

A REVIEW OF GEOGRAPHIC INFORMATION SYSTEMS APPLICATIONS TO ELECTION MAPPING IN NIGERIA

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Elections are the major hallmark of democratic societies and many countries have begun applying Geographic Information Systems (GIS) to manage the electoral process. GIS is also being utilised by political parties to assess the dispositions of voters and determine where to focus their campaign efforts. In a GIS, a combination of thematic layers of administrative areas such as population and land use can yield meaningful relationships or scenarios critical to decision-making processes and this makes it an exceptional tool for the management and analyses of elections at all stages. Nigeria's national electoral body, the Independent National Electoral Commission (INEC) has not been very proactive in leveraging GIS and Information Technology for ensuring hitch-free, free and fair elections in the country. GIS is key in enforcing the transparency of this system. This paper reviews the deployments of GIS for election mapping in Nigeria and discusses their applications in Nigeria's electoral system. The study shows that the status of GIS applications for electoral mapping in Nigeria is still in an infancy stage. The critical turning point lies in the full exploitation of GIS by the government's electoral apparatus.

Keywords: INEC, Polling Units, GIS, WebGIS, Nigeria

INTRODUCTION

One hallmark, critical to a functional democratic society are elections and its processes (Igbokwe-Ibeto *et al.*, 2016). According to Mesfin (2008), elections are prerequisites for any democracy, considered as the founding pillars of any democratic political system, whether considered fragile or established. It is a key component of political developments, which largely shapes a nation's socio-economic growth and development. An electioneering process is one which requires that an organised institution is saddled with the responsibility of organising, supervising and managing the nomination and subsequent election of aspiring individuals into various capacities (Egbala, 2014). In most established democracies, elections are routine processes, whose credibility is usually subjected to a list of factors. According to Elklit and Reynolds (2005), some of these factors include defective ballots, incomplete voter registers, inaccuracies in counting, impersonation and other blemishes. They also maintained that, human error happens sometimes, but if these errors are random and do not accumulate to determining the outcome of the election, then electoral credibility survives.

The standards for defining the measure of electioneering success or otherwise, is one which has benefited from contributions of the Inter-Parliamentary Union (IPU), with the aim of ensuring electoral quality (Boda, 2004). However, till date, there is still no general consensus on the terms defining 'Free and Fair elections'. As such, for the purpose of effective electioneering management, elections and its procedures are usually enshrined in a country's constitutional document, as a means of binding legal legitimacy. The term 'Election', however lacks a universal definition as stakeholders and different countries lean towards definitions in conformity with their democratic systems.

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As reported by Mesfin, (2008), two important factors on which the choice of an electoral system depends, includes: the identity of the State, characterised by sociocultural, historical, geographic, economic and political conditions and the prevailing political system in place. Nigeria, located in Western Africa on the Gulf of Guinea has always had turbulent elections. Past elections have been characterised by a number of irregularities ranging from imposition of candidates at party primaries, intra-party conflicts, political manoeuvres, manipulations of election results, disenfranchisement of eligible voters, thuggery and rigging, multiple registration of voters, and multiple voting (Nwagwu, 2016). The last presidential election in the country was held from March 28 – April 1, 2015. The 2015 elections were in many ways different from previous elections as the incumbency lost by a relatively wide margin of the total votes cast (CPPA, 2015). Nigeria's electoral administration hierarchy includes 774 Local Government Areas (LGAs), 360 Federal Constituencies, 91 Senatorial zones, 36 states and 1 Federal Capital Territory (Omoleke and Maduekwe, 2017). Figure 1 presents the administrative map of Nigeria. This system also includes sub-national electoral structures like State Constituencies and Councillorship Units located at the States and LGAs respectively.

The level of application of GIS to the Nigerian electoral system is very low. There is little evidence in the existing literature to show that there has been a systematic and thorough application of GIS in Nigeria's election system by the election management apparatus of Federal and State Governments in Nigeria. The few attempts made by INEC appear to have yielded mostly short-term deliverables. This is not unconnected with the trend in the Nigerian system of government which suffers from discontinuity in policies and development plans between successive governments. This situation is aggravated in the electoral process because key electoral officers are sometimes hampered from following through with implementation of digital technologies due to their untimely dismissals or redeployments caused by the massive distrust involved in electoral matters. There is also the problem of inadequate or poorly referenced geographic data to support electoral mapping with GIS. A lot of times, geographic data on Nigeria from internet databases are more detailed than what is available from mapping agencies in the country. Therefore, this study reviews the status of GIS applications for elections mapping in Nigeria with the aim of establishing a valuable knowledge base to inform stakeholders and researchers alike.

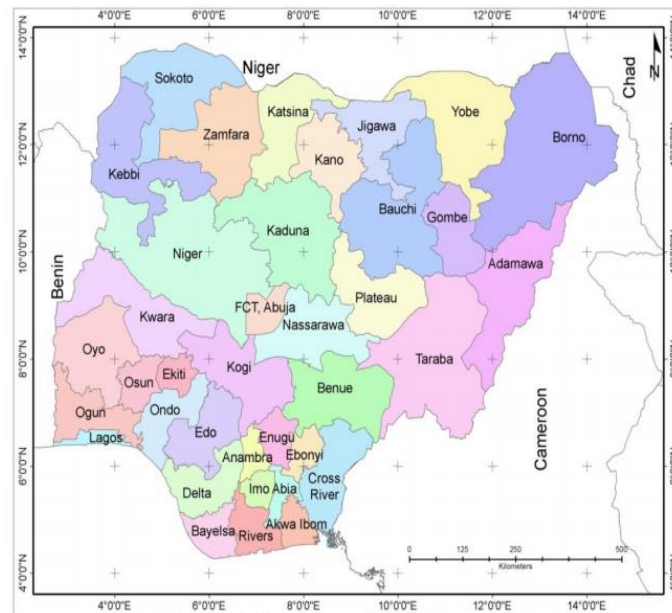


Figure 1: Administrative map of Nigeria (Source: Author)

Geographic Information Systems

Estimates have it that about 70-80% of all the information we deal with has some form of geographical (spatial) content. Many professionals have recognised the importance of this

spatial dimension in managing and analysing information and there is an increasing awareness about its importance in the larger society. Geographic Information (GI) combined into an Information System gives rise to what is termed as Geographic Information System (GIS). Basically, an information system consists of a database being managed by a Database Management System (DBMS), and a set of tools for manipulating and analysing this data (Zehnder, 1989; Bartelme, 2012). Innovations in information and communication technology plus fast-paced technological developments have broadened the frontiers of GIS application. As Longley *et al.* (2010) rightly state: “the modern history of GIS dates from the early 1980s, when the price of sufficiently powerful computers fell below a critical threshold”. A GIS is generally accepted to be a system for capturing, storing, checking, manipulating, analysing, and displaying data that are geographically referenced (Deakin, 2009). Its emphasis is on spatially distributed information and it is normally considered to involve a spatially-referenced and structured digital database, and appropriate applications’ software (Nwilo, 1998; Kufoniya, 1998). GIS introduces a perspective, which provides valuable insights such as the ability to assimilate divergent sources of data both spatial and non-spatial (attribute data), visualisation impact, analytical capability, and sharing of information (Akeh and Mshelia, 2016).

GIS for Elections Mapping

GIS incorporates adequate visualisation of map results and with a web-based and real time monitoring system of the elections, results can be easily displayed and made available to the public immediately the elections are over and at real-time. Electoral administration and governance matters like monitoring by electoral observers, determination of and siting of polling units, movement of election materials, collation and dissemination of election results etc. have geographic footprints. Thus, Geographic Information Systems can be deployed to provide solutions to some of the major challenges. GIS-derived maps make great use of digital technology in the process of their creation, and their great potential to get new perspectives on the world using highly advanced techniques can only be exploited because of advances in digital technology (Okolie, 2018).

GIS technologies have been applied in recent elections, for example, to view voter turnout and determine where politicians should focus their efforts (Hanewicz, 2012). The power of a GIS lies in the fact that thematic layers for key geographic areas being represented can be used to create multidimensional views of such areas over time. This means that when it comes to the management and analyses of elections, GIS is an exceptional tool that can be used in a better management process at all stages of an election. In the 2015 elections in Nigeria, a lot of problems were reported in the news media such as incomplete voters’ registration, low election turn-out, underage voting, hijacking of ballot boxes, multiple thumb-printing, contention over increase in polling centres across the country, and manipulations of votes in rural areas (Akintoye, 2015). The incidence of some of these problems would have been reduced if an effective GIS was in place. For example, a Nigerian citizen that is eligible to vote must carry out some key activities before the actual election day. Such a citizen must first locate his or her polling unit. Then the citizen must go to the polling unit to register, with pictures and details taken at the registration point. A voter ID card is issued to the citizen and this makes the person eligible to vote on the actual election day. This voters’ registration process is very time-intensive and this is one area where GIS can be useful. GIS will help minimize the time-consuming process.

When there is a robust GIS in place for the states in the country, the voters can locate the polling units via a web and a mobile based GIS platform without actually being in the locations physically. The intelligent maps produced from the GIS can aid in planning and research, direct knowledge (distance and direction search/points and area of interest search), access to hidden facts, exploration, exploitation and management of resources (Akintoye, 2015). With internet-enabled devices such as laptops, desktops and even smartphones, voters can easily and instantly find their geographic location in relation to the electoral map created for the state and they can use this to locate their polling stations in the area with ease. With the creation of key geodatabases when developing the GIS, voters can be provided with direct access to the registered voters’ database, which displays all information about the voters as provided during the registration process. With this in place, voters can authenticate as well as validate their voter records and take corrective action if necessary before the voting exercise. This in turn will facilitate the effective deployment of polling personnel such as polling officers, staff, security officers and others to manage the election process efficiently, since number of voters, voter registration, age, and other demographic information have been

adequately acquired. Electronic voting (if carried out) can also be better handled and monitored because of the GIS in place.

GIS serves as a backbone to aid election officers to manage their jurisdictions as well as coordinate operations. It also provides the following analytical capabilities: data processing, computational operations, modelling capabilities, thematic mapping, spatial analysis, and generation of new data (Okolie, 2015). Due to the fact that there is a GIS with an electoral map in place, the voting exercise carried out on the actual election day can be well monitored and managed. With a collection of algorithmic and functional tools within the GIS (Bartelme, 2012) and a web-based GIS interface in place, election officers can have access to a highly-sophisticated GIS application, making it possible to perform a wide range of duties and responsibilities. Live video broadcasting and viewing of the entire voting process of a polling station can be carried out by selecting the polling station located on the web-map. This is due to the fact that in addition to linking information about voters and images, videos and more can be linked to the electoral map in the GIS application, thereby providing the electoral officers with the responsibility of monitoring and supervising the accreditation and voting exercises at real-time. This provides easy coordination of elections; better monitoring process and officers are able to take decisions swiftly and confidently due to the availability of real time data from polling stations. After elections, results obtained can be more transparent due to automatic map visualisation of election results that a GIS can provide. Election maps and spatial representations with results embedded in them can be provided as soon as elections are concluded to the automated process. Spatial analysis of multiple databases can aid the provision of better visualisation of results down to the state and local government levels.

WebGIS Tools for Election Mapping

A WebGIS application is an application of GIS which one can access online via the internet (Purwonegoro and Windiastuti, 2014). The configuration of a WebGIS includes three tiers (Fu, 2012): the data tier (GIS database server), the logical tier (GIS server and web server), and the presentation tier (client - web browser, desktop or mobile). In this case the user/client can use any internet browser to access GIS information on the server. Voting has changed over the years. The technological process of administering elections has changed a lot. Hence, with the provision of a WebGIS application, maps can be accessed at real time and used for various electoral spatial and attribute analyses by electoral officers. With the required tools in place, such a system will aid the monitoring of the distribution of logistics for the election and authorities including general communities who may need the information can easily obtain this with permission from the Electoral Commission (INEC). A WebGIS application also provides the following functionalities - users can reach the whole world wide, at a fairly low cost; users do not need special software and tools; it can present an interactive map in the similar manner as desktop GIS software; and it is independent of the computer operating system (Purwonegoro and Windiastuti, 2014).

There are many WebGIS applications that can aid transparency in elections in Nigeria. These cuts across the use of existing applications provided by GIS software vendors to open-source software and even down to the development of customised applications for the election exercise. These tools are provided to not only meet the needs of the electoral officials but also the needs of the citizens that are engaged in the voting process on that very day of election. When it comes to WebGIS applications, there are certain tools that are required to perform processes beyond mapping. These tools consist of different types, ranging from finding an address to very more specific tools for calculating best routes and finding nearest facilities. These kinds of WebGIS tools will definitely be required in an electoral process of the country. These can be described in the following ways:

1. Many web GIS applications include software functions to perform GIS analysis and this comes with tools that can visualise and analyse the election map results. There can be a series of tools to chart, analyse, and understand the election results on a real-time basis via the web platform. This could come in the form of map result classification, statistical summaries and the generation of tabular results and graphs. This will make election transparency possible.
2. Electoral officers such as the Nigerian Independent National Electoral Commission (INEC) officials require a series of focused tools that help them accomplish their workflows and assignments. For example, tools to edit the electoral map, monitor elections and analyse the database can be of great use to them. This they can do at

almost any given location provided there is internet connection for the work process to be carried out.

3. Many end users or citizens will require designated layers on the platform with typical tools for their own use. Citizens can use the platform for finding polling units assigned to them. Registered voters can easily claim their voter records and even correct any inconsistencies by interacting directly with the WebGIS platform. They no longer need to go through polling agents and other non-governmental support staff to do this. This enhances transparency.

Distributing geographic information on the internet is an enforcing factor for information providers. Internet allows all levels of society to access geographic information, and provides a media for processing geo-related information with no location restrictions (Alesheikh *et al.*, 2015). This shows that with the provision of a robust WebGIS application and its tools, voters and election officers can be more involved in and well informed of the election process thereby encouraging transparency from start to finish of the electoral exercise. A good example is the Ushahidi election monitoring tool. Ushahidi has been used to monitor elections around the world, from Nigeria and Mozambique, to the United States of America (Manning, 2016). Figure 2 shows the interface of the Ushahidi platform used to monitor the United States (US) 2012 elections.

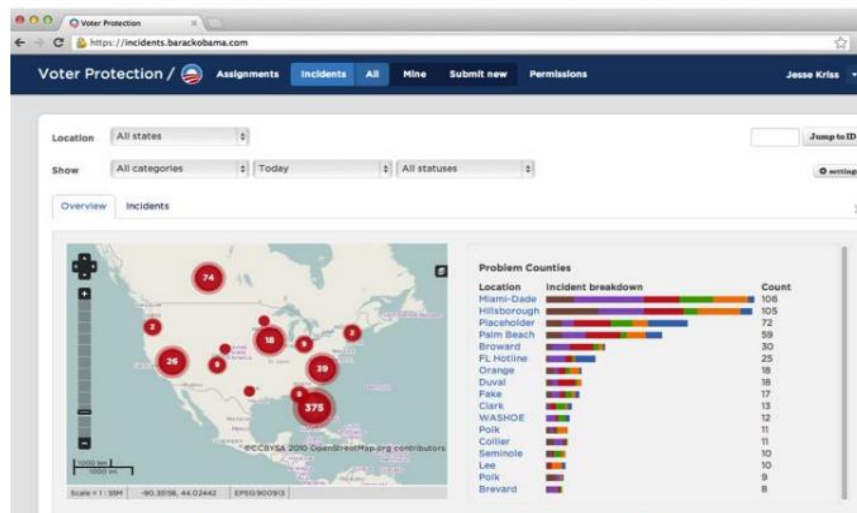


Figure 2: Monitoring the US 2012 elections with Ushahidi (Source: Manning, 2016)

Status of GIS Applications to Elections in Nigeria

ESRI (2007) reports that Nigeria's Federal Electoral body, the Independent National Electoral Commission (INEC) employed GIS to inventorise and spatially locate 120,000 polling units scattered across the country. In the mapping, Global Positioning Systems (GPS) digital photography and Database Management Systems (DBMS) technologies were integrated to create a data collection tool capable of capturing the coordinates and images of existing polling units. The result was a PUGIS (Polling Units - GIS) that could display polling units within two levels of administrative boundaries (state and local government areas), and the proposed registration areas; and also capable of executing simple GIS queries. More recently in 2014, the Office of the Surveyor General of the Federation (OSGoF) produced for INEC hundreds of satellite image maps showing the locations of Polling Units (Pus) in the country. The satellite imagery used was the 2.5-metre SPOT natural colour imagery which had recently been delivered to OSGoF by Infoterra, United Kingdom. Figure 3 shows an image map for a part of Kano State. INEC has also embedded maps on its website (<http://www.inecnigeria.org/>) showing the locations of polling units on its website (Figure 4). In addition, a PU locator on the site assists individuals in locating polling units in each state up to the ward level.

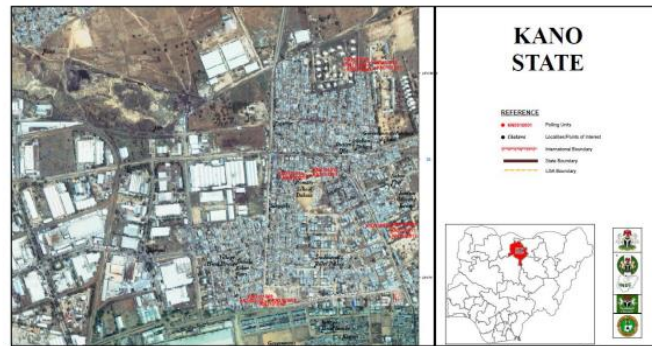


Figure 3: INEC Satellite image map showing locations of polling units in a part of Kano State (Source: Author)

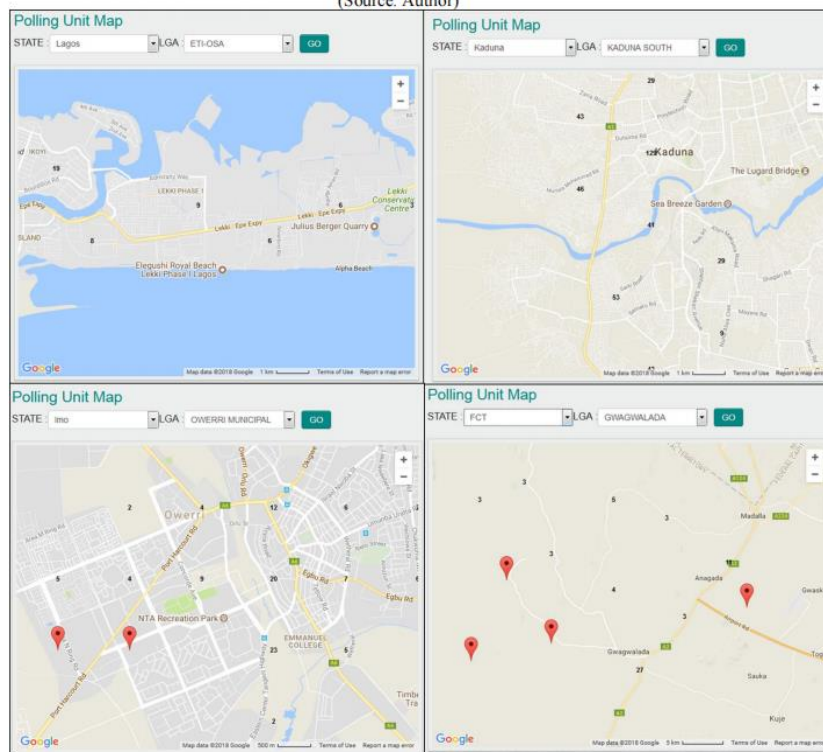


Figure 4: Polling unit maps of some local governments on the INEC website – Etiosa, Lagos (top-left); Kaduna South, Kaduna (top-right); Gwagwalada, Federal Capital Territory (bottom right); and Owerri Municipal, Imo (bottom left) (Source: INEC, 2018)

Other organisations have employed WebGIS and crowdsourcing tools to provide incident reports and monitoring of elections in Nigeria. For example, in the period leading to the 2015 elections, the technology company, Ushahidi partnered with the Stakeholder Democracy Network (SDN) and other stakeholders to create an early warning dashboard for violence in the run-up, during and immediately after the elections (Ushahidi Staff, 2015). Previously, during the 2011 elections, the Ushahidi powered Niger Delta Watch website was used to monitor events and highlight human rights abuses and forced evictions. To help track early warning signs of election-related violence in the 2015 elections, a non-profit group, Search for Common Ground (SFCG) used a system that combined information from long-term election observations; crowd sourced data and media reports to identify trends and hotspots of violence in the run-up to the elections (SFCG, 2018). A product of the collaboration was an online crowdmap of election-related violence called the Nigerian Electoral Early Warning

System (NEEWS) (Figure 5). NEEWS provided a mechanism to monitor early warning signs and incidents of electoral violence in the run-up to the 2015 elections.

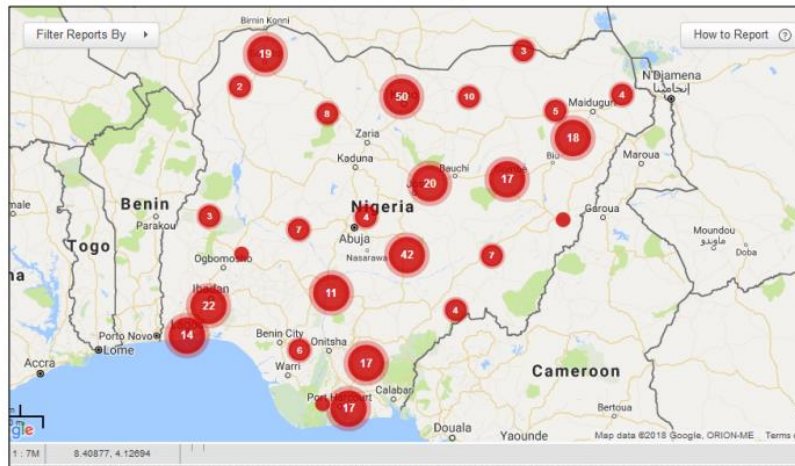


Figure 5: The interface of the Nigerian Electoral Early Warning System - NEEWS
(Source: SFCG, 2018)

In another effort, Connected Development (CODE) deployed an Ushahidi powered platform called Uzabe (<http://uzabe.org>) to create a web map for observing the 2016 Federal Capital Territory municipal elections (Figure 6) and the 2017 gubernatorial elections in Nigeria (Figure 7). Uzabe incorporates tools for collecting situation reports from observers. The thematic layers on the map include categories for ballot issues, polling station issues, security issues etc.

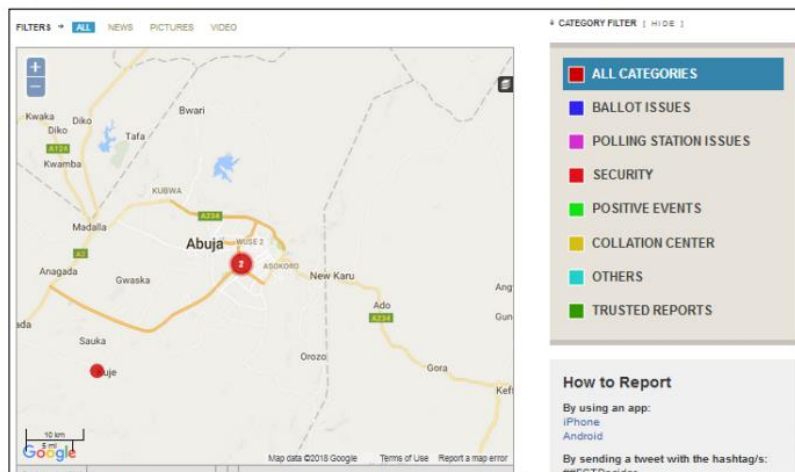


Figure 6: The Uzabe webmap which was used for observing the 2016 Federal Capital Territory municipal elections (Source: Uzabe, 2018)

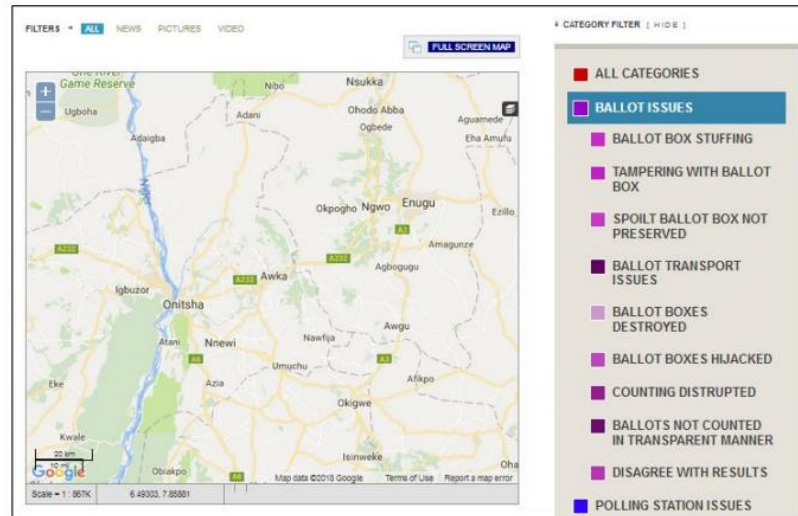


Figure 7: The Uzabe webmap which was used for observing the 2017 gubernatorial elections in Nigeria
(Source: Uzabe, 2018)

CONCLUSION AND RECOMMENDATIONS

Nigeria's electoral system has a long history of political violence, malpractices, and government interference. GIS is an exceptional tool for the management of elections at all stages and in engendering election transparency. The study shows that the Nigerian Federal Government through the Independent National Electoral Commission has made some modest progress in the adoption of GIS for electoral mapping. Also, the country has been slow in embracing technological advancements in electoral administration. The Independent National Electoral Commission has not been very proactive in leveraging GIS and Information Technology for ensuring hitch-free, free and fair elections in the country. The use of GIS and Information Technology in innovative ways throughout the election life cycle should be in the forefront of INEC's operations. GIS is the key in enforcing the transparency of this system. It is suggested that INEC goes beyond the traditional approach of utilising GIS to produce static maps and webmap interfaces with limited support for enhanced visualisation and intelligent analytics. INEC should exploit GIS for more in-depth analysis and novel decision-making tools to support the good management and transparency of the electoral process.

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