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Socioeconomic impact of African Swine Fever on Pig farming in selected Neighborhoods of Mont-Ngafula, Kinshasa, Democratic Republic Of The Congo

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Abstract : African Swine Fever (ASF) is a highly contagious hemorrhagic viral disease affecting domestic pigs and Eurasian wild boars (*Sus scrofa*). Its case fatality rate can reach 100% in susceptible animals, making it one of the most devastating diseases affecting the global pig industry. Beyond its health consequences, ASF causes substantial socio-economic impacts due to high mortality rates, sanitary culling, and reductions in pig populations.

The present study aimed to assess the socio-economic impact of ASF in pig farms located in selected neighborhoods of the Mont-Ngafula municipality in Kinshasa. A cross-sectional survey was conducted among 123 pig farmers selected through non-probability sampling. Data were collected using a structured questionnaire supplemented by direct observations. Economic losses were estimated based on zootechnical parameters and the economic value of the animals lost.

The results showed that all farms had experienced at least one outbreak of swine epizootic disease, and 60% of the farmers reported substantial mortality losses. Among these outbreaks, 79% were attributed to ASF, while 62% of the farms reported losing animals to the disease. The total economic losses were estimated at USD 450,160. These findings highlight the considerable socio-economic burden of ASF and emphasize the need to strengthen prevention and control measures in pig farms in Kinshasa.

Keywords: Socio-economic Impact; African Swine Fever; Kinshasa.

Résumé : La peste porcine africaine (PPA) est une maladie virale hautement contagieuse, hémorragique, qui affecte les porcs domestiques et les sangliers eurasiens (*Sus scrofa*). Sa létalité peut atteindre 100 % chez les animaux sensibles, ce qui en fait l'une des maladies les plus dévastatrices pour la filière porcine mondiale. Au-delà de ses conséquences sanitaires, la PPA entraîne d'importantes répercussions socio-économiques, notamment en raison des pertes liées à la mortalité élevée, aux abattages sanitaires et à la réduction des effectifs porcins.

Cette étude avait pour objectif d'évaluer l'impact socio-économique de la PPA dans les élevages porcins de quelques quartiers de la commune de Mont-Ngafula à Kinshasa. Une enquête transversale a été menée auprès de 123 éleveurs sélectionnés par échantillonnage

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non probabiliste. Les données ont été collectées à l'aide d'un questionnaire complété par des observations directes. Les pertes économiques ont été estimées à partir des paramètres zootechniques et de la valeur économique des animaux perdus.
Les résultats ont montré que toutes les exploitations avaient été confrontées à au moins un épisode d'épizootie porcine et que 60 % des éleveurs avaient enregistré des mortalités importantes. Parmi ces épisodes, 79 % ont été attribués à la PPA, tandis que 62 % des exploitations ont déclaré avoir perdu des animaux. Les pertes économiques totales ont été estimées à 450 160 USD. Ces résultats soulignent l'impact socio-économique majeur de la PPA et la nécessité de renforcer les mesures de prévention et de contrôle dans les élevages porcins de Kinshasa.

Mots-clés : Impact socio-économique, Peste Porcine Africaine, Kinshasa

1. INTRODUCTION

African swine fever (ASF) is a highly contagious viral hemorrhagic disease affecting domestic pigs and Eurasian wild boar (*Sus scrofa*). It is characterized by mortality rates of up to 100% in susceptible animals and is currently considered one of the most devastating diseases affecting the global swine industry (Ruiz-Saenz et al., 2022). Although ASF poses no zoonotic risk, its animal health, economic, and social impacts are substantial, affecting a wide range of stakeholders, including pig farmers, traders, veterinary services, public authorities, and trading partners(Blome et al., 2020).

The disease evolved in southern Africa within a sylvatic cycle involving warthogs (*Phacochoerus africanus*) and soft ticks of the *Ornithodoros moubata* complex. The movement of live animals and pork products subsequently facilitated its spread throughout sub-Saharan Africa and its introduction into other continents. The introduction of a genotype II virus into the Caucasus region in 2007 marked the beginning of its rapid spread into Eastern and Central Europe, followed by a major expansion into Asia beginning in 2018, particularly in China, before reaching numerous other countries (M.-L. Penrith et al., 2021). This global expansion highlights the need to develop prevention and control strategies tailored not only to the biological characteristics of the virus but also to the socioeconomic contexts in which the disease occurs (M.-L. Penrith et al., 2023).

In Africa, ASF remains endemic in several countries. A retrospective analysis documented more than 5,000 disease outbreaks between 1989 and 2017, several of which were reported in the Democratic Republic of the Congo (M. Penrith et al., 2019). The disease may persist for several decades in certain regions and continue to spread beyond currently affected areas (Schmidhuber et al., 2020). Family-based and small-scale pig farms are particularly vulnerable. In many rural areas of Africa, pigs are raised under extensive or semi-extensive production systems characterized by free-roaming animals, low levels of biosecurity, and limited access to veterinary services (M.-L. Penrith et al., 2021). These conditions facilitate virus circulation and complicate the implementation of effective prevention and control measures.

Beyond its animal health consequences, ASF has substantial socioeconomic impacts. Direct losses are primarily associated with high animal mortality, sanitary culling, and reductions in pig populations. Indirect losses include decreased household income, market disruptions, trade restrictions, increased production and biosecurity costs, and adverse effects on employment and pork value chains (Nguyen-Thi et al., 2021; Niemi, 2020). Studies conducted in Vietnam have shown that ASF outbreaks profoundly disrupted pig production and marketing systems, resulting in substantial economic losses for farmers and other stakeholders throughout the value chain. The impacts also extended to related sectors, such as the animal feed industry, where sales declined by as much as 30-50%, while employment losses were estimated to reach several hundred thousand jobs (Nguyen-Thi et al., 2021).

Research in animal health economics has highlighted that the impacts of epizootic diseases extend far beyond the direct losses observed at the farm level. Animal disease outbreaks can disrupt food systems, affect trade, alter consumer behavior, and generate spillover effects in other agricultural markets (Acosta et al., 2023). In low- and middle-income countries, where pig farming plays an important role in household livelihoods, food security, and poverty reduction, these consequences can be particularly severe (Jean-Pierre et al., 2022).

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In the Democratic Republic of the Congo (DRC), African swine fever (ASF) remains a major animal health constraint to the development of the pig production sector. A study conducted by Mulumba-Mumu (2016) reported a high prevalence of the disease in Mont-Ngafula municipality. Since then, sporadic ASF outbreaks have continued to be reported and officially notified by the National Epidemiological Surveillance Service (SENES) in several provinces across the country, including the city of Kinshasa. In Kinshasa, particularly in Mont-Ngafula municipality, many neighborhoods are home to family-based or semi-intensive pig farms that contribute substantially to household income, the local supply of pork, and the local economy. However, these farms frequently face animal health, economic, and structural constraints, including inadequate biosecurity practices, which may increase their vulnerability to transboundary animal diseases such as ASF. The persistence of ASF therefore highlights the need to assess its socioeconomic consequences for pig farms and the communities that depend on them. In this context, assessing the impacts of ASF in the Lutendele and Kimwenza neighborhoods is essential to better understand its effects on farmers' incomes, production systems, and household livelihoods, and to inform the development of appropriate strategies for disease prevention, control, and mitigation.

Therefore, the overall objective of this study was to assess the socioeconomic impact of African swine fever on pig farms in selected neighborhoods of Mont-Ngafula municipality, Kinshasa. Specifically, the study aimed to identify risk factors associated with the occurrence of ASF, estimate the direct and indirect economic losses incurred by pig farmers, and assess farmers' capacities to prevent and respond to ASF outbreaks.

2. MATERIALS AND METHODS

2.1. Study area

The study was conducted in Kinshasa, specifically in Mont-Ngafula municipality (Figure 1). Investigations were carried out in the neighborhoods of Lutendele, Kimwenza, Matadi-Mayo, Ndjili Kilambu, CPA Mushi, Don Bosco, Kibondo, Kimbwala, Mama Mobutu I, Mama Mobutu II, Mitendi, and Saya, where pig farming represents an important economic activity for many households (Figure 2).

Data were collected over a three-month period, from July 22 to October 21, 2025.

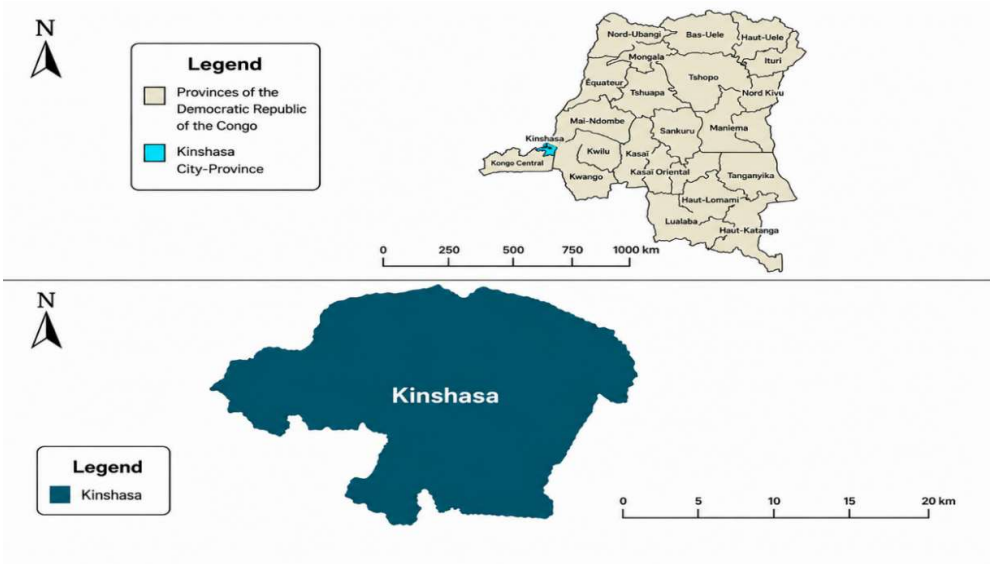


Figure 1 : Vector map of the Democratic Republic of the Congo and the Kinshasa City-Province.

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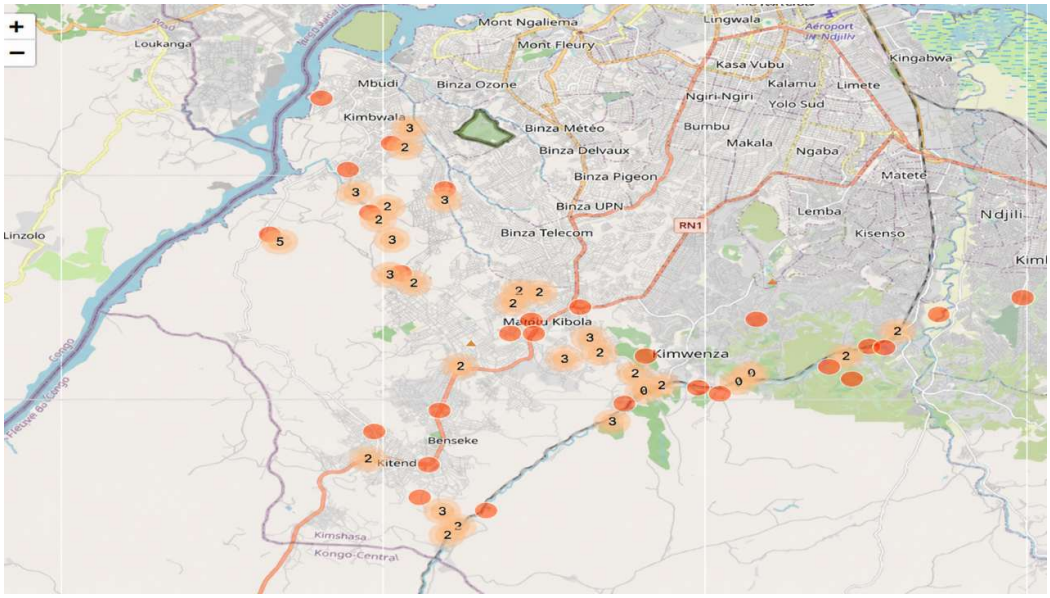


Figure 2 : Map showing the different survey sites in selected neighborhoods of Mont-Ngafula Municipality, Kinshasa, 2025.

2.2. Methods

This study used a mixed-methods approach combining quantitative and qualitative methods to assess the socioeconomic impacts of African swine fever on pig farms in Mont-Ngafula Municipality.

2.2.1. *Study population*

The target population consisted of pig farmers residing in the selected neighborhoods of Mont-Ngafula Municipality, where pig farming represents an important socioeconomic activity for households.

2.2.2. *Inclusion criteria*

The study included farmers who owned an operational pig farm at the time of the survey, had a minimum level of experience in pig farming, and agreed to participate after providing free and informed consent.

2.2.3. *Sample size and sampling*

Purposive (non-probability) sampling was used to select participants. Pig farms were selected based on their accessibility, representativeness within the study area, and the farmers' willingness and availability to participate in the survey. A total of 123 pig farmers were included in the study and distributed across the different neighborhoods surveyed.

2.2.4. *Data collection*

Before data collection, a preliminary phase was conducted to pretest the questionnaire, identify and correct potential inconsistencies, standardize response options, and code the study variables. This phase also provided an opportunity to inform the targeted farmers about the study and obtain the administrative authorizations required to conduct the research.

Subsequently, semi-structured interviews were conducted with pig farmers in the selected neighborhoods using a standardized questionnaire. The interviews were designed to collect quantitative data on pig health, disease-related economic losses, and husbandry practices implemented on the farms. All data were collected electronically using the KoboCollect application, allowing responses to be recorded directly in digital format during field data collection.

2.2.5. *Study variables*

The variables included in the study were defined according to the research objectives to assess factors associated with African swine fever and its socioeconomic impacts on pig farms.

2.2.6. *Dependent variable*

The primary dependent variable was the occurrence of African swine fever or an epizootic disease outbreak on the pig farm.

This variable was coded as a binary outcome:

- **Yes:** farm that had experienced an African swine fever or other epizootic disease outbreak;
- **No:** farm that had not experienced an epizootic disease outbreak.

The socioeconomic impact was assessed using several complementary indicators:

- **Direct economic losses:** animal mortality, reduction in herd size, and decreased production;
- **Indirect economic losses:** reduced income, decreased sales, and increased animal health-related expenditures;
- **Social impacts:** economic vulnerability, livelihood difficulties, and reduced household investment capacity.

2.2.7. *Independent variables*

The explanatory variables analyzed included:

- Farmer's age;
- Sex;
- Educational level;
- Occupation;
- Pig-farming experience;
- Pig breed raised;
- Herd size;
- Feeding system;
- Feeding frequency;
- Source of animals;
- Feeding practices, housing conditions, waste management, and hygiene practices.

2.2.8. Assessment of the impacts of African Swine Fever

2.2.8.1. *Estimation of economic losses associated with pig mortality*

The economic losses attributable to African swine fever were assessed by estimating the market value of pigs that died, together with the value of feed inputs invested before their death. This approach is widely used in animal health economics to quantify direct losses resulting from animal disease outbreaks (Rushton, 2009; FAO, 2019).

2.2.8.2. ***Estimation of feed-related losses***

To standardize the calculations, the average live weight of a market pig was set at 80 kg. This weight corresponds to the commercial live weight commonly observed in semi-intensive and intensive pig production systems in sub-Saharan Africa (FAO, 2018; Ahuja, 2004).

The total amount of feed required to produce a market pig was estimated using the feed conversion ratio (FCR), which represents the quantity of feed required to produce one kilogram of live-weight gain. This indicator is one of the main technical parameters used to assess the production and economic efficiency of pig farming systems (Whittemore & Kyriazakis, 2006; NRC, 2012).

The total amount of feed required was calculated using the following equation:

- $Q_{feed} = W_{pig} \times FCR_{breed}$

- Q_{feed} = total quantity of feed consumed (kg);
- W_{pig} = standard live weight of the pig (80 kg);
- FCR_{breed} = feed conversion ratio for the breed considered.

The feed conversion ratios used for the different breeds were obtained from zootechnical references commonly cited in the scientific literature on pig production (Whittemore & Kyriazakis, 2006; FAO, 2018).

The feed cost invested per pig was subsequently estimated using the following equation:

- $C_{feed} = Q_{feed} \times P_{feed}$
- P_{feed} represents the average cost per kilogram of feed recorded on each farm.

Feed-related losses attributable to pig mortality were then calculated by multiplying the estimated feed cost per pig by the number of pigs that died:

- $L_{feed} = N_{deaths} \times C_{feed}$

This approach provides an estimate of the value of feed resources invested in animals that died before reaching marketable weight, thereby representing a direct economic loss to pig farmers (Otte & Chilonda, 2002; Rushton, 2009).

2.2.8.3. ***Estimation of losses associated with the market value of dead pigs***

Losses in livestock capital were estimated based on the average market value of a live pig at the time of the survey. The economic value of a pig was calculated using the following equation:

- Pig value=Standard live weight×Price per kilogram of live weight

This method is commonly used in economic assessments of animal diseases to estimate direct losses associated with mortality (FAO, 2011; Bennett & IJpelaar, 2005).

Economic losses attributable to mortality were subsequently calculated as follows:

- Livestock loss=Number of pig deaths×Market value per pig

These losses represent the value of productive livestock capital lost as a result of the disease and generally constitute one of the major components of the economic burden associated with African swine fever outbreaks (Costard *et al.*, 2013).

2.2.9. Epidemiological indicators

The magnitude of the disease was assessed using key epidemiological indicators commonly recommended in animal health studies (Thrusfield, 2018; OIE, 2021).

- **Mortality rate:** The mortality rate was defined as the proportion of pigs that died relative to the total number of animals at risk:

- M=(Nm) × 100
- « m » : represents the number of pig deaths and N the total number of pigs at risk. According to Thrusfield (2018), this indicator provides a measure of the severity of a disease outbreak within an animal population.

- **Morbidity rate:** The morbidity rate was defined as the proportion of pigs that developed clinical signs of the disease:

- Mb=(Nc) × 100
- « c » : represents the number of pigs showing clinical signs and N the total number of pigs at risk. This indicator was used to assess the extent of disease occurrence within the affected pig farms (Martin *et al.*, 1987; WOAH, 2021).

2.2.10. Assessment of socioeconomic impacts

The socioeconomic impacts of African swine fever were assessed based on income losses, reductions in household productive assets, and disruptions observed in pork marketing and distribution channels.

According to Perry and Rich (2007), transboundary animal diseases affect not only livestock productivity but also food security, household income, and agricultural markets. Similarly, FAO (2019) emphasized that ASF has substantial consequences for the livelihoods of smallholder farmers, particularly in developing countries.

The main indicators assessed in this study included:

- Income losses associated with pig mortality;
- Reduction in household purchasing power;
- Job losses within the pig value chain;
- Changes in consumer behavior toward pork consumption;
- Changes in the prices of substitute products.

2.2.11. Analysis of Resilience Mechanisms

The resilience analysis focused on the strategies implemented by pig farmers to cope with the impacts of the disease and rebuild their livelihoods. Resilience is defined as the capacity of a system or household to absorb a shock, adapt to its consequences, and recover to an acceptable level of functioning following a disturbance (FAO, 2016 (Béné et al., 2014).

In this study, resilience mechanisms were assessed based on the following indicators:

- Strengthening of biosecurity measures;
- Diversification of income sources;
- Gradual restocking of pig herds;
- Reliance on family or community support networks;
- Access to veterinary services and institutional support.

The assessment of these mechanisms provided insights into the adaptive capacity of pig farms to cope with and recover from the economic and social consequences of African swine fever.

2.2.12. Conceptual framework for assessing the socioeconomic impacts of ASF

This study was based on a conceptual framework in which the socioeconomic impacts of African swine fever (ASF) are considered to result from the interaction of several categories of factors related to farmers' characteristics, animal husbandry practices, and health and biosecurity measures implemented on pig farms.

The framework assumes that farmers' socioeconomic characteristics, including age, educational level, occupation, and pig-farming experience, influence farm management practices. These practices, together with the level of biosecurity and sanitary conditions on the farms, may influence the risk of ASF occurrence.

The occurrence of ASF subsequently results in economic and social consequences that affect farm performance and the livelihoods and living conditions of pig-farming households (Table I).

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Table I **: Conceptual framework for assessing the socioeconomic impacts of African swine fever on pig farms in Mont-Ngafula, 2025**

Model Components	Main Variables	Observed Indicators	Expected Effects
Socioeconomic Characteristics of Pig Farmers	Age, sex, educational level, occupation, and pig-farming experience	Farmer profile	Influence on health management practices and response to disease outbreaks
Animal Husbandry Factors	Herd size, breed, feeding practices, animal origin, housing conditions, waste management, and hygiene practices.	Farm management system	Influence on exposure to animal health risks
Animal Health and Biosecurity Factors	Disinfection, quarantine, veterinary care, water source, and animal origin	Biosecurity level	Reduction or increase in the risk of ASF occurrence
Occurrence of ASF	Presence or absence of the disease	Outbreaks, frequency, and mortality	Onset of socioeconomic impacts
Direct Economic Losses	Mortality, reduction in herd size, and decreased production	Pigs lost and reduced sales	Reduced economic performance
Indirect Economic Losses	Reduced income, increased costs, and limited access to credit	Income losses and additional expenses	Financial vulnerability
Social Impacts	Food insecurity, job losses, and vulnerability	Standard of living, health, education, divorce, and employment	Deterioration in living conditions
Adaptive Capacity	Prevention, biosecurity, and veterinary services	Strategies implemented	Impact mitigation

2.2.13. Data analysis

Following data collection, the data were exported and organized in Microsoft Excel 2015. Statistical analyses were performed using R version 4.4.2.

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3. RESULTS

3.1. Sociodemographic and professional characteristics of pig farmers

3.1.1. *Spatial distribution of pig farmers by neighborhood*

The distribution of pig farmers across Mont-Ngafula Municipality varied among the surveyed neighborhoods. Kimwenza accounted for the largest proportion of pig farms, with 31 farmers (25.4%), followed by Lutendele with 19 farmers (15.6%) and Mitendi with 18 farmers (14.8%).

Intermediate numbers were recorded in Ndjili Kilambu (13 farmers; 10.7%), Matadi-Mayo (12 farmers; 9.8%), and Mama Mobutu II (9 farmers; 7.4%). Lower proportions were observed in Saya (8 farmers; 6.6%), Kimbwala (5 farmers; 4.1%), and CPA Mushi (5 farmers; 4.1%).

The lowest numbers were recorded in Don Bosco (4 farmers; 3.3%), Mama Mobutu I (3 farmers; 2.5%), and Kimbondo (3 farmers; 2.5%).

Overall, the findings indicate a concentration of pig farms in Kimwenza, Lutendele, and Mitendi, which together accounted for more than half of the pig farmers surveyed (Figure 3).

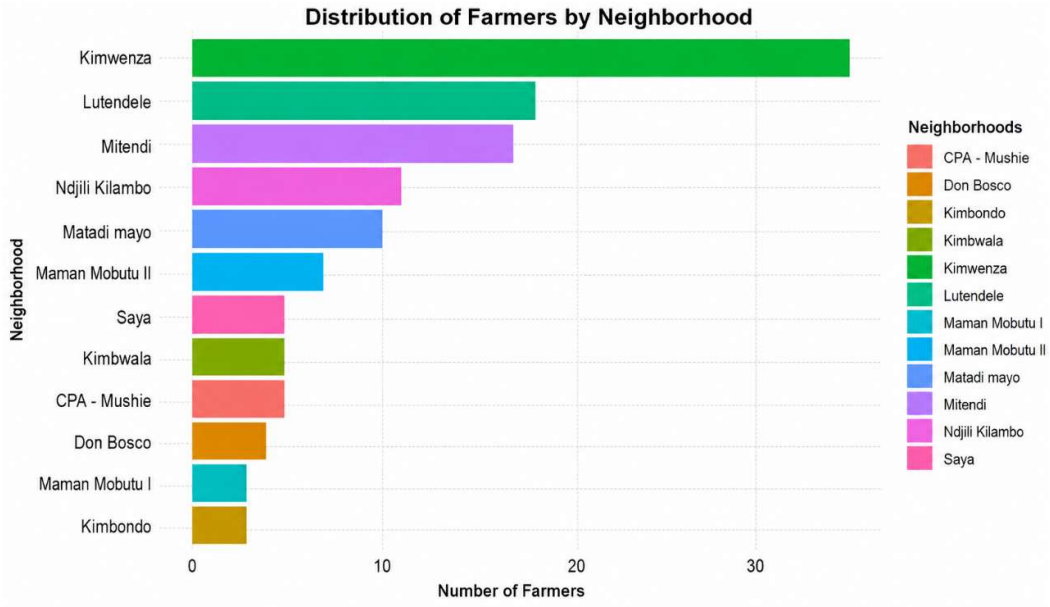


Figure 3 : Distribution of pig farmers by neighborhood in Mont-Ngafula Municipality, Kinshasa, 2025

3.1.2. *Sociodemographic distribution of pig farmers by sex and age*

Regarding the sociodemographic characteristics of the surveyed pig farmers, the 35-45-year age group was the most represented, comprising 59 participants (48.4%). This was followed by the 25-35 year age group, with 30 farmers (24.6%), and farmers aged 45 years and older, with 25 participants (20.5%). In contrast, young farmers aged 18-25 years were less represented, accounting for only 8 participants (6.6%).

Regarding sex distribution, the results showed a marked predominance of men in pig farming within the study area. Men accounted for 98.4% of the surveyed pig farmers, whereas women represented only 1.6%.

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3.1.3. *Farmer characteristics by educational level and marital status*

Analysis of the farmers' educational characteristics showed that secondary education was the most common level of schooling, reported by 68 respondents (55.7%). Farmers with no formal education accounted for 24.6% (30 individuals), while those with primary and university education represented 16.4% (20 individuals) and 3.3% (4 individuals), respectively.

Regarding marital status, single farmers constituted the largest group, accounting for 48.4% of respondents, followed by married farmers (47.5%). Widowed and divorced farmers represented only small proportions of the study population, at 2.5% and 1.6%, respectively (Figure 4).

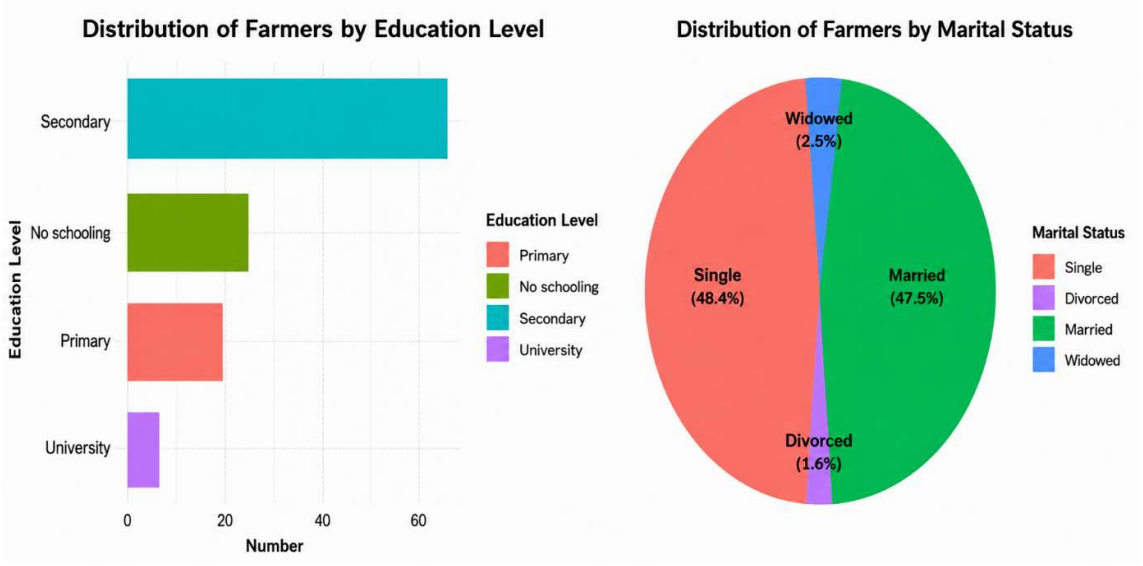


Figure 4 : Distribution of pig farmers by educational level and marital status in Mont-Ngafula Municipality, 2025

3.2. Occupational characteristics and pig-farming experience

Analysis of the respondents' occupational characteristics showed that pig farming was the primary occupation of 75.6% of respondents, followed by public-sector employment (12.6%) and crop farming (11.8%).

Regarding pig-farming experience, farmers with 5-10 years of experience constituted the largest group (43.9%), followed by those with less than 5 years of experience (24.6%). Farmers with more than 15 years of experience accounted for 18.4% of the study population, whereas those with 10-15 years of experience represented 13.2% of respondents (Figure 5).

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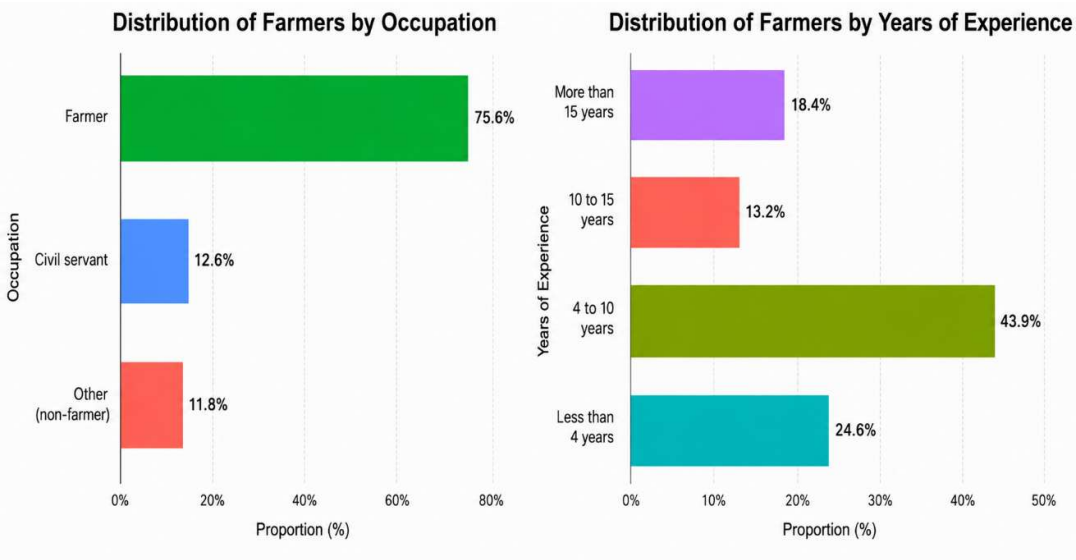


Figure 5 : Occupational characteristics and pig-farming experience among farmers in Mont-Ngafula Municipality, 2025

3.3. Zootechnical characteristics of the pig farms surveyed in Mont-Ngafula municipality

3.3.1. *Pig breeds raised on farms in Mont-Ngafula municipality*

The results showed a predominance of improved pig breeds among the surveyed farms. Large White was the most commonly represented breed, accounting for 38.3% of the pigs recorded, followed by Piétrain (35.0%). Local breeds accounted for 13.9% of the pigs, whereas Landrace (8.2%), Duroc (2.2%), and crossbred pigs (1.7%) were less frequently represented on the surveyed farms (Figure 6).

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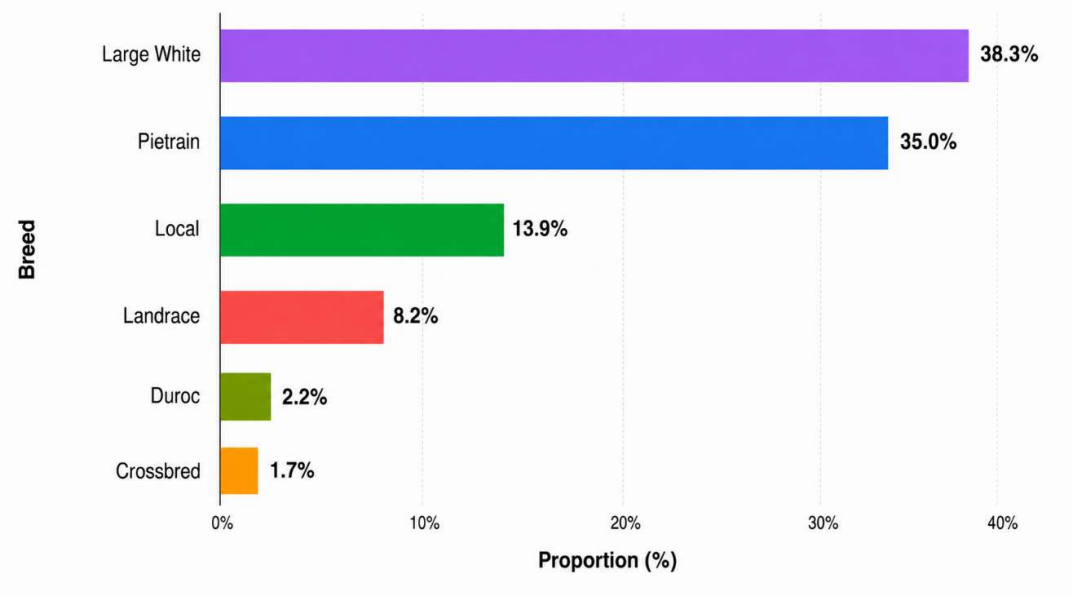


Figure 6 : Distribution of pig breeds raised by surveyed farmers in Mont-Ngafula Municipality, 2025

3.3.2. *Herd size and feeding practices on pig farms in Mont-Ngafula*

Regarding herd size, the results showed that most farms were small-scale at the start of their pig-farming activities. Specifically, 54.5% of farms initially had 1-5 pigs, while 23.6% had 6-10 pigs and 9.8% had 11-20 pigs. Only 4.1% of farms had more than 21 pigs at the start of their operations.

Current herd sizes, however, indicate a shift toward larger-scale pig farming. Overall, 52.8% of farms currently have at least 21 pigs, compared with 18.7% with 11-20 pigs, 17.1% with 1-5 pigs, and 5.7% with 6-10 pigs. Current herd-size data were not reported by 5.7% of respondents.

Regarding feeding systems, the results indicated a strong reliance on commercial feed. More than half of the farms (52.5%) primarily used commercially manufactured feed from feed mills, particularly products marketed by Minocongo. Locally formulated feed was also used by a substantial proportion of farmers (32.8%). In contrast, feeding systems combining commercial and locally formulated feeds were less common (8.0%), as was the exclusive use of cassava by-products (6.6%).

Regarding feeding frequency, most farmers provided feed once daily, accounting for 71 respondents (57.7%). Feeding twice daily was reported by 42 farmers (34.1%), whereas feeding three times daily was uncommon (0.8%). This information was not reported by 7.3% of respondents.

Regarding water supply, more than half of the farms (55.3%) relied on unimproved water sources, whereas 39.0% had access to improved water sources. Data on water sources were unavailable for 5.7% of farms.

Regarding farm infrastructure, 68.3% of the farms had housing facilities that met recommended zootechnical standards, whereas 25.2% lacked adequate facilities. Information on housing conditions was not reported by 6.5% of respondents (Table II).

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Table II **: Pig farming systems among surveyed farmers in Mont-Ngafula municipality, 2025**

Variable	Category	Number (n)	Percentage (%)
Initial herd size	1-5 pigs	67	54.5
	6-10 pigs	29	23.6
	11-20 pigs	12	9.8
	≥21 pigs	5	4.1
	Not reported	10	8.1
Current herd size	0-5 pigs	21	17.1
	6-10 pigs	7	5.7
	11-20 pigs	23	18.7
	≥21 pigs	65	52.8
	Not reported	7	5.7
Feeding frequency	Once daily	71	57.7
	Twice daily	42	34.1
	Three times daily	1	0.8
	Not reported	9	7.3
Water source	Unimproved	68	55.3
	Improved	48	39.0
	Not reported	7	5.7
Housing meeting recommended zootechnical standards	No	31	25.2
	Yes	84	68.3
	Not reported	8	6.5

3.4. Occurrence of fatal diseases and preventive measures on pig farms in Mont-Ngafula municipality

The survey results showed that the pig farms visited had experienced episodes of disease outbreaks. Among the surveyed farmers, 60% reported having experienced diseases associated with substantial pig mortality, while 35% reported disease episodes without sudden mortality. Only 5% of respondents reported no previous disease episode associated with substantial mortality (Figure 7).

Among the diseases reported as being responsible for pig mortality, African swine fever (ASF) was the most frequently cited, accounting for 79% of reported cases, compared with 21% attributed to swine erysipelas.

Regarding the magnitude of animal losses, 62% of farmers who experienced mortality reported losing fewer than five pigs, whereas 17% reported losses exceeding 10 pigs. However, 21% of respondents were unable to specify the exact number of pigs lost.

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Regarding disease prevention measures, vaccination was the main preventive practice reported by farmers, with 62 respondents (50.4%) indicating its use. However, 61 farmers (49.6%) did not provide information on the preventive measures implemented on their farms.

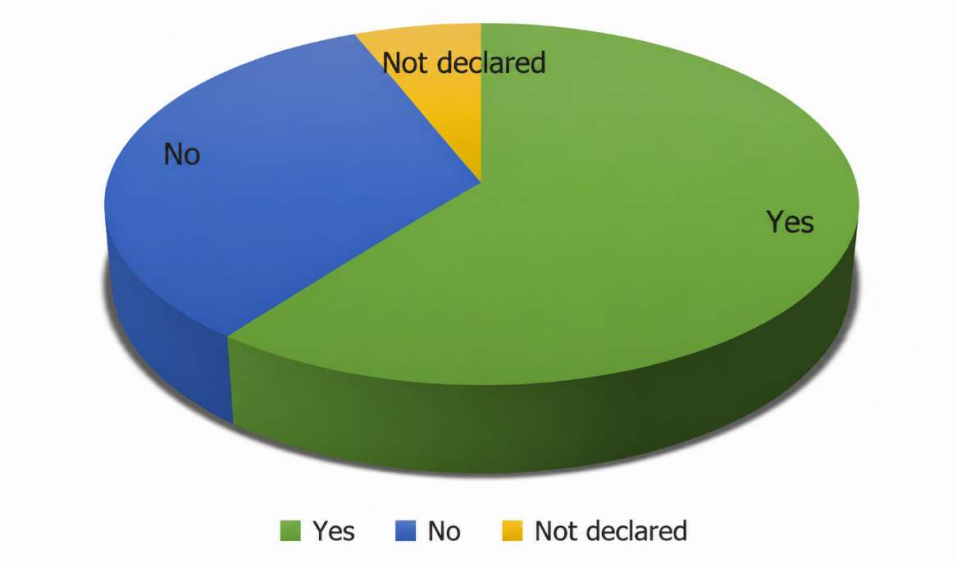


Figure 7 : Occurrence of diseases associated with sudden mortality on pig farms in Mont-Ngafula Municipality, 2025

3.5. Multiple correspondence analysis of epizootic diseases on pig farms in Mont-Ngafula

Multiple correspondence analysis (MCA) was used to visualize similarities among observations and identify farm profiles sharing similar animal health characteristics.

The factorial projection revealed a structuring of pig farms according to the epizootic diseases reported. Observations associated with African swine fever (ASF) formed a relatively dense cluster, indicating a marked occurrence of the disease within the study area. In contrast, farms reporting no epizootic disease were more widely dispersed, suggesting greater heterogeneity in their animal health profiles. Cases of swine erysipelas, which were less frequent, were located toward the periphery of the point cloud.

The MCA further highlighted the structuring of pig farms according to the presence or absence of epizootic diseases. The first dimension accounted for 9.4% of the total inertia, while the second accounted for 8.4%, representing a cumulative 17.8% of the total variability. Although these values indicate a relatively modest explanatory capacity, they are consistent with the multidimensional nature of livestock production systems and the multiple factors that may influence animal disease dynamics (Figure 8).

The distribution of observations on the factorial plane revealed partial differentiation among animal health profiles. Farms reporting no epizootic disease were predominantly located on the right side of the factorial plot, suggesting shared characteristics that may be associated with better animal health management. Conversely, farms reporting ASF were more concentrated on the left side of the factorial plane, indicating some degree of similarity in their structural characteristics or management practices.

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Cases of swine erysipelas were more widely dispersed across the factorial plane, indicating greater variability in the conditions associated with the occurrence of this disease on pig farms. This dispersion suggests that factors associated with swine erysipelas may be more heterogeneous or less specific than those associated with ASF.

From an epidemiological perspective, this pattern highlights ASF as the predominant epizootic disease reported on pig farms in Mont-Ngafula Municipality, while also indicating distinct animal health profiles among farms. The relative dispersion of observations around the origin of the factorial plane further suggests that disease occurrence may result from complex interactions among husbandry-related factors, biosecurity practices, animal movements, and farmers' socioeconomic characteristics.

Thus, although the first two MCA dimensions accounted for only a limited proportion of the total variability, the analysis identified structural patterns that may contribute to understanding the distribution of reported epizootic diseases and inform prevention strategies. These findings suggest that improved animal health management practices, better control of animal introductions, and strengthened farm biosecurity could contribute to reducing the risk of disease occurrence and spread among pig farms in the study area.

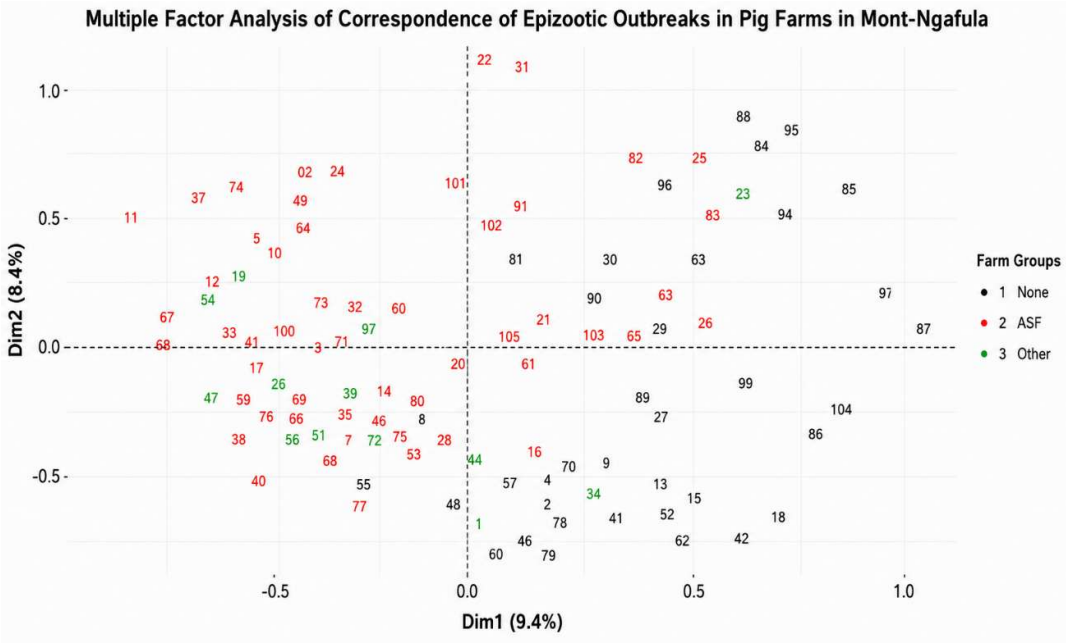


Figure 8 : Multiple correspondence analysis of epizootic diseases on pig farms in Mont-Ngafula Municipality, 2025

3.6. Economic analysis of the surveyed pig farms

3.6.1. Direct economic impacts

Direct economic impacts refer to the immediate financial losses incurred by farmers when pigs die as a result of African swine fever (ASF). These losses primarily affect livestock capital, breeding stock, and pig production intended for sale.

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The study showed that total direct economic losses across all surveyed farms amounted to USD 450,160. Improved pig breeds accounted for the largest share of these losses, particularly Large White and Piétrain pigs. Together, these two breeds represented 85.6% of the total economic losses, highlighting their substantial contribution to pig production systems in Mont-Ngafula.

Pig mortality also resulted in a reduction in the number of animals available for breeding and fattening. This loss of productive and reproductive stock may reduce the future production capacity of the affected farms (Table III).

Table III **: Direct economic losses associated with pig mortality and other factors on pig farms in Mont-Ngafula Municipality, 2025**

Category	Value
Total number of farms surveyed	123
Total direct economic losses	USD 450,160
Most affected breed	Large White
Economic losses associated with Large White pigs	USD 250,320
Share of total losses attributable to Large White pigs	55.6%
Economic losses associated with Piétrain pigs	USD 135,110
Share of total losses attributable to Piétrain pigs	30.0%

The results showed that African swine fever (ASF) accounted for the majority of direct economic losses on pig farms in Mont-Ngafula Municipality. Total direct economic losses were estimated at USD 450,160, of which approximately USD 360,128 (80%) were attributable to ASF. This substantial proportion indicates that ASF was the leading reported cause of pig mortality-related economic losses in the study area.

Other causes of losses, including diseases other than ASF, theft, accidents, and other causes of mortality, accounted for approximately USD 90,032 (20%) of total direct economic losses. Although these losses were considerably lower than those attributed to ASF, they nevertheless represented an additional economic burden on pig farms.

These findings highlight the substantial contribution of ASF to the economic burden borne by pig farmers in Mont-Ngafula. Strengthening farm biosecurity, improving animal health surveillance, and increasing farmers' awareness of ASF prevention and control measures may contribute to reducing disease-related economic losses (Table IV).

Table IV **: Contribution of African swine fever to direct economic losses on pig farms in Mont-Ngafula municipality, 2025**

Cause of Losses	Amount of Losses (USD)	Proportion (%)
African swine fever (ASF)	360,128	80.0
Other diseases, theft, and miscellaneous causes	90,032	20.0
Total	**450,160**	**100.0**

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Medium-sized pig farms experienced the greatest economic impact, accounting for more than 60% of the total direct economic losses observed. This finding indicates that medium-sized farms may be particularly vulnerable to the economic consequences of epizootic disease outbreaks because of the relatively substantial investments committed to pig production (Table V).

Table V **: Direct economic losses according to pig farm size in Mont-Ngafula municipality, 2025**

Farm Size Category	Economic Losses (USD)	Proportion (%)
Medium-sized farms	274,960	61.1
Small-scale farms	91,200	20.3
Not reported	74,000	16.4
Large-scale farms	10,000	2.2
Total	**450,160**	**100.0**

3.6.2. Indirect economic impacts

Indirect economic losses associated with feed investments were estimated at USD 143,876. Farms relying on commercial feed incurred the highest losses, largely because of the substantial cost of feed inputs invested in pigs prior to their death.

A substantial decline in farmers' income was also observed as a result of the reduced number of pigs available for sale. The resulting decrease in cash flow limited farmers' ability to purchase replacement breeding stock, invest in animal health and biosecurity measures, and access the credit needed to resume or expand their farming activities.

Thus, ASF not only resulted in immediate economic losses but also adversely affected the longer-term economic viability of pig farms by reducing their investment capacity and ability to rebuild productive assets (Table VI).

Table VI **: Indirect economic losses associated with feed investments on pig farms in Mont-Ngafula Municipality, 2025**

Type of Feed	Economic Losses (USD)	Proportion (%)
Commercial feed	66,666	46.3
Locally formulated feed	52,650	36.6
Mixed feeding system	15,210	10.6
Not reported	9,350	6.5
Total	**143,876**	**100.0**

3.6.3. Social consequences of African swine fever

The impacts of African swine fever extend beyond direct and indirect economic losses, affecting the daily lives and livelihoods of households that depend on pig farming.

The decline in income from pig farming contributed to increased food insecurity among many households. The losses incurred reduced households' ability to meet essential expenses, particularly those related to food, healthcare, and children's education.

Furthermore, the decline in pig production and marketing activities reduced employment opportunities throughout the pig value chain. This situation further increased the socioeconomic vulnerability of households whose livelihoods depended primarily on pig farming.

Overall, the findings indicate that African swine fever represents not only a major threat to pig production but also an important driver of economic and social vulnerability among pig-farming households in Mont-Ngafula Municipality (Table VII).

Table VII **: Main social impacts reported among pig-farming households in Mont-Ngafula Municipality, 2025**

Social Dimension	Observed Effects
Food security	Reduced household income available for food expenditure
Employment	Decline in activities related to pig farming and the pig trade
Economic vulnerability	Increased dependence on alternative sources of income
Access to social services	Difficulties in financing education and healthcare
Household resilience	Reduced capacity for savings and investment

African swine fever was the leading cause of economic losses on pig farms in Mont-Ngafula Municipality. Direct losses attributable to ASF were estimated at USD 360,128, representing 80% of the total direct economic losses recorded among the surveyed farms. Other losses, including those associated with diseases other than ASF, theft, and accidents, amounted to USD 90,032, accounting for the remaining 20% of direct losses.

In addition to these direct losses, indirect economic losses were estimated at USD 143,876. These losses were primarily associated with feed investments made before the death of the animals. Because these feed expenditures could not be recovered following pig mortality, they substantially increased the economic burden borne by farmers.

The estimated total economic burden attributed to ASF was USD 504,004. Beyond these monetary losses, ASF was associated with reduced household income, decreased investment capacity, limited access to financing, and increased economic vulnerability among pig-farming households. These findings highlight the importance of strengthening farm biosecurity, improving animal health surveillance, and providing appropriate support to pig farmers to mitigate the economic and social consequences of ASF in Mont-Ngafula Municipality (Table VIII).

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Table VIII **: Summary of the economic impacts of African swine fever on pig farms in Mont-Ngafula Municipality, 2025**

Impact Category	Economic Indicator	Estimated Value	Unit	Economic Interpretation
Direct losses attributable to ASF	Economic value of losses associated with ASF-related pig mortality	360,128	USD	Value of livestock capital directly lost as a result of African swine fever
	Contribution of ASF to total direct losses	80	%	ASF was the leading reported cause of mortality on the surveyed farms
Other livestock losses	Losses associated with other diseases, theft, and miscellaneous causes	90,032	USD	Reduction in livestock assets attributable to factors other than ASF
	Contribution of other factors to total direct losses	20	%	Economic impact of secondary animal health and non-health-related risks
Indirect economic losses	Value of lost feed investments	143,876	USD	Resources invested in feeding pigs before their death
	Share of indirect losses in the overall economic impact	28.5	%	Importance of unrecovered production costs following pig mortality
Overall economic impact of ASF	Direct losses attributable to ASF	360,128	USD	Value of livestock capital lost as a result of the disease
	Indirect losses associated with ASF	143,876	USD	Value of feed inputs and other investments lost
	Total economic impact of ASF	504,004	USD	Total economic burden borne by farmers affected by the disease
Observed economic consequences	Reduction in farmers' income	High	Qualitative	Substantial decline in revenue from pig sales
	Reduced investment capacity	High	Qualitative	Difficulties in rebuilding herds and resuming farming activities
	Difficulties accessing credit	High	Qualitative	Reduced borrowing and farm-financing capacity
	Household economic vulnerability	High	Qualitative	Increased fragility of the livelihoods of households dependent on pig farming
	Disruption of marketing activities	Substantial	Qualitative	Reduced commercial transactions and decreased confidence amo

3.7. Economic structure of the surveyed pig farms

The figure below presents a principal component analysis (PCA) describing the economic structure of pig farms in Mont-Ngafula Municipality based on several economic and animal health-related variables, including initial herd size, input costs, veterinary expenses, income losses, and mortality rate.

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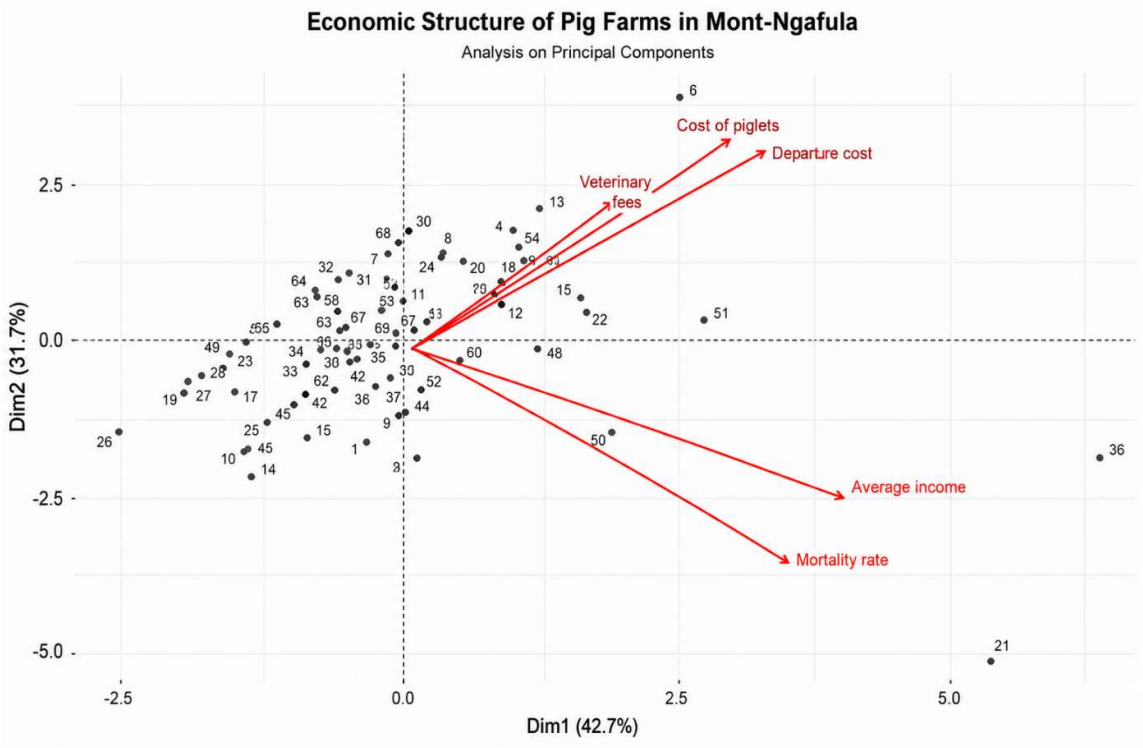


Figure 9 : Economic structure of pig farms in Mont-Ngafula Municipality, 2025

The principal component analysis (PCA) showed that the first two dimensions explained 74.4% of the total variance in the dataset (Dim1 = 42.7%; Dim2 = 31.7%). This relatively high proportion indicates that the two-dimensional representation captured a substantial amount of the information contained in the economic and animal health-related variables analyzed, thereby providing a concise representation of the economic structure of pig farms in Mont-Ngafula Municipality (Figure 9).

3.7.1. Interpretation of the first dimension (Dim1)

The first dimension was primarily driven by income loss and mortality rate, whose vectors were oriented in the same direction on the factorial plane. This pattern indicates a positive correlation between these two variables, suggesting that farms experiencing higher mortality rates also incurred greater economic losses.

In the context of pig farming in Central Africa, this relationship may be strongly associated with African swine fever (ASF). This highly contagious viral disease can cause extremely high mortality rates, sometimes approaching 100% in affected herds, resulting in sudden reductions in herd size and substantial direct income losses for farmers.

Thus, the first dimension mainly reflects the direct economic impact of epizootic disease outbreaks, particularly ASF, on pig farms.

3.7.2. Interpretation of the second dimension (Dim2)

The second dimension was mainly influenced by input costs, veterinary expenses, and initial herd size, whose vectors showed similar orientations. This pattern suggests positive correlations among these variables.

This indicates that farms with larger initial herd sizes tended to incur higher expenditures on production inputs and veterinary services, potentially reflecting more intensive production systems or greater investment in herd health management.

In the context of ASF circulation, these expenditures may also reflect efforts to prevent or manage animal health risks, although their effectiveness may remain limited in the absence of stringent biosecurity measures.

3.8. Relationships among variables

The relatively wide angle between the vectors representing income loss and mortality rate and those associated with input costs and veterinary expenses indicates that these variables reflect two distinct dimensions of farm economic performance.

Specifically, these dimensions can be distinguished as follows:

- On the one hand, variables related to disease-associated economic losses, particularly mortality and income loss;
- On the other hand, variables related to investment and production management, including input costs, veterinary expenses, and herd size.

This pattern suggests that production expenditures and investments in animal health alone may not always be sufficient to prevent substantial economic losses when a major epizootic disease such as ASF occurs. Even on farms that invest more heavily in production inputs or veterinary care, the introduction of ASF virus may result in rapid and substantial economic losses.

3.9. Animal health and economic implications

This analysis identified two main economic profiles among the surveyed pig farms:

- Farms heavily affected by pig mortality and associated economic losses, indicating greater vulnerability to animal diseases such as ASF;
- Farms characterized by higher investments in production inputs and veterinary services, reflecting more intensive management strategies or efforts to improve productivity and animal health.

These findings indicate that African swine fever represents a major source of economic disruption for pig farms in Mont-Ngafula Municipality. The economic impact of the disease is primarily reflected in increased pig mortality, reduced herd sizes, and direct income losses among affected farmers.

The findings also highlight the importance of strengthening farm-level biosecurity measures, epidemiological surveillance, and veterinary support to reduce the risk of ASF occurrence and spread and to improve the economic resilience of pig farms in the study area.

4. DISCUSSION

The findings of this study showed that pig farming in Mont-Ngafula Municipality was spatially concentrated in specific neighborhoods, particularly Kimwenza, Lutendele, and Mitendi. This uneven distribution suggests the existence of areas that are particularly favorable for pig production, whereas other neighborhoods have more limited farming activity. This concentration may be associated with several factors, including the availability of suitable land for livestock production, access to production inputs and markets, socioeconomic characteristics, and local traditions related to animal production. These observations are consistent with those of Miankoma and Banzadio (2020), who reported that peri-urban areas of Kinshasa provide favorable conditions for the development of agropastoral activities.

The surveyed farms were predominantly small- and medium-scale operations, reflecting the general characteristics of pig production systems in sub-Saharan Africa. These production systems are largely based on family-operated farms with limited financial and technical resources (Mutua & Dione, 2021a; Simbizi et al., 2025). They are generally characterized by limited access to veterinary services, often inadequate infrastructure, and insufficient implementation of biosecurity measures (FAO, 2023). Under these conditions, pig farms remain particularly vulnerable to epizootic diseases, especially African swine fever (ASF), whose transmission may be facilitated by uncontrolled animal movements, traditional husbandry practices, and inadequate animal health and biosecurity measures on small-scale farms (Amar et al., 2021).

Analysis of the sociodemographic characteristics revealed a marked predominance of men in pig farming, with men accounting for 98.4% of the surveyed farmers. The limited participation of women may be related to sociocultural factors, traditional divisions of labor, and inequalities in access to productive resources, particularly land, credit, production inputs, and technical training (UN Women, 2019; FAO, 2010; Kevane, 2012). Similar patterns have been reported in several African countries, where livestock production activities requiring relatively substantial investments remain predominantly controlled by men (FAO, 2023).

The 35–45-year age group was the most represented among the surveyed pig farmers. This finding indicates that pig farming is primarily undertaken by economically active adults who may have greater capacity to invest in income-generating activities. These findings are consistent with those of Mulumba-Mfumu (2016), who reported that pig farms in the Democratic Republic of the Congo are generally managed by adults with a certain degree of economic and household stability. The limited participation of younger individuals may be related to difficulties in accessing land and start-up capital, as well as the relatively low attractiveness of the agricultural sector to younger populations.

Furthermore, the predominance of secondary education among pig farmers may represent a potentially favorable factor for the adoption of technical innovations and biosecurity measures. Several studies have shown that higher educational attainment is generally associated with better understanding of animal disease prevention and control measure(Na et al., 2023; Wang et al., 2023). However, the high frequency of African swine fever reported among the surveyed farms suggests that theoretical knowledge does not necessarily translate into effective implementation of animal health and biosecurity measures. This discrepancy may be attributable to financial constraints, persistent traditional husbandry practices, and structural limitations commonly encountered in small-scale pig production systems in sub-Saharan Africa (Ekakoro et al., 2023; Mutua & Dione, 2021b).

The study also showed that pig farming was mainly practiced by producers with an intermediate level of experience, ranging from five to ten years. However, the coexistence of less experienced and more experienced farmers reflects considerable variation in expertise, which may influence farm management practices, production performance, and the management of animal health risks. The significant associations observed between certain sociodemographic characteristics and the occurrence of epizootic diseases further suggest that older and more experienced farmers reported more ASF cases. This pattern may be explained by the generally larger size of their farms and their greater involvement in animal trade, potentially increasing the risk of disease introduction and spread.

The findings also indicate a trend toward the progressive expansion of pig farms. Although most farms initially had relatively small herds, a substantial proportion currently maintain larger herds. This shift likely reflects the gradual intensification of pig production in Mont-Ngafula Municipality. However, this expansion continues to face several constraints, particularly those related to feed, access to water, farm infrastructure, and animal health management, which may affect zootechnical performance and increase farm vulnerability to disease.

All surveyed farms reported having previously experienced episodes of pig disease outbreaks. Among respondents, 60% reported diseases associated with substantial mortality, while 35% reported disease episodes without sudden mortality. African swine fever was identified as the leading reported cause of mortality, accounting for 79% of cases, compared with 21% attributed to swine erysipelas. This predominance is consistent with findings from several African countries, where ASF remains a major animal health constraint to the pig production sector because of its high case fatality, the lack of specific treatment, and challenges associated with implementing effective biosecurity measures (Ebwanga et al., 2021; Mutua & Dione, 2021a; M. Penrith et al., 2019). These findings are also consistent with the reported endemic occurrence of ASF in the Democratic Republic of the Congo, as described by Mulumba-Mfumu (2016).

Regarding the animal health impact of epizootic disease outbreaks, most farmers who experienced pig mortality reported losing fewer than five animals, whereas 17% reported losses exceeding 10 pigs. These mortalities resulted in substantial economic consequences for the affected farms. The estimates generated in this study indicated direct economic losses of approximately USD 450,160, illustrating the magnitude of the financial burden associated with African swine fever on pig farms in Mont-Ngafula. These findings are consistent with those of (Fasina et al., 2012), who highlighted the substantial economic losses associated with transboundary animal diseases in African livestock production systems.

Medium-sized farms accounted for the largest proportion of the economic losses observed. This pattern may be explained by their larger herd sizes and greater investments in pig production, which increase the economic value of animals lost during mortality events. In contrast, small-scale farms generally incurred lower absolute losses because of their smaller herd sizes. Similar observations have been reported by (Fasina et al., 2012; Jean-Pierre et al., 2022; Nguyen-Thi et al., 2021), who showed that the economic impact of ASF is strongly influenced by farm size, livestock value, and the level of investment made by producers.

Beyond the direct losses associated with pig mortality, African swine fever also generates substantial indirect economic consequences. These include reduced farmers' income, disruption of pig markets, restrictions on trade, increased household indebtedness, and reduced availability of animal-source protein from pork (Acosta et al., 2023; Nguyen-Thi et al., 2021; Niemi, 2020). In rural and peri-urban areas where pig farming represents an important source of household income, these effects may have long-term consequences for livelihoods and contribute to worsening poverty and food insecurity (Jean-Pierre et al., 2022; Schmidhuber et al., 2020).

Despite the relevance of the findings, this study has several limitations. First, the data collected were largely based on farmers' self-reports, which may have introduced recall bias or reporting errors regarding disease events and associated economic losses. Second, the absence of systematic laboratory confirmation of reported African swine fever cases limited diagnostic accuracy and may have resulted in either overestimation or underestimation of the actual occurrence of the disease. Finally, logistical and financial constraints prevented the survey from being extended to all municipalities of Kinshasa, thereby limiting the generalizability of the findings to other pig production settings. Nevertheless, the data generated provide valuable insights into the occurrence of African swine fever and its socioeconomic impact on peri-urban pig farms in Mont-Ngafula Municipality.

5. CONCLUSION

This study aimed to assess the socioeconomic impact of African swine fever (ASF) on pig farms in Mont-Ngafula Municipality. The findings indicate that ASF represents a major constraint to the development of the local pig production sector. Reported ASF outbreaks resulted in substantial economic losses, primarily associated with high pig mortality, reduced production, and decreased farmers' income.

Analysis of the data showed that all surveyed farms had previously experienced episodes of epizootic disease, with ASF being the most frequently reported disease associated with pig mortality. The estimated economic losses highlight the substantial burden of the disease on the economic viability of pig farms and on the livelihoods of households that depend on pig production.

Overall, these findings support the hypothesis that ASF has a substantial socioeconomic impact on pig farms in Mont-Ngafula Municipality. Beyond the direct losses associated with pig mortality, the disease undermines farm profitability, reduces producers' investment capacity, and constrains the sustainable development of the local pig production sector.

Given this situation, strengthening ASF prevention and control measures is essential. These efforts should include improving farm-level biosecurity, raising awareness and providing training for pig farmers, strengthening epidemiological surveillance, and increasing support from veterinary services and public authorities. Such interventions could help reduce the impact of ASF and enhance the resilience of pig farms in Mont-Ngafula Municipality.

Further studies incorporating laboratory confirmation of suspected ASF outbreaks and a comprehensive assessment of associated risk factors are needed to improve understanding of the actual impact of African swine fever on the pig production sector in the Democratic Republic of the Congo.

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Conflicts of Interest

The authors declare that they have no conflicts of interest.

Author Contributions

M.K. developed the study protocol; N.N. and L.M. reviewed and approved the study protocol; M.K. and B.K. conducted the field surveys; M.K., B.K., and D.T. performed the statistical analyses; and L.S. performed data cleaning. All authors contributed to the drafting and revision of the manuscript and read and approved the final version.

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