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Abstract

Guinea fowl (Numida Meleagris) production systems characterization was carried out in Burkina Faso through a baseline survey describing diversity in Guinea fowl farming practices in a context of limited references on this specie, in order to plan further development efforts and to enhance productivity. Five sites belonging to the three agro-ecological areas of Burkina Faso were covered as followed: one, three and one sites respectively in Sahel, Sudan-Sahel and Sudan areas. A total of 100 farmers were interviewed: 25 in Sahel area, 55 in Sudan-Sahel area and 20 in Sudan area. Descriptive statistics, multiple correspondence analysis and hierarchical classification have been performed using R software to establish the diversity of local Guinea fowl production system and typology.

Guinea fowl breeding is mainly practiced by men (93%) in a free-range production system (93%), predominant in Sahel area (80%) while semi intensive breeding system was mainly encountered in Sudan (75%) and Sudan-Sahel (82%) zones. According to interviewers, the main reasons for keeping guinea fowl compared to hen were egg quantity (76%), high price value (66%), meat quality (60%) and better productivity (36%). The main constraints rely on diseases and pests (77%), high mortality rate (65%), lack of knowledge in breeding practices (57%) and predation (54%). Moreover, to carry out their activity, guinea fowl keepers need support from extension services for capacity building. An institutional support with appropriate research in the production sector is needed to improve the living conditions of rural breeders’ association mixtures, which may contribute to alleviate poverty.

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Introduction:-
Burkina Faso is a land-locked country and a rural-based low income economy with livestock contributing 19.2% to country Growth Domestic Product (GDP). Roughly 90% of active population of Burkina Faso is involved in Agriculture and livestock breeding. This latter is one of the main economic activities on which the poorest populations depend for their foods and incomes. It is also essential to ensure against vulnerability and risk related to climatic conditions for populations which are highly dependent on rainfed agriculture for their livelihoods (Sanfo, 2009).

Family poultry is an important component in the economy of developing countries, representing a source of cash incomes for rural and economically disadvantaged households. There are several species of poultry out of which guinea fowl, which production fit very well with the climatic conditions of Burkina Faso regarding rainfall; the relatively lower rainfall which characterize roughly 90% of the three ecological areas, are ideal for guinea fowl production (Mahaka, 1990; Ikani and Dafwang, 2004). Compared to chicken and turkey, and according to several authors (Microlivestock, 1991; Ikani and Dafwang, 2004; Bonkoungou, 2005; Sayila, 2009), guinea fowls populations are generally resistant to most of the common viral diseases affecting poultry such as Newcastle disease, Fowl pox and Gumboro which decimate affected poultry populations, and are well adapted to traditional breeding production systems. However, mortality rate is dramatically higher in guinea fowl, mainly in rainy season and affecting young individuals with an average rate of 90%.

In Burkina Faso, the Guinea fowl population numbered 8 463 000 heads (MRA, 2014). It is reared throughout the country land (Sawadogo, 1995).

Apart from cash incomes generation, Guinea fowl plays a nutritional, cultural and social roles in African societies (Sanfo, 2009; Dahouda, 2003).

Although, guinea fowl production constitutes one of the key incomes sources for rural communities, there are very few detailed studies given comprehensive description of the flocks and smallholders characteristics and typology of their production system in Burkina Faso.

Therefore, this study aim to describe diversity in guinea fowl farming practices in a context of limited references on this specie, in order to plan further development efforts, to enhance Guinea fowl productivity in Burkina Faso.

Materials and methods:-
Sites, Sampling and data collection:-
Sampling was carried out in a total of 25 villages belonging to 5 provinces in the three ecological areas of Burkina Faso:

The Sahel area (Seno province) which is an arid area covering the northern part of Burkina Faso (from latitude 13° 5’ N to 15° 3’ N, approximately) with annual rainfall <600 mm, temperatures varying from 15°C to 47°C, and grassy, bushy, shrubby and thicket steppe vegetation, usually quite sparse, with ligneous species that may locally form penetrable bushes.

The Sudan-Sahel area (Sanguié, Gourma and Boulgou provinces) is a transitional zone with regards to rainfall and temperature. It covers the central part of the country (roughly from latitude 11° 3’ N to 13° 5’ N), with a short rainy season from June to September and very variable rainfall with average of 750 mm. Per year, temperatures varying between 20°C and 42°C, and vegetation varying from North to South with better hydric conditions, from the Sahel to the Sudan savannah and can eventually tend toward a clear forest in the Southwestern extreme of the zone.

The Sudan area (Poni province) covers Southern of Burkina Faso (latitude from 9° 3’ N to 11° 3’ N), shares with the Sudan-Sahel area a similar rainy season with annual rainfall >900 mm and a predominance of woodlands and both Sudanese and Guinean savannahs type. Temperatures are relatively low varying from 17 °C to 35 °C.

The sampling sites are described in figure 1.

A transversal survey was conducted in the three agro-ecologic zones of Burkina Faso from April to May 2016. A total of 100 guinea fowl keepers were selected with the approval of extension services in charge of animal resources
into their respective areas, and the only condition considered was to own a minimum of 5 heads of guinea fowl in their flock.

Data collected included socio-economic characteristics of smallholders (age, ethnic group, sex, education level) and their household (location, type of vegetation around, type of livestock owned, breed owned). The survey covered also guinea fowl production system including breeding objective, feeding practices, health management, reproduction and breeding management.

The detailed description of sampling is given in table 1.

**Data analysis:**
The typology of guinea fowl farming carried out in this study, took into account different elements of a farming system, the farmer, the herd and the management system including health, reproduction and breeding as stated by Gibson *et al.* (1990). All statistical analyses were performed using R Version 3.1.0 (R Core Team, 2015).

Descriptive statistics were first performed to determine the sampled herd characteristics. Multiple correspondence analysis (MCA) and hierarchical classification analysis (HCA, Ward’s algorithm) allowed establishing the typology using the FactoMineR package of R (Lê *et al.*, 2008).

Sixteen significant variables were used for this typology and the details are given in table 2.

**Results:**
**Socio-economic characteristics:**
Table 3 summarizes socio-economic characteristics of the 100 breeders involved in this study. Guinea fowl farms are mainly headed by men (93%). However, 20% of farm headers are women in Sahelian area.

Breeders belong mostly to Fulani ethnic group (31%) followed by Mossi (30%), Gourounsi (19%) and Lobi (13%) depending on the survey location. Lobi (70%) and Fulani (20%) were the most represented ethnic groups in Sudan area while roughly 92% are Fulani in Sahel area. Sudan-Sahel area is a mixed one composed by several ethnic groups, such as Mossi (55%), Gourounsi (35%) and Fulani (7%).

About 61% of the respondents were Muslim (100% in Sahelian area) whereas the remaining 23% and 16% are Catholic and Animists respectively.

Regarding age, the survey respondents ranged from 30 to 80 years old with an average of 47.7. The largest proportion (55%) of the respondents was more than 50 years old.

The Guinea fowl flocks size are mainly between 0-50 individuals (90, 85 and 65% respectively in Sudan, Sudan-Sahel and Sahel area). Only 8% (Sahel) and 10% (Sudan) of flock in Sudan area have more than 100 heads of Guinea fowl.

It was mainly the responsibility of women and children (80% of women and 74% of children) to feed and offer water to local guinea fowls. Their role is also focused to herd management while men are responsibles for marketing of Guinea fowl and Guinea fowl products.

About 81% of the respondents received no training in poultry and guinea fowl breeding and 59% of the interviewed were illiterate while 16% read and write in Arabic.

Twelve (12%) percent and 11% went through primary or secondary cycles respectively. Only 2% of interviewees have university level.

Most respondents (68%) were fully involved in Agriculture as main means of livelihood and 23% are involved mainly in livestock keeping (guinea fowl and others species). The remaining 9% of the respondents were merchants.

**Guinea fowl production system:**
The characteristics of the guinea fowl production systems are summarized in table 4. Three main productions
systems have been described in this study: the free-range, semi-free range and intensive production systems. The most predominant production system described is the free-range system (65%). However the predominant system in Sahel area is the free-range system (80%). In general, there is no separate housing system for guinea fowl in the study area (Table 4). About 63% of the respondents reported that guinea fowl share house with poultry in henhouse during night time while during day time, they scavenge around the house along with other domestic animals. This housing system is encountered in Sahel area (32%), Sudan (70%) and Sudan-Sahel areas (82%). In Sahel area, 84% of respondents declared that guinea fowl mainly perch on trees during nighttime.

Housing facilities in the areas are made with local and traditional materials, usually in banco mixed with straw.

The initial breeding stock were constitutes through three main different ways: inherited, purchased and gift. A considerable number of the farmers (82%) acquired their initial breeding stock through purchase from markets.

The main motives for keeping guinea fowl were profit; with 76%, 60% and 66% of interviewees keeping them for their high amount of egg, meat quality (organoleptic) and high price value respectively. However, differences are noted between sampling sites. The most reasons reported by Sudan and Sudan-Sahel smallholders were, the amount of egg (100% in Sudan area, 82% in Sudan-Sahel area), the meat quality (90% in Sudan area and 69% Sudan-Sahel area), high price (65% in Sudan area and 58% Sudan-Sahel area) and productivity (55% in Sudan area and 25% Sudan-Sahel area while in Sahel area guinea fowl are primarily kept for their high sales price (92%) followed by the amount of egg (44%) and productivity (36%). Moreover, breeders in Sudan area, the cultural and ritual reasons prevailed for keeping this specie (40%).

Home consumption and marketing of the guinea fowl products:-
According to interviewees, Guinea fowl and eggs were used for breeding (88% and 98% of citation respectively), self-consumption (99% and 97% of citation respectively), sale (93% and 83% of citation respectively) and donations (91% and 94% of citation respectively). Self consumption improves the supply of breeders in animal protein improving their income. Donation allow the maintenance of relationships and social cohesion (90%). The products were sold mainly in the breeder’s home (in 80% of cases) and others market in the village (in 60% of cases) in the Sudan and Sahel areas. However, in Sudan-Sahel zone, the poultry products were mainly sold at home (63%) and at the village market (46%). Eggs price was the highest in the Sahel (502.22 FCFA), while that of the guinea fowl was highest in Sudanese zone (2631 FCFA for females and 2675 FCFA for males).

Feed resources and feeding practices
The results of this study show that there is no formal specific feeding practice of guinea fowl in Burkina Faso. Scavenging feeding is practiced by 100% of respondents in the three agro-environmental zones. However, depending on the sampling area, scavenging feeding system is coupled with cereals distribution.

The distributed feed resources include mainly sorghum (68% and 64% respectively for young and adult guinea fowl), millet (60% and 52% respectively for young and adult guinea fowl) and maize (43% and 50% respectively for young and adult). The others feed resources (6%) consist in insect, termites and kitchen wastes.

Foods are distributed two to three times a day especially in the morning upon opening the henhouse, afternoon and/or evening. In Sudan area, foods were mainly distributed in the morning and lunchtime. In Sudan-Sahel and Sahel zones, distribution is made two times a day, in the morning and evening (Table 5).

Diseases and predation:-
Diseases and predation were recorded as the major factor limiting rural household guinea fowl production system in the sampling areas. The most common predators are cats, snakes and eagles. Overall, mortality is mainly related to those two constraints, 94% and 61% respectively for diseases and predation. The associated symptoms reported are mainly drooping wings (73%), somnolence (58%) and tremor (55%) (Table 6).

Health management:-
High percentage of farmers does not offer health interventions to sick Guinea Fowl. But some breeders often use ethno-veterinary medicine based on herbal plants in form of decoctions and infusions merged with drinking water. Mainly breeders in Sahel area, for prophylactic purpose use ethno-veterinary medicine, while breeders in Sudan-
Sahel and the Sudan areas use modern (conventional) medicine, respectively at 73% and 65% prevent diseases (Table 6).

**Constraints in guinea fowl production:**
The main constraints reported in this study were: health care problem (77%), mortality (65%), problem related to breeding techniques (57%) and predators (54%) (Table 7).

**Typology:**

**Multiple correspondence analysis (MCA):**
Multiple correspondence analysis (MCA) was applied on 16 variables with 55 modalities (Table 2). Two main factors representing 21.8% of total variation (Figure 2) allowed clear discrimination of breeders following those modalities. Axis 1 (Figure 2) opposes modalities related to intensification (health care, supplementation and semi-intensive system) on positive coefficient to those for extensive practices on the negative coefficient. Modalities describing extensive breeding system are associated mainly with breeders in Sahel area, with few experiences in guinea fowl breeding (less than 10 years), animals straying system and absence of shelters for birds (Guinea fowl perch on tree branches). Guinea fowl of these breeders do not benefit from supplements and special health care. These breeders are using ethno-veterinary medicine to treat guinea fowl. Most women of the sample were shown a link with this axis. The last group of modality describing intensive herding is associated with Sudan and Sudan-Sahel breeders with high experience in breeding of guinea fowl (above 10 years). These breeders practice a semi-straying system for the most and confined system for only a few parts of these smallholders. They have a shelter for guinea fowl, distribute a feed supplementation and have access to health services. Axis 2 shown a link with variables related to occupation and level of education of breeders. Indeed, in the positive coefficients of this axis, breeders with professional activities other than agriculture and livestock were found with high level of education (secondary and higher). Young breeders (30-50 years) were also found in this group, they have a large flock size of guinea fowl (superior to 100). At the negative coefficient, the professional activities of breeders is mainly agriculture or livestock, they have a low level of education, are elderly and have a small number of guinea fowl.

**Hierarchical classification and clusters’ description:**
Hierarchical clustering was performed on the 16 variables (Table 6) and allows retaining four clusters (Figure 3).

The proportions of the modalities that are most represented in different clusters are given in Table 8.

Group 1 (31 breeders) represents the breeders practicing traditional breed system. All Sahel breeders and 71% of women are in this group. The modalities related to extensive system, describe above on axis 1 positive coefficient, best describe this group.

Group 2 (47 breeders) consists of individuals with high level of education (82% of group individuals have a secondary level). Young breeders practicing intensive farming system characterize this group.

Group 3 includes only two individuals with high education level and where the breeding system is intensive in confinement mode.

Group 4 (20 breeders) consists on individuals with high experience in guinea fowl breeding. Those breeders practice feed supplementation and take care to their animals. 88% of farmers in this group have acquired their herd by buying and heritage.

**Discussion:**

**Description of breeders:**
The largest proportion of breeders (55%) in this study was in advanced ages, more than 50 years old and only 45% were between the ages of 30 and 50 years. It appeared that Guinea fowl breeding is mainly dedicated to residents with advanced ages. This observation coincide with that reported by Teye and Adam (2000), thinking that residents under 20 years of age were barred from rearing guinea fowl. The economic condition of young residents in rural area might not allow this category to have their own flocks. However, young breeders are more susceptible to adopt new technologies than advanced age breeders and this could constitute an inconvenient for the production improvement.
Results showed that majority of farmers in this study were male (93%). Guinea fowl breeding appeared to be a predominantly male occupation in all three agro-ecological areas of Burkina Faso, linked to socio-economic considerations telling that animal rearing is traditionally male dominated (Bounkoungou, 2005; Saina, 2005; Avornyo et al., 2016). Relative higher proportion of female farmers was found in Sahelian area due to the establishment of an innovative platform on guinea fowl breeding in this area, which takes into account gender issue. These results are in line with those shown before by Dankwa et al. (2000) in West Mamprusi district of Ghana. This is congruous also to the submission of Gueye (1998) who reported that approximately 70% of guinea fowl were under the control of women in rural Sub-Saharan Africa.

However, those results are in contrast with the case of Zimbabwe, where about 89% of surveyed farmers were female (Ndiweni, 2013).

Most of the farmers interviewed (59%) had no formal education. The estimate given by Teye and Adam (2000) was very similar, about 60%. Also, about 81% of respondents received no training in poultry and guinea fowl breeding. The results suggested that guinea fowl production was still largely the occupation of illiterates’ farmers and training in breeding is highly needed to improve breeding practices as noted by Kwesisi et al. (2015).

Crop production is the main occupation of the interviewed breeders. This covers food needs and constitutes the main source of income for rural families. However, this activity is precarious and dependent to the rainy season and cannot meet farmer’s food needs throughout the year. So, guinea fowl rearing could be a good opportunity for rural households to access a source of animal protein (meat and eggs) as well as the potential to generate income through the sale of guinea fowl and/or eggs (Magothe et al., 2012; Yakubu et al., 2013). The intense production periods and sale of Guinean fowl products coincide with the financial needs of farmers for the purchase of food (Idi, 1996).

The main motives for rearing guinea fowl in our study areas, compared to hen was the high amount of egg, the relative best price, meat quality, and productivity. These perceptions of guinea fowl are consistent with scientific literature. Indeed, Bonkoungou (2005) and Sanfo et al. (2007) showed a productivity of 80 to 100 eggs per year with an average of 97 eggs for guinea fowl in Burkina Faso, considering this specie as good layer, compared to local hen, which produce only 50 eggs per year (Hien, 2002). Ikani and Dafwang (2004) in Nigeria and Saina (2005) in Zimbabwe reported that eggs and meat qualities of guinea fowl were higher than those of hen. Baeza et al. (2001) reported higher protein content in guinea fowl meet compared to chicken. A rate of 23% and 21% were reported respectively for guinea fowl and chicken (IEMVT, 1983).

Breeders in this study mentioned a variety of reasons for keeping guinea fowl. The majority of households offers them for sale to solve families’ specific needs and consumed during special social events (Somda, 1987). Home consumption was another good reason why village guinea fowls are kept (Nagalo, 1984; Somda, 1987; Yakubu, 2013). The marketing of guinea fowls at the adult stage could be attributed to consumers’ preference, and the higher price they attract.

Production systems:

The semi free range production system practised by the majority of the farmers in this study was similar to the system adopted on village poultry by smallholder farmers in most sub-Saharan African countries (Idi, 1996; Dahouda, 2003; Saina, 2005). This system is widely used in Bangladesh for rearing of chickens (Swan, 1999). However, it is noted that the production system is highly related to the geographic area and this is confirmed by the typology; the free range production system is predominant in Sahelian area (80%). This system is well-known in West Africa is integrated in the poultry rearing system where birds of different age and species scavenge together (Sanfo et al., 2008). Its constitutes an important resource for resource-poor farmers in some countries, especially in developing countries. Improvements in this type of farming are of economic importance, because they involve the entire rural population. These improvements include placing drinking water at the disposal of the birds, and protecting their health.

In semi free range system, there was virtually no appropriate habitat for the protection of guinea fowl. The few shelters encountered in this study, are made with traditional materials (bacon or straw). The major constraint of this housing system is their confinement, poor ventilation with difficulties for cleaning. They are inappropriate and do not provide good protection to guinea fowl against bad weather and predators, that are the main causes of mortality. These observations are consistent with those made by Pousga (2009); Moula et al. (2012). Dahouda et al. (2007)
where 80% of henhouses are built in bacon and 73% with straw in rural areas. In Sahelian zone (graphical representation of modalities on axe1, positive coefficient and cluster 1), individuals were in total freedom in the majority of cases. In this area, the birds do not benefit any shelter and they spend the whole night roosting in trees (Boko, 2004; Dahouda et al., 2007) exposing them to predators and bad weather.

**Production management:**

It is shown in this survey that hatching commence during the rainy season. Similar results were obtained by Dahouda et al. (2007).

The incubation of guinea fowl eggs is commonly done naturally. Most smallholder farmers use chicken and duck to hatch guinea fowl eggs, as the guinea hen will often leave the nest after only a few guinea keets hatch (US Department of Agriculture, 1976). This behavior has been observed in Benin (Dahouda et al., 2007) and Burkina Faso (Bonkoungou, 2005). This allowed to improving guinea fowl egg hatchability, by inhibiting their brooding instinct and limit losses of keets as hens take more care of them.

Scavenging, consisting of wide range of flora and fauna (insects, leaves, grains) is the main feeding system under free-range and semi free range guinea fowl production systems in Burkina Faso. The same founding was reported in Zimbabwe (Saina, 2005). Guinea fowl has competitive advantages over chicken as a free ranging bird consuming non-conventional feed that is not used in chicken feeding (Nwagu and Alawa, 1995; Bonkoungou, 2005; Goromela et al., 2006; Dahouda et al., 2007; Pousga, 2009). However, in some cases they received feed supplementation. The main foods distributed in the three areas were sorghum, millet and maize. Similar observations have been reported in Burkina Faso (Bonkoungou, 2005) and Zimbabwe (Saina, 2005). This is different in India (Gawandé, 2007) where the food distributed to guinea fowl is mainly composed of rice. Regarding these observations, it seems that the type of supplementation distributed to guinea fowl depends on the cereal crops of each country. The food is distributed two to three times a day especially in the morning upon opening the henhouse before straying, afternoon and / or evening. Breeders, mainly, those of Sudan and Sudano-Sahelian areas, take more care of the keets by providing supplements termites which are a significant source of protein for guinea fowl. These farmers were filed essentially cluster 3 of typology groups. Practice of supplementation is not a particularity of this study, indeed, Dahouda et al. (2007) showed that a considerable number of breeders in Benin distributed supplements twice daily (37%) or three times a day (33%) and the rest did it occasionally. Principal purpose of food distribution was the domestication of the fowl by creating a habit of behavior.

In traditional poultry farming, diseases have been identified as one of the major constraints affecting productivity. They are caused by inadequate housing system, bad weather conditions and the absence of vaccination (Jagne et al., 1991). Ignorance, poverty and negligence were the reasons given by farmers for the poor vaccine coverage as already reported in Cameroon by Fotsa (2008). The way of treatment vary from one region to another. These observations are supported by the typology. The breeders of the cluster I represented by mostly breeders of the Sahel area are opposed to those from other clusters with breeders of Sudan and Sudan-Sahel regarding Health management.

This difference relies in the way of prevention against diseases and treatments of guinea fowl. Farmers in Sudan-Sahel and Sudan area used extensively vaccination as a means of prevention while the Sahel farmers do not vaccinate their animals. Despite this difference, the mortality rates are almost equal in the 3 surveys areas. This latter observation can be explained by the failure to respect vaccination programs (Gawande et al., 2007), the inadequate way to conserve vaccines (Fosta, 2008). In addition, referring to methods of treatment, the Sudan and Sudan-Sahel areas use modern and traditional methods. However, use of modern medication techniques is less in practice Sahel area (cluster1). Gawandé et al. (2007) attribute this difference to non-access to veterinary services due to the distance of the breeders.

**Constraints related to raising the guinea fowl:**

In this study, the main constraints were in health problem, high mortality, problem related to breeding techniques and predation. In traditional breeding system, the guinea fowl are in rudimentary shelters during nighttime where there is no care. In this system, poultry should be robust and fairly productive and not requiring special care (Sharma, 2007). Thus, significant progress remains to be made in the three areas to improve health status in order to minimize losses.
The high mortality rate of guinea fowl particularly keets, is a major problem and is a source of discouragement for farmers. Dahouda et al. (2007) found during their study that the large losses are recorded during the first month of breeding. These losses would be caused by cold and rain and probably by parasites. According to Le Coz-Douin (1992), the system of thermoregulation of the guinea fowl is ineffective during the first weeks of their life.

Technical constraints may be minimized by focusing on breeders’ training, strengthening their capacity to flock management.

![Sampling sites](image1)

**Fig 1:** Map describing the sampling areas.

![MCA](image2)

**Fig 2:** Graphic representation of modalities on axis 1 and 2
Fig 3: Graphic representation of clusters on axis 1 and 2 (the numbers correspond to breeders' identifiers).

Table 1: Description of sampling

| Provinces | Villages            | Number of interviewed farmers per area |
|-----------|---------------------|----------------------------------------|
| Sanguié   | Tio                 | 7                                      |
|           | Baleledo            | 8                                      |
|           | Tenado              | 2                                      |
|           | Tiogo               | 3                                      |
| Gourma    | Namougou            | 4                                      |
|           | Fada                | 11                                     |
| Boulgou   | Malenge             | 2                                      |
|           | Soungdin Peulh      | 2                                      |
|           | Kampoaga            | 8                                      |
|           | Sougri              | 2                                      |
|           | Lagwenda            | 3                                      |
|           | Tenkodogo           | 2                                      |
|           | Zougnobghim         | 1                                      |
| Seno      | Debere talata       | 5                                      |
|           | Towgel              | 9                                      |
|           | Yakouta             | 6                                      |
|           | Bangue              | 2                                      |
|           | Katchari            | 1                                      |
|           | Djomga              | 1                                      |
|           | Dori                | 1                                      |
| Variables                  | Codes   | Modalities                      |
|----------------------------|---------|---------------------------------|
| Poni                       | Gaoua   | 6                               |
| Gonfera                    | 9       |
| Hella1                     | 3       |
| sibera                     | 1       |
| Bouroum-bouroum            | 1       |
| Total                      | 25      | 25                             |
|                             | 55      | 20                             |

### Table 2: Variables used in MCA and HCA for the typology of guinea fowl production system in Burkina Faso

| Variables                  | Codes   | Modalities                      |
|----------------------------|---------|---------------------------------|
| Sampling area              | region  | Sahel : sahel                   |
|                            |         | East : East                     |
|                            |         | SWest : South West              |
|                            |         | Mweste : Midwest                |
|                            |         | CEast : East center             |
| Sex                        | sex     | Men                             |
|                            |         | Women                           |
| Age                        | age     | young : between 30 and 50 years |
|                            |         | old : between 50 and 60 years   |
|                            |         | Veryold : more than 60 years    |
| Instruction’s level        | level   | anyle : no education level      |
|                            |         | koran : koranic school          |
|                            |         | Primary : primary level         |
|                            |         | Second : secondary level        |
| Literacy in local language | alphab  | noalphab : no literacy in the national language |
|                            |         | alpha : literacy                |
| Training in breeding       | formati | noformat : received no training in breeding |
|                            |         | formation : received training in breeding |
| Main occupation            | agri    | agri : farmer                   |
|                            |         | breed : breeder                 |
|                            |         | Qteach : koranic teacher        |
|                            |         | nursman : nurserman             |
|                            |         | orph : manager of an orphanage  |
|                            |         | ambu : ambulance driver         |
|                            |         | teach : teacher                 |
|                            |         | dress : dressmaker              |
|                            |         | topo : topographer              |
|                            |         | electricien : electrician       |
| Number of guinea fowl      | effect  | low : less than 50              |
|                            |         | inter : between 50 and 100      |
|                            |         | larg : more than 100            |
| Experience in breeding     | experien| peu : less than 10 years experiences |
|                            |         | mieux : between 10 and 20 years experience |
|                            |         | expert : more than 20 years experiences |
| Breeding system            | mode    | Divag : Free-range system       |
|                            |         | Semi: guinea fowl left in semi-straying |
|                            |         | claust: guinea fowl breed in cloistering |

### Table 2 (continued): Variables used in MCA and HCA for the typology of guinea fowl production system in Burkina Faso

| Variables                  | Codes   | Modalities                      |
|----------------------------|---------|---------------------------------|
| Acquisition mode           | acquis  | Mode 1: purchased and/or donation |
|                            |         | Mode 2: inherited and/or donation |
|                            |         | Mode 3: donation                |
|                            |         | Mode 4: purchased and/or inherited |
| Health | Mod0: use of self medication medicines alone or no care | Mod1: access to health services and used of medicines | Mod2: access to health services and used of veterinary and self medication. |
|--------|------------------------------------------------------|------------------------------------------------------|---------------------------------------------------------------------|
| Supplement for very young | Suppintd nosup1 : no supplementation | sup1 : supplementation |  |
| Supplement for young | Supjeu nosup2 : no supplementation for young | sup2 : supplementation for young |  |
| Supplement for adults | supadlt nosup3 : no supplementation for adults | sup3 : supplementation for adults |  |
| Housing system | habitat branch : trees branches | coop : henhouse | comb : roofing + henhouse or henhouse + branch |

Table 3: Socio-economic characteristics of guinea fowl breeder’s in Burkina Faso

| Variables | Modalities | Smallholders’ percentages |
|-----------|------------|---------------------------|
| Ethnicity of breeder | Fulani | Overall 31 | Sudan 20 | Sudan-Sahel 7 | Sahel 92 |
| Gourounsi | 19 | 0 | 35 | 0 |
| Mossi | 30 | 0 | 55 | 0 |
| Lobi | 13 | 70 | 0 | 0 |
| Others | 07 | 10 | 03 | 08 |
| Sex | Men | 93 | 95 | 98 | 80 |
| Women | 07 | 05 | 02 | 20 |
| Age | Age | 51 | 48 | 52 | 52 |
| Religion | Muslims | 61 | 25 | 56 | 100 |
| Catholic | 23 | 25 | 33 | 0 |
| Animist | 16 | 50 | 11 | 0 |
| Neither | 59 | 65 | 58 | 56 |
| Education | Koranic school | 16 | 05 | 11 | 36 |
| Primary | 12 | 10 | 14 | 08 |
| Secondary | 11 | 20 | 13 | 0 |
| Superior | 02 | 0 | 04 | 0 |
| Literacy in local language | Yes | 10 | 0 | 13 | 12 |
| No | 90 | 100 | 87 | 88 |
| Livestock training | Yes | 19 | 15 | 02 | 24 |
| No | 81 | 85 | 20 | 76 |
| Role of women in breeding | No role | 08 | 21 | 08 | 24 |
| Feeding/watering | 80 | 79 | 87 | 76 |
| Herd management | 33 | 58 | 43 | 0 |
| Marketing of birds | 03 | 15 | 0 | 0 |
| Marketing of eggs | 03 | 11 | 02 | 0 |
| Role of Kids in breeding | No role | 09 | 15 | 11 | 44 |
| Feeding/watering | 74 | 85 | 79 | 52 |
| Herd management | 35 | 60 | 36 | 04 |
| Marketing of birds | 03 | 05 | 04 | 0 |
| Marketing of eggs | 02 | 05 | 02 | 0 |
| Main activity | Crop production | 68 | 65 | 65 | 76 |
| Livestock keeping | 23 | 15 | 27 | 20 |
| Others | 09 | 20 | 08 | 04 |
| Guinea fowl flock size | Low (0-50) | 82 | 90 | 85 | 68 |
| Average (50-100) | 11 | 10 | 05 | 24 |
| High (more than 100) | 7 | 0 | 10 | 08 |
Table 4: Local Guinea fowl farming system characteristics per agro-ecological zone of Burkina Faso

| Variables                        | Breeder’s percentages |
|----------------------------------|-----------------------|
|                                  | Overall | Sudan | Sudan-Sahel | Sahel |
| Farming systems                  |         |       |             |       |
| Free range                       | 33      | 25    | 14          | 80    |
| Semi free range                  | 65      | 75    | 82          | 36    |
| Intensive                        | 02      | 0     | 04          | 0     |
| Guinea fowl housing system       |         |       |             |       |
| Henhouse                         | 63      | 70    | 82          | 32    |
| Branch                           | 32      | 15    | 14          | 84    |
| Mix                              | 05      | 15    | 04          | 0     |
| Foundation stock                 |         |       |             |       |
| Inherited                        | 24      | 10    | 31          | 20    |
| Purchase from market             | 82      | 85    | 84          | 76    |
| Gift                             | 07      | 10    | 07          | 04    |
| Reasons for breeding guinea fowl |         |       |             |       |
| Quantity of egg                  | 76      | 100   | 82          | 44    |
| Quantity of meat                 | 60      | 90    | 69          | 16    |
| High price                       | 66      | 65    | 58          | 92    |
| Productivity                     | 36      | 55    | 25          | 36    |
| Ease of breeding                 | 21      | 40    | 13          | 24    |
| Rusticity                        | 16      | 35    | 13          | 08    |
| Cultural                         | 16      | 40    | 15          | 0     |
| Use of guinea fowl               |         |       |             |       |
| Adaptation                       | 09      | 20    | 09          | 0     |
| Reproduction                     | 88      | 100   | 98          | 56    |
| Consumption                      | 99      | 100   | 98          | 100   |
| Marketing                        | 93      | 90    | 91          | 100   |
| Gift                             | 91      | 85    | 93          | 92    |
| Use of eggs                      |         |       |             |       |
| exchange                         | 05      | 0     | 09          | 0     |
| reproduction                     | 98      | 100   | 100         | 92    |
| consumption                      | 97      | 95    | 100         | 92    |
| Marketing                        | 85      | 75    | 87          | 88    |
| Gift                             | 94      | 90    | 96          | 92    |
| exchange                         | 0       | 0     | 0           | 0     |
| Reason for disposal              |         |       |             |       |
| family feeding                   | 96      | 100   | 96          | 92    |
| cash need                        | 90      | 85    | 91          | 92    |
| social cohesion                  | 90      | 90    | 98          | 72    |
| Price of animals (FCFA)          |         |       |             |       |
| Egg                              | 45.24   | 40.38 | 44.18       | 50.22 |
| Female                           | 2405    | 2631  | 2368        | 2324  |
| Male                             | 2419    | 2675  | 2378        | 2324  |
| Incubation                       |         |       |             |       |
| guinea fowl                      | 14      | 0     | 16          | 20    |
| hen                              | 98      | 100   | 96          | 96    |
| duck                             | 09      | 15    | 07          | 08    |
| turkey                           | 10      | 6     | 18          | 0     |
| artificial                       | 03      | 05    | 04          | 0     |

Table 5: Types of feed and their distribution period in the three agro-ecological zones of Burkina Faso

| Variables                        | Percentages of citation by farmers |
|----------------------------------|-----------------------------------|
|                                  | Overall | Sudan | Sudan-Sahel | Sahel |
| Food type for keets              |         |       |             |       |
| Sorghum                          | 62      | 50    | 54          | 88    |
| Mil                              | 59      | 20    | 60          | 88    |
| Maize                            | 25      | 15    | 38          | 04    |
| Others                           | 06      | 15    | 22          | 24    |
| Food type for young guinea fowl  |         |       |             |       |
| Sorghum                          | 68      | 35    | 71          | 88    |
| Maize                            | 60      | 20    | 60          | 88    |
| Mil                              | 43      | 50    | 56          | 05    |
| Others                           | 06      | 15    | 22          | 20    |
| Food type for adults guinea fowl |         |       |             |       |
| Sorghum                          | 64      | 25    | 65          | 88    |
| Distribution periods for keets | Morning | Noon | Eveniing |
|-------------------------------|---------|-------|----------|
| Mil                           | 52      | 10    | 51       | 88       |
| Maize                         | 50      | 60    | 67       | 04       |
| Others                        | 06      | 15    | 05       | 20       |
| Distribution periods for young guinea fowl | Morning | Noon | Eveniing |
| Mil                           | 96      | 100   | 100      | 88       |
| Others                        | 44      | 90    | 42       | 12       |
| Distribution periods for adults guinea fowl | Morning | Noon | Eveniing |
| Mil                           | 93      | 90    | 96       | 88       |
| Noon                          | 28      | 50    | 31       | 12       |
| Others                        | 52      | 35    | 60       | 48       |
| Supplementation               | Keets   | 65    | 95       | 75       | 08       |
| Young                         | 49      | 35    | 67       | 04       |
| Adults                        | 47      | 35    | 65       | 04       |

Table 6: Causes of mortality, symptoms, prevention and treatment of diseases in the three agro-ecological zones of Burkina Faso

| variables                      | Modalities | Percentages of citation by farmers |
|--------------------------------|------------|-----------------------------------|
| Causes of keets mortality      | Predators  | Overall 61 | Sudan 60 | Sudan-Sahel 60 | Sahel 64 |
|                                | Accident   | 14       | 25       | 15       | 04       |
|                                | Diseases   | 94       | 80       | 98       | 96       |
|                                | Others     | 15       | 35       | 11       | 08       |
| Causes of adults mortality     | Predators  | 19       | 55       | 07       | 16       |
|                                | Accident   | 14       | 25       | 13       | 08       |
|                                | Diseases   | 58       | 50       | 58       | 64       |
|                                | Others     | 20       | 30       | 23       | 08       |
| Symptoms of diseases encountered| Diarrhea   | 52       | 65       | 40       | 68       |
|                                | Cough      | 09       | 25       | 04       | 08       |
|                                | Drowsiness | 58       | 80       | 60       | 36       |
|                                | Smallpox   | 11       | 15       | 11       | 08       |
|                                | Drooping wings | 73    | 85       | 87       | 32       |
|                                | Swelling of the head | 15    | 15       | 18       | 08       |
|                                | Trembling of paws | 55    | 40       | 67       | 04       |
| Diseases prevention            | Housing hygiene | 43    | 50       | 58       | 12       |
|                                | Vaccination | 47       | 75       | 53       | 0        |
|                                | Others      | 29       | 05       | 25       | 04       |
| Treatment diseases             | Vitamin    | 40       | 50       | 53       | 04       |
|                                | Deworming  | 27       | 30       | 36       | 0        |
|                                | Antibiotics | 54       | 65       | 73       | 04       |
|                                | Traditional treatment | 48    | 40       | 58       | 04       |

Table 7: Constraints and recommendations

| Variables                      | Percentages of citation by farmers |
|--------------------------------|-----------------------------------|
| Constraints in livestock       | Overall 46 | Sudan 35 | Sudan-Sahel 50 | Sahel 48 |
| Lack of henhouse              | 20       | 65       | 11       | 04       |
| Lack of laying nest           | 77       | 75       | 81       | 68       |
| Health problem                | 11       | 15       | 15       | 0        |
| Lack of water                 | 54       | 90       | 41       | 52       |
| Mortality                     | 65       | 80       | 80       | 20       |
| problem of breeding           | 57       | 85       | 56       | 36       |
Table 8: Distribution of breeders in clusters for the most relevant modalities

| Modalities          | Cluster 1 | Cluster2 | Cluster3 | Cluster4 |
|---------------------|-----------|----------|----------|----------|
| Coop                | -         | 57.1     |          |          |
| Branc               | 90.6      | -        |          |          |
| East                | -         | 100      |          |          |
| SWest               | -         | 85       |          |          |
| Mweste              | -         | -        | 100      |          |
| Sahel               | 100       | -        | -        |          |
| moda0               | 84.4      | -        | -        |          |
| moda1               | -         | -        | -        | 40.8     |
| moda2               | -         | 64.7     | -        |          |
| Semi                | -         | 60       | -        | 32.3     |
| Claust              | -         | -        | 100      |          |
| Divag               | 84.2      | -        | -        |          |
| nosup1              | 67.6      | -        | -        |          |
| nosup3              | 52        | -        | -        |          |
| nosup2              | 52        | -        | -        |          |
| Super               | -         | -        | 50       |          |
| Second              | -         | 81.8     | -        |          |
| Koran               | 62.5      | -        | -        |          |
| Anyle               | -         | -        | -        | 30.5     |
| Woman               | 71.4      | -        | -        |          |
| Man                 | 30.1      | -        | -        |          |
| sup3                | -         | -        | -        | 44       |
| sup2                | -         | -        | -        | 44       |
| sup1                | -         | -        | -        | 34.8     |
| Larg                | -         | -        | 28.5     | -        |
| Topo                | -         | -        | 100      | 88.8     |
| Electri             | -         | -        | 100      | -        |
| Breed               | -         | -        | -        | 47.8     |
| Expert              | -         | -        | -        | 60       |
| Bett                | -         | 65.6     | -        | -        |
| mod2                | -         | -        | -        | 55.5     |
| mod1                | -         | 55.1     | -        | -        |
| young               | -         | 65.2     | -        | -        |

Conclusion: 
Guinea fowl is central to many circumstances of socio-cultural, economic and religious of the rural households in Burkina Faso. The breeding of this bird is a socio-economic activity that allows farmers to have animals’ protein and incomes. It was clear from our study that this activity present insufficiencies in health level, housing and feeding. These constraints are an obstacle for production development. However, the increase of poultry productivity is an important mean to fight against rural poverty and to meet the needs of producers. For this, technical constraints
raised in this study have to be minimized by focusing on the formation of farmers. Genetic can also contribute to the improvement of productivity and for this, a characterization of different populations would be needed.

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References:-
1. Avornyo, F. K., Salifu, S., Panyan E. K., Al-Hassan B. I., Ahigbe, M., Yeboah, F. (2016): Characteristics of guinea fowl production systems in northern Ghana. A baseline study of 20 districts in northern Ghana. Livestock Research for Rural Development. Volume 28, Article #134. Retrieved May 31, 2017, from http://www.lrrd.org/lrrd28/8/avor28134.html
2. Baeza, E., Juin, H., Rebours, G., Constantin, P., Marche, G., Leterrier, C. (2001): Effect of genotype, sex and rearing temperature on carcass and meat quality of guinea fowl. Br. Poult. Sci. 42:470- 476.
3. Boko, C. K. (2004) : Contribution à l’amélioration de l’élevage villageois de la pintade locale dans le Département du Borgou (Nord-Est du Bénin). Mémoire de DEA. Université de Liège, Faculté Universitaire des Sciences Agronomiques. 45p.
4. Bonkoungou, G. F. X. (2005): Characteristics and performance of Guinea fowl production under improved and scavenging conditions in the Sahelian region of Burkina Faso. M.Sc. Thesis. The Royal Veterinary and Agricultural University. Copenhagen. Denmark. 68 p.
5. Dahouda, M., Toleba, S.S., Youssao, A. K. I., Banikogui S., Yacoubou Aboubakari, S., Hornick, J. L. (2007): Contraintes à l’élevage de la pintade et composition des cheptels dans les élevages traditionnels du Borgou au Bénin. Aviculture Familiale. 17,1-2
6. Dahouda, M. (2003) : Elevage de la pintade locale dans le Département du Borgou au Bénin: comparaison des caractéristiques de production en station et en milieu rural. Mémoire de DEA. Faculté de Médecine Vétérinaire de Liège. Belgique. 35 p.
7. Dankwa, D, Nelson, F. S., Mzamo, K. B., Oddoye, E. O. K. (2000): A survey of rural poultry management in the West Mamprusi District and the Ga Rural District of Ghana. Ghana Journal of Agricultural Science, 33: 71 – 77. Retrieved March 24, 2016 from www.gains.org gh/articles/gias_v33_p71 _77
8. Fotsa, J.C. (2008) : Caractérisation des performances de poules locales en station expérimentale. In : Fotsa J.C., Caractérisation des populations de poules locales (Gallus gallus) au Cameroun. Thèse de doctorat, Université de Dschang. 301 p.
9. Gawandé, S.S., Kalita, N., Barua, N., Saharia, K. K. (2007) : Elevage du poulet local en milieu rural d’Assam (Inde). Aviculture Familiale Vol. 17, No. 1et 2.
10. Goromela, E. H., Kwakkel, R. P., Verstegen, M. A. W., Katule, A .M. (2006): Strategies to optimize the use of scavenging feed resource base by smallholders in traditional production systems in Africa: A review. African Journal of Agricultural Research. 1(3), 091-100.
11. Gueye, E. F. (1998): Poultry plays an important role in African village life. World’s Poultry Science Journal 14: 14-17.
12. Hien, O. C. (2002) : Effets de l’amélioration des conditions sanitaires sur le développement testiculaire, la LH et la ponte de la pintade locale au Burkina Faso. Thèse de Doctorat. Université de Ouagadougou. 126 p.
13. I.E.M.V.T. (1983) : Manuel d’aviculture en zone tropicale, deuxième édition. Ministère de la Coopération: Maison Alfort. 186p.
14. Idr, A. (1996) : La méléagriculture au Niger. Rapport final de l’activité "Connaissance des systèmes de production des pintades au Niger". 19 p.
15. Idr, A. (1998): Peasant practices in traditional poultry farming in Niger. International Network for Family Poultry Development Newsletter, Newsletter, 8(3): 2-4.
16. Ikani, E. I., Dafwang, I. I. (2004): The production of guinea fowl in Nigeria. Extension Bulletin No. 207, Poultry Series No. 8. National Agricultural Extension and Research Liaison Services, Zaria, Nigeria. Accessed 23rd May 2011 from http://www.naerls.gov.ng/extmat/bulletins/Guineafowl.pdf.
17. Jagne, J., Aini, I., Schat, K. A., Fennell, A., Touray, O. (1991): Vaccination of village chicken in the Gambia against Newcastle disease using heat resistant food pelleted V4 vaccine. Avian Path. 20,721-724.
18. Kwesisi, V. Oloko, M., Ommeh, S. (2015): Value chain and market performance for poultry in Kenya: case of guinea fowls & quails. International Journal of Management and Commerce Innovations 3(1): 210-220,
Available at: www.researchpublish.com
19. Le Coz-Douin J. (1992): L'élevage de la pintade. Edition point vétérinaire : Maisons-Alfort, 252 p.
20. Lê, S., Josse J., Hussn F. (2008): FactoMineR: An R package for multivariate analysis. Journal of Statistical Software. 25(1):1–18 3.
21. Magothe, T. M., Okeno, T. O., Muhuyi W. B., Kahi, A. K. (2012): Indigenous chicken production in Kenya: 1. Current status. World’s Poultry Science Journal. 68,119-132.
22. Mahaka, S. (1990): Existing rural poultry production systems in Zimbabwe. In Proceedings of a Workshop on Rural Poultry in Africa.ed. E. B. Sonaiya, pp. 177-181.
23. Microlivestock, (1991): Little known small animals with promising economic future. Board on Science and Technology for International Development. Washington, DC: National Academy Press. Washington. pp. 115-125.
24. Moula, N., Detiffe, N., Farnir, F., Antoine Mousiaux, N., Leroy, P. (2012) : Aviculture familiale au Bas-Congo, République Démocratique du Congo (RDC). Livestock Research for Rural Development. Volume 24 Article #74. Retrieved November 13, 2014, from http://www.lrrd.org/lrrd24/5/moul24074.htm
25. MRA, (2014) : Annuaire des statistiques de l’élevage. Document élaboré avec l’appui du Programme d’appui au renforcement de la gestion des finances publiques et des statistiques (Par-Gs) financé par l’Union européenne, 177 pages.
26. Nagalo, M. (1984) : Contribution à l’étude du parasitisme chez la pintade commune (Numida meleagris) en Haute Volta, les helminthes parasites du tube digestif. Thèse Méd. Vét. Dakar. Sénégal.112 p.
27. Ndiweni, N. J. (2013): Prudent poultry farming as a source of livelihood and food security in a changing climate: The case of Zhombe communal lands, Zimbabwe. International Journal of Scientific and Research Publications, 3(10) ISSN 2250-3153.
28. Nwagu, B. I., Alawa, C. B. I. (1995): Guinea fowl production in Nigeria. World’s Poultry Science Journal, 51: 261-270.
29. Pousga, B. (2009) : Synthèse des travaux de recherche en aviculture au Burkina Faso : Rapport de recherche No 4. Réseau International pour le Développement de l’Aviculture Familiale.18 (1/2): 28-35.
30. Core Team, R. (2015) : R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/
31. Saina, H. (2005): Guinea fowl (Numida meleagris) production under smallholder farmer management in Gurove district, Zimbabwe. M. Phil. Thesis. Department of Animal Science. Faculty of Agriculture. University of Zimbabwe.108 p.
32. Sanfo, R. (2009) : Eléments d’analyse de l’élevage villageois de la pintade locale (Numida meleagris) dans le Plateau Central du Burkina Faso. Revue Africaine de Santé et de Productions Animales.
33. Sanfo, R., Boly, H., Sawadogo, L., Ogle, B. (2007): Caractéristiques de l’élevage villageois de la pintade locale (Numida meleagris) au centre du Burkina Faso. Tropicultura. 25 (1): 31-36.
34. Savadogo, A. (1995) : Contribution à l’amélioration de l’élevage de la pintade (Numida meleagris) au Burkina Faso. Mémoire de fin d’études d’ IDR. Option : Elevage. Université de Ouagadougou. 102 p.
35. Sayila, A. (2009): Guinea fowl farming becomes popular in Botswana. World Poultry, 25(10): 30-31.
36. Sharma, R. K. (2007) : Rôle et pertinence de l’aviculture familiale rurale dans les pays en voie de développement: cas particulier de l’Inde. Aviculture Familiale Vol. 17, No. 1et 2.
37. Somda, J. C. (1987): Etude de la croissance des pintadeaux sur plusieurs types d’alimentation et modes d'élevages. Mémoire I.T.D.R. Université de Ouagadougou. 57p.
38. Swan, S. E. J. (1999): The poultry development strategy of the livestock development project in Bangladesh. The Danish Agricultural and Rural Development Advisors Forum. Ed. Frands Dolberg and Poull Henning Petersen. Proceedings of a workshop on poultry as a tool in poverty alleviation and promotion of gender equality. Tune Landboskole, Denmark March 22-26, 1999, pp 128-135.
39. United States, Department of Agriculture, (1976): Raising guinea fowl. Northern Region, Agricultural Research Service, Washington DC. Leaflet No. 519: pp7.
40. Teye, G. A., Adam M. (2000): Constraints to guinea fowl production in northern Ghana: A case study of the Damongo area. Ghana Journal of Agricultural Science 33:153-157.
41. Yakubu, A., Abiniiku, H. K., Musa-Azara, I. S., Idahor K. O., Akinsola O. M. (2013): Assessment of flock structure, preference in selection and traits of economic importance for domestic turkey (Meleagris gallopavo) genetic resources in Nasarawa State, Nigeria. Livestock Research for Rural Development 25, Article 018.