

## Evolution of Geographic Information System in Improving Revenue Generation in Nasarawa State: A Case Study of Lafia and Akwanga Modern Markets, Nigeria

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### Abstract

Government at various levels need adequate amount of data to perform critical tasks especially in revenue generation in a most efficient manner. Geographic Information Systems (GIS) have become an effective tool for revenue generation in many countries. However, in the case of Nasarawa State, markets administration is still done manually. Therefore, this study seeks to examine how GIS technology can be used to improve revenue generations in Lafia and Akwanga modern markets. The study adopted survey research design approach to collect information from participants. The primary source of data was used and questionnaires were distributed. A questionnaire was designed using Google Forms to collect data from participants. The participants were drawn from the two modern markets; Akwanga and Lafia with 1005 and 78 stalls/shops respectively. The study used Yamane formula, a sample size of 110 stalls/shops was arrived and a convenient method was used to select respondents and 10 markets administrators were also randomly selected. The questionnaire was administered online using Google Forms and descriptive statistic was used to analysed the data with aid of Google Analytics. The results were presented as percentages and charts. The findings of the study revealed that revenues are often lost due to lack of adequate information on tax payers and GIS have proven to be power tools in markets administration on tracking defaulting tax payers thus assisting in raising the revenue collection. The study suggested the evolution of a GIS-database for efficient markets administration and further made other recommendations to enhance more and accurate revenue generation. The study concludes that revenue collection is quite difficult and cumbersome without application of computer assisted technology; therefore, the issue of automating the revenue generation process should be given preferential attention by the market authority.

**Keywords:** Geographic Information System, Evolution, Markets, Revenue Generation, Businesses.

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## 1. Introduction

The use of Geographic Information Systems (GIS) has revolutionized the way governments and organizations generate revenue. GIS technology has enabled the creation of digital maps, analysis of spatial data, and identification of new revenue streams (Longley *et al.*, 2015). In the context of market management, GIS has been used to enhance revenue collection, improve market layout, and optimize resource allocation (Maguire *et al.*, 2018).

In Nigeria, the use of GIS in revenue generation is still in its infancy. However, some studies have demonstrated the potential of GIS in improving revenue collection in markets (Ojomolade *et al.*, 2017). For instance, a study on the use of GIS in market revenue collection in Lagos State found that GIS increased revenue collection by 15% (Adeyemi *et al.*, 2019).

Many businesses especially public own business lose revenue as a results of corruption, carelessness, poor tracking and management, lack of use of technology etc. this create leakages in revenue that is expected to accruing to the government and thereby making certain individuals or group of individual short-change the government and reducing resources that is available for provision of public facilities and service.

Poor tracking and management of revenue is a serious problems facing local authority especially in developing economy. As part of decentralization and or local government autonomy, many countries have devolved revenue and expenditure responsibilities to Local Government Authorities (LGA's). LGA's therefore, face the task of assembling suitable level of revenue to enable effective service and infrastructure provision (Ashiagbor & Fosu, 2012). They further highlighted that Inadequate data on all economic activities in the district e.g. hairdressers, seamstresses, traders, barter, lotto kiosk etc and Misclassification of properties and Business and inappropriate tax assessment basis, Lack of realistic means of accessing the revenue potentials of local authorities due to lack of accurate data, Revenue collectors not paying to the local authorities all monies collected and the, absence of tracking mechanisms, Property owners avoiding the payment of property rates, Some individuals and small-scale enterprises engaged in economic activities avoid the payment of taxes to local government, Laborious and time consuming business licensing and permit acquisitions are some of the problems facing Local authorities.

Furthermore, Ebifuro, Mienye and Odubo (2016), stated that tax compliance in their study area is very low as business owners are not willing to register their businesses despite operating their businesses for more than 11 years and confirmed they have never paid taxes. It is on this note that Mathew (2017) stated in its research that a requirement for tax administration is to know who the tax payers are and whether they are active or not. Many towns and cities in Africa are beginning to embrace Technology to enhance their revenue base. The Nairobi County government is using Geographic Information System (GIS) mapping to improve revenue collection and service delivery (Iyanda, 2021). It is as a result of this that the researchers want to study the evolution of Geography information system (GIS) in revenue generation, in some selected markets in Nasarawa state, central Nigeria.

## 2. Conceptual/Literature Review

Geographic Information System (GIS) is a computer system that analyzes and displays geographically referenced information. Most of the information we have about our world contains a location reference. Therefore, GIS uses data that is attached to a unique position or location. The National Geographic Society (2024) defines GIS as a computer system of capturing, storing, checking, and displaying data related to positions on Earth's surface. In addition, data is usually tabulated, known as attribute data. Attribute data can be generally defined as additional information about each of the spatial features. An example of this would be schools. The actual location of the schools is the spatial data. Additional data such as the school name, level of education taught, student capacity would make up the attribute data. This means that GIS can help organizations and or individuals to better understand spatial patterns and relationships. Furthermore, it is said to be related to three major disciplines which formed the core of GIS: Geography Science, Information Science, and Computer Science. The infiltration and integration of Geography Science, Information Science, and Computer Science, as well as their crossover formed the bases of the analysis of future development (Dongqing, 2008).

GIS can use any information that includes location; the location can be expressed in different ways, such as latitude and longitude, address, or ZIP code. One can map a spatial location of real-world features and visualize the spatial relationships (Martindale, 2024). GIS can be used in several ways, as tool in both problem solving and decision makes processes, as well as for visualization of data in a spatial environment. Geospatial data can be analyzed to determine the location of features and relationships to other features; it can also be used to identify the density of features in a given space.

GIS technology has revolutionized various sectors, including marketing, urban planning, and revenue management, by analyzing spatial data. It also helps in identify trends, patterns, and opportunities for revenue growth. According to studies by Harris *et al.* (2005) shows that GIS help in Market Segmentation by identify high-value customer segments based on demographic, socioeconomic, and spatial factors. Advantages of adopting GIS for revenue generation are very numerous. It can analyzes market potential, competition, and customer behavior, informing business location decisions (Brimicombe, 2000). In addition, Lloyd & Dicken, (2016) believed that GIS defines market boundaries, estimates market share, and identifies opportunities for expansion.

Additionally, in retailing for example GIS gives retailers a clear, visual understanding of what is happening in their market, arming them with insights that can drive product. Aside that GIS has the ability to integrate and analyse a wide variety of information based on their spatial locations. It also provides accurate information on the revenue potential of an activity and automates the revenue mobilization processes (Ashiagbor & Fosu, 2012). Likewise, Geographical information systems have proven to be power tools in the collection of taxes and tracking delinquent tax payers thus assisting in raising the revenue collection. This was shown by locating the tax defaulters where they are geographically located and other related details which proves to be useful (Jerry *et al.*, 2020).

### 3. Research Methodology

#### Description of the study area:

The first case study (case study 1) area where one of the markets is located is Lafia local government area, comprising of Lafia East and Lafia North development areas of Nasarawa state and is situated on latitude  $08^{\circ} 30'$  East and Latitude  $08^{\circ} 31'$  north. The Lafia region is the State close settled cells with intensive land use corridor of development. Its location at the junction of regional roads confers on it good linkages with Makurdi. Lafia town which is the capital of both the LGA and Nasarawa State is bounded Doma LGA to the west, Obi LGA to the east, Quanpan LGA to the southeast and Nasarawa Eggon to the north (Grater Lafia Master plan 1998). The population of study is 269,958 by projection from the 1991 population census to 2024 with an average of 12 persons per household which represent 22,297 total households in the urban area.

The second case study (case study 2) area is Akwanga, located within latitude  $8^{\circ}5'$  and  $9^{\circ}0'$  North of the equator and between longitude  $8^{\circ}15'$  to  $8^{\circ}30'$  East of the meridian with a point location of  $8^{\circ}55', 8^{\circ}25'E$ . The Local Government Area is bounded in the north by Sanga Local Government of Kaduna State, Nassarawa Eggon in the south, and Wamba in the East and lastly Kokona in the West (Ogah *et al*, 2013). Akwanga has the population of 111,902 as at 2006 census. When projected to 2024 with the growth rate of 3.0 the population is estimated at 190,506 people.

#### Research Design and Population Sample/Sample size

This study employed quantitative and qualitative research method. A survey research method was used to collect data from participants. The population consists of business owners of small and medium scale enterprise. This consists of 1005 and 78 stalls/shops in Lafia and Akwanga modern markets respectively.

The sample size will be determined from the target population for the study which will be shops or stalls owners within the markets. The study population in case one is 1005 shops/stalls. Case two study population is 519 stalls or shops. The sample size will be determined by use of the modified sample size formula adopted after Yamane (1969) and a sample size of 110 stalls/shops was arrived. Furthermore, 10 markets administrators would also be sample randomly, to get information concerning market administration. The study employed purposive or convenient sampling technique to select respondents and 10 markets administrators were also randomly selected.

#### Sources of Data

The study utilized both primary and secondary data; the primary source been through field work (Lafia and Akwanga) by use of GPS to acquire coordinate positions and also by questionnaire administration. While the secondary data involved the use of relevant literature such as text books, journals, internet, conference and seminar proceedings.

## Method of Data Collection

Methods or strategies used are as follows;

1. **Field Work:** This method was based on respect, trust and persuasion. With the help of research assistants questionnaire was used to collect information from the study population. The questionnaire was designed using Google Forms to collect data from participants. The questionnaire consisted of [number] questions, including [types of questions, e.g., multiple-choice, Likert scale, open-ended]. The questions were designed to elicit information on variables/concepts of interest. The questionnaire was administered online using Google Forms. Participants were invited to participate in the study through social media/email/institutional websites. The questionnaire was accessible for [duration] and participants were allowed to respond at their convenience. Google Analytics was set up to track the responses to the questionnaire. The analytics tool was used to monitor the number of responses, response rates, and completion rates. The data was also exported from Google Analytics for further analysis.
2. **Confidentiality:** Finally, strong confidentiality agreement or parameters such assurances from the government to respondents that their participation would in any way compromise them and their enterprise.

## Data Analysis

The questionnaire was administered online using Google Forms and descriptive statistic was used to analysed the data with aid of Google Analytics. The results were presented as percentages and charts

## 4. Discussion of Results and Findings

Chart 2 below shows the gender distribution of business owners comprises responses from Lafia and Akwanga.

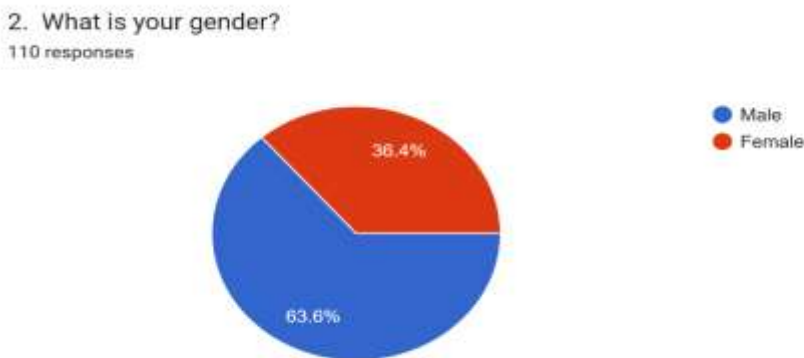
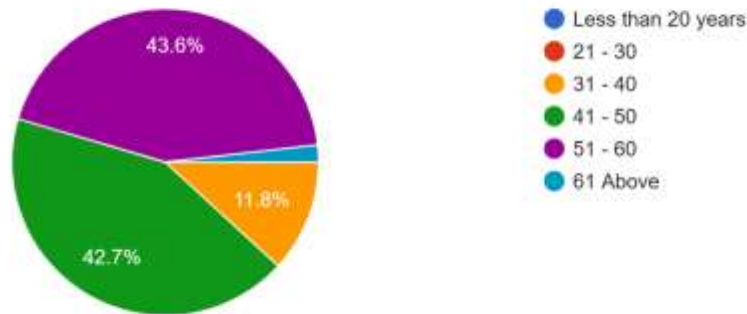


Chart 2 above shows the categories of people who were interviewed for the study. 63.6% of the respondents are male while 36.4% are female. It indicates the male dominance and it could also probably mean as head of the family as African culture is concerns, male are expected to go out and work for the family. It also indicates those females too are not left behind in attempt to support the family. It's a fair representation for this study.

### 3. Please tick your age bracket

110 responses



In chart 3 above represents the age bracket which shows that majority of people interviewed in the markets or stall owners are between ta ages of 51-60 years of age which represent 43.6% of the respondents, followed by those with ages of 41-50 years of age which is 42.7% of the respondents. The respond show active age groups of between 51-60 years are actively participating in market activities while only few people are above 60 years of age. This study population is a good mix for responses on the current issues under discussion.

### 5. State of Origin

110 responses

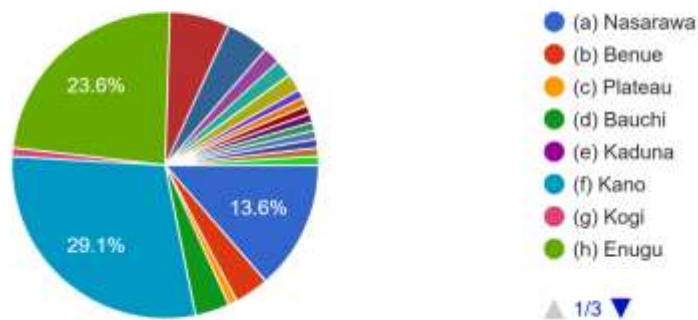


Chart 5 above revealed that so many people from different states are trading in the markets. However, Nasarawa state indigene represent only 13.6% the people trading in the markets, while Enugu state has 23.6% of traders within the markets and Kano state has the highest numbers of traders within the markets. The implication of this is that most of revenue generated from the markets is from non-indigenes traders who are more in number in the markets trading in variety of goods and services. This could probably be as results of indigenes inability to access to huge capitals to invest in trading business or the I don't care syndrome of most indigenes.

6. If A above, which Local Government Area

15 responses

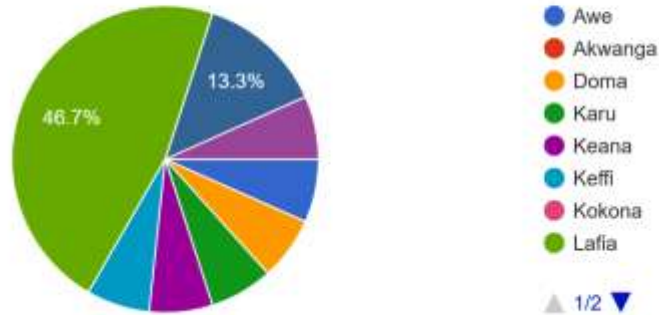


Chart 6 above shows details of representation of the traders in the markets by local government. From the few indigenes that trade in markets, majority are from Lafia local government area representing 46.7% of the respondent, it could possibly be as a result of the market location while other local governments are represented sparingly in the markets. This interest might send a wrong signal to government intending to build modern markets in all the local government of the state to boost revenues generation.

7. What is the nature of your business?

110 responses

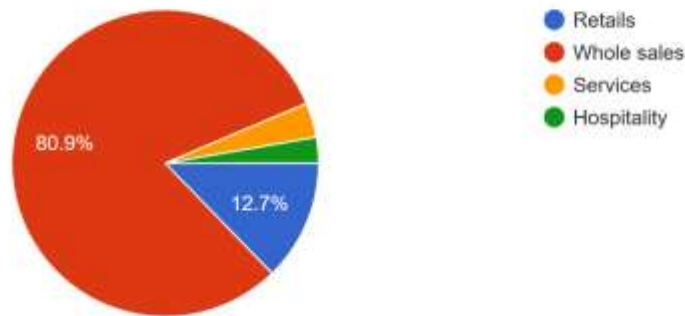


Chart 7 shows the nature of the businesses the respondents are involved in, in the markets. Wholesales activities represented the highest nature of businesses with 80.9% of the respondent's involved in, while retails activities take 12.7% and services and hospitality took a negligible part of the products provided within the markets. This indicates that smaller businesses or retailers shop for tier goods and other product in the markets to support the businesses either within the markets or in the community within the local government or outside the local government.

9. How long have you been operating in this market?

110 responses

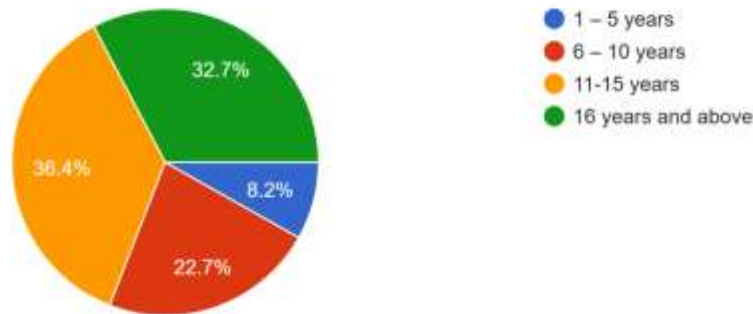


Chart 9 indicated that 36.4% of the respondents have been operating in the markets for about 11-16 years, meaning from the beginning of the markets, only few traders' occupied the market probably because it was new or fear of losing customers from their previous markets (old Market). Only 32.7% of the traders have traders for more than 16 Years in the markets as shown in the responses above.

8. Please tick appropriate what type of products/services do you sell?

110 responses

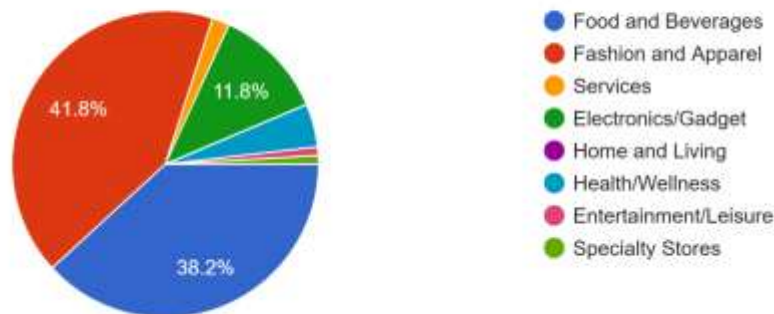
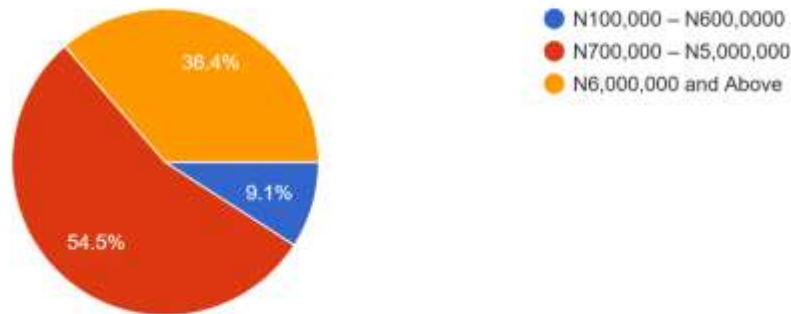


Chart 8 indicated that the different products sold in the markets. Fashion and apparel carries the highest percentage of 41.8%, while food product follows with 38.2% and electronics and Gadgets follow with 11.8%. This shows the population major demand is food and clothing which in my opinion is a characteristic of a developing economy.



10. What is your average monthly sales revenue?

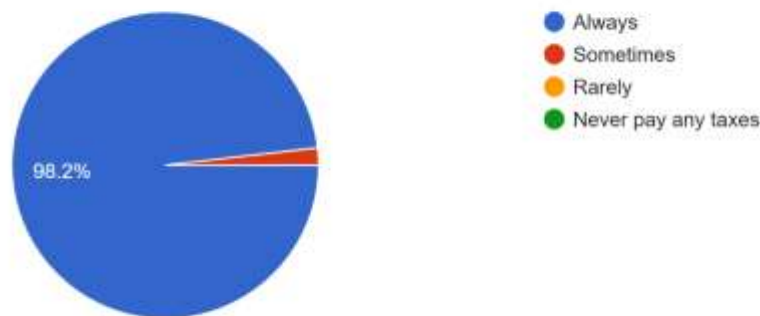
110 responses



In chart 10 above, the average monthly sales in revenues is between 700,000-5,000,000 naira, which represent the highest responses within the markets with 54.5%. while others make between 100,000-600,000 naira monthly representing 36.4% of the respondents, while other make above 6,000,000 naira monthly, representing 9.1% of the respondent in the markets. This could be attributed to demand and the population of the people. As the population is growing, the revenue in the markets is likely to increase depending on economic power of the people.

11. How often do you pay tax?

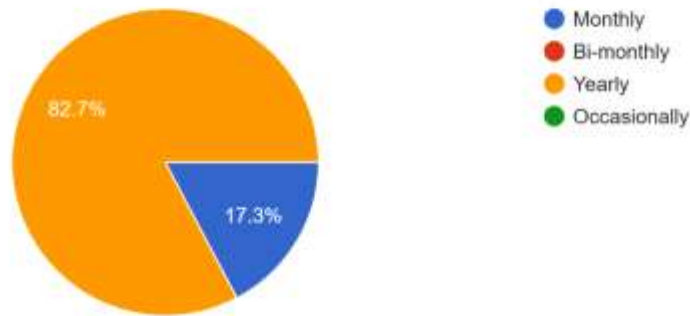
110 responses



In chart 11 above, 98.2% of the respondent said they often pay their tax. This represent a very high success rate or response rate to tax payment within the markets, and it a good indication for the local economy.

### 12. How do you pay your tax

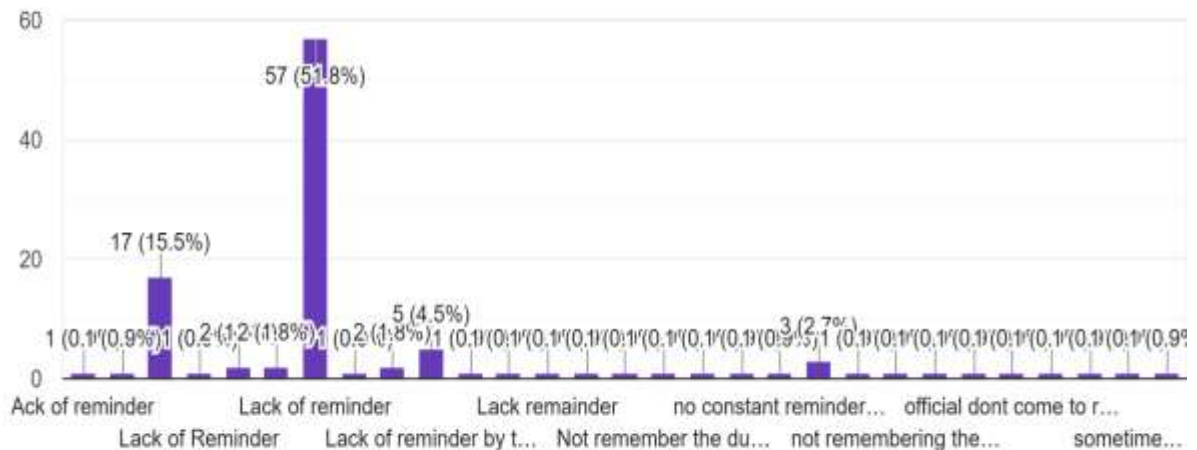
110 responses



In chart 12 above the respondent show some discrepancy in the mode of payment of tax, while other pay monthly, some said they pay yearly. 82.7% of the respondent said they pay yearly and 17.3% said they pay monthly. Whatever it is, if the entire respondents are paying tax as at when due, it will be to the advantage of the market management and the government at large. It will help in the smooth running of the market and maintenance or improvement of the decaying facility, utilities and services within the markets.

### 13. What make you don't pay tax as at when due?

110 responses

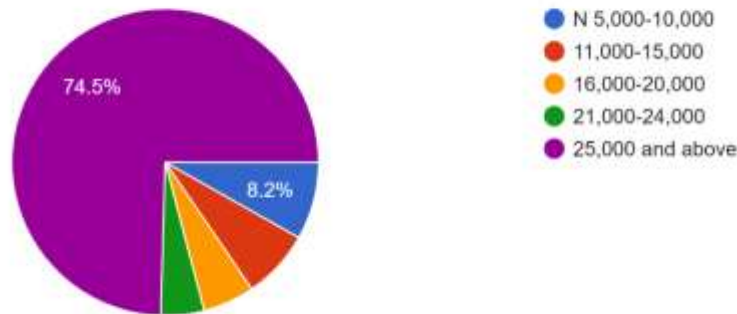


In chart 13, some of the respondent who do not pay their tax as at when due attributes it to lack of reminder by the markets authority. Therefore, it will be very important for the market authority to create a platform or an app or a computerize form of data entry and reminders for tax

defaulters to pay on a certain date. Alternatively, traders could be asked to set up a payment system through their banks or to use the Geography information system to identify and remind traders or when and how they could remit their taxes to the authority.

#### 14. How much do you pay monthly as your tax

110 responses



In chart 14 above, 74.5% of the traders said they pay above 25,000 naira monthly as tax, while 8.2% said they pay between 5,000-10,000 as tax monthly. These depend on shop size and location within the markets. Bigger shop/stall pays more and smaller shop/stall pay less.

#### 15. Did you heard about tax payment?

110 responses

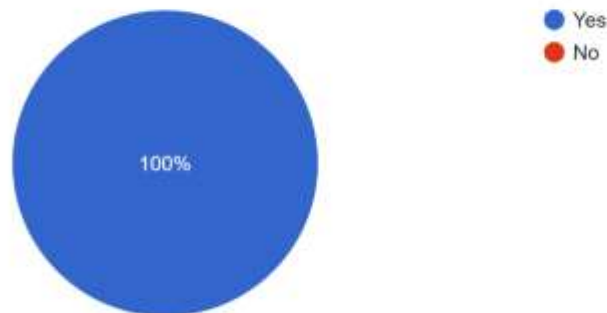


Chart 15 has shown that the entire traders in the markets have heard about tax, therefore, none is ignorant of the fact that he/she is expected to pay tax at one point or the other. At a point one can attribute to a system that have existed before modern tax system, were traders pay to local authority daily or seasonally during markets day as it were the practice in the old.

16. If "Yes" How did you hear about tax payment?

109 responses

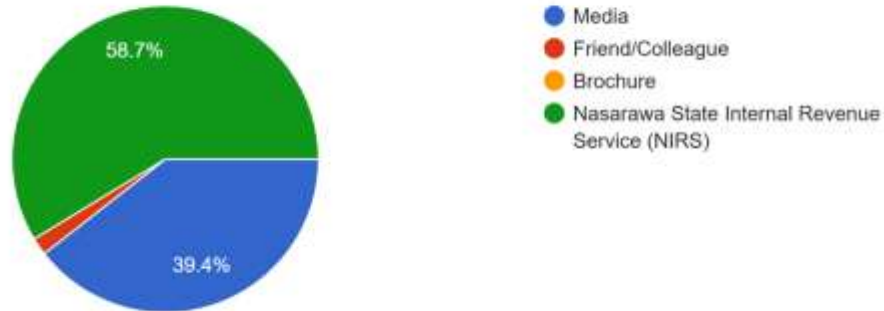


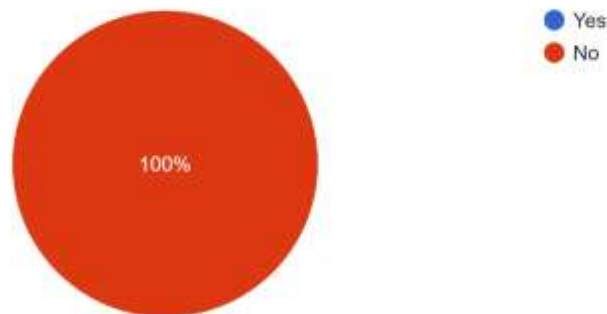
Chart 16 shows the means by which these traders got informed about tax. 58.7% got their information from Nasarawa state internal revenue board; while 39.4% got their information from the media. Others got their information from friends.

### 5. Suggestions for respondents in improving Market Operations or Revenue Generation

Suggestion from traders in the markets on how taxes could be collected easily and other improvement shows that most of the traders insist on the use of modern technology for easy access to tax. Others said the use of computerize system as seen in other modern markets especially in Abuja should be encouraged in Nasarawa state markets, that will make revenue generation/collection more easier and faster. Furthermore, use of proper technology would reduce human interference in the collection of tax. Others talked about the government to provide social amenities to the market considering the huge revenue accrue to the markets e.g. borehole. Some traders insist that there should be supervision of the market officials and that the government should supervise the markets and see what is going on personally.

8. Is GIS currently used in market administration? If yes, for what purposes?

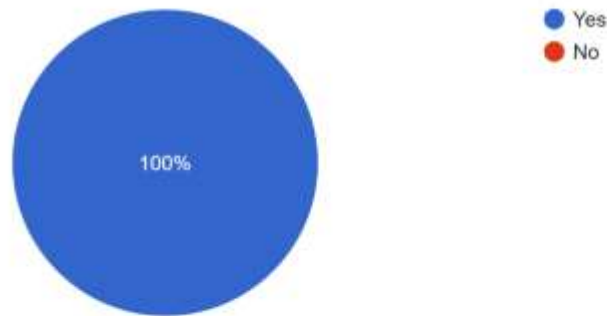
10 responses



Currently, GIS as a tool is not use to generate revenue in the market. This an opportunity for the markets authority to embrace the GIS tool to enhance revenue generation/collection within the markets. Chart 8 above shows none use of the GIS in revenue collection within the modern markets in the study areas.

9. Do you think GIS can improve revenue generation in the market?

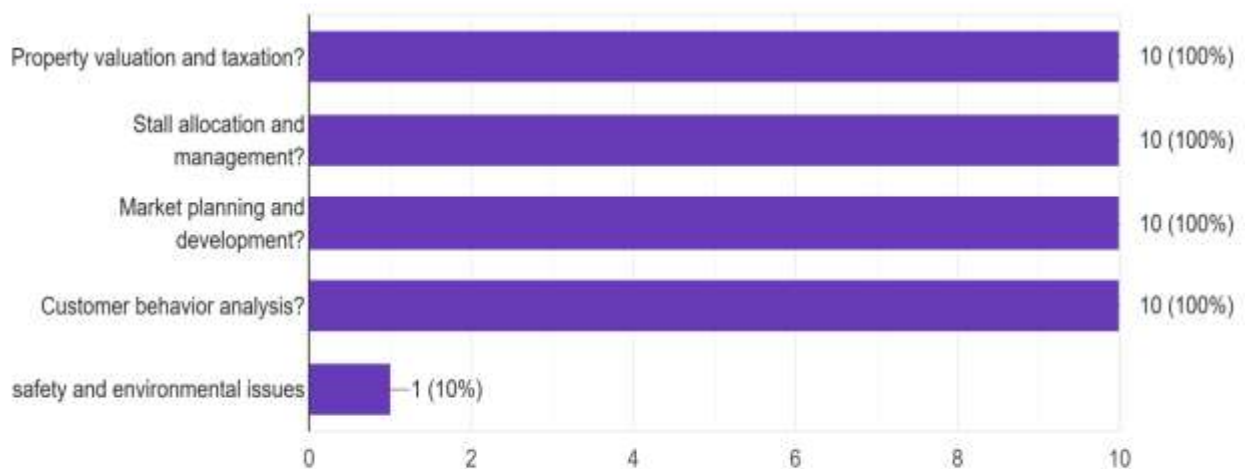
10 responses



In chart 9 above, the markets administrator believed 100% that GIS adoption can improve revenue generations in the markets. Therefore, it will be good for the markets authority to adopt GIS in revenue collection for all its modern market for efficiency and convenience.

13. Would you like to use GIS for:

10 responses

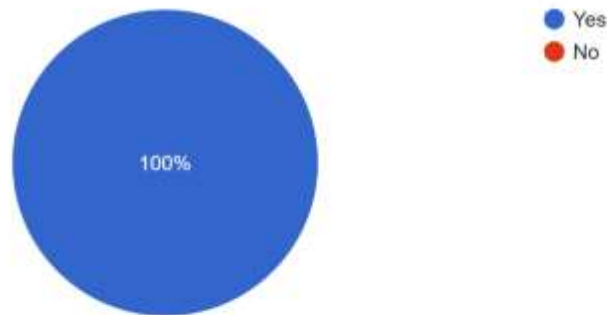


In chart 13 above, the markets administrator agreed to use GIS for property valuation, for stall allocation and management, for markets planning and development and for customer behaviors

analysis. The chart above show details of what the markets administrator wish to accomplish with the GIS.

14. Do you think GIS could help identify untapped revenue streams?

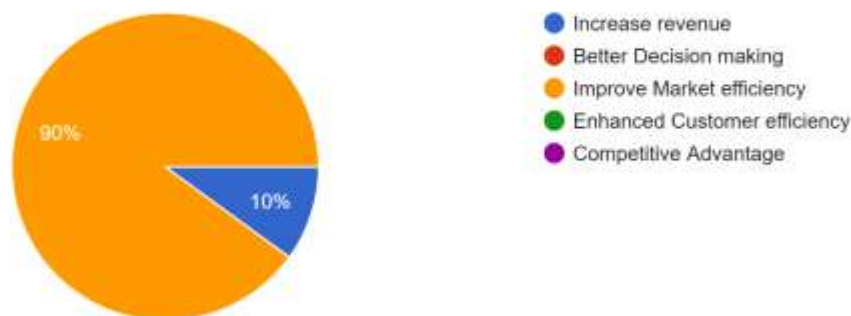
10 responses



In chart 14 above, the markets administrator agreed that GIS could help identify untapped revenue in the markets and boost revenue generation for the government. This indicates support for the use of modern technology within the markets for revenue generation and facility update.

19. What benefits do you expect from using GIS in the market?

10 responses



In chart 19 above, 90% of the markets administrators believed that the benefit expected from the use of GIS would improve markets efficiency and increase revenue drive in the market.

## 6. Study Findings

The use of GIS is no longer a new phenomenon as it has been adopted by advance society to enable smote and efficient runner of their activities and programed especially spatial activities. The study set to examine the evolution of Geographic information system in revenue improvement in Lafia and Akwanga modern markets in Nasarawa state, Central Nigeria. The study has found out that the markets still collect revenue directly from its traders and none of the

traders' uses any technology in the market to advanced their product and generate more revenue for themselves.

The study has shown that GIS can play an important role in revenue generation in the study area. The finding also reveals that there are leakages in the current system of revenue collection in the markets which is a direct method of revenue collection. The method is not friendly, allows room for fraud and tracking revenue could be difficult etc, for revenue collectors. 60% of the staff of the markets have at least tertiary education, meaning they are literate enough to handle new technology and invention when train in the field.

The research has shown the willingness of the market administration to adopt the use of GIS in the market administration henceforth. All that is required is training for the staff of the market to be able to handle the technology that comes with GIS. Furthermore, identifying and mapping of the stalls and shops in the market is required. Property valuation and taxation is required and predicting demand areas for planning purpose in the markets. This will in turn enhance transparency, efficiency and improve revenue generation in the markets.

## **7. Conclusion and Recommendations**

The manual system of administration of revenue in Nigeria's has proved to be ineffective and inefficient and thus the yield from revenue collection is usually abysmally low. A lot of setbacks are attached to the manual system of revenue generation such as omissions, discrepancies, slowness and data redundancy. The manual system of handling data makes the processes of data up-dating and processing quite tasking, especially where the quantity of data to deal with is huge and complex, as is often the case with revenue records. Finally, revenue collection is quite difficult and cumbersome without application of computer assisted technology; therefore, the issue of automating the revenue generation process should be given preferential attention by the market authority.

The researcher having interviewed and made some observations in the field of study, come up with these recommendations for improvement in revenue generation in markets of this capacity as follows:

- i. That the market authority adopts the use of GIS in its market administration henceforth to enhance more and accurate revenue generation. The markets administrators will benefit by automating their services through GIS for the realization of their goals.
- ii. The evolution of a Geodatabase will save them from the many risks of losing important documents
- iii. That trader within the markets should be encouraged to key into the new technology by supplying all the details required when the time for implementation comes.
- iv. Traders should be informed of the highest level of protection or privacy and secrecy of the information provided.
- v. The market authority should employ the services of consultant identify, map out stall or shops in the market and develop GIS software for markets.
- vi. Training of staff on the latest technology that support smooth running of markets.
- vii. Improve security through the use of CCTV at the entrance and exit points.

- viii. Provide facilities to enable both human and vehicular traffic counts at exit and entry points

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