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Application of GIS in pig production system in Nigeria

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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,
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 Ometosu, 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 malnourishment 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
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 s

tudy 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 1. Spatial distribution of pig farms in the study area.
Figure 2. Adopted mapping procedure from local to the national level.

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

<table>
<thead>
<tr>
<th>S/N</th>
<th>State</th>
<th>No of farms</th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Abia</td>
<td>32</td>
<td>19235</td>
</tr>
<tr>
<td>2</td>
<td>Adamawa</td>
<td>92</td>
<td>3026</td>
</tr>
<tr>
<td>3</td>
<td>Akwa Ibom</td>
<td>108</td>
<td>4589</td>
</tr>
<tr>
<td>4</td>
<td>Anambra</td>
<td>40</td>
<td>5535</td>
</tr>
<tr>
<td>5</td>
<td>Bauchi</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>Bayelsa</td>
<td>9</td>
<td>1151</td>
</tr>
<tr>
<td>7</td>
<td>Benue</td>
<td>29</td>
<td>6836</td>
</tr>
<tr>
<td>8</td>
<td>Borno</td>
<td>15</td>
<td>225</td>
</tr>
<tr>
<td>9</td>
<td>Cross River</td>
<td>16</td>
<td>472</td>
</tr>
<tr>
<td>10</td>
<td>Delta</td>
<td>33</td>
<td>3390</td>
</tr>
<tr>
<td>11</td>
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<td>30</td>
<td>4992</td>
</tr>
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<td>12</td>
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<td>45</td>
<td>3674</td>
</tr>
<tr>
<td>13</td>
<td>Ekiti</td>
<td>27</td>
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</tr>
<tr>
<td>14</td>
<td>Enugu</td>
<td>105</td>
<td>14659</td>
</tr>
<tr>
<td>15</td>
<td>Federal Capital Territory</td>
<td>5</td>
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</tr>
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<td>Gombe</td>
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<td>0</td>
</tr>
<tr>
<td>34</td>
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<td>0</td>
</tr>
<tr>
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<td>24</td>
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<td>28</td>
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<td>Plateau</td>
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<tr>
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<td>Rivers</td>
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<td>66</td>
</tr>
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<td>31</td>
<td>Taraba</td>
<td>33</td>
<td>5192</td>
</tr>
<tr>
<td>36</td>
<td>Yobe</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>37</td>
<td>Zamfara</td>
<td>0</td>
<td>0</td>
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</table>
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...
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...
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
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 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 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.

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