Developing a Geo-Spatial Database and Standard Queries for Election Management by Stakeholders within Jos South, Nigeria

Isa Agaie Dawodu[1*], Francis Ifeayi Okeke[2], Raphael Ndukwu[3], Soulman Lamidi[4]

[1*,2,3,4]*Department of Geo-Informatics and Surveying; University of Nigeria, Enugu Campus (UNEC), Nigeria.*

Corresponding Email: [1]agaieisa@yahoo.com*

Abstract: One of the major set-backs of the 2023 general elections in Nigeria as highlighted by YIAGA Africa (2024) was the failure of the body saddled with election management which is Independent Electoral Commission (INEC), to deploy Geo-spatial Database (GSDB) as a repository in the efficient management processes which enable all election stakeholder participate seamlessly and interactively. The modus of oparandy for the geo-spatial database was hierarchical by dis-aggregating GSDB to the lowest geographical unit. The recent court verdict on re-delineation of electoral wards in Rivers State did not go down well with the political pundits prior to the forth coming local government election in the state. It surffices to say that, INEC from the on-set never had a geo-spatial database from which delineation and update of electoral wards, polling units can be carried out This will further build confidence and integrity, then reducing litigations that characterized the 2023 elections. The GSDB used was predicated on file geo-database of ArcGIS, where both spatial and attribute data of the study were stored; and standard query languages that are pertinent to elections were issued at prompt which generated maps and texts for decision making by all stakeholders.

Keywords: GSDB, ArcGIS, File Geo-Database, Standard Query and Stakeholders.

1. INTRODUCTION

One of the five key thematic areas advocated for by 'Geo-Enabled Election' Best Practices (2019) was to develop a data validation process, and this can only be done by geo-enabling election process via standardized geo-spatial ArcGIS. This of-cause require a sound plan, effort, and resolve.

Elections in Nigeria for the past two decades of democracy has been characterized with barrage of controvercies, and principal amongst were multiple voting and voter aparthy. The reason not far-fectched; the Independent National Electoral Commission (INEC) saddled with the conduct of elections do not have a repository geo-spatial database system. The modest and recent system was the Bi-modal Voter Accreditation System (BVAS). It is an electronic device designed to read Permanent Voter Card (PVC) and authenticate voters using the voters' finger print in order to prove that the voter is eligible to vote at a particular polling unit.

Unfortunately, the last 2023 election defiled its use in many states, especially in the far North and Lagos State where there were schemitshes of multiple voting at election as reported by Channels TV Station, (2023). It means INEC never had the required technology to drive the entire election processes.

Besides, the willingness on the path of the authority saddled with elections to do the right thing and lack of cohesion amongsy other relevant stakeholders, particularly the political pundits was obvious. For instance, there was a Memoranda of Understanding (MoU) between the National Population Commission (NPopC) in 2012 while delineating the entire country into smaller units called Enumeration Area Demarcation (EAD) using GIS and Very High Resolution (VHR) satellite imagery in preparation for National Census; and INEC, The election management body on their part were to provide names of electoral wards and localities in each of the ward; then INEC staff to assist in the field to identify the extent of these electoral wards.

Unfortunately, INEC could not fulfill their own aspect of the MoU before the expiration of the EAD in 2022 by withdrawing their staff from the field prior to the 2015 elections. INEC also was unable to provide the needed geographic point data of all the electoral wards and their localities. It means INEC never had it nor a geo-spatial database; neither are they willing to develop the capacities of their staff in the area of technology for election or GIS.

Therefore, to overcome the issue of un-available geographic data from INEC, the NPopC had to digitize each locality extent as polygon layer and stored all attributes as file geo-database. Apart from all these, the off-season governorship election conducted in Nov, 2023 by INE C in Bayelsa, Kogi and Imo States was another evidence of INEC not having geographic data nor a geo-spatial database needed for election data type was further revealed while in 48hrs, the INEC Cbairman (Prof Yaqub Mahmood) announced on Channels and Arise TVs the cancilation of forty-two (42) polling units where there will be no elections for lack of electorates (i.e., no registered voters in all these PUs) in Imo State. Question, why were they registered initially; who registered them; and how were polling units located?

Furthermore, the recent verdit by the Supreme Court of Nigeria in 24th August, 2024 (This Day Live) on the governorship elections in Bayelsa, Kogi and Imo States; despite reported different controversies, excluded IREV portal as part of election collation platform, except

the BIVAS and INEC form EC-8A. What it means is that, the previous law enabling INEC to use the IREV portal in collating election results no longer valid.

It is against this background that, this article seeks to demonstrate the strength of Geographic Information System (GIS) by developing a geo-spatial database with a standard query tool that is interactive and carry all relevant stakeholders along on Election Day in Jos South, Nigeria as a proto-type.

2. RELATED WORKS

In order to compare, contrast, synthesize and provide an introspect about the available knowledge on developing a geo-spatial database with standard query for managing election processes, countries like India, USA, Kenya had a semblance of GSDB election driven, except Estonia that was able to mirror the geo-enabled election principles by adhering to the precept as proffered by the 'Best Practices' (2020). India's last election was geo-enabled despite the huge voting population and large expanse of land and hard to reach areas. Their GSDB was dis-aggregated into geographical zones and districts for ease of data management and information dissemination. The only snag was lack of confidence in election result transmission. It is believed that, the database can easily be hacked. United State of America (USA) and Kenya had the same set-back of not knowing who the voters are and election result transmmission. But Estonia's last election was successful largely for using geo-enabled method. The reason was also attributed to the less than 1.5million voting population coupled with small Island Area. It was not difficult managing election process; all election stakeholders were carried along interactively and seamlessly.

The INEC in 2012/2015 had an MoU with National Population Commission (NPopC) to participate in the then nation-wide Enumeration Area Demarcation (EAD) using Remote Sensing (RS) and Geographic Ineormation System (GIS), in order for INEC's staff to have a practical knowledge and at the end establish their own GSDB. But INEC could not fulfill their own side of the aggrement.

The Bi-modal Voter Accreditation System (BVAS) introduced by INEC in 2015, 2019 and 2023 elections was manipulated and frustrated by some election stakeholders as said by Inter-Party Advisory Council (IPAC) and Socio-Economic Rights and Accountability Project (SERAP) after-math of the 2023 general election.

Furthermore, elections in Nigeria for the past two-decades have always being won in the courts, especially the 2023 election that was evidently marred with variety of election maleficient. All these were as aresult of INEC's in-ability to deploy GIS and GSDB with standard query format for transparent and effective management of election.

Data in the geo-spatial database has unique attributes such as, typically large and stored in complex data types, that requires a specialized indexing,querying, processing and analysis algoritms. The data represents simple 2D and 3D vector geometric objects , which include

polygons, lines and points. But, there are complex raster data like satellite imagery and ed data.

Another critical feature of a geo-spatial database according to C.J. Dates (2011) is that, the storage includes both the schema and the base for each geographic data-set in addition to the simple tabular storage of the spatial and its attribute data. These are referred to as primary data-set domiciled in the geo-database, otherwise called feature classes attributes, tables and raster data-set; all these are stored in a tabular formats.

3. MATERIAL AND METHODOLOGY

3.1 Material
For this article, after a careful material needs assessment study, two key elemwnts were resolved at and it include master data list, showing all the geographic data-set and their attributes as required; the type of application required per type of data-set and operation in order to achieve standard and desired accuracy.. The material needed for this article were the lines, points and polygon data layers with their attributes of all the study electoral wards and names in a file geo-database compartible with the analytical software (ArcGIS); which were obtained from NPopC office. Subsequently, the required data-type was extra-polated for ease of integration and analyses since the data are in the same reference system and file format.

3.2 Method
Each data-type is perculiar with its own table and corresponding attributes. And for each data-type in a table, a primary-key is usually the first cell to differentiate each table. It has also a foreign-key to link table for analysid. While composite-key was used to mitigate where names co-incides. All these were carried-out during normalization of the database, in order to avoid repetition, etc. Specific and standard query language (SQL) expressions like 'Select' were issued via the query builder tool of ArcGIS to generate results at prompt of the file geo-database as shown in figure 1 below. The syntax are usually coded for specific query. For instance, select a subset of feature and table records; Q1-how many electoral districts in the study area?; and the syntax= 'Select by Location where the Electoral District intercept with the Study area'.

4. RESULT AND DISCUSSION

This result validated the citation of re-delineating electoral wards clamoured for in the forth coming local government election in Rivers State. There are pertinent questions to facilitate query expressions so as to provide answers at prompt of ArcGIS query builder tool such as select a subset of feature and table records, and it is as follows. 1). How many electoral districts in the study area? The Syntax is: 'Select by Location where the Electoral District intercept with the Study area'. Figure 1 below is the screen shot of the query at prompt of ArcGIS query builder tool

Figure 1: Syntax for Number of Electoral Districts
Source: Author's Field Work (2024)

Query Result;

The result revealed that, there are four (4) geographically delineated electoral districts in the study area. It implies that, there is no electoral district with at least two Ward. See figure 2 below; Please note that, it was the aggregation of polygon localities resulted into each electoral ward by edge-matching; and combination of electoral wards produced a djstrict.
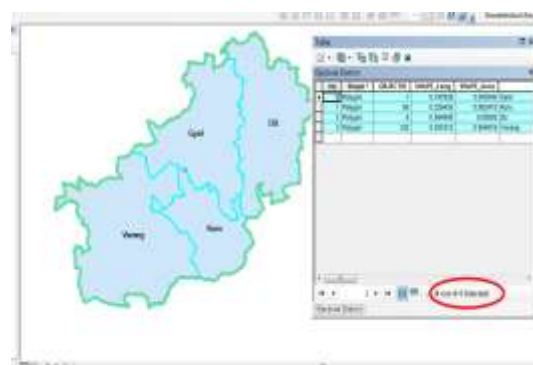

Figure 2: Number of Electoral Districts in Their Location
Source: Author's Field Work (2024)

Query 2:

In each electoral district, how many Wards available? For example, in Gyel Electoral District; the syntax: 'Select by location where RA_Ward have their centroid in Gyel_District'. Figure 3 below is the syntax in screen-shot at prompt of query builder of ArcGIS.
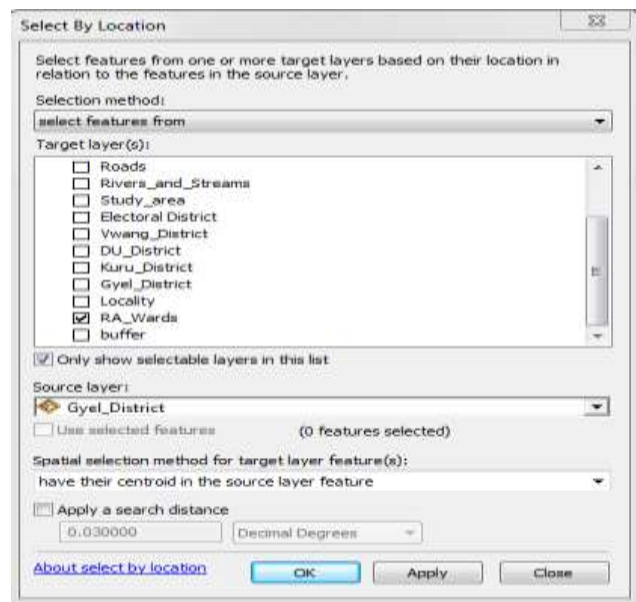
Figure 3: Syntax for Number of Wards per Electoral District
Source: Author's Field Work, (2024)

Result of Query 2;
Figure 4 below shows that, out of the twelve (12) electoral Wards that make up the study area, Gyel district alone had five (5) Wards. It implies that, Gyel district shall require more polling units, personnel and logistics.
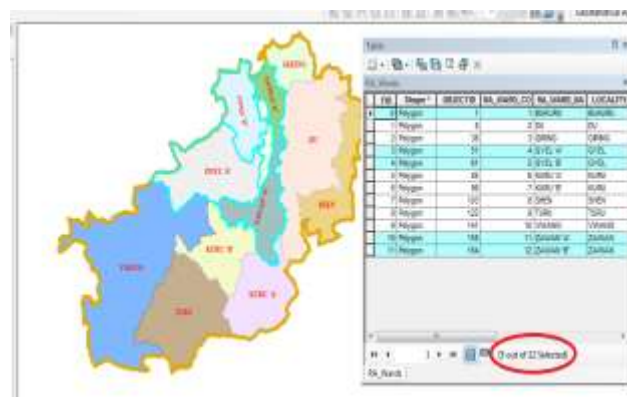

Figure 4: Results of number of wards per electoral district
Source: Author's Field Work, (2024)

Query 3
How many voting points available per electoral district and wards. This query is meant to ascertain two key election management concerns; the number of voting point and proximity to eligible voters; then are these polling units geographically located or arbitrary. The syntax at prompt of ArcGIS query builder tool for Du electoral district as a sample in figure 5 thus::

'Select by location where PU are within(clementin) of DU_District See figure 5 for the screen shot of the syntax.

Figure 5: Syntax for Number of Pus per Electoral District
Source: Author's Field Work, (2024)

Query Result

There are twenty-four (24) polling units in Du electoral district. This number of polling units is grossly in-adequate compared with the voting age population. It shows that, these polling units were arbitrarily sited as revealed on the map. See figure 6 below:

Figure 6: Result for Number of Pus per Electoral District
Source: Author's Field Work (2024)

Query 4

How many residence per electoral district and ward? This query would assist INEC to determine the required number of polling units, where to place or position them and facilitate
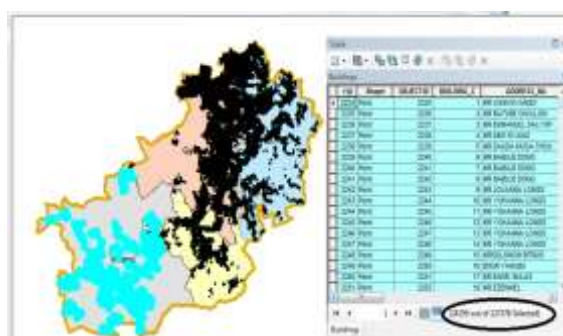
geo-coding of these residential houses of would be voters. V wang district was an example using the syntax in parenthesis as shown in figure 7:

Figure 7: Syntax for Number of Residence per Electoral District
Source: Author's Field Work (2024).

Query Result

Figure 8 below revealed that, there are twenty-four thousand, two hundred and fifty-nine (24259) residential buildings in Du district out of one hundred and twenty-seven thousand three hundred and seventy-eight (127,378) residential buildings in the study area. This proportion of residential buildings represents 19.0%; which means, INEC and the politicians would have to plan strategies for logistics, monitoring and personnel distributions during elections, including polling units.

Figure 8: Result of Number of Buildings in Du District
Source: Author's Field Work (2024)

5. CONCLUSION

These standard queries explained the capacity and the efficacy of geo-spatial database in election management, interactively and seamlessly. It is easier to plan, secure, logistics, monitoring by all stakeholders and it also serve as a repository in the case of any litigations and for developing metadata and standards. The geospatial database of election standard query could serve as a form of foundational data-set for a sister organization.
The election management body (INEC) can now identify who their voters are, since each can be pinned to a particular geographic location. Re-delineation of electoral boundary no longer require additional expenses without consuming time, using technology.

6. REFERENCES

1. Best Practice. Article of Geo-Enabled Election (Best Practice) of 2022; Five thematic steps for establishing Geo-Enabled Election in phases; Assembling a team of GIS experts; Collection and sustaining a voting unit GIS layer; Implementing a geocoding strategy; Assembling the best available contextual layers and Defining and implementing data validation processes; 2023.
2. Bill Sweeney. Nigeria's 2015 Elections: A Critical Vote for Democracy in Africa Published March 31st, 2015. On March 28th, 2015, Nigerians went to the polls and voted decisively for change; 2015.
3. European Union (EU) Election Observer: Report on 2023 Nigeria's election. 'Elections held on schedule, but lack of transparency and operational failures reduced trust in the process and challenged the right to vote; 2023.
4. Channel TV Station, on the 29th, July 2024: Report of Appeal Court of Nigeria Verdict on 'Re-delineation of Electoral Wards' in Rivers State Before the next Local Council Election in the State.
5. C.J. Dates (2011): Database Management System and Design (DBMS). A Geo-Spatial Database Perspective.
6. Geo-enabled election.: Best Practices for geo-enabled election of May 20th, 2022.NSGIC (2019):
7. Isa Agaie Dawodu, Francis Ifeanyi Okeke, Mubarak Umar Faruk, Yusuf Ibrahin Kuriwa. Geo-coding of Voter's Residential Address: A Panacea to Election Malpractice in Jos South LGA of Plateau State, Nigeria. JPPS. 2023;3(06):56-62.

Available:https://journal.hmjournals.com/index.php/JPPS/article/view/3384[Accessed on: 2024 May 3];

8. IPAC. Channels TV station on 2023 general election result announcement program, then July, 2023 INEC retreat on the general election: Inter Party Advisory Council, established 11th April, 2013 to mediate between political parties and Election Management Body (INEC) for f7ir and transparent election in Nigeria; 2023.

9. NPOPC. National Population Commission, 2015 Enumeration Area Demarcation Exercise (EAD), Point Attribute Data of Eligible Voter's Address; 2019.

10. SERAP, Socio-Economic Rights and Accountability Projects; Retreat on postelection of 2023 general elections organized by Nigeria's election manager (INEC); 2023.

11. This Day Live (2024): Live Report on Nigeria's Supreme Court Verdict on the Bayelsa, Imo and Kogi States off-season Governorship Election.

12. YIAGA Africa. Director of YIAGA Africa (Samson Itodo) report, appraisal and recommendation of the 2023 general elections; 2023.