

Full Length Research Paper

Application of GIS in pig production system in Nigeria

Taiwo Omodele*, Isaiah Annayochukwu Okere, Mutiu Olakunle Oladele-Bukola, Adeboye Joseph Omole and Ajoke Oyegbami

Institute of Agricultural Research and Training, Obafemi Awolowo University, P.M.B. 5029, Moor Plantation, Ibadan, Nigeria.

Accepted 20 November, 2022

This study aimed to identify the pig producers across various administrative regions and to determine the pig production system in Nigeria through an intensive survey of pig farms with the use of Global Positioning System (GPS). Categorization of farms by proportion in Nigeria showed that 81.1% of states had very low (<5) and low (5 to 50) number of pig farms, 8.1% of states had medium (50 to 100) number of pig farms and 10.8% of states had high (100 to 150) and very high (>150) number of pig farms. In Nigeria, there are two separate pig production systems: small and medium scales. The small scale system is essentially characterized by very low to low scale of production. Analysis of categories of production in Nigeria showed that 45.9% of states recorded very low (<100 pigs) and low (100 to 1,000 pigs) scales of production, 46% of states were in the medium (1,000 to 10,000 pigs) scale of production and 8.1% of states had high (10,000 to 100,000 pigs) and very high (>100,000 pigs) scales of production. GIS qualitative analysis showed that in the North, the production classes: very low, low, medium, high and very high scales of production by states were 40, 30, 25, 0 and 5%, respectively while in the South, the production classes were 0, 17.6, 70.6, 11.8 and 0%, respectively. A high number of Northern states were identified in the low category of pig production scales while most Southern states were in the medium category. The application of GIS revealed that the pig sector in Nigeria is dominated by small and medium scales of production while the harsh climate and its future change pose a major threat to pig farming in the Northern Nigeria.

Key words: Data integration, extension services, farm survey, pig meat, qualitative analysis and rainfall distribution.

INTRODUCTION

The importance of livestock sub-sector is in line with recommendation of the Food and Agricultural Organization (FAO) (2003) that on an average basis, a man's daily protein intake should be between 65 to 72 g and 53% (about 35 g) of this should be animal based.

The major sources of animal protein in Nigeria are beef, pork, poultry, goats, fish and game animals (Ajala, et al., 2007). Pigs have some unique advantages over other domestic animals. They grow at a faster rate and are more prolific than cattle, sheep and goats (Holness,

*Corresponding author. E-mail: modeltaiwo@yahoo.com

Author(s) agree that this article remain permanently open access under the terms of the [Creative Commons Attribution License 4.0 International License](https://creativecommons.org/licenses/by/4.0/)

1991 and Osaro, 1995). In addition, the pig sector provides employment and generates income.

Dwindling profit in a pig enterprise has been reported to be a function of poor quality feeds resulting from unbalanced ration (Adesehinwa and Ogunmodede, 1995). However studies on pig and poultry industries seem to reveal that the initial enthusiasm in these enterprises, especially pig production, is being constrained due largely to dwindling profit margins (Ogunfowora, 1980).

Evidences abound in different parts of the world that pig sector is moving forward, unlike what is obtainable in Nigeria. According to Pig International (1997), a single integrated Spanish Company "VALL Company of Spain" hit a production target of two million seven hundred thousand pigs, as early as 1986, with directors still making projection of making it four million by the year 2002. A similar report was given about farmers choice in Kenya, a company that single handedly produces virtually all the national herd of sows in Kenya, having 2500 sows in contract and another 2000 from internal production (Pig international, 1999). It is however pathetic to compare all these figures with the meager pig population system in Nigeria. The large Muslim population of northern Nigeria may also not favour profitable pig production in that part of the country (Adetunji and Adeyemo, 2012).

In Nigeria, the Pig sector is dominated by small scale and medium scale holders. According to Eusebio (1980), backyard pig farming and large scale pig production are more profitable than medium scale pig production. His claim was that large scale pig producers enjoy economies of scale which lowers the unit cost of production when compared to small scale of production. He further claimed that the cost of feeding is skipped. He discouraged medium scale production for the reason that purchasing of feed ingredients were made in small quantities. It is generally known that the more the quantity of production the more the profit. Ojo (2000) said that the problem associated with small scale farming was that their scale of operation made it for them to obtain loan due to lack of collaterals. Economic development is normally accompanied by improvements in a country's food supply and the gradual elimination of dietary deficiencies, thus improving the overall nutritional status of the country's population. Furthermore, it also brings about qualitative changes in the production, processing, distribution and marketing of food (WHO, 2003). In spite of all policies that successive government made, the prevailing economic hardship in Nigeria has also made the pig production system to remain underdeveloped as a result of the poor purchasing strength of the consumers. Generally, livestock production in Nigeria is not as efficient relative to the developed countries. Apart from poultry, pig farming is a class of animal production that is not subjected to such heavy losses resulting from failure to follow good sanitation practices. Despite the inherent

productive capabilities of pigs, its production is low in Nigeria and it is faced with a number of problems amongst which are inadequate supply of feed, water, worm infestation, good health management, religious, veterinary services, change in climate, housing and waste disposal, as well as government policy.

Social factors that could influence pig production in Nigeria include a general preference for ruminant meat and lack of incentives for investing in large scale pig production due to economic, religious, political and climatic factors. The large Moslem populations of Northern Nigeria may also not favour profitable pig production in that part of the country (Adetunji and Adeyemo, 2012). Other social factors that have militated against pig production in Nigeria include the belief by the general populace that pigs are dirty and constitute a health hazard. This is absolutely untrue for pigs that are produced under modern intensive production techniques since under suitable modern husbandry pigs can be very clean animals (Ajala et al., 2007.) It is relatively easy to establish intensive pig production in a developing country like Nigeria if capital are available and adequate feed supplies are assured (Ogunniyi and Omoteso, 2011). Inadequate supply of feed poses the most critical problem. A number of pig farmers are faced with this problem leading to heavy losses due to malnutrition's and increased death of embryo during early stage of pregnancy. Hence, feed determines both productivity and growth performance of livestock. It has been identified as a major constraint in animal production. Consequently, animal farmers opt for small scale production mainly to reduce cost of feeding. There are indications that pig production in the study area is mostly in the hands of small scale producers who may not have access to credit facilities because generality of the pig farmers are assumed to be peasants. The social factors that have militated against pig production in Nigeria include the belief by the general populace that pigs are dirty and constitute a health hazard. This is absolutely untrue for pigs that are produced under modern intensive production techniques since under suitable modern husbandry pigs can be very clean animals (Ajala et al., 2007.). Therefore this study is expected to provide relevant information that would encourage pig farmers and new entrants to venture into pig farming, as Nigerian population provides a readily available market.

As the genetic potential of pigs is being improved, management intervention is also essential to help overcome the constraints on production set by variation in climate. The physical environment and the health hazards also pose threat to huge production of pigs in Nigeria. Heat stress is more common in the dry season and especially when the environmental temperature and relative humidity are high with prolonged exposure to direct sunlight (Okoruwa, 2014). There is little or no robust data on the current facts about entrepreneurial characteristics and constraints to the development of pig



Figure 1. Spatial distribution of pig farms in the study area.

enterprises in Nigeria. Previous research involving the effects of heat stress on reproduction has been conducted using dairy cows (West, 2002). Amundson et al. (2006) also reported that of the environmental variables studied, minimum temperature had the greatest influence on the percent of cows getting pregnant. With all clarity, increases in temperature and/or humidity in the tropical regions of Nigeria have the potential to affect and reduce conception rates of pigs not adapted to those conditions especially in the Northern region of the country. If farmers are not making efficient use of existing technology, low production will be recorded both in food and livestock (Ajibefun and Daramola, 2003). This study will definitely provide succinct and invaluable information to policy makers, to help them design policies that will improve the pig sector as a control in filling the identified gaps in food security in Nigeria. There is a continual need therefore to generate information on the facts about pig production and such information is needed for proper planning and regulation of the sector in Nigeria. In this view, application of Geographic Information Systems (GIS) technology is needed to collect data, store, manage, analyse and produce useful information for timely monitoring of the pig sector in Nigeria. GIS capability in pig farming is achievable and useful in production level scaling, monitoring feed cost, investigating credit facility sources and disease spread analysis.

MATERIALS AND METHODS

Pig farm survey

The survey was carried out in the year 2010 across all geopolitical zones in Nigeria. The spatial dataset of identifiable pig farms were collected by surveyors with the use of GPS for the identification of

positions of the farms in the study area (Figure 1). The data collected was accompanied by the administration of a set of questionnaire which was designed to obtain information on the production level of the sampled farms. The farm survey stage is the most important stage as its accuracy ascertains the production capacity estimate for the investigated boundaries.

GIS data integration

For the purpose of data integration and querying, the logical structuring of the spatial and attribute data of both the farm and questionnaire were performed using ArcGIS © capabilities. The geographical position (centroid) of each farm was defined as a feature data and linked with the attribute dataset of the respective farm to derive the farm production in a GIS environment. The production scales of the farms resulted in the local to the national estimates of scales of production. The framework of the mapping procedure as adopted from Omodele and Okere (2014) is shown in Figure 2.

RESULTS AND DISCUSSION

Analysis of production by states

Table 1 displays the production by States in Nigeria. No records of pig farms and their production were made available for Jigawa, Kano, Katsina, Plateau, Yobe and Zamfara States. Bauchi had some farms record but no production data.

Analysing Table 1, the order of production by farms was profiled in Figure 3. Nassarawa State was discovered to have recorded the highest percentage production of pigs in Nigeria followed by Abia state, which had an appreciable level of production when compared with its percentage proportion of farms. Enugu state was also discovered to have recorded a significant level of production. It was expected that Kaduna state which had

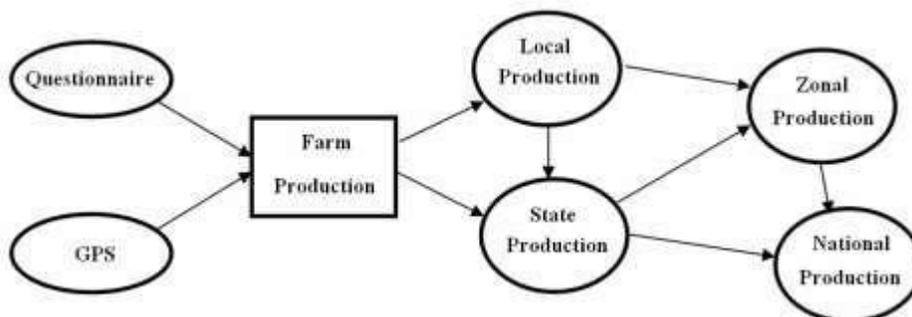


Figure 2. Adopted mapping procedure from local to the national level.

Table 1. Pig production status per State in 2010 (pigs).

S/N	State	No of farms	Production
1	Abia	32	19235
2	Adamawa	92	3026
3	Akwa Ibom	108	4589
4	Anambra	40	5535
5	Bauchi	12	0
6	Bayelsa	9	1151
7	Benue	29	6836
8	Borno	15	225
9	Cross River	16	472
10	Delta	33	3390
11	Ebonyi	30	4992
12	Edo	45	3674
13	Ekiti	27	1798
14	Enugu	105	14659
15	Federal Capital Territory	5	102
16	Gombe	40	2466
17	Imo	27	4955
32	Jigawa	0	0
18	Kaduna	157	4857
33	Kano	0	0
34	Katsina	0	0
19	Kebbi	14	405
20	Kogi	9	615
21	Kwara	12	633
22	Lagos	14	2961
23	Nassarawa	122	104149
24	Niger	13	789
25	Ogun	72	5740
26	Ondo	30	927
27	Osun	66	4890
28	Oyo	36	6700
35	Plateau	0	0
29	Rivers	7	552
30	Sokoto	1	66
31	Taraba	33	5192
36	Yobe	0	0
37	Zamfara	0	0

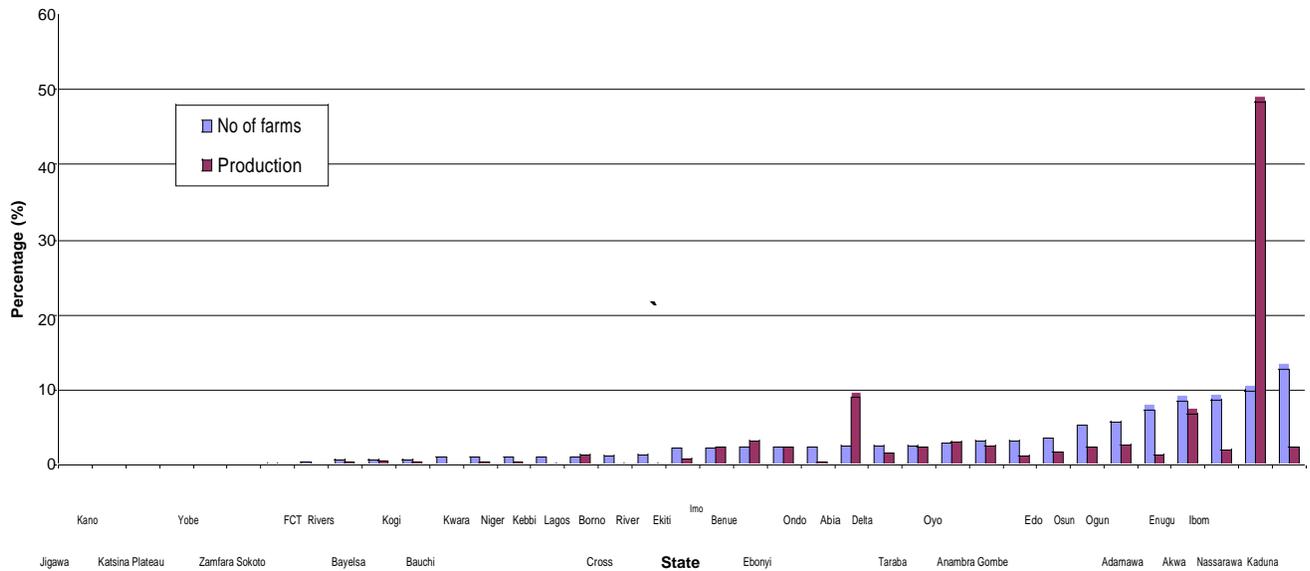


Figure 3. Percentage production per state in Nigeria.

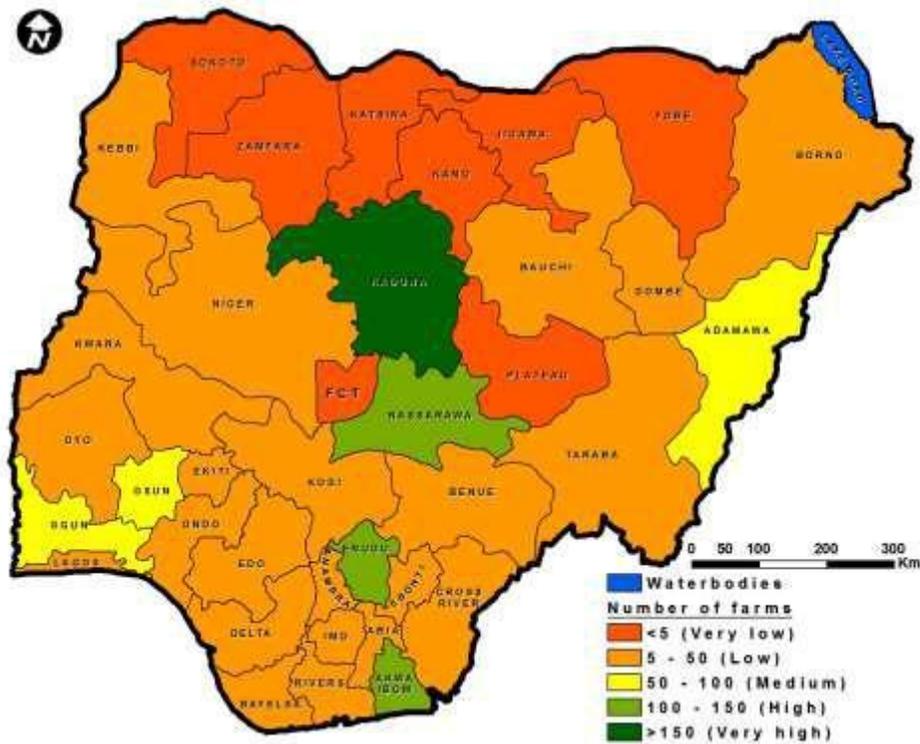


Figure 4. Pig farms proportion by States in Nigeria.

the highest number of farms in Nigeria should have the highest proportion of pigs but this presumption was not achieved. The occurrence in Kaduna state justifies the finding of Omodele et al. (2014) that the high number or proportion of farms in an area does not guarantee a high production in such a locality.

State-based analysis of farms proportion and production

As displayed by Figure 4 and expressed in Figure 5, categorization of farm proportion in the states in Nigeria showed 21.6% of states had very low (<5) proportion of

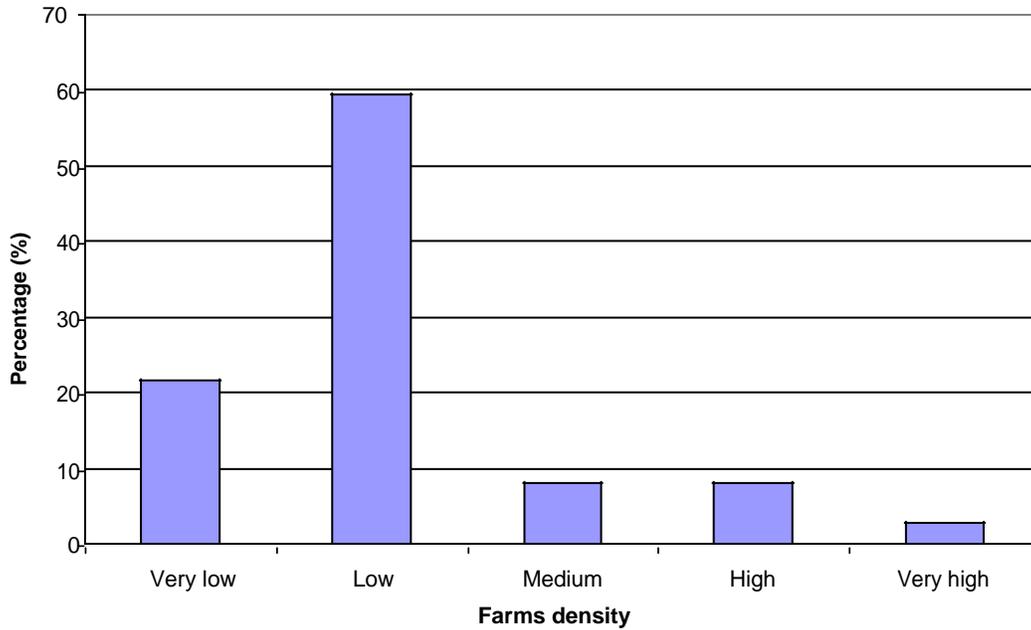


Figure 5. Categories of percentage proportion of pig farms in Nigeria.

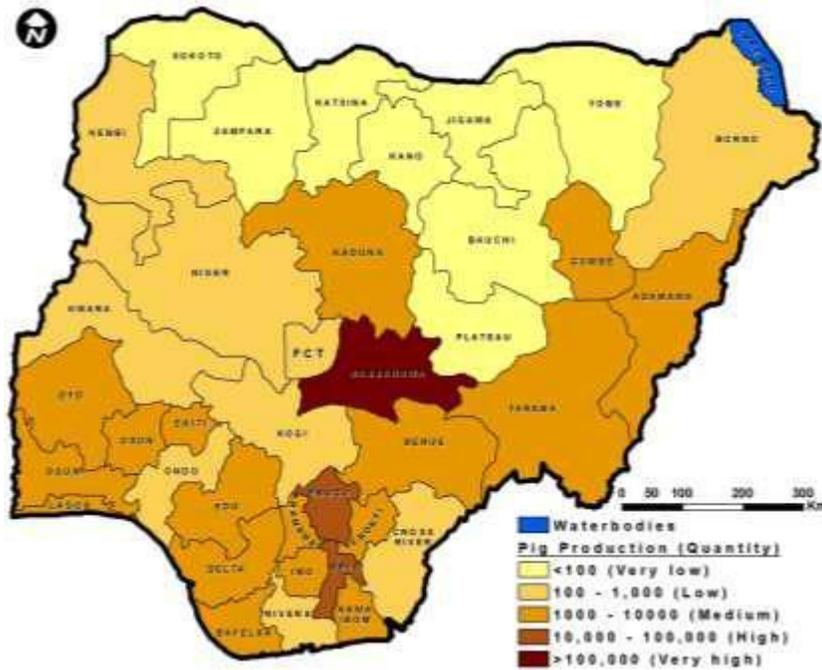


Figure 6. Pig production level by States in Nigeria.

farms, 59.5% of states had Low (5 to 50) proportion of farms, 8.1% of states had medium (50 to 100) proportion of farms, 8.1% of states had high (100 to 150) proportion of farms and 2.7% of states had very high (>150) proportion of farms. The highest proportion or density of pig farms was discovered in the low density category. This connotes that pig farms are not many in Nigeria,

therefore pig production level is expected to be low because it is expected that the lower the proportion of farms the lower the quantity of production. By analyzing the categories of production in the states as shown in Figure 6 and summarized by Figure 7, the analysis showed 21.6% of states in the very low (<100 pigs) production class, 24.3% of states in the low (100 to 1,000

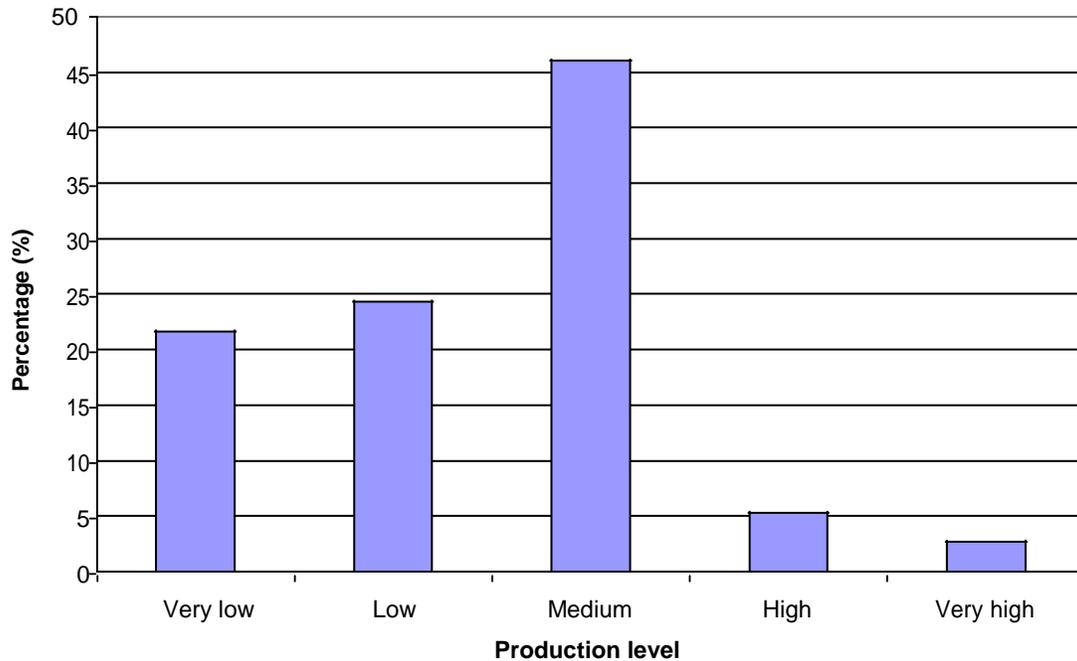


Figure 7. Categories of pig production in Nigeria.

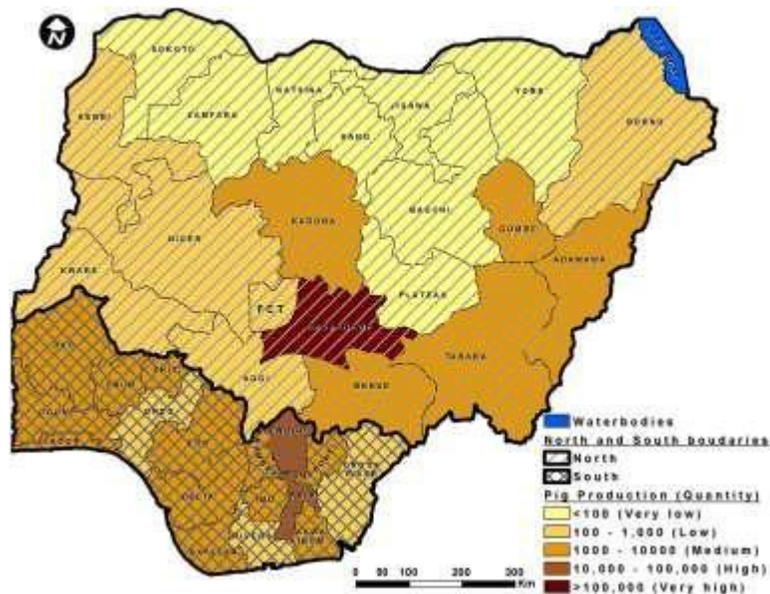


Figure 8. North and South assessment of pig production.

pigs) production class, 46% of states in the medium (1,000 to 10,000 pigs) production class, 5.4% of states in the high (10,000 to 100,000 pigs) production class and 2.7% of states in the very high (>100,000 pigs) production class. The production analysis showed that the highest pig production level in Nigeria is in the medium class. This indicated that the pig sector and its production systems in Nigeria are absolutely in the small

and medium scales.

North and South qualitative production analysis

As displayed in Figure 8 and summarized in Figure 9, further analysis of the qualitative performance of states in the Northern and Southern zones showed that in the

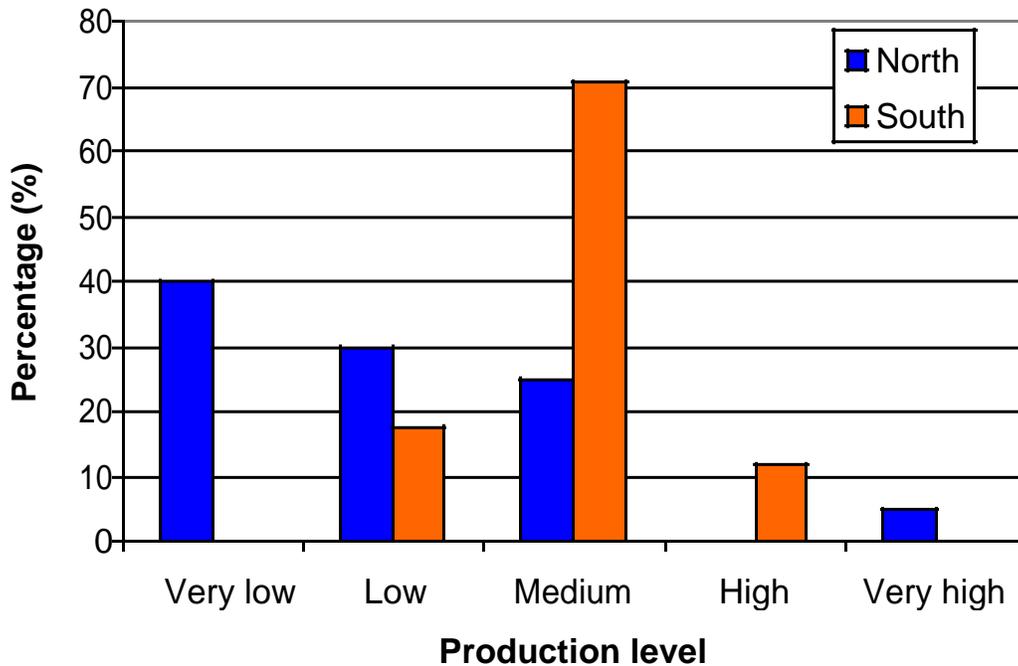


Figure 9. North and South pig production level.

North the production classes: very low, low, medium, high, very high were 40, 30, 25, 0 and 5%, respectively while in the South, the production classes were 0, 17.6, 70.6, 11.8 and 0%, respectively. The most practiced production classes of pig meat by States in the North were in the low categories. In the South, the widely practiced class was the Medium scale of production. There existed an appreciable acceptance and general production of pig meat in the Southern part of Nigeria as compared with the Northern part. This approach has formed a platform on which further research could be made.

Climatic approach to pig production

As climatic conditions vary across geographic boundaries in Nigeria, the surrounding environmental conditions are expected to directly affect the rates of heat gain or loss by all animals. Lack of prior knowledge of adequate conditioning to weather events most often results in these catastrophic losses. As noticed that the atmospheric temperature of the earth has been increased as a result of cumulative effects of greenhouse gases emitted into the atmosphere through different industrial and agricultural activities of human. The performance of both domestic and wild animals ranging from insects, amphibians, birds to mammals are expected to be affected by climate variation. Therefore rainfall distribution pattern plays a crucial role in this regard. As in Figure 10, the Southern part of Nigeria experiences a

cooler atmospheric condition from the annual rainfall distribution. Adopting the rainfall distribution patterns: <1000mm, (1000-1400)mm, (1401-1700)mm, (1701-2000)mm and >2000mm, Table 2 and Figure 11 showed that 5% of farms within <1000mm of rainfall had 0.8% of production, 46.2% of farms within (1000-1400)mm of rainfall had 69.9% of production, 14.3% of farms within (1401-1700)mm of rainfall had 0.6% of production, 15.3% of farms within (1701-2000)mm of rainfall had 11.5% of production and 19.2% of farms within >2000mm of rainfall had 17.2% of production. The extreme part of the Moslem communities in the North with the lowest rainfall distribution pattern had the lowest farms proportion and production. Apart from the religious belief/barrier, the harsh climate in the North poses another major threat to pig farming in that part of the country.

CONCLUSION AND RECOMMENDATION

This study with the use of GIS techniques has revealed that the pig sector in Nigeria is dominated by small scale and medium scale holders. A high number or proportion of farms in an area does not guarantee a high production in such a locality or zone. There existed an appreciable acceptance general acceptance in general production of pig meat in the Southern part of Nigeria where a higher number of states had medium scale of pig production. A State and region-based agricultural development and monitoring of piggery is essential as it encourages grass-root awareness and sensitization, especially in the

forgotten pig meat production sector. Introduction of modern hygienic practices could reduce the major constraints of religious and cultural restrictions in pig farming in Nigeria. Pig production is essential to food security in providing a fast and adequate protein level for the rapidly growing Nigerian population. As the climate changes, substantial funding of the sector is essential especially for construction of modern housing system in the tropical regions of Nigeria. Therefore, application of GIS techniques has assisted the decision makers and strengthened their horizon and perception of the pig farming system in Nigeria. GIS has also revealed the areas where possible developmental strategies, agricultural extension services and further research are most essential in the pig farming domain of Nigeria.

Conflict of interests

The authors have not declared any conflict of interest.

ACKNOWLEDGEMENT

The authors appreciate the availability of the pig farm data from the Federal Ministry of Agriculture and Rural Development (FMA&RD).

REFERENCES

- Adesehinwa AOK, Ogunmodede BK (1995). Swine feeds and practical Feed Composition techniques in National pig production Training manual N.A.E.L.S/ABU. pp. 27-56.
- Adetunji MO, Adeyemo KE (2012). Economic Efficiency of Pig Production in Oyo State, Nigeria: A Stochastic Production Frontier Approach. *American Journal of Experimental Agriculture* 2(3):382-394.
- Ajala MK, Adesehinwa AOK, Mohammed AK (2007). Characteristics of small-holder pig production in southern Kaduna area of Kaduna state Nigeria: *American-Eurasian Journal of Agricultural and Environmental Sciences* 2(2):182-188.
- Ajibefun IA, Daramola AG (2003). Efficiency of microenterprises in the Nigerian economy. AERC Research Paper 134 African Economic Research Consortium Nairobi. Available at: <http://dspace.africaportal.org/jspui/bitstream/123456789/32113/1/rp134.pdf?1>
- Amundson JL, Mader TL, Rasby RJ, Hu QS (2006). "Environmental effects on pregnancy rate in beef cattle", *Journal of Animal Science* 84:3415-20.
- Eusebio JA (1980). *Pig production in the Tropics*, Longman group Limited Essex U. K.
- FAO (2003). *Food and Agricultural organization of the United Nations, Quarterly Bulletins of Statistics*.
- Holness HD (1991). *The tropical Agriculturist (pigs)* publ. by Macmillan/CTA Ltd, London.
- Ngoka DA (1979). *Principles of Livestock Production in the Tropics*, Alphabet Publishers, Owerri. pp. 1-67.
- Ogunfowora O (1980). *An Evaluation of the state of Developed and Economics of pig production in Nigeria*. Report prepared for the Federal livestock Department Lagos, Nigeria.
- Ogunniyi LT, Omoteso OA (2011). Economic Analysis of Swine Production in Nigeria; A Case Study Of Ibadan Zone Of Oyo State. *Journal of Human Ecology* 35(2):137-142.
- Ojo SO (2000). Enhancing livestock production in Nigeria Book of proceeding of the 25th Annual NSAP Conference 19-23 March 2003, Umudike.
- Okoruwa MI (2014). Effect of Heat Stress on Thermoregulatory, Live Bodyweight and Physiological Responses of Dwarf Goats in Southern Nigeria. *European Scientific Journal* 10(27):255-264.
- Omodele T, Okere IA (2014). GIS application in poultry production: identification of layers as the major commercial product of the poultry sector in Nigeria. *Livestock Research for Rural Development*, Volume 26, Article #097. Available at: <http://www.lrrd.org/lrrd26/5/omod26097.html>.
- Omodele T, Okere IA, Deinne CE (2014). Technical assessment of rural development of the poultry meat sector in Ogun State, South Western Nigeria: A Geographic Information System (GIS) approach. *Livest. Res. Rural Dev.* 26(7).
- Osaro OM (1995). Enhancing production performance of small-holder pig farmers In: pig production workshop Training manual NAERLS, ABU, Zaria, Nigeria. pp. 100-130.
- Pig international September (1997). Europe's Biggest produce. 27(9)57-61.
- Pig International (1999). Kenya's Dominants integrator. 29(12):26-30.
- West JW (2002). Physiological effects of heat stress on production and reproduction. Pages 1-9 in Proc. Tri-State Dairy Nutr. Conf., Fort Wayne, IN.
- WHO (2003). *Diet, Nutrition and the Prevention of Chronic Diseases*. WHO Technical Report Series 916:13.