

Rural pig production and pork consumption in Imo State, Nigeria

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Target Audience: *Pig Farmers, Pig Breeders, Animal Scientists, and Researchers.*

Abstract

The study examined pig production and pork consumption in rural communities of three Local Government Areas in Imo State, Nigeria. The data used for the study were obtained from 120 farmers including 60 pig producers and 60 pork consumers. Random sampling techniques were employed for the study and data collected were analysed in descriptive statistics and multiple regression. Results presented were on the socio-economic, production and management characteristics of pig farmers, resources used for pig production, factors affecting pig production and pork consumption, pig production systems, constraints of pig production and pork consumption patterns in the study area. Result showed that the pig farmers were educated to tertiary education and had not less than 20-24 years of pig farming experience. The study also revealed that majority of pig farmers kept inventories, had animal husbandry training, access credit facilities, and agribusiness cooperatives as management characteristics. The factors affecting pig production include income, cost of feed, farm size, household size, cost of drugs, and cost of labour while factors affecting pork consumption were pork price, environmental conditions, poor hygiene, cultural and religious beliefs, and nutritional values. The major constraints affecting pig production in the study area were high labour, poor housing, high finance, land holding, high incidence of disease, and high cost of feed. In conclusion, crossbred pigs were reared more than indigenous breeds due to their low productivity. However, pig breeders can preserve indigenous pig germplines through on-farm and ex-situ conservation for genetic diversity improvement.

Keywords: *Pig farmers, Pork, Production, Consumption, Management, Constraints.*

Description of Problem

Pig and pork production play an important role in providing food security for human sustenance, poverty eradication, employment generation, social status, draught power, transportation, income savings, insurance, financial security, and inorganic manure for crop farming for both urban and rural economy (1,2). Smallholders in pig industry generate over 90% of pig population under production systems of pig management classified into intensive (3,4); semi-intensive (5); and traditional/extensive (6). Global report

in 2005 has shown that 34% of pig production are kept under extensive/backyard systems, 54% under intensive systems while 12% of pig stocks are kept under semi-intensive/intermediate systems (7). However, herd sizes, structures, and resource availability determine the type of production system employed in pig production (8,9). These systems have different levels of technical development and diverse feed sources, varying from local products and international feed products (10).

Agriculture accounts for 17.5% and

11.7% of gross domestic products (GDP) and attributes 5.7% and 22.3% to total employment in sub-Saharan Africa and North Africa respectively. Interestingly, in Nigeria, small-scale farmers are the main contributors of livestock growth with 6-8% of the national GDP and labour force (11). Presently in Africa, Nigeria has the highest pig population estimated at 7.5 million head in 2017 (12) with an increase in the human population of 203,452,505 people with an annual growth rate of 2.54 % in 2018 (13). Furthermore, in the last five decades, pig production in Nigeria has increased 4-fold with an estimated annual production of approximately 3.1%. The increase in pork consumption is estimated at an annual growth rate of 10.8% during 1980-90 and 4.0% in 1990–2000 (14). However, both small-scale and large-scale farms exist, but they differ in efficiency, output, and feed resource utilisation (15,16).

Pig keeping contributes significantly to the livelihood of many Nigerians by supplying animal protein and essential nutrients (17). The annual per capita meat consumption in Nigeria is projected to triple from 2012 to 2030 due to human population growth and per-capita food demand towards animal protein (18,19). Furthermore, factors that impact on the consumption of pork in a locality includes economic growth (income per-capita/household income), human population growth, urbanization, pork prices, dietary diversity, consumer preference, environmental conditions, cultural, social and religious beliefs (20). Consequently, Nigeria is faced with the problem of dietary animal protein shortage for an increasing human population where the daily protein intake per capita is 46 g/kg, which is below the minimum recommended intake of 66 g/kg by FAO (21). The animal protein shortage threatens protein malnutrition due to insufficiency and the potential protein deficit gap-filler is pig farming.

Currently, pig and poultry production are the fastest growing agricultural livestock subsector in the globe and Nigeria is not left behind. An attractive aspect of pork production for farmers in developing countries as Nigeria is driven by the rapid increase in demand for pork and pork products, specialisation, automation, production and trade of cheap feedstuffs, market liberalisation, cheap energy, and improved technological in genetics and feeding strategies (22). Interestingly, pork consumption is gaining prominence as a substitute to the conventional meat sources of beef, chicken, mutton, and chevron as chicken is currently the biggest competitor to pork consumption (23).

Intriguingly, economic contributions of pig farming are constrained by major factors like management, health, housing, feeding, and marketing constraints (24,25). Smallholder in pig industry could be experiencing low productivity due to poor management practices, lack of farm infrastructural facilities, inadequate market opportunities, high cost of feedstuffs, and insufficient processing units (26,27). Disease outbreaks are associated with poor genetic breeds, high mortality rates, feed inefficiency, lack of skills, experience, and knowledge are factors that affect pig production. Improved feeding practice, herd management and proper manure management can reduce the environmental impact of pig production. Biosecurity measures and effective husbandry need urgent consideration in pig production to avoid disease occurrence (28,29). These include allocating and distributing adequate resource inputs, investment in research and development, reducing bottlenecks to efficient resource use, utilisation at the farm level, technological and institutional changes, and a changing resource base to help bridge the gap between production and consumption. Government should embark on a proper agricultural livestock policy, reduced

subsidy, developmental strategy and programme formulation to effectively stimulate pig farming and productivity (30). The current study investigates pig production and pork consumption in three (3) rural autonomous communities in (Aboh, Ahiazu, and Ezinihitte Mbaise Local Government Areas (L.G.As)) of Imo State. Additionally, the study compared the statistics of Nigerian pig production and pork

consumption within 2000-2017. The objectives of the study were to examine the socio-economic, production and management characteristics of the local pig farmers, resources used for pig production, production system of pig management, factors that affect pig production and pork consumption, and constraints of pig production and pork consumption in the study area.

Table 1: Socio-economic characteristics of pig farmers

Variable	Frequency (N=120)	Percentage (%)
Gender		
Male	98	81.67
Female	22	18.33
Farmers' age		
20-29	8	6.67
30-39	26	21.66
40-49	12	10.00
50-59	58	46.67
60-69	10	8.33
70-79	6	5.00
Educational level		
Primary Education	28	23.33
Secondary Education	35	29.17
Tertiary Education	57	47.50
Household size		
0 – 4	22	18.33
5 – 9	56	46.67
10 – 14	42	35.00
Years of experience		
5 – 9	20	16.67
10 – 14	22	18.33
15 – 19	24	20.00
20 – 24	42	35.00
25 – 29	12	10.00
Farm/herd size		
20-39	40	33.33
40-59	30	25.00
60-79	50	41.67

Source: Field data.

Table 2: Production characteristics of pig farmers

Variables	Frequency (N=120)	Percentage (%)
Breeds of pigs		
Locals breeds	20	16.67
Cross breeds	65	54.16
Exotic breeds	35	29.17
Pig weight (kg)		
41-50	30	25.00
51-60	40	33.33
61-70	30	25.00
71-80	20	16.66
Land holding (plots)		
Small (1-2)	35	29.16
Medium (2-3)	60	50.00
Large (4-5)	25	20.83
Business activities		
Part time	45	37.50
Full time	75	62.50
Income levels		
₦ 10,000 – ₦ 49,999	27	22.50
₦ 50,000 – ₦ 89,999	48	40.00
₦ 90,000 – ₦ 129,999	30	25.00
₦ 130,000 – ₦ 169,999	15	12.50
Source of capital		
Personal savings	28	23.33
Contribution scheme	27	22.50
Cooperative societies	21	17.50
Salary/wages	19	15.83
Credit facilities/bank loans	15	12.51
Borrow from friends/relatives	10	8.33

Source: Field data.

Materials and Methods

Study location

Imo State has a human population of 5.5 million and the population density varies from 230-1,400 people as square kilometre (sq/km²) with an area of around 5,100 sq/km² (31). The study area lies between 4⁰45'N to 7⁰15'N latitude and 6⁰50'E to 7⁰25'E longitude with an attitude of 200 meters above sea level (32). The weather conditions of the area are

characterized by a mean annual rainfall of 1850 mm with high relative humidity of over 75%, wet season of 6-8 months, average annual ambient temperature of 27⁰C (80⁰F) on a vegetation of humid rainforest (33). The study was conducted in the rural autonomous communities of Aboh, Ahiazu, and Ezinihitte Mbaise L.G.As within the Imo East senatorial district of Imo state, Nigeria. The study area is predominantly Igbo speaking people (99%) and

are Christians (34). Their main occupations are plant and animal agriculture, commerce, and handcrafts (35). The main food crops are palm oil, cassava, maize, yam, fruits, and vegetables. The main animal productions are poultry, pigs, goats, catfish and grasscutter (cane rat) farming.

Table 3: Regression analysis of factors affecting pig production in the study area

Variables	Linear	Semi-log	Double-log	Exponential
Income	0.528 (11.092) ^{xxx}	0.475 (7.395) ^{xxx}	0.692 (12.660) ^{xxx}	0.608 (7.524) ^{xxx}
Cost of feed	-0.419 (-3.337) ^{xxx}	-0.029 (-0.470)	-0.074 (-1.691) ^x	-0.110 (-1.806) ^x
Farm size	0.190 (9.388) ^{xx}	0.331 (3.988) ^{xxx}	0.254 (4.296) ^{xxx}	0.239 (2.700) ^{xx}
Cost of drugs	0.073 (2.179) ^{xxx}	0.50 (0.832)	0.124 (2.880) ^{xxx}	0.230 (4.029) ^{xxx}
Cost of other inputs	0.047 (1.505)	0.236 (0.667)	0.014 (0.371)	0.024 (0.455)
Cost of labour	-0.045 (-1.536) ^{xx}	0.000 (0.005)	-0.037 (-0.967)	-0.019 (-0.387)
Household size	-0.055 (-1.644) ^{xx}	-0.109 (-1.897)	-0.056 (-0.370)	-0.047 (-0.821)
Access credit	-0.021 (-0.681)	0.008 (0.159)	-0.027 (-0.748)	-0.017 (-0.332)
Years of experience	-0.024 (-0.795)	-0.052 (-1.030)	-0.008 (-0.220)	-0.007 (-0.139)
Constant	-0.105 (-0.945)	-3.824 (-5.243) ^{xxx}	-8.079 (-11.243) ^{xxx}	-1.766 (-6.784) ^{xxx}
R ²	0.906	0.716	0.856	0.729
F- statistics	128.466 ^{xxx}	34.254 ^{xxx}	79.403 ^{xxx}	36.587 ^{xxx}

XXX=significant at 1%, XX=Significant at 5%, X=Significant at 10%.

Source: Field data.

Table 4: Factors affecting pork consumption in the study area

Factors	Frequency (N=120)	Percentage (%)
Pork prices	60	50.00
Environmental conditions	41	34.17
Pork contamination via diseases	28	23.33
Cultural and religious belief	19	15.83
Nutritive value	2	1.67
Likeness of pork		
Yes	88	73.33
No	32	26.67

Source: Field data.

Table 5: The production system of pig management practiced by the pig farmers

Production system	Frequency (N=120)	Percentage (%)
Intensive system	85	70.83
Semi-intensive system	25	20.83
Extensive system	10	8.33

Source: Field data.

Data collection

Data and meta data information from pig producers and pork consumers were collected from a defined study area. The selected autonomous communities were chosen based on the concentration of pig production,

human population, accessibility of transport, diverse occupations, farmers' income levels, number of pig farmers and pork consumers in the study area. Multi-stage sampling procedures were adopted for the study. A total of 5 autonomous communities in each L.G.A were selected for the study. The farmers were randomly selected making up of 20 pig producers and 20 pork consumers from each L.G.A i.e 60 each. Within the three L.G.As, a simple random sampling technique was used in

the choice of the households. A semi-structured questionnaires and formal oral interviews were used as a primary source to obtain data and information. The questionnaires consisted of questions related to the socio-economic, production and management characteristics of the pig farmers, resources used for the pig production, production system of pig management, factors that affect pig production and pork consumption, and constraints of pig production and pork consumption.

Table 6: Management characteristics of the pig farmers in the study area

Production system	Frequency (N=120)	Percentage (%)
Recording Keeping		
Yes	90	75.00
No	30	25.00
Animal husbandry training		
Yes	69	57.50
No	51	42.50
Extension services visits		
Yes	35	29.17
No	85	70.83
Credit facilities		
Yes	65	54.16
No	55	45.83
Agribusiness cooperatives		
Yes	80	66.67
No	40	33.33

Source: Field data.

Table 7: Constraints of pig production in the study area

Constraints	Frequency (N=120)	Percentage (%)
High labour	90	75.00
Poor housing	73	60.83
High finance	61	50.83
Land holdings	59	49.17
Disease incidence	50	41.67
High cost of feed	48	40.00
High cost of vaccine	32	26.67
Inaccessibility of road	25	20.83
High cost of drugs	20	16.67

Source: Field data.

Data analysis and regression model specification

Data obtained were analysed using the Statistical Package for Social Sciences (SPSS) Version 16 in descriptive statistics of frequency, percentage, and multiple regression model. The regression model adopted was the Ordinary Least Square used to determine the socioeconomic characteristic of the pig farmers and pork consumers. The four functional regression models used were simple linear, semi-logarithmic, double-logarithmic, and exponential. The criteria used in selecting the functional equation were the best fit on the regression model included: (i) highest regression (R^2), (ii) highest number of significant variables, (iii) highest F value and (iv) conformity to the a priori expectations of the regression coefficients.

Result and Discussion

Table 1 represents the socio-economic characteristics of pig farmers in the study area. The result showed that 18.33% of the pig farmers were females and 81.67% were males. The majority of the pig farmers 46.67% were over 50 years, 21.67% were above 30 years, 10% were above 40 years and less than 8% of the farmers were over 60 years, >29 or <70 years of age. Most of the pig farmers (47.5%) had tertiary education, 29.167% had secondary education and 23.3% had primary education. About 46.67% of the farmers' household size had >5 persons, 35% had above 10 household size and 18.33% were less than 4 people. Majority of the pig farmers 35% had 20-24 years of experience in the pig production, 20% had 15-19 years of experience, 18.33% had experience of above 10 years, 16.67% had experience of above 5 years and 10% had experience of above 25 years in pig production. Majority of the farmers had about 41.67% stocking rate of over 60 pigs in their farm, 33.33% had not less than 20 pigs in stock and

25% farmers had above 40 pigs in stock. To the best of our knowledge, this is the first report that analyses pig production and pork consumption in rural communities of Aboh, Ahiazu, and Ezinihite Mbaise LGAs of Imo State, Nigeria. Socio-economic characteristics of the pig farmers revealed that pig farming was a male dominated enterprise of economic empowerment and autonomy in pig production. Pig farming is a laborious and capital-intensive venture which may preclude women in some areas of production and management. The current finding corroborates with reports that suggest pig production was a male activity in places like Southwest Nigeria, Congo and South Africa (5,36,37). In Southern Nigeria and Botswana, both men and women are involved in pig production whereas in some part of Northern Nigeria they are not due to their religious inclination of belief (38,39,40). The majority of pig farmers were within the age of 50–59 years old, which aligns with observations from Southwest Nigeria and South Africa where pig farmers were within 40–60 years of age (5). In the study area, the pig farmers were generally well educated with nearly half having tertiary education such that they can read and write effectively. The pig farmers in the study area were experienced mature farmers and can manage the business efficiently due to their age bracket (5). In Southern Nigeria and few parts of the Northern Nigeria, most of the pig farmers are also educated and they combine pig production with other business activities (38,39,40). Most of the pig farmers had a household size above 5 people with the family as major contributors to the farm workforce and family income, but also factoring as people to feed from farm outputs (6,41,42). Increased household size decreases the cost of labour and maximizes production cost efficiency, increases productivity, increases profitability and improves livelihood. The current result corroborates with reports from Northeast India,

Congo, and some parts of Northern and Southwest Nigeria (2,4,11,43). The experience (in years) for pig farmers is an important factor to determine increased output in productivity. Measurable years of experience in pig farming correlates with impact on methods of production, management ability, record keeping and access to market opportunities as assistance to productivity and profitability of the venture. Reports from some part of Northern Nigeria, Southeast and Southwest Nigeria showed that the majority of the pig farmers had more than 10 years of experience in pig production in conformity to the current finding (37,44). Most pig farmers in the study were small scale farmers with 60-79 pigs and were found to be on a moderate level income from pig farming. Pig farming therefore contributes significantly to the livelihood of smallholders which agreed with previous reports that smallholders rear pig for supplementary income, food and manure (45,46). Farm/herd size relates to the availability of land for pig farming (47) as the larger the herd size the bigger the land requirements in rural communities compared to peri-urban areas (2). Any increase in herd size also involves disproportionate investing or accruing of cash or feed resource for smallholders (48).

Table 2 shows the production characteristics of pig farmers in the study area. The results showed that about 54.16% of the pigs were crossbred, 16.67% local and 29.17% (exotic). The pig weights ranged between 41–50 kg (25%); 51–60 kg (33.33%); 60–70kg (25%) and 71–80kg (16.66%) before slaughtering. Most of the pig farmers raised their pigs within 2-3 plots of lands and the farmers took pig production as a full time not a part time investment. Result from income earners' level showed that about 40% of the pig farmers had income above ₦50,000 and below ₦90,000, 25% had income above ₦90,000 and below ₦130,000, 22.50% had income above

₦10,000 and below ₦50,000 while 12.5% had income above ₦130,000 per production cycle. The majority of the farmers 23.33% got their capital from their personal savings, 22.50% had their source of capital from monthly contribution scheme of money lender, 17.50% got their capital from different group cooperative societies, 15.83% had their sources from jobs/workplaces as wages/salaries, 12.51% of the farmers had their sources from bank loans or credit facilities and 8.33% had their sources of capital from relatives/friends as borrow. The production characteristics of pig farmers in the study area revealed that majority of the pigs reared were crossbred and exotic breeds of pigs. The choice of pig breeds reared by the pig farmers in the current study might depend on the availability and access of stock breeds, production resources, returns to investment, productivity and profitability in the venture (3). This confirms studies in Enugu, Southeast Nigeria, and North East India where pigs were mostly crossbred and exotic breeds (3,39,49). The increasing demand of pork production to meet the nutritional sufficiency of the rapidly growing human population has led to indiscriminate or uncontrolled crossbreeding and replacement of indigenous pigs with crossbred and exotic breeds. It is unfortunate that indigenous breeds of pigs from Southeast Nigeria have been neglected most especially in the study area. This might ultimately lead to the extinction of indigenous pig breeds and local landraces with the loss of advantageous traits and genetic diversity for further genetic breeding improvement (39). Indigenous pigs in the locality have been perceived and viewed to underperform compared to the crossbred or exotic breeds in terms of litter size, litter weight, birth weight, weaning weight, average daily weight gain (50,51) so are less attractive to farmers in the area. However, they may contain valuable alleles relating to potential adaptive traits selected by the local tropical climate and

diseases that could be introgressed into high productivity elite commercial varieties at a later date. Therefore, pig breeders, animal health technicians, veterinarians, and extension services should encourage pig farmers to adopt the indigenous breeds of pig in their rural farm operation to avoid extinction of the breed. The majority of pig weights were within 51-60 kg before slaughter for pork consumption. This may be due to early returns for profitability and market consideration according to some reports (36,39). Again, the number of sows in the farm depends on the capacity and ability of the pig investment and factors into the weight of pigs before slaughter. Better provision of central slaughterhouse facilities and improved transport infrastructure within the study area will help in market accessibility for slaughtered pigs (52). Most of the pig farmers raised their pigs within 2-3 plots of lands which is related to the small-scale of the farms and the number of animals reared/herd size (2). These landholdings might be inherited lands or specifically purchased land for pig investment. Our finding agreed with reports from some parts of Africa (Tanzania, Kenya and Congo) where small-scale farming is carried in small land holdings of 1–2 plots of lands (8,9,53). The majority of the pig farmers' activities in pig production were full-time not a part-time investment. However, the proportion of part time pig farmers recorded in the study was lower at 37.5% compared to numbers (78%) in northern Nigeria (46). Pig production is highly profitable, and the majority of the pig farmers had income between ₦50,000 and ₦90,000 per month. The access to credit facilities in both production and management characteristics of the farmers helped in the small-scale nature of the production recorded in the study (3). The sources of capital used by the pig farmers were varied and included personal savings, contribution schemes, cooperative societies,

credit facilities/loans from banks, relatives or friends.

Figure 1 shows the distribution of other preferred meat consumed in the study area. The results revealed that pork consumers also preferred other meats as 37.5% preferred beef, 29.17% preferred chicken, 18.33% preferred grass cutter meat, 12.51% preferred fish, <2% preferred goat and sheep meat. According to our findings, the majority of the pork consumers liked pork while only a few consumers showed that they did not like pork. The few consumers that do not like pork consumption might relate it to the suggested cultural, social and religious beliefs toward pork as taboo and they might be among the respondents that preferred alternative meat like beef and chicken in the study. The pork consumers in the study area also enjoyed other meats such as beef, chicken, grasscutter, fish, goat, and sheep (expressed in results). It was clear that pork consumers preferred mostly beef or chicken than other meats in the study. However, their alternative preferences might be biased due to the availability of beef or chicken meat and was also influenced by some religious and cultural significance associated with particular meats. Pork consumers emphasized that pork prices, income, taste, and texture of meat were their major reasons for the choice of preference. The study agreed with the report carried out in Southwest (Oyo, Osun, Ondo States) and some parts of Southeast Nigeria where beef was the most preferred meat by consumers (17,54).

The total livestock production (head) produced in Nigeria within 2000 – 2017 (Figure 2a), showing chicken, goats, sheep, cattle and pigs. Goats, sheep and cattle had a steady increase while chicken and pigs showed a significant dip in production following 2011. Figure 2b stands for the total number of pigs produced in Nigeria within 2000 - 2017. The highest was recorded in 2017 (7,506,015 head) and the lowest was 2000 (5,047,624 head). In

2011 pig production (6,282,453 head) decreased by 15.92% compared to 2010. However, in 2012 – 2015, pig production gradually increased with annual growth rate of 4.07% to 7.51 million head in 2017. Overall the number of pigs in Nigeria increased from 800,000 head in 1968 to 7.51 million head in 2017 growing at an average annual rate of 4.93 %. Figure 2c stands for the total pork production (metric tonne) in Nigeria within 2000–2017. The consumption of pork in the study area was measured on a carcass weight basis (metric tonne) from the year 2000-2017 consumed by Nigerians. The total pork production in Nigeria from 2005-2017 was a generally positive trend with small temporary dips in 2003 and 2014. Overall, between 1968 and 2017, production of pig meat of Nigeria grew from 26,550 to 278,051 tonnes rising at an increasing annual rate that reached a maximum of 29.41 % in 1984 and then decreased to 1.20 % in 2017. Figure 2d represents the total number of slaughtered pigs in Nigeria within 2000 - 2017. The graph followed the same trend of figure 2b and 2c. The adopted Nigeria statistics on pig production and pork consumption are equated to the study area as stated in the aim of the study. The consumption of pork in the current study was measured on a carcass weight basis from the year 2000-2017 as adopted from Nigerian statistics in pig production and pork consumption (12). The figures show an increase in pig production tracking an increase in pork consumption. From 2011 to 2014, pork consumption in the study grew on an average of 35.49 percent per year. In detail, pork consumption in the study area increased by 37.5 percent in 2011, 46.4 percent in 2012, decreasing by 3.73 percent in 2013 and then increasing again in 2014 by 22.58 percent. Pork consumption in the study therefore grew annually with the exception of 2014, but then increased again in 2015 and onward. The growth in per capital pork consumption may be

attributed to an increase in the income level of the pork consumers. The model is that income growth leads to increased pork consumption which therefore requires higher levels of pig production. If there is continuous increase in income levels of the pig consumers in the study area, then pork consumption growth in Imo State will have large impacts on future pork demand of the populace. These findings are in line with report of (55).

To determine the various factors which influences pig production, the quantity of pork consumed was regressed on farmers' income, cost of feed, farm size, cost of drugs, cost of other inputs, cost of labour, household size, access to credit and years of experience of the pig farmers (Table 3). The four functional forms of multiple regression models were used for the analysis for the best fit model; linear, semi-log, double-log, and exponential presented in Table 3. However, the linear model showed the best fit on the basis of the regression (R^2), level of significance, magnitude of the regression coefficients and conformity to a prior expectation. Income and cost of drugs were highly significant at 1% and were positively related to the quantity of pork consumed. Cost of feed was significant at 1% but was negatively related to the quantity demanded of pork consumption. Farm size was significant at 5% and was positively related to the quantity of pork demanded for consumption. Cost of labour and household size were significant at 5% but was negatively related to the quantity demanded of pork consumed. The f-ratio was highly significant at 1% linear model revealed the overall significance of the linear function model. The regression (R^2) value was 0.906 which implied that about 90.6% of the variation in the dependent variables was explained by the explanatory variables included in the model. The regression analysis on the factors affecting pig production and pork consumption in the study area is expressed in the result. The factors

that influenced pig production and quantity of pork demanded was regressed on income, cost of feed, farm size, cost of drugs, cost of other inputs, cost of labour, household size, access to credit and years of experience of the pig farmers. The linear regression model was chosen as the lead equation as the regression (R^2) value was 0.906 and F-ratio was significant at a 1.0% level. The pig farmers' income was highly significant at 1% and was positively related to the quantity of pork demanded by pork consumers for consumption. This finding corroborates with (17,56). This agrees with the general expectation that the higher the quantity of pork demanded by pork consumers, the higher the income of the farmers. The quantity of pork demanded also increases as consumer income increases (57), which leads to an increase in pig production to meet the demand of pork consumers, thereby further increasing the profits for pig farmers. Pork consumers with high income would also tend to buy more pork as individuals than those with low income (58). Cost of feed was also significant at 1% but was negatively related to the quantity demanded of pork. This showed that the higher the cost of feed, the lower the quantity of pork available for demand by pork consumers. The higher cost of feed might lead to reduction in pig production due to low profit margin from investment. In addition, the high price of pork mentioned by pork consumers might be due to the high cost of feed in pig production. Farm size was statistically significant at 5% level and was positive related to the quantity of pork demanded by the pork consumer. This showed that the higher the farm size the higher the output. Also, the availability of matured pigs in stock for slaughter by the pig farmers drives higher demand for pork by pork consumers suggesting a potential opportunity for expansion in the supply chain. The availability of pigs for slaughter drives demands from pork consumers which suggests that there are

available market opportunities for pork, such that pig production needs to be enhanced and improved in the study area to fulfil this potential demand. This does reflect some productivity expectations towards a significant supply gap since the pig farmers were small scale farmers. The cost of drugs/medication was significant at 1% level and was positively related to the quantity of pork demanded by pork consumers. This indicated that the more the pig farmers spent money to acquire drugs for medication to take care of disease occurrence in the animals, the higher the output or healthier the pigs will be, given that it takes a healthy animal to perform well and pork consumers prefer to purchase animal meat that is well fed and fit for consumption (59). Cost of labour was significant at 5% but was negatively related to the quantity demanded of pork consumers. This may suggest that a higher cost of labour reduces pig production leading to a reduction in the availability of pork received by pork consumers, or that increased labour costs decreases the quantity of pork demanded by pork consumers because of higher prices (60,61). Household size was significant at 5% and had an adverse relationship with the quantity of pork demanded by pork consumer. The more people in the family, the lower the quantity demanded of pork by pork consumers (56,62). This could reflect factors such as on-farm consumption of the product (the larger the household size the lower the quantity of pork available for sale); or may be an indirect measure of labour costs (as above); or could even reflect consumer preference when considering the size of the family.

Factors affecting pork consumption in the study area is presented in Table 4. The majority of pork consumers (50%) said that pork was expensive to consume due to high pork price rate, 34.17% of the pig consumers said that pork is not hygienic to consume because of the environment where the pigs were

kept or raised, 23.33% said that pork are contaminated with disease and infection due to their nature, 15.83% of the pork consumers said eating pork meat is taboo due to their cultural, social and religious restriction of belief and 1.67% said that pork has low nutritive value, tasteless and not rich in essential nutrients. However, the majority of the pork consumers (73.33%) confirmed that they liked consuming pork compared to 26.67% who revealed that they did not like pig meat. The pork price, environmental conditions, pork contamination, cultural and religious beliefs, and nutritive values were the factors affecting pork consumption in the study area. Majority of the pork consumers said that pork was expensive to consume due to its high prices and this could reduce the rate of pork consumption unless there is an increase in the income level of the

pork consumers. The high price of pork might be attributed to the observation that smallholder farmers kept pigs as a source of cash during on and off festive seasons (6,63,64). The high price of pork might be an inducement for pig farmers to take advantage of the economic benefits of rearing pigs. Some pork consumers argued that pork is not hygienic to consume due to the environment/surroundings where the pigs were raised and processed. Some pork consumers gave their belief that pork was contaminated due to disease and pest infestation as a reason not to consume the meat (65). Other pork consumers said eating pork meat is a taboo which is against their cultural and religious beliefs (66). Some consumers even said that pork meat is tasteless/was not rich in essential nutrients with high cholesterol.

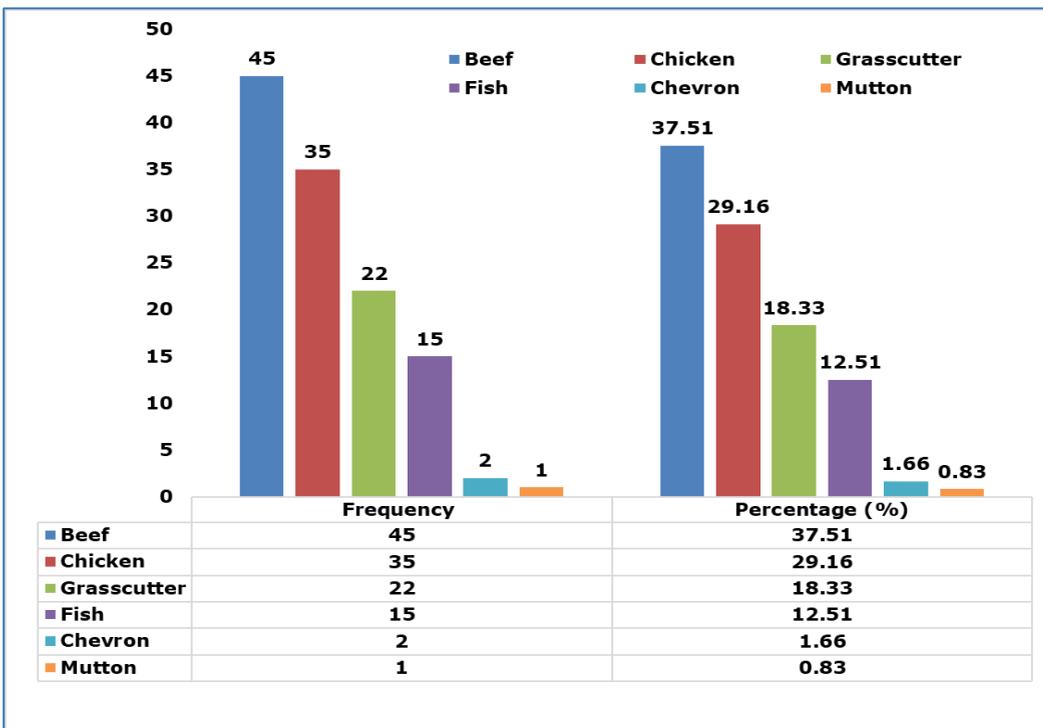


Fig. 1: Distribution of other preferred meat consumption in the study area.

Source: Field data.

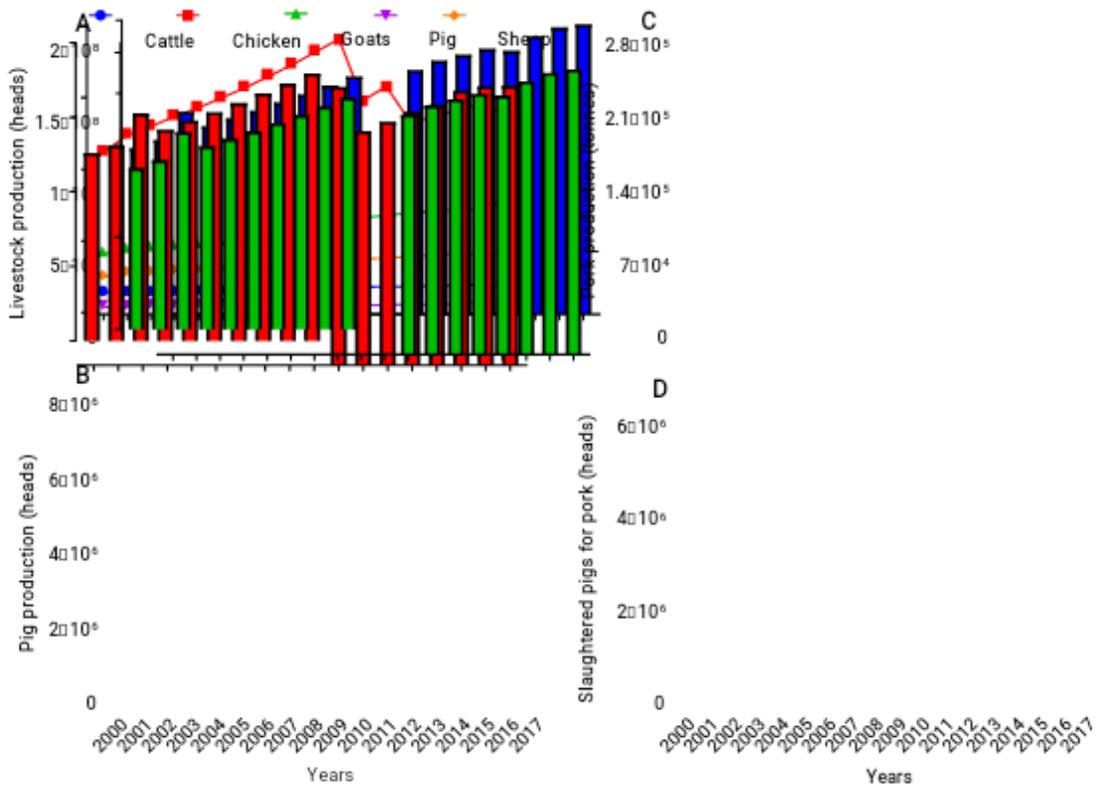


Fig. 2: Nigeria livestock statistics within 2000–2017 (a) livestock production (head), (b) total pig production (head), (c) total pork production (tonnes), and (d) slaughtered pigs for pork (head). Source: (12,75).

Table 5 showed the production system of pig management in the study area. Majority practised intensive management systems (70.83%) while 20.83% and 8.33% practiced semi-intensive and extensive system respectively. The pigs in the study were reared under intensive, semi-intensive and extensive production management system. The result showed that the intensive system of pig production was majorly practiced by the rural pig farmers. The practise of intensive system in the study might relate to the total number (60-79) of pigs raised by the farmers as a small-scale farming. Recently studies have shown that pig farms in rural areas are mostly under small-scale enterprise with 1–100 pigs within a small

land space, as the pig farmers combine pig production with other trades to secure their livelihood (3,44). More so, the intensive system of pig production in the study offered security and protection for pigs, proper management, greater control, easy monitoring, assessment of pigs and less destruction of environment (39,67). This emphasized the provision of feeds and feeding, housing, production, management, and veterinary care (3,37,68). The intensive system of pig management helped in the reduction of disease occurrence, total confinement to against aggression and fighting and human-animal relationship in exploratory behaviors among pigs (4,69).

The management characteristics of the pig farmers in the study area is presented in Table 6. The results showed that majority of the pig farmers keep records of their ventures (75%), no animal husbandry training (42%), no extension services visits (70%), no access to credit facilities from either banks or government (45%) and no agribusiness cooperatives or organisation (33%). The study revealed that majority of the pig farmers kept records of their ventures, had animal husbandry training, had no extension services visits in their farms, had access to credit facilities from banks loans or government grants and belong to agribusiness cooperatives or organisation like pig farmer's associations in agreement with previous findings (3,52). The involvement of pig farmers in agribusiness cooperatives like pig farmers association were a source of empowerment, with access to market consideration, and shared technical knowledge. Formal animal husbandry training is a complementary factor to enhance and improve animal production. Limited access to such training can cause poor technical ability, inadequate skills, poor management knowledge, and limited information to production. In addition, agricultural education is crucial to farm productivity (70,71). Our findings did not agree with the reports from (5,72). It was observed that pig farmers have to request for extension service visit to their farms before environmental inspection and evaluation can be conducted on their farms. The low extension service visit might affect the management characteristics of pig farmers in the area.

The constraints of pig production in the study area are shown in Table 7. From the analysis, high labour, poor housing, high finance, landholdings, disease incidence, high cost of feed, high cost of vaccine, inaccessibility of road and high cost of drugs are the constraints of pig production in the study area. The major

constraints that affected pig production in the study area above 50% were high labour (75%), poor housing (60.83%), and high finance (50.83%). Other constraints of pig production in the study area are landholdings (49.17%), disease incidence (41.67%), high cost of feed (40%), high cost of vaccine (26.67%), inaccessibility of road (20.83%), and high cost of drugs (16.67%). Interestingly, the constraints of pig production raised by pig farmers in the study were in descending order of importance as high labour, poor housing, high finance; land holdings, high incidence of pest and disease, high cost of feed, high cost of vaccine, inaccessibility of road and high cost of drugs. The major constraints that affected pig production in the study area were poor housing, high labour and high finance that were above 60% in agreement with previous reports (9,73,74). High labour was the key constraint of pig production in the study that led the pig farmers to use family labour to reduce the high cost of hired labour involved in the production of pig and pork. Poor housing was another constraint that affected pig production in the study area. Pig farmers also noted that land holding was a constraint in pig production.

Conclusion and Application

1. The intensive system was the most practised system of pig management in the study area. The result revealed that farmers' income, cost of feed, farm size, cost of drugs, cost of labour, and household size were significant factors that influenced pig production.
2. The pig farmers financed their pig business with self-capital from personal savings, contribution schemes, and cooperative societies. The majority of pig farmers kept inventories, had training on animal husbandry, and managerial skills for pig production.

3. Most consumers in the study liked pork but also enjoyed other meats like beef, chicken, and bush meat as an alternative preference. The factors that affected pork consumption in the study includes pork price, environmental conditions, poor hygiene, cultural and religious beliefs, and nutritional values.
4. The major constraints that affected pig production in the study area were high labour, poor housing, high finance, land holding, high incidence of disease and pest, and high cost of feed. Based on the above findings of the study, the following recommendations are made for application:
5. Pig breeders should consider preserving indigenous germplines and potentially useful traits of pigs through on-farm and ex-situ conservation. Biosecurity measures should be employed in pig farms in locals to avoid disease outbreaks, including allowing extension officers, veterinarians, and animal health officers to visit farms without invitation to inspect and encourage pig farmers to report disease occurrence for adequate herd-health management.
6. Younger generations should be incentivized in animal agriculture and given improved training on herd-health management for better productivity and job creation. Efforts should be made by pig farmers to create cooperative societies towards the efficient management of pig farmers within each community so to bridge the gap of increase demand in pork meat in the area. State government should provide agricultural support systems for pig farmers in these rural communities to expand to meet demand, alongside better market channels for pig farmers to sell their produce. To encourage expansion to meet the demand, government should also

increase access to subsidized loans and credit facilities for pig farmers to enable them to increase their output and subsidize the cost of feedstuffs for the pig farmers to increase productivity.

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