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Development of A Housing Information Management System for Tambari Estate, Bauchi Metropolis, Nigeria

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ABSTRACT

Economic activity and population growth Bauchi metropolis contributed to the emergence of the Tambari Estate to house the state's civil service's senior and junior staff. This has not only increased the need for land to accommodate the various land uses, but it has also posed challenges to proper and efficient layout management. Appropriate land administration is critical to any nation's socioeconomic development and long-term land information systems. In this period, information and new strategies for sustainable land administration are becoming increasingly important. However, the storage and management of land information have continued to remain analog, resulting in difficulties in land boundary litigation and economic losses. In this paper, a digital housing information management system for the Tambari estate in Bauchi Metropolis was developed. ArcGIS 10.7 was used to digitize and update the layout of the estate sourced from the Bauchi State Ministry of Housing while the attribute data like ownership information, plot details, plot type, number of rooms, status, land use, and other relevant information were gotten through fieldwork. The information of each house was entered into an attribute table to create a relational database. The relational database was used to develop the user interface created using Microsoft Visual Basic 6.0 software which then allowed for the development of the housing management system with an interactive interface with username and password. The development of a Housing Information Management System will provide accurate information to the government and stakeholders in a timely and efficient manner for proper planning and decision-making, as well as effective land-use management. The study recommended the implementation of housing information systems by all levels of government. The system will stimulate economic activity, social cohesion, and long-term development.

1. INTRODUCTION

After food, the second most valuable aspect of man's physical survival is housing (Tsemberis, 2010), which is built on land. Land management is essential to development at the individual, community, and national levels because it guarantees land resource use and development (FAO, 2002; Ojigi et al., 2011). Housing has a significant impact on man's health, welfare, quality of life, and efficiency (Abimbola and Pauline, 2015). According to Festus and Amos (2015), housing is essential to human survival. Traditional land administration methods are combined with corruption and poor land management on the part of customary landowners. Dale and McLaughlin (1988)

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define an information system as "a mixture of technical and human resources, along with a set of organizing methodologies that generates information in support of some supervisory requirement." Population growth in cities is not being matched by an adequate supply of land for housing, infrastructure, utilities, and services to maintain a reasonable standard of living. This lack of preparedness could manifest as a lack of knowledge about various types of land tenure, estate valuation and taxation, physical extension potentials, and so on (Billen, 2014; Osabuohien, 2013). This has also resulted in the spread of informal settlements, pollution of water bodies and air, and ramshackle housing (Williamson, 2004; Usman, 2010). Constituently, governments, urban planners, hydrologists, ecologists, and others must track and identify urban growth for proper planning and decision-making (Yusuf, 2022). Musa et al. (2016) in their study, stored details like ownership, location, plot size, plot status, use, and the worth of the building constructed on-site in a spatial database. If this information is effectively handled and the correct decision is made, adoption would greatly help with the issues related to landed properties.

The housing data in the study area are stored on paper forms that were easily torn and misplaced. Similarly, most agencies at both the national and state levels are not fully digitized, resulting in poor storage and retrieval of information on time, which can lead to conflict. The information is kept on paper, which is easily torn and misplaced. These datasets are difficult to manipulate, query, and even update, unlike the digital database which is easy to operate. Even though cadaster has been in place in the country since 1883, there has been a lack of collaboration and cooperation between agencies with technical expertise to use new technologies available for the development of an effective administration of land resources (Osabuohien et al., 2020).

Furthermore, urban growth greatly influences the local climate, notably because it raises the earth's temperature (Yusuf et al., 2023). Omosebi (2016) created a housing management system that is web-based. The system will handle senior staff housing and make it easier to apply for and update lodgings. Adobe Creative Suite 5 was used to develop the front end of the web-based system, while the graphics on the pages were designed using CorelDraw Version 15. The XAMMPServer version 5.3.5, which included PHP and MySQL applications, was used to make the site pages dynamic. PHP was used as middleware, and MySQL was used as the web portal backend. The new system demonstrated its necessity and essential features in the areas of information capture and processing, as well as database management.

Okae (2022) created a powerful online residential housing management system that can aid administrators in attending to students' housing issues. Using the University of Ghana as a case study, the system was designed to meet the accommodation demands of both continuing and freshmen students. The conclusions from subsequent data obtained from system users after its deployment proved that it decreased the timeframes for residential housing searches, changing halls or rooms, and paying fees to the bare minimum.

Zegeye (2019) developed a cadastral information system in a GIS interface to improve land management in Tepi Town, South Western Region, Ethiopia. The geographical and non-spatial data for the research area were compiled into a geodatabase using a thorough GIS-based methodology. Spatial data were added using Coordinate Geometry (COGO) in the GIS interface.

Mustapha and Hassan (2017) developed a functional database of the current situation of their research area in order to present virtual information and information such as land use, plot type, parcel information, ownership details, and so on. The researchers failed to include the images of each house will could have made their work more comprehensive.

However, Musa et al. (2016) in their research reveal the non-adoption and deployment of GIS methods in collecting and managing spatial information by Land and Survey ministries, agencies, and similar organizations. The authors advised the bodies concerned to continue the current trend in the use of geospatial technology.

AL-Hameedawi et al. (2017) used an old agricultural cadastral map from the 1930s as a hardcopy in their study in the Wassit province south-east of Baghdad, which was then digitized and upgraded utilizing control points and a recent satellite image for the same location. They improved the technique for updating Iraq's agricultural cadastral maps using Differential Global Positioning System (DGPS), Satellite Imagery, and Total Station, as well as the cadastral editor extension in ArcGIS software to create new agricultural maps.

Property records are critical since they serve as the foundation for the Government of Nigeria's proposed land reform programs (Ibimilua and Ibitoye, 2015). As a result, the purpose of this paper is to develop a housing information management system for the Tambari estate in Bauchi, Northern Nigeria. The Housing Information Management System (HIMS) will aid in guaranteeing title, legal security, quick services for users, complete coverage, comprehensive liable secured system that is computerized and will cater to the needs of current and future generations.

2. METHOD

In this section, data acquired and different methods adopted in this study are discussed.

2.1. Data Needed for the Study

To achieve the aim of this study, both spatial and non-spatial data for the Housing Database were

gathered from various sources and using multiple techniques (Table 1). The data acquired for the research include the layout plan of the study area; attribute data such as parcel details, house number, area, ownership information, and land use; the photographs of the buildings on the parcels of the study area will be captured during fieldwork. A 2022 satellite image of the study area was acquired and geo-reference using 10 ground control points within the study area. The types of Pre-processing carried-out on the image include radiometric correction, geometric correction and geo-referencing using ERDAS Imagine 2014.

Table 1. Data needed for the study.

Data type	Source
Layout Plan	Bauchi State Ministry of Housing
High-Resolution Satellite Image	Google Image 2022
Parcel/Ownership Information	Fieldwork
Pictures	Fieldwork
Coordinates	Handheld GPS GARMIN 76 (Accuracy: ±3m)

The layout plan of the estate was obtained from the Bauchi State Ministry of Housing which was updated using satellite images and the attribute data obtained will be obtained from the field during data collection. The following are the types of information acquired from the site to develop the housing database.

Table 2. The information needed to create the database.

Category	Data needed
Ownership Details	Name, occupation, and Phone number
Parcel Information	Plot number, Date of allocation and Plot address
House Type	Number of rooms, Image

Table 2 shows the type of information needed to create the database.

2.2. The Database Creation

The steps below were followed to create the housing database for the estate.

2.2.1 Digitization of satellite image

The satellite image was sourced from Google Earth Pro and saved in the Tambari Project folder and imported into ArcGIS 10.7. The image was then georeferenced to UTM, WGS 84, Zone 32 using the coordinates captured on-site using Handheld GPS (GARMIN 76).

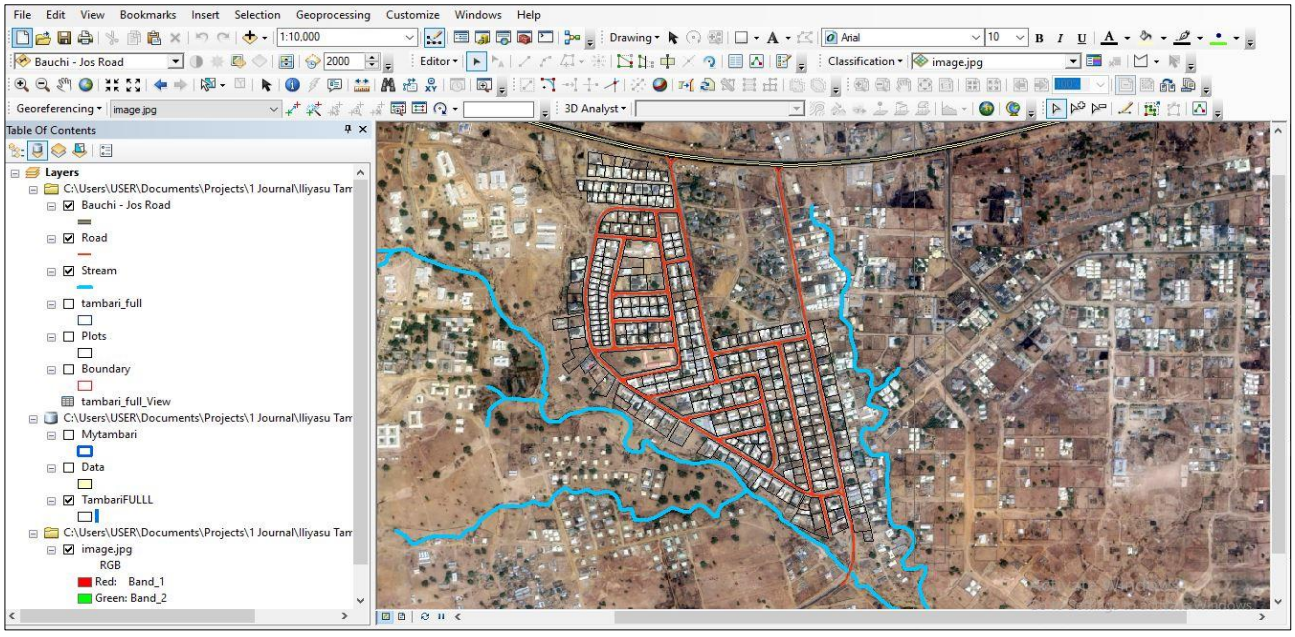

Figure 1. Digitization process.

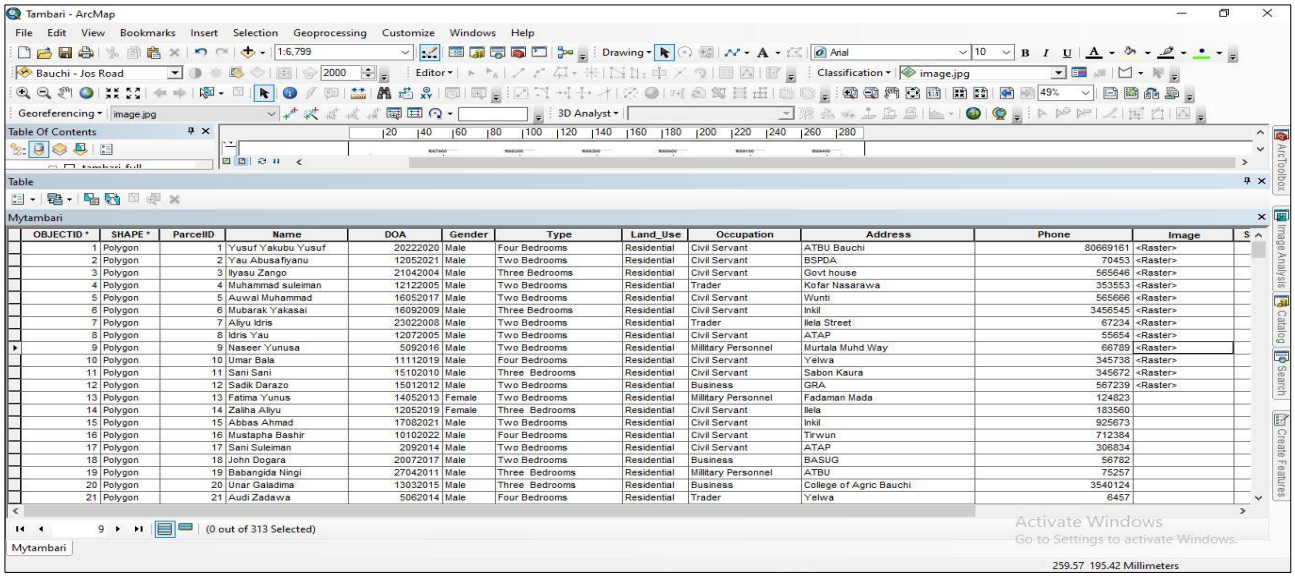

Figure 2. Relational database.

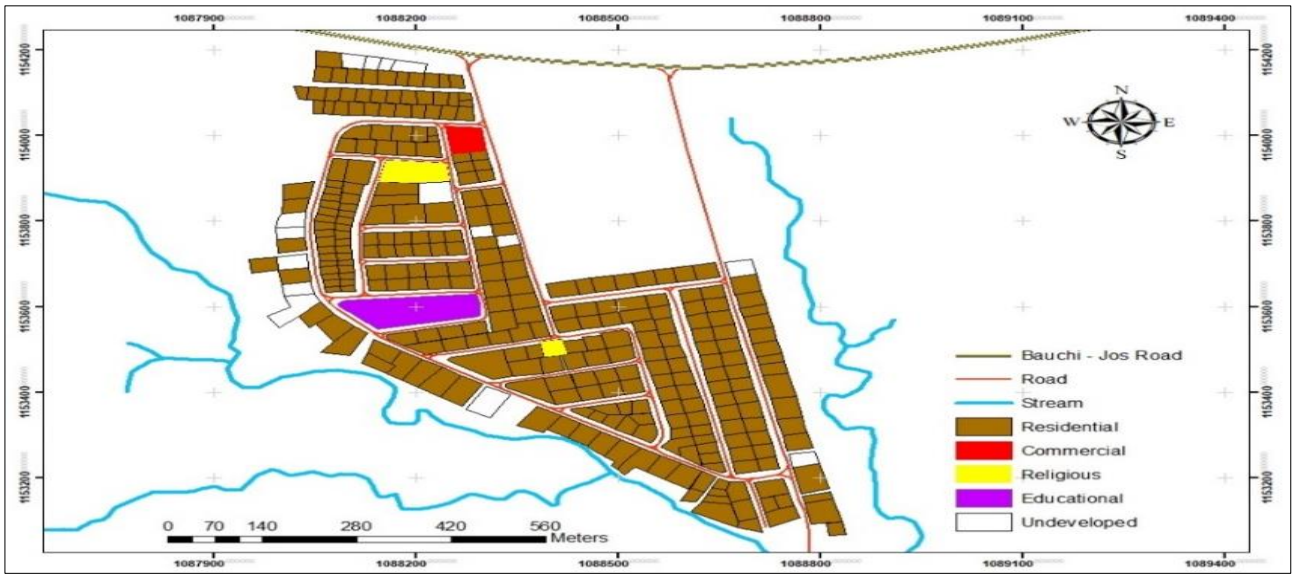

Figure 3. Land use map of the study area.

2.2.2 Adding shapefiles

In order to be able to work on ArcGIS, it is necessary to use folder connection using the connect folder function in ArcCatalog. The shapefiles created are; Plots, Roads Network, Stream, and Jos-Bauchi expressway. The shapefiles were created as independent layers to show the features that made up the estate and their relationship with each other (Figure 1).

2.2.3 Relational database

The attribute table was automatically created while digitizing the map features. Add field function was used to create additional Columns for Parcel ID, Name of the owner, Gender, Date of allocation, type of house, Address, land use occupation, and phone number added in the table. To create the database, the plots were assigned ID numbers and the data acquired from the field was stored against the respective plots (Figure 2).

2.2.4 Land use map

After successfully digitizing the plots, the various land uses were identified through fieldwork, and every plot was assigned its respective land use. To export the different land uses, a right click was done upon the plots layer in the table of the content panel to view the table of contents. Selection by attribute was done to select the land uses to export them and add them as an independent layer (Figure 3). The same process was performed for all the land uses to get the substantive and updated land use map of the estate. Residential land use is the largest in terms of area coverage followed by commercial, educational, and access roads while religion is the

least. The buttons added are controlled behind the scenes by the codes written as shown below.

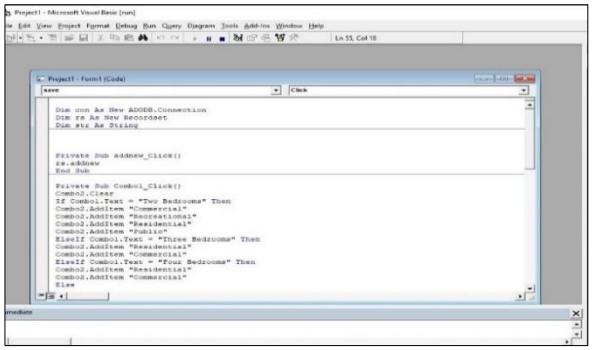

Figure 4. Visual Basic Code Editor for command buttons.

A login functionality was also added for added security to the interface. Access will only be granted if and only if the correct name and password are entered into their respective fields as depicted in Figure 5 and Figure 6.

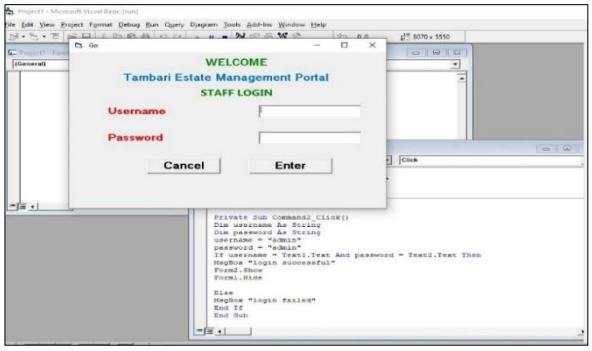

Figure 5. Visual Basic staff login interface.

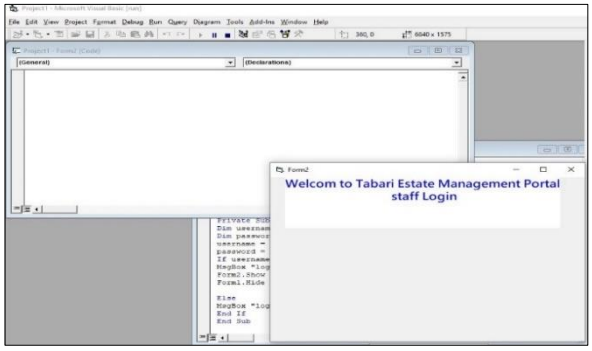

Figure 6. Visual Basic welcome staff login.

3. RESULTS

3.1 Tambari Housing Database

The database created has many functionalities and advantages that will aid in proper management. The system was designed to allow for storage, retrieval, and updating without any obstacles, unlike the traditional method (Figure 7 and 8).

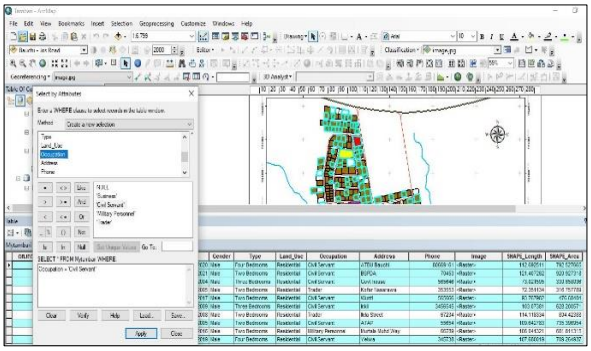

Figure 7. Database query showing houses owned by civil servants.

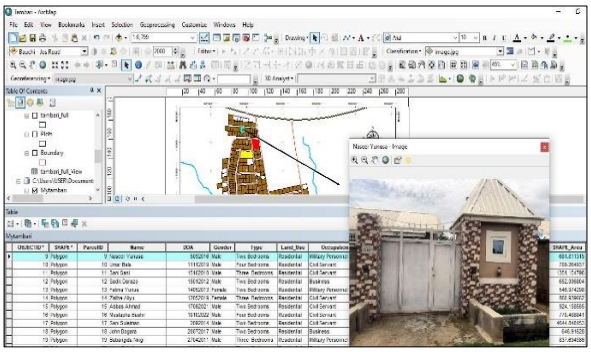

Figure 8. Database showing house information.

3.2 Virtual Login Interface

Microsoft Virtual basic software was used to create a user interface that will connect with the relational database for easy retrieval of the data when needed (Figure 9). A new form was created and fields like Parcel ID, Name of the owner, Gender, Date of allocation, type of house, Address, land use occupation, phone number, and pictures were added to the form. Fields, labels, commands, and textboxes were used in the creation of the form as shown in above in Figure 4.

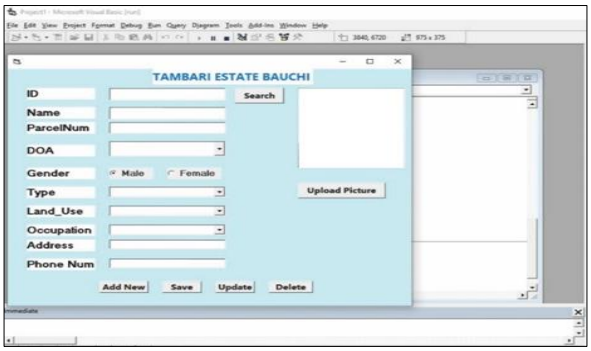

Figure 9: Visual Basic 6.0 user interface.

The interface is an added security to the database as it only allows authorized persons with access to the database. To gain access to the database, an Active Password and username must be entered and accepted before granting access.

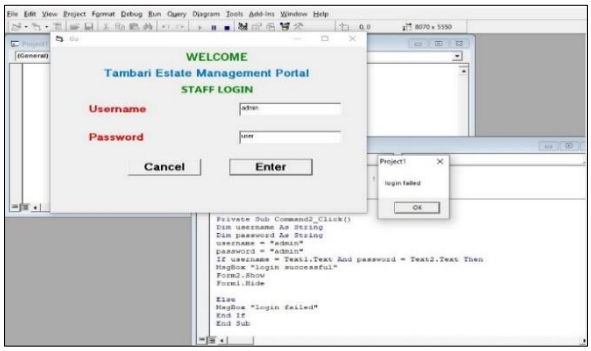

Figure 10. Failed login attempt.

Figure 10 shows a wrong password entered into the login page which denied access to the database.

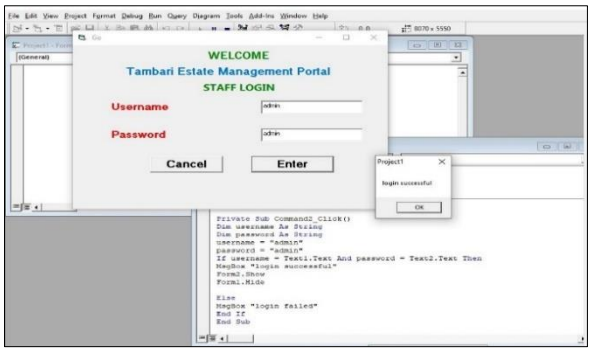

Figure 11. Successful login.

Entering a valid password will show login successful and allow the user access to the database as designed to protect the database from unauthorized personnel (Figure 11).

3.3. Database Management Form

The interface has all the functions needed for effective management of the housing estate. It allows for viewing, modifying, and adding new data to the table without any obstacles. It also allows for searching of certain data using the Parcel ID for easy retrieval of information.

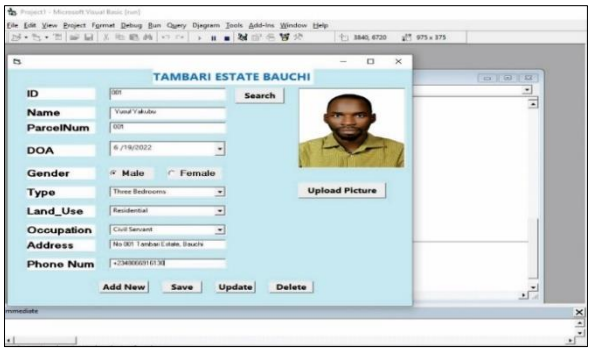

Figure 12. User interface.

4. CONCLUSION

The study demonstrated that the use of GIS provides a sufficient solution to manage land and its resources due to their simple, intelligent automation and capacity to analyze a lot of data in a short length of time. The knowledge expressed in this study has a significant possibility of assisting the citizens of Bauchi state by providing vital information to decision-makers (land administrators) that will allow them to make choices that are favorable to sustainable development within the context of appropriate land management and administration. The globe is a global village, and the spirit of integration is the mother of harmony and growth, which is why GIS should be used at all levels of human activity (Dukiya and Morenikeji, 2017).

The Bauchı state government can utilize this system to ease effective land management in the state. The failure of Land and Survey ministries, authorities, and similar institutions to integrate GIS techniques to collect and handle spatial information leads to ineffectiveness. The platform will promote long-term development, social cohesiveness, and economic growth if implemented.

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Author Contributions

Yusuf Yakubu Yusuf: Collected the datasets and analyzed the data, Methodology, Validation and writing of the Visual Basics script. **Kuforijimi Olorunsola:** Reviewing and proofreading the manuscript before submission. **Ahmed Hafeez Auwal:** Methodology, reviewing and proofreading the manuscript before submission. **Yau Abu Safiyan:** Data collection in the field. **Abe Bashir Saidu:** Participated in GIS analyses. **Yakubu Hamza Adam:** Writing the manuscript, review and editing. **Muhammad Ilyasu:** Writing the manuscript, review and editing. **Mohammed Alhaji Abdullahi:** Writing the manuscript, review and editing.

Conflicts of Interest

The authors declare no conflict of interest.

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Ibimilua, A.F., & Ibitoye, O.A. (2015). Housing policy in Nigeria: An overview. *American International Journal of Contemporary Research*, 5(2), 53-59.

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