broilers, layers, etc.). Despite the fact that quails are recognized as animals with very rapid growth rates, surpassing those of other poultry species, their nitrogen needs during the growth period are significantly higher than those of domestic poultry species, as are their needs for energy, vitamins, and minerals. Despite the existence of dietary recommendations for quails in the literature, feed establishments in West Africa do not seem to show interest for several reasons: the level of development of the poultry industry may justify such interest, and the profitability of quail farming allowing them to spend additional amounts to acquire these inputs, considering the complaints already recorded regarding the cost of feed. However, a balanced diet could well offset these costs in terms of growth rate and the shortening of the production cycle (animals sent for slaughter earlier).

In Benin, efforts are underway to propose a dietary regimen tailored to the specific needs of quails (Dahouda et al. 2013). This could help alleviate the feed constraints experienced by quail farmers. The uniqueness of the development project accompanying such an initiative is to mobilize local feed resources to propose a diet that would be both biologically effective and economically profitable. The feed ingredients used for these feeding tests are protein-rich ingredients (soybean meal, fish meal), and Moringa oleifera leaf powder. Similar initiatives are also observed in other regions of Africa; in South Africa, sorghum, millet, and cassava have been subjected to feeding tests. In Ghana, there is a feed company, "Akropong Feeds and Stationary Limited in Kumasi," which offers feeds specific to the nutritional needs of quails (Akarikiya, 2021).

Only 9% of farmers formulate the feed ration for their flock of birds themselves in order to reduce production costs. The ration formulated on the production unit generally uses ingredients such as corn bran, crushed corn, fish meal, limestone, ground baobab leaves, and table salt. Some farmers (3% of respondents) provide simple feeds to their birds, such as corn bran. The study by Katchouang et al. 2015, showed that in Cameroon, 14% of farmers make efforts in the self-production of feed rations. The ingredients used in our study to compose the quail ration are similar to those used for domestic poultry, and in some cases, they are feeds prepared and adapted to the nutritional needs of domestic

poultry species. In West Africa, very few feeding tests have been carried out on quails to propose local and cost-effective ingredients.

The frequency of feed distribution to quails in production varies from once to three times a day, or even ad libitum in rare cases. The most common practice is twice-daily distribution (42%), followed by once-daily (24%), three times-daily (21%), and finally, ad libitum distribution, which is rare (9%).

Daily feed distribution is the accepted practice among quail farmers in Burkina Faso. This distribution method is characteristic of the feeding of poultry farms operating in intensive systems (Farghly et al. 2012). The frequency of distribution has an impact on zootechnical performance, farm profitability, and the nutritional composition of animal products, particularly meat (Adikari et al. 2018). Animals in growth and fattening stages generally benefit from ad libitum distribution, while breeders are often rationed to prevent excessive fattening, which would have a negative impact on reproductive parameters. The ad libitum feeding method in the Burkinabe context is justified by relevant economic objectives given the cost of feed in the production factors of farms (nearly 60%).
Entreprise Martin à côté de la place du paysan, A la place du paysan, ELKAF
Élevage, Faso Grain, Marché,
Place du paysan, SIATOL, Société Sandwidi et frère, SOFAB

Table 3. Characteristics of quail feed

Parameters	Modalities	Number of respondents	Percentage of total
Type of feed distributed	Commercial compound feeds	32	97%
	Simple foods	1	3%
Origin of feed distributed to quails	Shop purchases	30	91%
	Self-produced feed	3	9%
Type of ingredients used	Fodder (onion and lettuce leaves)	2	6%
	Sound	1	3%
	Corn, seeds, dried fish, soybean meal	1	3%
	Corn bran, crushed corn kernels, fish meal, limesto	1	3%
Composition of commercial concentrated feeds	Quail-specific rationing	0	0%
	Poultry-specific rationing (broilers, layers, chicks, chickens, growers)	33	100%
Feeding frequency	Once a day	8	24%
	2 times a day	14	42%
	3 times a day	7	21%
	Ad libithum	3	9%

Production and reproduction situation in Quail Farms

The production system adopted by quail farmers shows a diversity of results in terms of reproduction. Table 4 presents the results of reproduction management in the studied quail farms.

To start a quail farm, all farmers exclusively acquire their breeding stock of Japanese breed "Coturnix Japonica" from individuals. These individuals focus on breeding products intended for herd replacement (eggs for incubation, breeding quails).The choice of the Japanese quail and its widespread adoption by farmers could be explained by its rapid growth and reproduction, and its ability to withstand the conditions of intensive farming systems using battery cage installations. Farming this breed is common in the sub-region, notably in Ghana (Aikins et al. 2019), with similar reasons for its exploitation.

In the studied farms, the adjustment of the size of breeding quails within the surveyed farms is not uniform. Most farms do not adhere to recommendations in terms of sex ratio. These ratios vary from 1 male to 5 females to 1 male to 3, with an average of 2 to 5.

On average, the sex ratio exceeds the recommended ratio of 1 male to 5 females. Previous studies have reported higher ratios in Central Africa, reaching 1 male to 1.75 females (Katchouang et al. 2015). The underutilization of males could be explained partly by a low level of knowledge among those leading the activity and, on the other hand, by a tendency to put males into reproduction early. Young males, due to their limited experience, show lower performance than adults. To increase the chances of reproduction, an increase in the sex ratio is important. While this may represent an economic loss for farmers by leading to the underutilization of males, it seems to play a determining role in the performance of hatching rates. The underutilization of adult males with a ratio of 1 male to 2.5 females is lower than that observed in Cameroon (Katchouang et al. 2015) with a ratio of 1 male to 1.75 females.

The age of use of females for reproduction averaged 46 days, with the vast majority of farmers (67%) stating that they use them at 45 days. The average age of use for males is also 45 days, with 73% of farmers stating that they put them into service at this age. Reproductive females and males are used early by quail farmers, with an average age of use of 45 days (6 weeks). The age at sexual maturity is in line with that indicated by Mondry, 2016. However, it is 15 days lower than the results found by Katchouang et al. 2015. The climatic conditions (temperature and lighting) in the country seem suitable for quail farming according to the statements of quail farmers.

On average, females start laying at 60 days of age according to 88% of respondents. These females lay an average of 287 eggs per year, and the estimated hatch rate during incubation reaches 83%. These figures are in line with the technical performance grid established for this species (Randall, 2007; Abu and Judah, 2019).

The highly appreciable hatch rate estimated at 83% ± 5% by respondents could find its foundation in compliance with conservation standards, other upstream and incubation stage steps, and farming conditions, as well as the performance of the egg incubation system. Indeed, the sex ratio below recommendations in quail farms was largely favorable to the fertility of laid eggs. Authors like Katchouang et al. 2015, observed

considerably low hatch rates and justified them by the use of locally manufactured incubators that did not sufficiently meet recommended standards.

The average duration of the laying period varies among farmers, ranging from 5 to 24 months. The majority of farmers (64%) maintain production for 12 months, while 21% keep quails in production for 5 to 10 months. Only 15% maintain quails in laying for as long as possible, for 24 months. The average laying period of 12 months obtained in this study is higher than the recommended slaughter age of females at 5 months for intensive systems, corresponding to a laying period of 3 months. Previous studies in real conditions have reported production durations ranging from 8 to 10 months (Katchouang et al. 2015).

Overall, reproduction management in these farms indicates a particular focus on herd replacement. Cases of consanguinity are very rare, with only 6% of farmers reporting this problem in their farms. In case of occurrence, consequences observed by these farmers include a decrease in herd productivity and signs of leg deformities. This low occurrence of consanguinity cases over several generations could be explained by the extended career of breeders, characterized by late reform of breeders and a gradual replacement of the herd.

Table 4. Reproduction status of quail farms

Parameters	**Modalities**	**Number of respondents**	**Percentage of total**
Race	Japanese Quail	33	100%
Lieu d'approvisionnement	Private	33	100%
Sex ratio	1 male to 5 females	2	6%
	1 male to 3 females	24	73%
	1 male to 2 females	1	3%
	2 male to 3 females	3	9%
	1 male to 1 females	2	6%
	1,3 male to 1 females	2	6%
Age of Use for Females	Early (40-42)	6	18%
	Normal (45)	22	67%
	Late (60-75)	3	9%
	Undefined	2	6%
Age of Use for Males	Early (40-42)	5	15%
	Normal (45)	24	73%
	Late (60-75)	4	12%
Age at First Egg	Early (40-42)	2	6%
	Normal (60)	29	88%
	Late (75)	2	6%
Number of eggs laid per female per year	160 eggs	1	3%
	250 - 280 eggs	7	21%
	300 eggs	25	76%
Laying time	5 – 10 months	7	21%
	1 year	21	64%
	2 years	5	15%
Hatching rate	Low (70 - 80%)	17	52%

Parameters	Modalities	Number of respondents	Percentage of total
	Medium (80 - 90%)	3	9%
	High (plus de 90%)	11	33%
	Undefined	2	6%
Consanguinity	Number	2	6%
	Sign and Impact	Decrease productivity and deformed legs	

Health status of quail farms

Table 5 presents the health status of quail farms. The results show that quail farms are less prone to diseases. Approximately 70% of farms reported not having recorded any diseases in their quail farms. The hardiness of this species in its natural habitat has been reported by several authors. The results obtained in Burkina Faso can be explained by an ability to adapt to climatic conditions, unlike other regions of Africa where authors have noted a high incidence of pathologies affecting quails in many farms (64%; Katchouang et al. 2015; Aikins et al. 2019). When diseases occur in farms, quail chicks are the most affected category (30%) due to their very weak immune system, followed by fattening quails and breeders (24%). The pathologies suspected by the quail farmers involved in the study include coccidiosis, coryza, torticollis, and cough.

These farms practice health prophylaxis through vaccination and deworming. Less than 20% have used preventive treatments to avoid diseases in various animal categories such as quail chicks, fattening quails, and breeders.

A minority of farmers (18 to 21%, depending on the animal categories concerned) opted for curative treatments during the study. They used veterinary products such as antibiotics and anticoccidials, as well as ethno-veterinary methods like moringa powder.

The mortality rate of quails varied from 0 to 30% across all animal categories despite medical measures taken by the farms (Table 5). The mortality rate of quail chicks was the highest, reaching almost 30% in some farmers. The mortality of quail chicks was observed in all farms and is largely due to breeding conditions (deaths of quail chicks by drowning due to mismatches in the size of the drinkers for young animals) or the lack of control over certain environmental factors such as heating temperature and light). According to Katchouang et al. 2015, the same causes of quail chick mortality were observed in their study, with deaths occurring between 0 – 3 weeks of age. To reduce deaths by drowning, this author revealed that farmers placed small stones around the drinkers to reduce access space to water. In Benin, lower mortality rates have been reported and would be linked to the degree of healthcare provided to the animals (Ekpo et al. 2020). For categories of quails fattening or reserved for reproduction, mortality rates range from 0 to 5%. However, the results highlight a low occurrence of mortality in the farms.

Table 5. Health status in quail farms

Parameters	Modalities	Number of respondents	Percentage of total	Comments		
Symptoms of bird diseases	quail chicks	10	30%	Diarrhoea, bloody faeces,		
	Fattening and breeding stock	8	24%	Diarrhoea, bloody faeces,		
Preventive treatments for birds	quail chicks	5	15%	Antibiotics (Vigal 2x)	Dewormer	
	Fattening and breeding stock	6	18%	Antibiotics (Vigal 2x)	Dewormer	
Curative treatments for birds	quail chicks	6	18%	Anticoccidiosis	Moringa leaf powder	Antibiotics
	Fattening and breeding stock	7	21%	Anticoccidiosis	Moringa leaf powder	Antibiotics
Quail mortality	0-5% 5 - 20% 20 - 30%	6 22 5	18% 67% 15%			
Fattening quail mortality	0% 1 - 5% Undefined	6 26 1	18% 79% 3%			
Breeding stock mortality	0% 1 - 5%	9 24	27% 73%			

Housing description for quails

Table 6 presents the results of the typology of facilities used by quail farmers for housing their animals while assessing their adequacy to the imperatives of quail welfare.

Farmers engage in quail farming either by using cages with an elevated floor at a specified height above the ground (79% of respondents) or by using ground-level cages (21% of respondents) directly placed on the ground. These cages, comprising multiple compartments stacked at different levels, are designed to accommodate different categories of quails (quail chicks, fattening quails, breeding quails). About a quarter of farms using cages with ground-level floors (21%) apply litter to cover the floor, thus providing protection to the animals residing there. The types of housing used by quail farmers in this study meet the criteria for intensive systems described by Ojedapo (2013) and Olawumi (2015). These authors list housing including deep litter systems (enclosures with concrete floors) as well as battery cage systems.

Regarding the acquisition of facilities, farmers adopt a dual approach. Some manufacture the housing for quails themselves (45%), while the majority (55%) hires external labor for remuneration to obtain shelter for their birds. These carefully designed infrastructures provide a level of comfort to the animals, and all surveyed farmers believe that they fully comply with quail requirements in terms of climatic conditions, ensuring protection against excessive temperatures (85%), and adaptation to the required lighting duration for reproduction.

Table 6. Some characteristics of quail housing and environmental factors

Parameters	Modalities	Number of respondents	Percentage of total
Housing Type / building	Cage farming	26	79%
	Cage and floor farming	7	21%
Cage Construction Materials	Mesh	33	100%
	Wood	31	94%
	Metal	2	6%
Cage Acquisition Method	Self-fabrication	15	45%
	Third-party construction (local artisan)	18	55%
Level of adaptation of cages to environmental conditions	Heat	33	100%
	Light	33	100%
Influence of climatic factors on quail production	Heat	28	85%
	Cold	0	0%
	Light	32	97%

Economic situation of quail farms

Quail farmers pursue various production objectives in the context of their activity (Table 7). Farming is oriented towards egg production (97%), fattening (76%), quail chick production (70%), and breeding (48%). The products and by-products from quail farming mainly include eggs (100% of farms), quails (100% of farms), and manure (85% of farms). These products are marketed directly from the farm or through farmer delivery.

Prices for products and by-products are determined based on the production goals set by the farm. Eggs and quails intended for consumption are sold at lower prices compared to those intended for reproduction (breeding stock or hatching eggs; Table 8). Prices for egg flats (containing 30 eggs) and live quails varied between 2,500 - 4,000 and 2,000 - 3,000 Fcfa, respectively, for hatching eggs and consumption eggs. Breeding quails and quails intended for reproduction have respective prices of 1,500 – 3,000 and 1,000 – 1,500 Fcfa. The price of feed ranges from 300 to 551 Fcfa per kilogram, depending on whether it is produced on the farm or purchased from the market. The revenues generated from egg sales ranged from 30,000 Fcfa to 3,797,100 Fcfa, those from quails from 124,170 Fcfa to 24,764,705 Fcfa, and manure used in horticulture from 3,440 Fcfa to 110,560 Fcfa. The total price of all products and by-products sold varied from 184,470 Fcfa to 28,642,945 Fcfa.

The structure of quail farms shows great variability, with numbers ranging from 9 to 5,000 quails. These differences explain the significant variations observed in the generated revenues (Table 2). Furthermore, depending on the farm's orientation towards

the production of slaughter animals or herd replacement, the disparities intensify. Farmers assert that the profitability of quail farming depends mainly on the sale of products intended for herd replacement (sale of breeding stock and hatching eggs) rather than those oriented towards consumption (slaughter quails and consumption eggs).

The marketing system is still in its early stages, with a low demand for products except for farms that have managed to establish a distribution network to hotels or specialized markets offering competitive prices. The ordinary selling price of products intended for consumption represents a major constraint to profitability for farmers and leads to losses in farm units in the absence of outlets. The results indicate that farmers estimate the constraint related to product marketing at 28%, thus constituting a significant reason for several farmers to abandon quail farming as they failed to integrate into a profitable distribution network.

The issue of marketing quail products is a shared challenge with some countries in the sub-region, such as Ghana (Aikins et al. 2019), and Benin (Ekpo et al. 2020). However, this issue is not widespread across the African continent; some countries like Kenya, Zambia, and Nigeria are not affected (Bakoji et al. 2013).

Quail farming has become widespread in the country, reducing the market share once occupied by new members or promoters seeking breeding stock to initiate their activities. According to one farmer, 'Before, quail farming flourished thanks to the regular influx of new promoters seeking to acquire breeding stock or hatching eggs, representing our potential clientele; however, today, the activity is saturated, reducing sales outlets. The alternative could be a thriving consumer market, except that few consumers direct their demand towards quail products. This observation has been corroborated by other studies conducted by various researchers (Arthur, 2013).

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Table 1. Production objectives and products from quail farms

Parameters	**Modalities**	**Number of respondents**	**Percentage of total**
Production Objective	Egg production	32	97%
	Hatchery (quail chick production)	23	70%
	Fattening breeding (slaughter of adult meat quails)	25	76%
	Breeding stock	16	48%
Products and by-products sold Eggs	Eggs	33	100%
	Quail	33	100%
	Droppings	28	85%
Type of use unsold droppings	Agricultural use as crop fertilizer	2	6%
	Livestock use by incorporation into ruminant rations	1	3%
Place of sale of products	Place of sale Home	25	76%
	Home and delivery	8	24%

Table 8. Unit prices and income generated from the marketing of quail products

Parameters	**Modalities**	Unit Price of Zootechnical Inputs and Quail Products / Income generated
Price per kilogram of feed (Fcfa)	Minimum	300
	Maximum	551
	Average	367
Quail products	Hatching eggs	2,500 – 4,000
	Table egg	2,000 – 3,000
	Breeding stock quails	1,500 – 3,000
	Table quails	1,000 – 1,500
	Droppings (50kg bag)	750 – 2,500
Average quantity sold	Eggs	300 – 40,000
	Quails	100 – 20,000
	Droppings (50kg bag)	0 - 100
Income from the sale of quail products and by-products	Income from egg sales	30,000 – 3,797,100
	Income from quail sales	124,170 – 24,764,705
	Income from droppings sales	3,440 – 110,560
	Total Income	184,470 – 28,642,945

Constraints of quail production

Quail farmers have listed the obstacles encountered throughout the breeding process, from production to marketing.Table 9 reveals the nature of these constraints and their significance in terms of their impact on the technical and economic performance of their production units. In order of importance, a major difficulty is noted regarding the sale

of farming products (28%), the monitoring of quail chicks (23%) during the start-up period, leading to increased drowning-related mortalities or inadequate adjustment of heating and lighting. Next, there is a lack of space (9%) to expand farming during the growth phase, financial problems (9%), and the inadequacy of farming equipment and feed composition adapted to the species' needs (6%). Other minor difficulties have been mentioned, including feed wastage, low reproductive performance with a low hatching rate, quail mortality, and noise nuisances.

Constraints related to product marketing do not affect all quail farmers, and those who are exceptions manage to achieve profits, especially experienced farmers of 5 to 10 years (33% of the sample).

Analyzing the income level generated per quail, a wide variation is observed ranging from 100 to 42,850 Fcfa. It is important to recall the obtained results, confirming the commendable performance of this bird, with high prolificacy (280 eggs on average in this study), a high hatching rate (90%), low mortality (20%), a high number of breeders (46% of the farm's population), and a significant potential for animals sold per year. Income levels depend on the quail farmers' ability to market breeders in large numbers. A simulation with favorable scenarios for the career of a female showing remarkable technical and economic performance shows higher annual income levels than those obtained in this study. Although the profitability of quail farming was not clearly defined in this study, stakeholders in the sector have concluded on the profitability of quail farms (Zambia AgriBusiness Society, 2019). The difficulty in marketing is not specific to Burkina Faso but common to practitioners in quail production in countries such as Ghana (Arthur, 2013). The main cause of the marketing constraint cited by the author is the poor organization of the sector, hindering market access, and the limited availability of information. Key players include bars, restaurants, stores, hotels, and street vendors. However, the stability and frequency of customers are crucial factors for the development of sectors, influencing the production and distribution of products. Limited market opportunities reduce the maneuvering margins of farmers and processors who have no control over markets and essentially have to accept the prices offered by customers.

Respondents also mentioned feeding difficulties as a less significant constraint (only 6%). Although the literature has extensively addressed the issue of the mismatch between the distributed rations and the nutritional needs of animals, initiatives in neighboring countries such as Benin (Dahouda et al. 2013) have been implemented to develop a suitable diet aimed at improving the zootechnical and economic performances of animals.

Quail farmers attribute additional obstacles to the consumption of quail products, notably the high quantity/cost ratio compared to other poultry species. An in-depth study on the determinants of quail meat consumption by consumers would be necessary to position quail as a future protein source for Burkina Faso. This would also guide development actors in supporting and organizing quail farming as a sector, similar to

other branches of poultry farming, whether traditional or improved. The importance of the poultry sector in improving the livelihoods of populations, especially women in Burkina Faso and sub-Saharan Africa, is widely demonstrated (Pousga, 2009; SB et al. 2013).

Other challenges encountered during marketing that hinder demand and quail egg sales include the mixed perception of the color of quail eggs, deemed unattractive by the population (Okins et al. 2019). Furthermore, additional barriers to marketing impede demand and quail egg sales, such as the mixed perception of the color of quail eggs, deemed unattractive by the population (Okins et al. 2019).

Table 9. Constraints hindering the effective implementation of quail breeding activities

Nature of Constraint	**Magnitude**
Flow issues	28%
Monitoring problems	23%
High cost of feed, equipment, and animals	19%
Lack of space	9%
Financial problems	9%
Inadequacy of farming equipment and feed type distributed	6%
Feed wastage	1%
Hatchability performance	1%
Mortality	1%
Noise nuisance	1%
Labor quality	1%
Total	**100%**

CONCLUSION

Quail farming is making slow progress in Burkina Faso. Its practice primarily involves young, male individuals, both single and married, with low levels of experience and frequent cases of abandonment. Zootechnical parameters are characterized by the unavailability of a diet adapted to the specific needs of quails or well-balanced rations suitable for this species. Reproductive performances, on the other hand, are commendable and close to those recorded in the technical-economic performance grid of the species. On the health front, the animals are very hardy, and mortalities are mainly due to breeding conditions such as the inadequacy of breeding equipment, leading to increased mortality of quail chicks by drowning. Finally, economic constraints play a significant role, resulting in a lack of outlets for some quail farmers, leading to selling products at low prices. However, other farmers have managed to overcome economic difficulties by weaving networks that facilitate the sale of their animal products.

The income derived from the sale of quails, products, and by-products is considerable, after deducting the charges borne by the farms. The challenge in quail farming is to delve into understanding the marketing circuit and the factors influencing the adoption of quail consumption among consumers. This will guide the actions of the government and its development partners in supporting and assisting this emerging sector, which could formalize itself to contribute to household food and nutritional security, strengthen livelihoods, and consequently increase the country's wealth.

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