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# Characterization and Typology of Traditional Poultry Farming Systems in Southern Niger

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## ABSTRACT

An appropriate agricultural policy that integrates knowledge of endogenous poultry practices should enhance household resilience by contributing to food and nutrition security and sustainable development in developing countries. The current cross-sectional survey aimed to characterize poultry breeding systems and identify types of traditional poultry farmers in Maradi and Zinder in southern Niger. Therefore, 600 households were investigated for the socio-economic parameters of poultry farmers, the breeding methods, the zootechnical parameters of the local chicken, and the health parameters relating to biosecurity and animal care. The results of the descriptive analyses indicated that traditional poultry activity is mainly carried out by men (73.5%) and small farmers (74.2%). Breeding management was primarily free-range breeding (99.3%). The majority of the surveyed herders (67.8%) were illiterate. However, 41.5% of them attended traditional Islamic Koranic schools. Most farmers (80%) were small-scale livestock farmers with an average herd size of 22 ± 24.9. The poultry raised were 93.3% local breeds, with chicken domination (66%). The housing did not meet the required standards, and the feed was mainly cereals. The female chicken can potentially produce 12.64 fertile eggs per clutch and brood 3.53 times per year. The leading cause of mortality in poultry was avian diseases (93.7%) and Newcastle disease in some cases. Poultry vaccination against Newcastle disease was reported by 31.5% of respondents. Of the respondents, 20% have partially observed hygiene and biosecurity measures. About 35.5% of the participants reported the provision of veterinary care, while 44% used phytotherapy to prevent or treat poultry diseases. Based on the results of this cluster analysis, three classes of poultry farmers were distinguished, each with specific characteristics. Poultry farmers in class 1 were particularly characterized by the diversity of their main activity and their level of education, those in class 2 were mostly employed in agriculture and had little school experience, and those in class 3 were characterized by their low level of vaccination practice and their lack of therapeutic animal care. The results also indicated that 15.7%, 70.8%, and 13.5% of poultry farmers belonged to classes 1, 2, and 3, respectively.

**Keywords:** Characterization, Farmer, Niger, Poultry diseases, Poultry production

## INTRODUCTION

Niger is a Sahelian country by excellence. It faces recurrent food crises, forcing the government to consider political and institutional solutions to provide definitive responses. In 2012, the government developed and implemented a strategy for sustainable food and nutritional security and agricultural development that includes the promotion of short-cycle livestock systems (poultry and fish farming) as one of the production's priority investment programs (HCI3N, 2012).

In Niger, poultry production is dominated by the traditional system. Of the population, 80% practice poultry farming, and 98% come from the traditional sector (MAG/EL, 2020). Similar to other developing countries, traditional poultry farming in Niger plays an important socio-cultural, nutritional and economic role. It is a means of improving food security (Wong et al., 2017) and nutrition (Scanes, 2007), alleviating poverty (Dolberg, 2003), creating employment and income, and contributing significantly to improving the living standard of poor populations (Fasina et al., 2007).

Despite its potential, traditional poultry farming faces many performance challenges, as well as biosecurity and husbandry barriers (Moula et al., 2012; Alem, 2014). The development of any strategy to promote the growth of the

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traditional poultry sector must be based on reliable and updated statistical data. These data constitute a decision-making means. However, data on the current situation are not widely available and can only be obtained through better monitoring of farms and better collection and analysis of field data. Over the past decade, few studies have documented traditional poultry farming in Niger. These studies focused on diseases in local chickens and guinea fowl (Idi et al., 1999; Idi et al., 2001; Souley et al., 2021) and characterization of local chickens (Moussa et al., 2020). However, none of these studies addressed the rearing system. The breeding system results from interactions between humans, their environment, and the flock. The study of breeding systems aims to account for the diversity of breeding practices and understand and analyze the animal's performance without blaming the delay on the producers or the inefficiency of knowledge transfer (Lhoste, 1984; Dedieu et al., 2008).

Thus, the present study aimed to advance the documentation of traditional poultry farming in Niger and to provide decision-makers with the information needed to guide research and development actions. Specifically, it described the characteristics of traditional poultry farming systems and highlighted the different types of poultry farmers, management methods, and the main factors and practices involved. Finally, the study provided relevant data to guide traditional poultry development projects and programs.

## MATERIALS AND METHODS

### Study area

The study was conducted in southern Niger, in 10 departments and 2 cities in the regions of Maradi and Zinder. These 12 administrative entities are covered the Sahelian and Sahelo-Sudanian agroecological zones.

The Sahelian zone is a steppe area with a Sahelian climate that covers the Departments of Mirriah, and Takeita, the Northan Departments of Aguié, Gazaoua, and Tessaoua, and the city of Zinder. The Sahelo-Sudanian zone is the savanna domain that covers Guidan Roumdji, Madarounfa, Kantché, Magaria, Dungass, the southern part of the departments of Aguié, Gazaoua, and Tessaoua, and the city of Maradi. This part of the territory is a transition zone between the Sahelian and Sudanian zones (Wata et al., 2012).

Zinder rain station records an average rainfall annual of 502.12 mm in 43 days, an average temperature ranging from 22.18 to 35.3°C, and an annual relative humidity ranging from 20.4 to 49.8% (INS, 2020). Maradi rainfall station records an average annual rainfall of 562.8 mm in 45 days, an average temperature ranging from 21.54 to 35.38°C, and an annual relative humidity of 27 to 57.6%. Rainfall occurs between June and September (INS, 2020).

The two study regions have an area of 197,574 km², or 15.6% of the national territory, with an estimated population of 9,584,421 inhabitants in 2021, representing 40.6% of the total population (INS, 2019).

Administratively, Niger is subdivided into regions, regions into departments and cities, departments into urban and rural communes, and cities into boroughs. Communes and boroughs are, in turn, subdivided into administrative villages, hamlets, camps, and neighborhoods. Figure 1 clearly illustrates the study area.

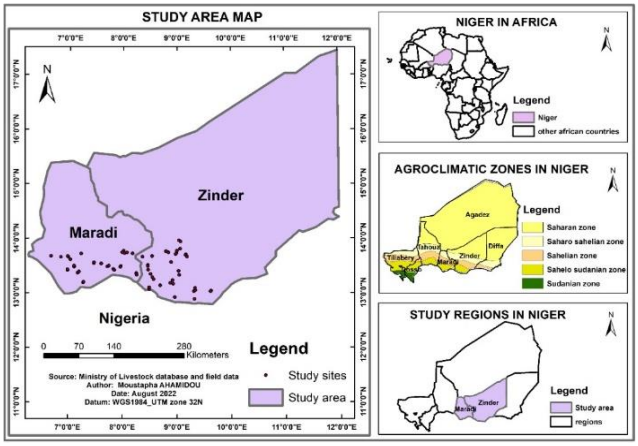


**Figure 1.** Study area of Southern Niger

### Sampling

A stratified random sampling method with proportional allocation was used to define the samples. In the first stratum, the agricultural departments located along the border with the Federal Republic of Nigeria were selected in each of the two regions as well as the cities of Maradi and Zinder. In the second stratum, a maximum of three communes or boroughs were selected per department or city. In the next stage, a maximum of three localities were randomly selected in each commune or borough. Then, by referring to the national directory of localities (ReNaloc), the number of farm households to be surveyed per commune or borough was determined in proportion to the number of total farm households. Finally, the households surveyed were drawn from the list of households drawn up by the village chief. Table 1 shows the distribution of households surveyed.

### Data collection

Data were collected from November 2021 to January 2022, including semi-open and closed-ended questions. The questionnaire was administered face-to-face using the

KoBoCollect collection tool (Version 2021.2.4). Information collected included geographic location, household socioeconomic data (gender, age, main activity, education level, poultry training, husbandry goals, and experience), farm technical data (species, breed, origin of animals, type and size of farming, habitat, feed, breeding parameters), and farm health data (mortalities and causes, knowledge of Newcastle Disease, biosecurity, vaccination practice, types of treatment, and access to husbandry service). Information on plants used by poultry farmers to prevent and treat poultry diseases was obtained in local languages, and the scientific names were checked in the lexicon of Niger plants written by Peyre de Fabregue (1979).

**Table 1**. Number of households surveyed by commune or borough in Niger from November 2021 to January 2022

| Region | Departments and cities | Communes and boroughs | Number of households surveyed |
|---|---|---|---|
| Maradi | Aguié | Aguié | 32 |
| | | Tchadoua | 18 |
| | Gazaoua | Gangara | 11 |
| | | Gazaoua | 23 |
| | Guidan Roumdji | Chadakori | 23 |
| | | Guidan Roumdji | 19 |
| | | Tibiri | 22 |
| | Madarounfa | Dan Issa | 19 |
| | | Djirataoua | 16 |
| | | Serkin Yamma | 9 |
| | Tessaoua | Hawandawaki | 9 |
| | | Maijirgui | 14 |
| | | Tessaoua | 31 |
| | Maradi | Maradi 1 | 3 |
| | | Maradi 2 | 2 |
| | | Maradi 3 | 3 |
| Zinder | Dungass | Dungass | 34 |
| | | Dogo dogo | 16 |
| | | Malawa | 23 |
| | Kantché | Matamey | 12 |
| | | Kantché | 12 |
| | | Yaouri | 14 |
| | Magaria | Bande | 32 |
| | | Magaria | 27 |
| | | Sassoumbroum | 19 |
| | Mirriah | Dogo | 32 |
| | | Droum | 29 |
| | | Mirriah | 18 |
| | Takeita | Dakoussa | 16 |
| | | Garagoumssa | 14 |
| | | Tirmini | 30 |
| | Zinder | Zinder 1 | 5 |
| | | Zinder 2 | 4 |
| | | Zinder 5 | 9 |
| Total | | | 600 |

**Statistical analysis**

To analyze the data, R software (Version 4.1.2) was used. The descriptive analysis was run to characterize the breeding systems by calculating the means, standard deviations, and relative and absolute frequencies. To carry out the typological study, Mixed data factor analysis (MDFA) was first used to combine the quantitative and qualitative variables into a single analysis and to identify subsets of homogeneous and strongly related variables according to the method of Pagès (2004). This method was performed using the ClustOfVar algorithm, a package of R. Secondly, principal component analysis (PCA) was applied to the synthetic obtained variables to identify those that can participate in the classification of the investigated poultry farmers. This approach resulted in an appropriate classification with a fairly acceptable explained variance. At this level, a step-by-step top-down method was applied. For the selection of synthetic variables, when the PCA is compiled, the variable that is poorly represented and/or contributes less to the construction of the principal components is eliminated. This means that this synthetic variable was nonsignificant ($p > 0.05$). The process was

repeated several times until an acceptable PCA was obtained. The synthetic variables retained in the PCA were subjected to Hierarchical ascending classification (HAC). Finally, the results of the variable classification were interpreted using the method by Kuentz-Simonet et al. (2013).

## RESULTS

### Socioeconomic characteristics of poultry farmers

The obtained results of the present study showed that traditional poultry farming is an activity dominated by men (73.5%) and small farmers (74.2%). The age of the poultry farmers surveyed ranged from 12 to 92 years, with an average of 39.45 ± 15.02 years. Most of them (67.8%) had no school experience. However, a large proportion of them (41.5%) had received Islamic education at the Koranic school. Regarding marital status, 86.2% of the herders surveyed were married. Regarding the years of experience in poultry farming, more than half (54.84%) had 1-10 years of experience (Table 2). About 53% of the households surveyed kept poultry for consumption plus income, 25% for income, 14% for ritual and tradition purposes, and 8% for consumption only.

### Breeding methods and animal composition

In the case of the surveyed households, scavenging system (78.5%) and mid-scavenging system (20.8%) were the dominant breeding methods. In the scavenging system, the animals are not confined and can roam over long distances in the village. In contrast, in the mid-scavenging system, the animals are confined to their concessions and rarely have access to the village. Most of the poultry farmers surveyed (80%) could be classified as small-scale farmers with an average of 22.10 ± 24.9 head. The birds raised were mostly (93.3%) local breeds, and the basic stock was mainly acquired from local markets (64.8%), neighboring villages (29.8%), and traditional hatcheries (4%). The 87.2% of eggs laid by the hen were used for brooding. Approximately 60% of the farmers surveyed practiced single-species breeding, as opposed to 40% who combined chicken breeding with other species of domestic birds. The flock households were dominated by chickens (66%), followed by guinea fowls (22.2%), ducks (5.8%), pigeons (5.2%), and turkeys (0.5%).

### Shelter and breeding equipment

In the traditional breeding system, the chicken house provides bird shelter at night and protects them from bad weather and predators. The findings of the present study indicated that nearly a quarter (22.7%) of the farmers surveyed did not have a chicken coop. In these households, the animals find shelter at night in the corners of houses in unfinished rooms on walls and trees. Among households with chicken coops (77.3%), three types of coops could be distinguished. The most common coops were made of straw huts (60%), improved coops were made of wood (30%), and wire coops (10%). In almost all cases, the breeding equipment was limited to the drinking trough, which served as a feeder. There are practically no feeders. However, the troughs are often made of pottery pieces, fragments of worn tires, or other troughs of circumstance.

### Feed

Poultry feed was composed of cereals, including millet, sorghum, millet bran, wheat bran, kitchen waste, and water during the dry seasons (cold and hot). During the rainy season, it was made of birds' peck at insects and vegetation in addition to grain and water. The drinking water for poultry came mainly from wells, boreholes, and ponds.

### Reproduction

Table 3 tabulates the mean for age at maturity of a cock, age at the first laying of a hen, number of eggs per laying, number of eggs hatched per laying, and number of layings per hen per year. The p-values of these reproductive parameters between the two agroecological zones were 0.82, 0.98, 0.36, 0.67, and 0.82, respectively. The difference in the means of the reproductive parameters between the two agroecological zones was nonsignificant ($p < 0.05$). Therefore, the agroecological zone factor did not affect the reproduction parameters.

### Advisory and technical support for poultry farmers

Few of the farmers surveyed (9.7%) had received short-term training in poultry farming. The state designed a community animal health system and its partners to extend the network of veterinary services and bring the breeding service closer to the breeders. Thus, in 2003, the rural veterinary clinic and its network of auxiliaries were created in Niger. Basic animal health services were then provided by the technical breeding services, the private veterinary services of proximity, and especially by the breeding auxiliaries. Farmer schools' field are also set up to disseminate technological innovations and improve local practices in small-scale breeding. Poultry kits were also distributed to enhance poultry production or

distribute genetic materials. These operations were usually accompanied by deworming and mass vaccination. A new concept of poultry enterprise is implemented. It involves re-training the poultry farmer in the poultry business by building rural mini-farms in compliance with technical standards in terms of the structure of buildings, density of birds, monitoring of the farms, and training the farmers with the necessary support.

**Table 2.** Socioeconomic characteristics of poultry farmers in Niger from November 2021 to January 2022

| Variables | Modalities | Number of poultry farmers | Frequency (%) |
|---|---|---|---|
| Gender | Male | 441 | 73.5 |
| | Female | 159 | 26.5 |
| Age | Youth (Under 36 years old) | 278 | 46.33 |
| | Adults (36 to 60 years old) | 268 | 44.67 |
| | Old (Over 60 years old) | 54 | 9 |
| Marital status | Single | 76 | 12.7 |
| | Married | 517 | 86.2 |
| | Widowed | 7 | 1.2 |
| Level of education | Non-literate | 107 | 17.8 |
| | Literacy | 48 | 8 |
| | Koranic school | 249 | 41.5 |
| | Primary | 100 | 16.7 |
| | Secondary | 91 | 15.2 |
| | Higher | 5 | 0.8 |
| Years of experience in poultry production | 1 to 5 years | 133 | 22.17 |
| | 6 to 10 years | 196 | 32.67 |
| | 11 to 20 years | 170 | 28.33 |
| | 21 to 30 years | 84 | 14 |
| | Over 30 years | 17 | 2.83 |
| Principal activity | Agriculture | 445 | 74.2 |
| | Trade | 40 | 6.7 |
| | Public service | 32 | 5.3 |
| | Other activities | 83 | 13.8 |

**Table 3.** Zootechnical parameters of local chickens in southern Niger from November 2021 to January 2022

| Agroecological zones / Production parameters | Sahelian | Sahelo-soudanian | Mean |
|---|---|---|---|
| Age at maturity of a cock (months) | 4.75 ± 0.66 | 4.77 ± 0.67 | 4.76 ± 0.67 |
| Age at which hens start laying (months) | 6.5 ± 0.62 | 6.5 ± 0.61 | 6.5 ± 0.61 |
| Number of eggs laid per clutch | 12.51 ± 2.58 | 12.71 ± 2.52 | 12.64 ± 2.54 |
| Number of chicks hatched per clutch | 10.39 ± 2.05 | 10.46 ± 2.16 | 10.44 ± 2.12 |
| Number of broods per year | 3.54 ± 0.49 | 3.53 ± 0.49 | 3.53 ± 0.49 |

**Causes of mortality and knowledge of Newcastle disease**

The poultry farms in the households surveyed were characterized by high mortality of chickens and guinea fowl of all categories caused by disease (93.7%), trampling (3.2%), predators (1.6%), and climatic hazards (1.5%). Almost all surveyed farmers (96.7%) were aware of Newcastle disease and could describe its clinical signs, such as greenish diarrhea, torticollis, respiratory distress, and depression, most often associated with high mortality of approximately 90%. Approximately 82.7% of the surveyed farmers stated that Newcastle disease occurred in the cold dry season. However, 12.7% of the surveyed farmers reported that it happened in the hot dry season, and 4.6% of the surveyed farmers stated that it appeared all year round. According to poultry farmers surveyed,

outbreaks of Newcastle disease occur mainly at the beginning and end of the cold, dry season, and the Harmattan wind spreads the disease.

**Biosecurity**

Biosecurity is the set of practices and measures used to prevent the introduction, maintenance, and dissemination of pathogens on a farm. The results of the current study indicated that only one-fifth of the farmers practiced quarantine of newly acquired animals (20.2%) and isolation of sick animals (19.2%). Approximately 70.8% of poultry farmers, discarded dead birds in the wild. Almost all farmers (99%) swept the poultry house, but with a wide range of frequency. Only 1% of the poultry farmers swept the barn daily, 60% swept weekly, 16% swept monthly, and 23% rarely. The majority of poultry farmers (60%) washed water troughs weekly. However, only 22% used soap or detergent for washing. The sanitary vacuum is a sanitation operation on the farm that includes disinsectization, deratting, cleaning, and disinfection of the poultry house and its surroundings. In the present study, 17% of the farmers practiced sanitation by changing the location of the barn, spreading hot ash in the barn, or incinerating the barn. Approximately 31.5% of the farmers stated that they had vaccinated their animals at least once and only against Newcastle disease. Vaccination of poultry against Newcastle disease usually occurs during the free vaccination campaign for livestock (cattle, sheep, goats, and camels) in December. This prophylaxis operation is carried out by state services and private actors, including breeding auxiliaries, for 0.09-0.17 USD per poultry. Nevertheless, periodic vaccination operations are organized and financed with the support of non-governmental organizations and livestock development projects in their areas of intervention.

**Animal care**

To treat poultry diseases, 85% of the poultry farmers responded that they provided therapeutic care to the animals. Of these poultry farmers, 35.5% provided veterinary care, 44% used ethnoveterinary methods, 15.5% combined both methods, and 5% used non-conventional treatment with human products. Fake veterinary products were highly accessible to farmers. Due to the porous borders, they were sold in weekly markets at a very affordable cost and came from neighboring countries. The most popular medications were Antiparasitics, dewormers, antibiotics, and vitamins in tablets or sachets. The human medicines were mainly Paracetamol, Metronidazole, and Amoxicillin. Traditional knowledge of medicinal plants was commonly used for animal treatment. The herders used different parts of the plant (leaves, bark, root, stem, seeds, and fruits). Some ingredients, such as chili and ash, were also used in the treatment and deworming of poultry. A total of 17 plants from 12 commonly used botanical families were identified in this regard (Table 4).

**Table 4.** Plants commonly used by poultry farmers for the prevention and treatment of poultry diseases in southern Niger

| Vernacular names | Scientific names and botanical families | Plant organs | Diseases |
|---|---|---|---|
| Dogo'n yaro | *Azadirachta Indica* (*Méliaceae*) | Leaves, bark, and seeds | Diarrhea, Mites, Infection |
| Dânia | *Sclerocarya Birrea (Anacardiaceae)* | Bark, leaves, roots | Diarrhea |
| Faru | *Lannea Fruticosa (Anacardiaceae)* | Bark, leaves | Diarrhea |
| Kukuki | *Sterculia Setigera (Sterculiaceae )* | Bark, root | Infection |
| Golo'n zaki | *Cucumis Metuliferus (Cucurbitaceae)* | Fruits | Apathy, Depression |
| Aguwa | *Euphorbia Balsamifera (Euphorbiaceae)* | Branch | Diarrhea, Newcastle disease |
| Ida'n sânyia | *Solamum Incanum (Solanaceae)* | Fruit, Leaves, Stem, Root | Newcastle disease, Mites |
| Ida'n zakara | *Withania Somnifera (Solanaceae)* | Leaves, root | Nervous disorders |
| Pfataka | *Pergularia Tomentosa (Apocynaceae)* | Leaves, root | Respiratory disorders |
| Duman kada | *Ipomoea Asarifolia (Convolvulaceae)* | Leaves | Diarrhea, Nervous disorders |
| Kafurdo | *Citrullus Colocynthis (Cucurbitaceae)* | Fruits | Diarrhea, Nervous disorders |
| Kiryia | *Prosopis Africana (Mimosaceae)* | Leaves, bark, root | Diarrhea, Anorexia, Depression |
| Bagaruwa | *Acacia Nilotica (Mimosaceae)* | Fruit, leaves, bark, root | Diarrhea, Mites |
| Raydoré | *Cassia Occidentalis (Caesalpiniaceae)* | Leaves, stem, flowers, roots | Prostration, Roundworm, Tapeworm |
| Gamjy | *Ficus Platyphylla (Moraceae)* | Bark, root | Apathy, Plague, Infection |
| Thiédya | *Ficus Sycomorus (Moraceae)* | Leaves, bark | Diarrhea, Respiratory disorders |
| Tum-iya | *Aerva Javanica (Amaranthaceae)* | Sheets | Diarrhea, Roundworm, Tapeworm |

**Access of poultry farmers to the breeding service**

The results of the survey indicated that 97.7% of poultry farmers had physical access to the livestock service. Among these farmers, 53.5% had access to the public service, 18.5% used the private service of proximity, and 25.7% had access to both types of service.

**Classification of variables**

Following the factorial analysis of the mixed data and their compilation with the ClustOfVar algorithm, eight synthetic variables (SV) were identified based on the 14 source variables introduced, with a cohesion gain of 72.59%. The SV 1 represents the origin of the animals in relation to the type and size of breeding, SV2 corresponds to the agroecological zone, SV3 represents gender, SV4 reflects the main activity of the poultry farmer in relation to his level of education, SV5 corresponds to the poultry breed, SV6 reflects animal care in terms of variety of health care, disease management, and poultry house ownership. Synthetic variable 7 includes prophylaxis, management of dead poultry bodies, and vaccination practices, and SV8 corresponds to access to breeding services. After applying a step-by-step top-down selection based on the contribution to the axes and the quality of the representation of each synthetic variable in PCA, the SV3, SV4, SV6, and SV7 gave the best result with an explained variance of 59.16% of the total variance. Thus, these synthetic variables were selected to participate in the classification of breeding systems.

**Classification of breeding systems**

The application of the Hierarchical ascending classification (HAC) method on the synthetic variables retained in the PCA led to the classification of the farms into three classes with an explained inertia rate of 65.1%. Figure 2 shows the projection of the colored individuals according to their class in the factorial plane and indicates that the classes are homogeneous and separated from each other. Table 5 shows that the participation of each synthetic variable in the classification of the cluster is significant ($p < 0.05$). The measure of the intensity of the relationship between the cluster of poultry farmers and each synthetic variable is given by the value of Eta2. Eta2 is a Spearman correlation coefficient that measures the strength of the relationship between the synthetic variables and the clusters. When the value of Eta2 < 0.5, the relationship is weak. When the Eta2 value is between 0.6 and 0.7, the relationship is strong, and when the Eta2 > 0.7, the relationship is very strong. The Eta2 values of the synthetic variables SV4 and SV6 being higher than 0.7; these synthetic variables have strongly contributed to the classification of the poultry farmers groups.

**Table 5.** Relationship between the cluster variable of poultry farmers and associated synthetic variables

| Variables | Eta$^2$ | P-value |
|---|---|---|
| VS6 | 0.86302574 | $p < 0.05$ |
| VS4 | 0.75380497 | $p < 0.05$ |
| VS7 | 0.07860523 | $p < 0.05$ |
| VS3 | 0.03042297 | $p < 0.05$ |

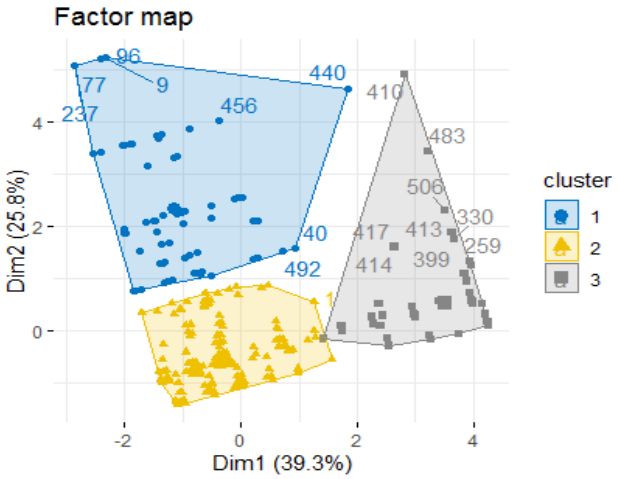


**Figure 2.** Graphical representation of the classes on axes 1 and 2

Class 1 represented 15.7% of the survey population and is dominated by men (85.11%). The poultry farmers in this class were mostly employed (73.41%) in the secondary and tertiary sectors. They belonged to four socio-professional sub-groups. The largest subgroup (36.17%) included several heterogeneous socio-professional categories, consisting of restaurant workers, pupils, motorcycle cab drivers, agricultural product processors, butchers, tailors, mechanics, carpenters, masons, blacksmiths, tire repairers, workers, marabouts, town criers and traditional practitioners. The second subgroup (29.79%) was made up of public service employees assigned by the state or recruited by the local authorities to serve in the surveyed localities. This subgroup comprised teachers, health workers, rural development workers (agriculture, breeding, and environment), and municipal workers. The third subgroup was farmers (26.6%), and the last and least important subgroup was traders (7.45%). In this class, all the herders were educated (100%). Most of these farmers (84.04%) had a shelter or a henhouse to house the birds at night. In

addition, more than half of them practiced vaccination (56.32%). Regarding the disease, 53.19% of them administered therapeutic care to the animals, and 42.55% opted for sanitary slaughter to minimize the risk of loss. However, some of them engaged in risky behavior by disposing of sick birds by sale (2.13%) or doing nothing (2.13%). Of those who treated sick animals, half (51.06%) used veterinary care, 13.83% used ethnoveterinary medicine, 24.47% combined both methods, and 10.64% used human medications. Regarding the management of dead poultry bodies, 72.34% of the farmers discarded the dead bodies in the wild, while 27.66% incinerated or buried the dead poultry bodies.

Class 2 had the largest number of poultry farmers studied (70.8%), with a dominance of men (73.41%). In this class, the majority of poultry farmers (84.47%) worked in the primary sector (agriculture) and were largely (80.71%) not in school. Most of these farmers (84.04%) had a shelter or a henhouse to house the birds at night. In addition, two-thirds of these farmers (66.65%) practiced vaccination. In case of disease, 61.41% administered care to the animals, while 37.18% eliminated the animals by slaughter. However, a minority of farmers tended to sell sick animals (0.71%) or observed sick animals without doing anything (0.71%). Regarding the types of therapeutic care, 38.82% of the poultry farmers administered veterinary care, 28.47% used ethnoveterinary medicine, 24.71% combined both methods, and 8% used human products. In this class, 64.24% of the farmers disposed of the dead birds in the wild, 34.35% buried or incinerated the dead birds, and 1.42% consumed the dead bodies.

Class 3 represented 13.5% of the total surveyed population. It was the class with the least number of farmers. In this class, there was a high proportion of women (40.74%). The majority of farmers (82.72%) were employed in the primary sector (agriculture). Considering literacy, 77.55% of them did not attend school. About 70.37% of the poultry farmers had a chicken coop. However, almost all the breeders (98.77%) did not vaccinate their animals. In case of disease, 7.41% of the farmers disposed of the animals by stamping out, 2.47% got rid of birds by selling, and 90.12% did nothing. Regarding the management of poultry corpses, 96.3% of the farmers left poultry corpses in the wild, and 3.7% incinerated or buried poultry corpses. The characteristics of the different classes of traditional poultry farmers in southern Niger are shown in Table 6.

**Table 6.** Characteristics of the different classes of traditional poultry farmers in southern Niger

| Variables | Modalities | Class 1 (%) | Class 2 (%) | Class 3 (%) |
|---|---|---|---|---|
| Sex of the breeder | Male | 85.11 | 73.41 | 59.26 |
| | Female | 14.89 | 26.59 | 40.74 |
| Principal activity | Agriculture | 26.6 | 84.47 | 82.72 |
| | Trade | 7.45 | 6.82 | 4.94 |
| | Public service | 29.79 | 0.71 | 1.23 |
| | Other activities | 36.17 | 8 | 11.11 |
| Level of education | Koranic school | 0 | 52 | 34.57 |
| | Literacy | 0 | 9.41 | 9.88 |
| | Non-literate | 0 | 19.3 | 32.1 |
| | Primary | 2.13 | 19.29 | 19.75 |
| | Secondary | 92.55 | 0 | 3.7 |
| | Higher | 5.32 | 0 | 0 |
| Possession of a henhouse | Yes | 84.04 | 84.71 | 70.37 |
| | No | 15.96 | 15.29 | 29.63 |
| Vaccination practice | Yes | 56.38 | 66.65 | 1.23 |
| | No | 43.62 | 34.35 | 98.77 |
| Disease management | Treatment | 53.19 | 61.41 | 0 |
| | Sanitary slaughter | 42.55 | 37.18 | 7.41 |
| | Sale | 2.13 | 0.71 | 2.47 |
| | Nothing | 2.13 | 0.71 | 90.12 |
| Types of care | Veterinary medicine | 51.06 | 38.82 | 0 |
| | Ethno-veterinary medicine | 13.83 | 28.47 | 0 |
| | Combination of both methods | 24.47 | 24.71 | 0 |
| | Non-conventional treatment | 10.64 | 8 | 0 |
| | None | 0 | 0 | 100 |
| Management of corpses | Disposal in nature | 72.34 | 64.24 | 96.3 |
| | Incineration or burial | 27.66 | 34.35 | 3.7 |
| | Consumption | 0 | 1.41 | 0 |

Class 1: 94 poultry farmers, Class 2: 425 poultry farmers, Class 3: 81 poultry farmers

## DISCUSSION

The results of the current study revealed that the practice of traditional poultry farming is dominated by men (73.5%). This trend was previously reported in the results of the General Census of Agriculture and Livestock (RGAC, 2008), indicating that poultry breeding in Niger is practiced by 48% of men, 28% of children, and 24% of women. The findings of the current study are in agreement with the study conducted in Burkina Faso, where Pindé et al. (2020) reported that 70.26% of men practiced poultry farming. Conversely, a Zimbabwean study revealed that 88.9% of women dominated poultry activities (Ndiweni et al., 2013). Small-scale poultry breeding by women has been highly advantageous because the income generated through the sale of poultry and eggs would be under their control, which would enhance their empowerment and help households to overcome financial difficulties (Begum et al., 2019). Guèye (2005) indicated that poultry ownership results from the communities' socio-cultural and religious conditions in most rural areas of Africa.

The present results indicated that 74.2% of the households were engaged in agriculture as their primary activity. Similarly, Talaki et al. (2020) reported that 91.35% of poultry farmers in Togo are employed in the agricultural sector. In the study area, households involved in agriculture or other occupational sectors have diversified into poultry farming to supplement their income. Kalifa et al. (2018) noted that integrating poultry practice into farms is profitable. The reason is that poultry contributes to farm income and organic manure production to fertilize the fields. Poultry in rural areas is a means of saving income that can be easily mobilized to meet the basic needs of households. It serves as a social safety net and solidarity for rural populations (Melesse, 2014; Nahimana et al., 2019).

Regarding the herders' education level, it was found that 67.2% of the herders did not attend school. However, a high proportion (41%) attended Islamic teachings at the Koranic school. The current results contrast with the study conducted in Côte d'Ivoire, where Etienne et al. (2021) recorded that 52.5% of herders had no experience of attending school. The Koranic school is one of the most popular types of school in the Muslim-majority countries of Sub-Saharan Africa. It constitutes the only training and literacy offered for populations marginalized by the formal education system (Meunier, 1995; Stefania, 2003).

The results of the present study contradict the one conducted by Ebwa et al. (2019) in the Democratic Republic of Congo, indicating that 77% of poultry farmers raised poultry solely for consumption.

Regarding the breeds of poultry raised and the predominance of chicken, the present results are consistent with the study conducted in Burkina Faso by Bansé et al. (2017), reporting that almost all producers raised poultry of local breeds with 66% chickens.

Age at the first laying of a hen, number of eggs laid per clutch, number of eggs hatched per brood, and number of egg laying per hen per year are almost identical in the two agroecological zones. With respect to the age at first laying, the present results are close to those reported by Dzogbema et al. (2021) in Togo and Ayssiwede et al. (2013) in Senegal, recording 6.76 and 6.38, respectively. Regarding the number of eggs laid per hen per clutch, the findings of the current study were close to those of Mauritania and Ethiopia, where Ahmed and N'Daw, (2015) and Dassie and Ogle (2001) reported 12.96 and 12.9 eggs per hen per clutch, respectively. The number of eggs hatched per clutch by Dassie and Ogle (2001) in Ethiopia was similar to that of the present research. Concerning the number of broods per hen per year, the obtained results of the current study were comparable to those reported by other authors in Africa (Mwalusanya et al., 2002; Fotsa, 2008; Ayssiwede et al., 2013; Ahmed and N'Daw, 2015; Kibreab et al., 2016; Dzogbema et al., 2021). Generally, the number of broods per hen per year for indigenous African chicken ranges from 3 to 4 (Ahmed and N'Daw, 2015; Kibreab et al., 2016; Dzogbema et al., 2021). However, Mammo et al. (2008) reported a clutch number per hen of 5.06 ± 1.65 per year in Ethiopia.

Avian diseases were the main cause of mortality (93.7%) in the present study. This finding is in agreement with several previous studies. Meskerem (2019) and Otte et al. (2021) reported 67% and 60% disease-related poultry loss in village poultry farming in their studies in Ethiopia and Tanzania, respectively. Meskerem (2019) and Otte et al. (2021) also reported that Newcastle disease accounted for 64% and 54% of the identified diseases.

Regarding animals' origin, the present results are in agreement with a previous study conducted in Nigeria, where Ameji et al. (2012) reported that 64.7% of poultry farmers obtained their breeding stock from the live bird market and other unknown sources.

Present results are close to the study results conducted in Nigeria, where Ajewole et al. (2014) reported that 27.5% of the farmers practiced the quarantine of new birds. As for the isolation of sick birds and regular cleaning of the birds' environment, the current study

contrasts with Ajewole et al. (2014), where 100% of the surveyed farmers regularly cleaned the birds' habitat and practiced the isolation of sick birds. Ndem and Ogba (2017) indicated that the isolation of sick birds and corpses, movement control, and sanitary practices could be used effectively to prevent poultry diseases.

In the present study, 70% of the poultry farmers surveyed were disposing of dead poultry bodies in the wild. Similar observations were made in a previous study conducted by Abdurrahman et al. (2016) in Nigeria. These authors revealed that 50% of farmers disposed of dead poultry bodies by dumping them in landfills. Guittet et al. (2018) indicated that this practice is not without risk of the contamination of susceptible animals, the case where the birds' dead bodies are infected.

In terms of medical prophylaxis, 31.5% of the poultry farmers surveyed stated that they had vaccinated their animals only against Newcastle disease. This percentage is relatively low. The emphasis on vaccination against Newcastle disease is justified. This is the most important disease in traditional poultry production. However, the current results agree with those of a previous study conducted in Kenya, where Ezra et al. (2020) reported that 35% of poultry farmers reported having vaccinated their animals. Bessell et al. (2017) indicated that implementing a strategy based on the distribution of vaccines and community awareness of good breeding practices helps to increase the vaccination rate. The traditional system of treating animal diseases is still widely used in remote rural areas where modern veterinary care facilities are scarce or deficient (Phondani et al., 2010). The low cost of ethnoveterinary medicine makes it an alternative to modern medication for traditional poultry farmers (Adebayo et al., 2020). Several authors have documented the use of medicinal plants in the management of poultry diseases (Lagu and Kayanja, 2010; Meskerem, 2019). Some of the plant species identified in the present study have been reported in previous studies with scientific evidence of their use in poultry. The extracts of these plants, including *Acacia nilotica*, *Withania somnifera*, and *Azadiractha indica* have biological activities against *Escherichia coli*, *Staphyllococcus aureus*, *Klebsiella pneumoniae* and against Newcastle disease and fowl pox viruses (Mohamed et al., 2010; Ashraf et al., 2018). They also act on external parasites and helminths (Carine et al., 2021).

Although the government's policy of bringing the breeding service closer to the breeders, and the surveyed farmers had the best physical access to the breeding service (97.7%), the use of veterinary care (35.5%) and vaccination (31.5%) were relatively low. A previous study conducted by Asfaw et al. (2021) in Ethiopia found that poultry health services are at minimum due in part to the lack of organized private poultry health service providers available to all and the low financial means of rural poultry farmers to hire private veterinarians. In many rural areas of low- and middle-income countries, the size of the area to be covered and the lack of resources and infrastructure can limit veterinary and extension services. Veterinary services are mostly devoted to crop or ruminant production, with little health care or advice accessible to small-scale poultry farmers (Wong et al., 2017). According to Enahoro et al. (2021), it is essential to improve the distribution channels of good quality drugs and vaccines, strengthen the technical level of poultry farmers, and support stakeholder involvement mechanisms to improve community-based poultry care services.

The typological analysis allowed us to meet one of the objectives of this study, which is to classify traditional poultry breeding farms according to the values of the synthetic variables taken into account in the classification and the significant links established between the groups of individuals. The results of the present study differ from those obtained by Dzogbema et al. (2021), and Pindé et al. (2020) in Togo, and Burkina Faso with regard to the objectives of the study and the variables introduced for the analysis.

## CONCLUSION

This survey explored the characteristics of traditional poultry breeding systems in southern Niger and highlighted the variety of breeding systems by considering the socioeconomic aspects of breeders and animal health management (biosecurity, animal care). The main constraints to the current state of production of these types of breeding systems have been identified. To improve the current condition, future research is needed to focus on the control of poultry diseases, particularly Newcastle disease, to reduce mortality. Moreover, more studies should be conducted on adaptable and sustainable biosecurity measures for family poultry farming to reduce the risk of contamination; improvement of the habitat, poultry feed and breeding methods to optimize production; development of veterinary ethnomedicine as an alternative to modern medicine; capacity building for all stakeholders; and dissemination of good poultry practices.

## DECLARATION

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**Authors' contribution**

This work was carried out by the contribution of all authors. Ahamidou Moustapha designed the protocol, collected and analyzed data, and draft the manuscript. Akourki Adamou validated the protocol, supervised the data collection and revised the manuscript. Essodina Talaki validated the protocol, supervised the data collection and revised the manuscript. All authors read and approved the final version of the manuscript.

**Competing interests**

The authors declare that they have no competing interests.

**Ethical considerations**

The authors of the current study have checked ethical issues (including plagiarism, consent to publish, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy).

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