Peer reviewed

Original research

Production characteristics, disease prevalence, and herd-health management of pigs in Southeast Nigeria

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Summary

Objectives: To assess the management practices of swine production and herd health and disease prevalence in Southeast Nigeria.

Materials and methods: Fifty-four farms were conveniently selected from three states of Southeast Nigeria. Information on socioeconomic characteristics of farmers (sex, occupation, educational status, and farming experience), management practices, and disease prevalence were collected. Samples were screened for ectoparasites (skin scrapings), trypanosomes and *Brucella* antibodies (blood samples), and helminth and cestode ova and coccidia oocysts (fecal samples).

Results: Of 54 farm owners surveyed, 43% were exclusively farmers, 32% were in the buying and selling business, 17% were civil servants, and 6% were students. More men (89%) than women (11%) kept pigs, with the majority having a herd size of < 100 pigs. Most pigs were crosses between native and European breeds. Management was predominantly intensive (96%), with most of the barns built of cement blocks, with concrete floors and galvanized roofing sheets. Prevalences of 47%, 25%, 20%, and 0.95% were recorded for infection with coccidia, helminths, ectoparasites, and trypanosomes, respectively; 0.6% of pigs tested were positive for *Brucella* antibodies. Significant associations were noted between disease prevalence and litter size and management system, and between productivity and farmer's educational level.

Implications: In spite of the good productivity recorded in this study (farms having ≥ 6 pigs marketed per litter), efforts should be made to encourage better management practices to significantly reduce disease prevalence for better performance. Public-health risks associated with *Brucella* and trypanosome infections recorded in this study should not be neglected.

Keywords: swine, production characteristics, disease prevalence, herd-health management, Nigeria.

Received: June 28, 2010
Accepted: September 24, 2010

Resumen - Características de producción, prevalencia de enfermedades, y manejo de salud del hato de cerdos en el Sureste de Nigeria

Objetivos: Evaluar las prácticas de manejo de la producción de cerdos, prevalencia de enfermedades, y la salud del hato en el Sureste de Nigeria.

Materiales y métodos: Se seleccionaron convenientemente 54 granjas de tres estados del Sureste de Nigeria. Se colectó información sobre las características socioeconómicas de los productores (sexo, ocupación, nivel de educación, y experiencia en granja), prácticas de manejo, y prevalencia de enfermedades. Se analizaron muestras en busca de ectoparásitos (raspados de piel), anticuerpos contra tripanosomas y *Brucella* (muestras de sangre), huevecillos de helmintos y cestodos, y oocistos de coccidia (muestras fecales).

Resultados: De 54 dueños de granjas encuestados, 43% eran exclusivamente productores, 32% estaban en el negocio de compra-venta, 17% eran funcionarios públicos, y 6% eran estudiantes. Más hombres (89%) que mujeres (11%) manejaban a los cerdos, teniendo la mayoría un tamaño de hato de < 100 cerdos. La mayoría de los cerdos eran cruzas entre razas nativas y Europeas. El manejo era predominantemente intensivo (96%), con la mayoría de los edificios construidos con bloques de cemento, pisos de concreto, y techo de lámina galvanizada. Se registraron prevalencias de 47%, 25%, 20%, y 0.95% para las infecciones de coccidia, helmintos, ectoparásitos, y tripanosomas, respectivamente; 0.6% de los cerdos analizados resultaron positivos a anticuerpos contra *Brucella*. Se encontraron asociaciones significativas entre la prevalencia de enfermedad y el tamaño de la camada y el sistema de manejo, y entre la productividad y el nivel de educación del granjero.

Implicaciones: A pesar de la buena productividad registrada en este estudio (granjas con ≥ 6 cerdos vendidos por camada), deberían hacerse esfuerzos para fomentar prácticas para reducir significativamente la prevalencia de enfermedades para un mejor desempeño. Los riesgos de salud pública asociados con las infecciones de tripanosoma y *Brucella* registrados en este estudio no deben ser negados.

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This article is available online at http://www.aasv.org/shap.html.

Nwanta JA, Shoyinka SVO, Chah KF, et al. Production characteristics, disease prevalence, and herd-health management of pigs in Southeast Nigeria. *J Swine Health Prod.* 2011;19(6):331–339.

Résumé - Caractéristiques de production, prévalence de maladies, et pratique de régie de troupeau de porcs dans le sud-est nigérien

Objectifs: Évaluer les pratiques de régie de la production porcine de même que la santé des troupeaux et la prévalence de maladies dans le sud-est du Nigéria.

Matériels et méthodes: Cinquante-quatre fermes dans trois états du sud-est du Nigéria ont fait l'objet d'un échantillonnage de convenance. De l'information sur les caractéristiques socio-économiques des éleveurs (sexe, occupation, le niveau de scolarité, l'expérience en élevage), sur les pratiques de régie et la prévalence de maladies ont été amassées. Les échantillons ont été vérifiés pour la présence d'ectoparasites (grattages cutanés), d'anticorps contre les trypanosomes et *Brucella* (échantillons de sang), et d'œufs d'helminthes et de cestodes ainsi que d'ookystes de coccidies (échantillons de fèces).

Résultats: Parmi les 54 propriétaires de fermes interrogés, 43% étaient exclusivement des éleveurs, 32% des commerçants, 17% des fonctionnaires, et 6% des étudiants. Plus d'hommes (89%) que de femmes (11%) gardaient des porcs, et la majorité avait < 100 porcs ou moins. Les porcs étaient pour la plupart des croisements entre des races indigènes et Européennes. La gestion était à prédominance intensive (96%), et la plupart des fermes étaient construites en bloc de béton, avec des planchers en ciment et un toit de tôle. Des prévalences de 47%, 25%, 20%, et 0.95% ont été enregistrées, respectivement, pour les infections par les coccidies, les helminthes, les ectoparasites, et les trypanosomes; 0.6% des animaux testés avaient des anticorps contre *Brucella*. Des associations significatives ont été notées entre la prévalence de maladies et la taille de la portée et le système de régie, ainsi qu'entre la productivité et le niveau de scolarité de l'éleveur.

Implications: Malgré la bonne productivité notée dans la présente étude (les fermes ayant ≥ 6 porcs mis en marché par portée), des efforts devraient être faits pour encourager de meilleures pratiques de conduite d'élevage afin de diminuer de manière significative la prévalence des maladies et améliorer les performances. Les risques en santé publique associés avec les niveaux d'infections par *Brucella* et les trypanosomes enregistrés dans la présente étude ne devraient pas être négligés.

Swine production plays a vital role in food security, poverty eradication, and employment generation in Nigeria.[1] The pig population in Nigeria stands at 3.5 million animals,[2] and in the past decade, the supply of pork for human consumption has expanded, compared to the supply of other meat.

Veterinary services are obtainable in the form of disease diagnosis and treatment, vaccination, and general advice on disease prevention and other management practices by government and private veterinarians, who are readily available. In humid Southeast Nigeria, pigs, poultry, small ruminants, and fish are the major sources of animal protein.[3] Environmental restrictions due to the increasing human population, urbanization, and land use pressure have compelled most communities in Southeast Nigeria to begin to adopt intensive and semi-intensive systems of livestock production instead of the extensive (traditional) system of management.[3] In the intensive management system, small-scale producers with a unit of approximately 50 pigs provide feed, housing (often concrete construction), and veterinary services for the pigs.[4,5] In the semi-intensive management system, pigs are partly provided with feed, housing, and veterinary care, but are also left to scavenge within the neighborhood on domestic or agricultural waste. In the extensive (free-range or traditional) management system, pigs are left without housing to scavenge on domestic or agricultural waste within and outside the compound, without feed supplementation or veterinary care.[6,7]

Nigeria has the second largest population of pigs in Africa, which accounts for approximately 4.45% of the total meat supply in the country.[8] The industry thrives very well under favorable conditions, especially in the Southern part of Nigeria,[9] where ownership is largely restricted to small-holder farms averaging 20 to 50 pigs.[10]

In spite of these advantages, diseases and poor herd-health management practices pose significant challenges to efficient management and profitable swine production in developing countries of the world, including Nigeria.[1,10,11] Low productivity (number of pigs marketed per litter) of pigs in Southeast Nigeria has been attributed to high piglet mortality, slow growth rate due to poor feed conversion ratio, and diseases such as helminthosis, coccidiosis, brucellosis, ectoparasitism, African swine fever, and trypanosomiasis.[1,10,12] Insect vectors play a vital role in swine disease conditions through spread of blood parasites in their hosts.[13] A preweaning mortality rate of 15% has been recorded in many backyard piggeries (small-holder farms) in Southeast Nigeria.[14] Similarly, preweaning mortality rates of 29.3% and 44.8%, respectively, have been recorded for exotic and indigenous breeds within the first week of life of piglets in Nigeria.[15]

There is a paucity of information on the production characteristics, disease prevalence, and herd-health management practices adopted in swine production in Southeast Nigeria. This study was conducted to answer questions on production and herd-health management practices, disease prevalence, and methods of disease prevention, including the relationships between productivity and disease prevalence, management systems, and level of education of farmers in the study area.

Materials and methods

Approval for this project was given through the Enugu office of the Federal Department of Livestock and Pest Control Services of the Federal Ministry of Agriculture and Rural Development of Nigeria, who evaluated the use of animals in this research.

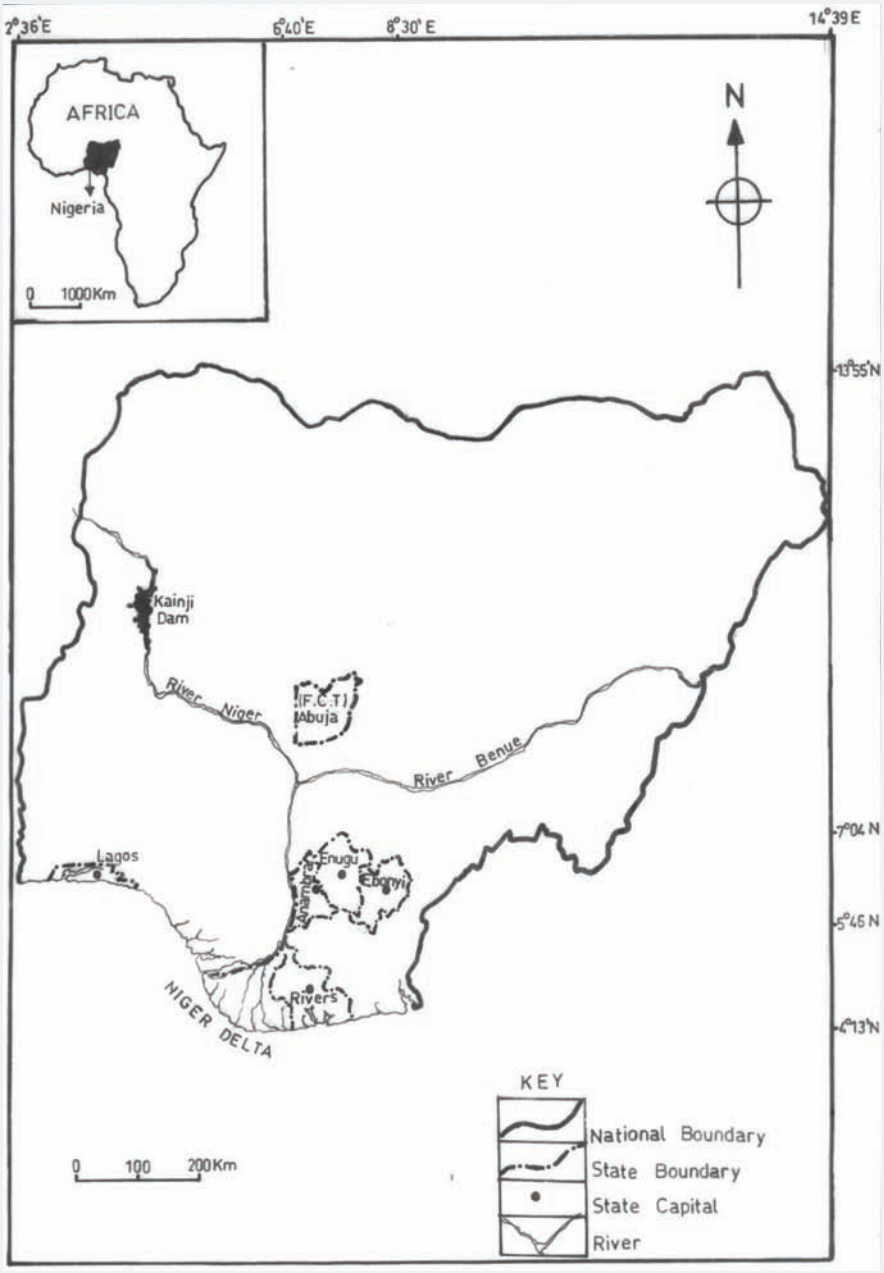
Study area

The study was carried out in Anambra, Ebonyi, and Enugu States of Southeast Nigeria, which covered a total land area of 17,545 km^2 and included a population of 16,395,755 (Figure 1). The Southeast geopolitical zone is located between latitudes 7°07'N and 3°90'N and longitudes 6°51'E and 8°30'E and includes Abia, Anambra, Ebonyi, Enugu, and Imo States. It is bounded in the north by Benue State, in the south by River State, in the east by Cross River and Akwa-Ibom States, and in the west by Delta State and the River Niger.[16]

The area is ecologically diverse, although tropical forest and savanna predominate. The wet season lasts from April to October, with annual rainfall having a bimodal pattern with two cropping (planting and growing) seasons.[16] June and September are the wettest months. The dry season occurs from late October to early April. The indigenous people of the Southeast are predominantly Igbo speaking and are involved in agriculture with two major farming activities, crop and livestock. Cassava and yam are the main crops cultivated in the Southeast; other crops of importance are maize, cocoyam, and plantain. In some locations, rice and oil palm have historically been important cash crops.

The major animal production activity in the area is poultry. Other livestock produced

Figure 1: Maps of Africa and Nigeria showing Southeast states where a survey was conducted on swine production and herd-health management practices, disease prevalence, and methods of disease prevention, and their relationships to the socio-economic characteristics of the farmers.



include pigs, goats, sheep, and on rare occasions, cattle. Livestock are valued as a source of meat (usually slaughtered during festivals or ceremonies) and cash. Small ruminants (sheep and goats) and pigs may be confined in barns. Animals are fed household scraps, tree foliage (commonly palm leaves for small ruminants), and the by-products of food processing or kitchen waste. Most pig breeding stock are crosses between the Nigerian indigenous pig breeds and Large White or Landrace.

Data collection

A study of production and herd-health management practices and disease prevalence in swine herds in different locations of Southeast Nigeria was conducted for a period of 5 months (March to July 2008). All farms included in the study had sows, and productivity was based on the number of pigs born alive or marketed per litter.

A multistage sampling procedure was used to select three states and nine local government areas. The three states, Anambra, Ebonyi, and Enugu, were selected from Southeast Nigeria using a simple random sampling technique (coin toss). Three local government areas from each state were similarly selected. Fifty-four farms from the selected local government areas were conveniently selected by their willingness to make their farms and farm records available to the researchers. A total of 20, 11, and 23 farms were sampled in Anambra, Ebonyi, and Enugu States, respectively.

The structured questionnaire used in data collection was designed to collect information on socio-economic characteristics of the farmers, such as sex, occupation, level of education and farming experience, swine-production and herd-health management practices, disease conditions (prevalence of diseases that directly affect productivity of pigs in the study area), and veterinary health-care services. Questions on whether the farms had experienced clinical signs compatible with African swine fever, eg, very high fever with huddling and shivering, reddening of the ear, flank, and tail areas, and leg weakness, were incorporated in the questionnaire. The contents of the questionnaire were transmitted to farmers who were unable to read or write in their native language, and their responses were recorded. Data from farm records were used to confirm the information obtained from respondents in some cases. A pilot survey was carried out to determine the number of farms and their herd sizes suitable for the study in each state of the region prior to the study. During the pilot survey, the farmers were informed of the purpose of the study and the need for their cooperation. Only farms that gladly welcomed the researchers and volunteered information needed were sampled. The responding farmers were assured of the confidentiality of the information supplied. The farmers were informed that they had the right to refuse to participate. However, participation was encouraged by the promise made during the pilot survey that the researchers would provide veterinary services to the farms after sampling, eg, advice on production and herd-health management problems when the study results were reported to the farms.

Skin scrapings were collected and screened for ectoparasites, while fecal samples were examined for helminth eggs and coccidia oocysts, and blood samples for trypanosomes and *Brucella* antibodies. Disease choice was based on prevalence in the study area.[17,18]

In each of the conveniently selected farms, a marker pen was used to serially number the pigs in the farm. These identification numbers were recorded on slips of paper which were mixed in a container: 10% of them were drawn from the container to determine which animals would be sampled.

Immediately after collection, fecal samples were examined grossly for adult roundworms and tapeworm segments. Samples were then transported on ice and later refrigerated at 4°C and analyzed within 8 hours of collection for helminth ova and coccidia oocysts using the simple egg floatation technique.[19]

A total of 540 pigs from the 54 farms (10 pigs per farm) were randomly selected by drawing their identification numbers from the container and examined for external parasites such as ticks, lice, fleas, and mites. However, there were cases where the researchers were unable to collect blood specimens from some of the selected pigs due to restraint difficulties. Skin scrapings from all pigs sampled were examined for ectoparasites as described by Hendrix and Robinson.[20] These and all other tests were performed in the laboratories of Veterinary Parasitology and Public Health, Faculty of Veterinary Medicine, University of Nigeria, Nsukka, Enugu State, Nigeria.

Blood samples were collected from 324 adult pigs randomly selected in the 54 farms sampled (six to 10 pigs per farm). For each pig, duplicate blood samples were collected: one into an evacuated blood vial containing ethylenediamine tetra-acetic acid (EDTA) for identification of trypanosomes and another into an evacuated blood vial without anticoagulant for serological screening for *Brucella* antibodies. For diagnosis of trypanosomes in blood samples, the microhematocrit buffy coat technique was used to increase sensitivity of the test.[21] Blood samples without anticoagulant were allowed to clot and sera were harvested and stored in a refrigerator until tested for *Brucella* antibodies. The serum samples were subjected to the rose Bengal plate agglutination test[22] using *Brucella abortus* and *Brucella melitensis* antigens procured from the Veterinary Laboratory Agency (New Haw, Addle Stone, Surrey, UK). This is the commonly available test for *Brucella* antibodies used at the brucellosis unit in the Faculty of Veterinary Medicine of the University of Nigeria.

Trapping nets were set for 7 days in each farm sampled to capture insect vectors of trypanosomes, which were later identified.

Data analysis

The data collected were collated and the socio-economic characteristics of the farmers and production systems were analyzed using descriptive statistics such as means, frequencies, and percentages. A chi-square test was used to determine the significance of association between production management systems and productivity and presence or absence of disease. Chi-square tests were also used to determine the significance of association in the responses of farmers and ages of pigs at death, the significance of association between the presence or absence of disease and productivity, and the significance of association between productivity and level of education of the farmers. The proportion of pigs positive for each helminth parasite were compared by age category using a chi-square test. The analysis included all farms with sows. All analyses were performed using the SPSS package version 16.0 for Windows (SPSS Inc, Chicago, Illinois) at a 5% probability level.

Results

Most pigs in the study area were raised as a secondary source of income for the family (Table 1). Most of the pig owners were holders of First School Leaving Certificates, while 22% were secondary school leavers, and very few had no formal education. More men than women were in pig production (Table 1). The number of pigs marketed per litter was significantly higher in farms managed by educated farmers than those managed by less educated farmers (Table 2).

The majority of farmers had a herd of < 100 pigs (Table 3). In addition to pig farming, approximately 65% of the pig farmers kept poultry, while 31% reared goats and sheep. Very few respondents reared pigs only, and none of the pig farmers in the study area reared cattle (Table 4).

Management systems were primarily intensive (52 farms, 96%), while two farms (4%) were managed semi-intensively. Approximately 93% of the pig farms had barns with concrete floors and 85% had galvanized roofing sheets. Most pig barns were screened with insect-proof wire nets (Table 5). Most respondents reported that swine production was profitable, and more than half were willing to expand production due to its profitability (Table 5). A minority used commercial feeds for their pigs, while many used kitchen and restaurant waste (Table 5). Most respondents complained that their pigs frequently experienced skin lesions suggestive of ectoparasitism (Table 5). None of the farmers observed clinical signs of an outbreak of African swine fever in their herds (Table 5). Almost all survey respondents indicated interest in receiving training in swine-farm management and disease prevention and control. Approximately 67% of farmers used protective clothing while on routine farm operations (Table 5). All farmers recorded mortality of pigs of all ages in their farms (Tables 5 and 6). Productivity in terms of number of pigs marketed per litter was significantly higher in intensively managed farms than in farms managed semi-intensively (Table 7).

The prevalences of disease agents, based on laboratory analysis of samples submitted, are presented in Table 8. Almost half of the 232 fecal samples screened were positive for coccidia oocysts, and 25% were positive for helminth ova. Mange mites (*Demodex*) were detected in 20% of skin scrapings, while *Brucella* antibodies and *Trypanosoma* species were found in only two and three, respectively, of the blood samples screened. The prevalences of these etiologic agents were significantly higher in the 52 intensively managed farms than in the two semi-intensively managed farms (Table 8). The prevalence of trypanosomiasis was higher in semi-intensively managed farms than in farms managed intensively (Table 8). There was no significant association in the prevalence of gastrointestinal parasites among age categories of pigs sampled, except that significantly fewer pigs were positive for ascarid and trichuris eggs at > 6 months than earlier in life (Table 9).

The majority of farmers procured their breeding stock from reliable farms (farms with good records and that utilized veterinary services), and 19% acquired theirs from markets (open markets where livestock were displayed for sale by their owners for slaughter or breeding). Approximately 9% reared their own stock, a practice whereby at the age of 4 to 6 months, healthy gilts possessing at least 14 prominent teats and good body conformation were selected by the farmers from their stock. There were significant differences in the sources of replacement stock among farms (Table 10). On average, one or two boars were usually selected per 50 gilts as replacements.

The insects trapped were houseflies (*Musca domestica*), mosquitoes, fruit flies, and *Glossina* species.

Table 1: Distributions of sex and occupational, educational, and farming experience of 54 farm owners responding to a questionnaire survey in Southeast Nigeria

Characteristics	Frequency (%)
Sex	
Male	48 (88.9)
Female	6 (11.1)
Occupation	
Sole farming*	23 (42.6)
Trading and farming	17 (31.5)
Civil servant and farming	9 (16.7)
Others (retirees and farming)	2 (3.7)
No response	3 (5.6)
Educational qualification	
First School Leaving Certificate	23 (42.6)
West African School Certificate	12 (22.2)
Post secondary education	0 (0.0)
No formal education	2 (3.7)
No response	17 (31.5)
Farmer's experience	
1 year	5 (9.3)
1-5 years	12 (22.2)
6-10 years	20 (37.0)
> 10 years	5 (9.3)
No response	12 (22.2)

* Sole farmers earned their livings exclusively by farming, having no other means of livelihood.

Table 2: Relationship between level of education and productivity* in 37 pig farms that kept production records in Southeast Nigeria†

Level of education	No. of respondents	
	< 6 pigs/litter	≥ 6 pigs/litter
No formal education	2[a]	0[a]
First School Leaving Certificate	7[b]	9[b]
West African School Certificate	4[c]	15[c]
Post secondary education	0	0
Total	**13**	**24**

* Productivity = number of pigs marketed/litter.

† One respondent per farm for the 37 farms that kept production records among the 54 farms included in this study.

[abc] Values within a column with different superscripts differ significantly ($P < .05$; chi-square analysis).

Discussion

The predominance of men in swine production as observed in this study is in agreement with the findings of Oni and Yusuf[23] and Adesehinwa et al,[24] who reported that pig production is dominated by men in Southwest Nigeria. Though the proportion of part-time pig farmers recorded in this study (approximately 57%) is lower than the 78.0% reported in Kaduna State,[25] this still implies that many people in other occupations are also involved in pig production as a source of additional income, probably due to its high rate of profitability. Over 31% of the respondents combined buying and selling of goods with pig farming. This points to the fact that pig production may be profitable. The second largest population of people in other occupations who were in swine production were civil servants. Swine production served as a way of diversifying their income base, since salaries were inadequate to meet family financial needs. In Southeast Nigeria, pigs are owned by both men and women, and ownership of pigs determines a man's financial status, as evidenced by his financial capability.[14] The majority of pig farmers view pig production as a source of income and as part of their tradition. Most farmers surveyed were experienced, and this might have improved their productivity and influenced their views that swine production is lucrative, and therefore they were willing to expand their operations. With better management and experience, swine production is highly profitable.[26] Thus, there is much potential to be realized from such improvements in Nigeria.

The high rate of the respondents in this study who had formal education, compared to the low rate in those who had no formal education, agrees with the observations of Adesehinwa et al,[24] who reported that a higher percentage of pig farmers in Oyo State of Western Nigeria had formal education. This development may be of assistance to extension officers for easy communication and understanding of extension messages, especially for application of new technology in swine production and management. Literate farmers might be more likely to adopt good husbandry and health-management practices. Education and training has been shown to improve business performance and returns of farmers.[27] In other words, better trained and educated farmers might adopt better technology and management practices that will guarantee success and better returns on investment.

The herd sizes in this study are within the range reported by other researchers.[8,14,26] A majority of respondents combined pig production with poultry farming. This may be due to the favorable climatic conditions of the Southeast that favor poultry and pig production. It might also be because poultry manure is used to feed grower and finisher pigs in Nigeria.[28]

The intensive management system and good housing with concrete floors and insect-proof wire netting adopted by the majority

Table 3: Herd size distribution in 54 pig farms surveyed in Southeast Nigeria*

Herd size	No. of respondents (%)
1-99	48 (88.9)
≥ 100	6 (11.1)
Total	**54 (100.0)**

* One respondent per farm.

of pig farmers in the study may have been responsible for the good performance recorded by the farmers. This is contrary to the findings of Rekwot et al[10] in Kaduna and Benue States in Northern Nigeria, where most pig farmers practiced a semi-intensive system in the day time, wherein pigs are allowed to scavenge, with supplementary feed given in confinement in the evening.

The respondents reported that most deaths of pigs in their farms occurred at ≤ 3 months of age. This is in agreement with the report of Ukoh et al[15] in which preweaning mortality rates were 29.3% and 44.8%, respectively, in exotic and indigenous pig breeds in Nigeria. These high rates of mortality could be due to poor management practices.[25]

Table 4: Livestock species kept in 54 pig farms surveyed in Southeast Nigeria*

Species	No. of respondents (%)
Pigs only	2 (3.7)
Pigs and poultry	35 (64.8)
Pigs, goats, and sheep	17 (31.5)
Pigs and cattle	0 (0.0)
Total	**54 (100.0)**

* One respondent per farm.

Table 5: Farmers' affirmative answers on pig production and disease prevention in 54 pig farms surveyed in Southeast Nigeria*

Production parameters	Frequency (%)
Swine production was profitable	43 (79.6)
Would like to expand production if constraints were removed	35 (64.8)
Had improved housing and sanitation†	33 (61.1)
Spent money on veterinary care	37 (68.5)
Needed credit facilities	30 (55.6)
Purchased commercial feed	21 (38.9)
Used kitchen and restaurant wastes	37 (68.5)
Would like to benefit from farm management training	52 (96.3)
Had insect-proof netting	47 (87.0)
Experienced skin lesions	46 (85.2)
Recorded mortality in the farm	54 (100.0)
Recorded mortality in young piglets (< 1 month of age)	31 (57.4)
Experienced clinical signs of African swine fever	0 (0.0)
Intensive management system: good housing and concrete floor	54 (100.0)
Used boots, gloves, and other protective clothing on routine farm operations	36 (66.7)

* One respondent per farm.

† "Improved housing and sanitation" refers to farms with concrete floors, insect-proof netting, corrugated iron roofs, and biosecurity measures in place.

The questionnaire survey showed that all respondents recorded gastrointestinal parasites. This finding does not agree with the observations of Holmes,[4] who reported few clinical signs of gastrointestinal parasitism and other infections in pigs reared under an intensive management system. Roepstorff and Nansen[29] showed that the occurrence of gastrointestinal parasites of pigs and other infections is influenced by the type of production management system. In addition to this, poor management practices (such as inadequate hygiene, drug abuse and misuse, and poor housing and feeding), adverse weather conditions (including the tropical climate: high temperature and humidity), and low genetic potential, contribute to a high incidence of parasites and insect vectors.[30] The high prevalence of gastrointestinal helminths, coccidia, and ectoparasites recorded in most of the farms studied confirms the endemic nature of these disease agents as causing major economic losses in pig production in Nigeria.[10,31,32] Routine prophylactic measures against parasites as part of veterinary care in the farms studied might have helped reduce the parasitic load[1] and subsequently boosted production.[30]

There was no significant association between the prevalence of gastrointestinal helminths and coccidia across age categories of pigs. This does not agree with the reports of Soulsby,[33] Adejinni et al,[34] Nganga et al,[35] and Adebisi,[1] who showed that the prevalence of these parasites increases with age.

Prevalence of brucellosis recorded in this study was low; however, the choice to survey the disease was based on the reports of abortion and infertility by the farmers in the study area prior to this study. The public health and economic implications of brucellosis necessitated its investigation for recommendations on prevention and control. The farmers in the study area recognized the seriousness associated with cases of brucellosis, suggesting that they are aware of its zoonotic potential. Secondly, the disease causes abortion and stillbirth in sows and orchitis and hygroma in boars. These conditions may affect productivity in affected farms and in farms that acquire replacement stock from

Table 6: Common age of death of pigs reported in 54 pig farms surveyed in Southeast Nigeria*

Age at death	No. of respondents (%)
< 1 month	31[a] (57.4)
1 to 3 months	20[b] (37.0)
> 3 to 6 months	2[c] (3.7)
> 6 months	1[c] (1.9)
Total	**54 (100.0)**

* One respondent per farm.

[abc] Values within a column with different superscripts differ significantly ($P < .05$; chi-square analysis).

Table 7: Effect of production management systems on reproductive performance of sows in 54 farms surveyed in Southeast Nigeria*

Productivity†	Production management system		Total
	Intensive	Semi-intensive	
< 6 pigs	5[a]	2[b]	7
≥ 6 pigs	45[a]	0[b]	45
No record	2	0	2
Total	**52**	**2**	**54**

* Farmers were surveyed using a structured questionnaire. There were 52 intensively and two semi-intensively managed farms. Intensive management: farms with approximately 50 pigs provided with food, housing, and veterinary care; semi-intensive management: partial provision of housing, with pigs allowed to scavenge for food outside, especially in the day time, with or without veterinary care and feed supplementation.

† Productivity = number of pigs marketed/litter.

[ab] Values within a row with different superscripts differ significantly ($P < .05$; chi-square analysis).

them. Other species of animals, such as cattle and goats raised in close proximity to infected pigs, may also be affected.

Insect vectors such as the *Glossina* species found in this study area may transmit trypanosomes and also cause mechanical irritation and injuries.[13] Wire netting of pens in many of the farms sampled may have been responsible for the low prevalence of trypanosomes. Fumigation and use of fly repellents may be of help in further reduction of insect vectors. The high human population density (167.5 people per km^2) in Southeast Nigeria[36] may have resulted in the location of pig farms predominantly in urban areas, which may not be conducive to survival of insect vectors (eg, tsetse fly and biting flies).

In conclusion, the intensive management system of swine production should be encouraged in Southeast Nigeria as it favored better productivity, but to reduce prevalence of disease, an effort should be made to improve management practices, for example, adequate nutrition, prophylaxis against parasites and microbial infections, and general biosecurity measures.

Implications

- Under the conditions of this study, education of pig farmers increases productivity (number of pigs marketed per litter).
- Under the conditions of this study, an intensive management system appears to favour productivity more than a semi-intensive management system.
- Under the conditions of this study, prevalence of strongyle, ascarid, and trichuris helminth infections do not vary with age among pigs in Southeast Nigeria except that fewer ascarid and trichuris eggs are found in pigs > 6 months of age.
- Under the conditions of this study, mortality rates among pigs in Southeast Nigeria are highest in piglets ≤ 3 months of age.
- Under the conditions of this study, an intensive management system seems to favour gastrointestinal parasitism and demodectic mange more than a semi-intensive management system.
- In the area of Southeast Nigeria in this survey, most pig farmers source their replacement stock from farms keeping health and production records and utilizing veterinary care.

Acknowledgement

We are grateful to the University of Nigeria administration and especially to the Senate Committee on Research Grants for funding this project (Senate Research Grant No. 07/21). The authors acknowledge the cooperation of the Directors of Veterinary Services in Anambra, Ebonyi, and Enugu States in the course of this study. We also appreciate the efforts of the Faculty Technologists and the Secretariat of the Department of Veterinary Public Health and Preventive Medicine, University of Nigeria, Nsukka, for their roles in actualization of this study.

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Table 8: Disease prevalence and distribution in 54 farms in Southeast Nigeria*

Disease	No. of positive samples/no. of samples collected	Prevalence (%)	No. of samples tested positive	
			Management system†	
			Intensive n = 52 farms	Semi-intensive n = 2 farms
Coccidiosis	108/232	46.6	107[a]	1[b]
Helminthosis	58/232	25.0	50[a]	8[b]
Demodectic mange	110/540	20.4	100[a]	10[b]
Trypanosomiasis	3/351	0.9	0[a]	3[b]
Brucellosis	2/351	0.6	2[a]	0[b]

* Prevalence and frequency based on laboratory analysis. The simple egg floatation technique was used for detection of helminth ova and coccidia oocysts in fecal samples collected from 10 pigs per farm. Skin scrapings from 10 pigs per farm were examined for ectoparasites using the Hendrix and Robinson method.[21] Blood samples were collected from 6-10 pigs per farm. Trypanosomiasis was diagnosed by the microhematocrit buffy coat technique.[22] Sera were tested for *Brucella* antibodies using the rose Bengal plate agglutination test using *Brucella abortus* and *Brucella melitensis* antigens.[23]

† Intensive and semi-intensive management systems described in Table 7.

[ab] Values within a row with different superscripts differ significantly ($P < .05$; chi-square analysis).

Table 9: Distribution of helminth eggs among age categories of pigs in 54 pig farms surveyed in Southeast Nigeria*

Age category (no. of samples)	Helminth eggs identified			Total
	Strongyles	Ascarids	Trichuris	
< 1 month (92)	11[a]	2[a]	1[a]	14
1-3 months (106)	14[a]	2[a]	2[a]	18
> 3 to 6 months (153)	13[a]	1[a]	1[a]	15
> 6 months (189)	11[a]	0[b]	0[b]	11
Total (540)	**49**	**5**	**4**	**58**

* Fecal samples were collected from 10 pigs per farm and examined by simple fecal flotation.

[ab] Values within a column with different superscripts differ significantly ($P < .05$; chi-square analysis).

Table 10: Sources of replacement stock in 54 pig farms surveyed in Southeast Nigeria*

Sources	No. of respondents (%)
Farms with good records and veterinary care	39[a] (72.2)
Pig markets	10[b] (18.5)
Own stock†	5[c] (9.3)

* One respondent per farm.

† Own stock: the practice of selecting as replacements healthy pigs with a history of good production within the same farm.

[abc] Values within a column with different superscripts differ significantly ($P < .05$; chi-square analysis).

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