©Ibadan Journal of the Social Sciences
Volume 24, No. 1, 2026

DOI: 10.36108/ijss/6202/42.0160

Geospatial Analysis of Legal Land Dispute in Ibadan Metropolis (1972 – 2018)

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Land disputes constitute one of the most persistent forms of socio-economic conflict in Nigeria, particularly in rapidly urbanizing cities such as Ibadan. As cases are decided in the courts, from the Magistrates' Court to the Supreme Court, a large volume of law reports is produced. Land matters rank high in Ibadan Metropolis. This study investigates the spatial and temporal dynamics of legal land disputes in Ibadan Metropolis over 46 years (1972-2018), aiming to identify patterns and inform evidence-based land management strategies. The study utilized Geographic Information Systems (GIS) and the Elasticsearch, Logstash, and Kibana (ELK) stack framework. Published law reports obtained from Law Pavilion, Global Positioning System (GPS) coordinates of court locations, and OpenStreetMap datasets were integrated into a geospatial database for analysis. Spatial analytical tools, including Average Nearest Neighbour, Standard Deviational Ellipse, and Emerging Hot Spot Analysis, were employed to identify clustering patterns and temporal trends in land conflict distribution, while the ELK stack was used for queries with interactive maps. Findings revealed that land disputes in Ibadan are spatially clustered, particularly within Ibadan North, Ibadan North-West, and Ibadan South-West Local Government Areas. Temporal hotspot analysis further indicated persistent and consecutive hotspots in areas experiencing rapid urban growth and increasing land values. The study demonstrates the usefulness of integrating GIS and ELK stack technologies in legal information retrieval, judicial record management, and spatial visualization of dispute patterns. The study recommends improved geocoding standards in judicial records, digitization of legal archives, and institutional adoption of geospatial technologies for efficient justice administration and land governance in Nigeria.

Keywords: ELK stack, GIS, Hot Spot Analysis, Law Pavilion, legal land disputes

Introduction

Enabling public access to court decisions and judgments helps clarify irregularities in legal cases, conflicts of interest, and instances of corruption. For this to happen, justice must therefore be transparent and predictable, ensuring that societal affairs are ordered according to the dictates of the law. To achieve this transparency in the legal sector, record management systems need to facilitate easy access to and retrieval of legal case documents for public information.

Land issues are one of the leading causes of conflict in Nigeria because land is a commodity used daily for various purposes and it influences the lives of people in the country socially, economically, and politically. In Ibadan, land conflicts rank among the most prominent conflict occurrences. This is due to the administrative and commercial importance of the city, which leads many people from various parts of Nigeria to migrate to Ibadan. Land in Ibadan is seen as an asset, a status symbol, and a key investment. As a result, there is competition for land, which false and fraudulent landowners have taken advantage of to dupe land buyers. (Olaniyan, 2023) and (Lamidi & Olaleye, 2023) examined the role of informal governance in Ibadan, especially the role of community elders and traditional institutions in resolving land disputes. However, cases of land conflicts eventually get to the formal courts if they are not resolved at the initial stage by traditional authorities. Some cases eventually end up in the Federal Courts (the highest courts in the country) as a result of appeals and counter-motions filed by the

parties, and as such upon resolution, the case is filed and then published as law reports for judicial precedents and future references. Due to the frequency of such cases in the formal courts and a large volume of such law reports being created on a regular basis, it is therefore very important to effectively manage these law reports. This is for the sake of judicial precedents and also for transparency to the public to show that cases in the formal courts are handled with the utmost integrity and high legal precision. Good management, storage, prompt access, and easy retrieval of such law reports are essential.

One major way for organising the information in the case files and giving access to the public is through law reporting. While there is no official Council for Law Reporting in Nigeria, a plethora of law reports have emerged over the years to serve the ever-growing demands of legal practitioners in Nigeria; consequently, law reports are being published and made available even on legal websites, such that anyone can easily view and download the judgments of the federal courts for little or no cost.

Statement of the Problem

Despite the increasing volume of legal land disputes in the Ibadan metropolis, judicial records relating to these disputes remain poorly organised, fragmented, and difficult to retrieve spatially and temporally. Existing legal record management systems in Nigeria focus primarily on archival storage and text-based retrieval with limited integration of geospatial analytical capabilities.

Although the field of legal data analysis has largely moved towards Large Language Models (LLMs) and NLP for similar tasks, as demonstrated by Shu et al. (2024), in the Nigerian context, little attention has been given in the literature to the application of geospatial techniques to give a rapid and visual, interactive access to these law reports through geographical analysis and visualisation, for query-based searching and retrieval of desired law reports. The application of GIS for legal management of land disputes and other matters is therefore necessary in this regard.

Previous studies on land disputes in Nigeria have largely concentrated on land governance, tenure security, conflict resolution mechanisms, and stakeholder roles (Shiyanbola et al., 2024; Olorunfemi et al., 2021). Similarly, existing geospatial studies have mainly applied conventional GIS approaches for mapping disputed lands and identifying conflict-prone areas (Muhammed & Babalola, 2025).

However, limited attention has been given to the integration of judicial litigation records with scalable geospatial analytical frameworks such as Elasticsearch, Logstash, and Kibana (ELK) for spatial querying, temporal analysis, hotspot detection, and visualization of legal land disputes across multiple court hierarchies. Consequently, judicial authorities and land administrators lack comprehensive geospatial intelligence for identifying litigation hotspots, directional trends, and long-term patterns of land conflicts.

This study fills this gap by demonstrating the use of Elasticsearch, Logstash and Kibana (ELK) software working in unison as a stack, and as a mapping tool to analyse the land case report information and visualise it as maps. The tool also provides the location of the land conflict and the courts of judgment, and the data is analysed by filtering the courts' decisions through different.

Aim and Objectives

This study aims to investigate the spatial and temporal dynamics of legal land disputes in the Ibadan Metropolis (1972–2018) using a geospatial framework. The specific objectives are to:

1. Map the locations of legal land disputes identified in published law reports.
2. Analyse the spatial distribution and directional trends of these disputes using Standard Deviational Ellipse (SDE).
3. Develop an interactive geospatial dashboard using the ELK stack (Elasticsearch, Logstash, and Kibana) for enhanced retrieval and visualization.
4. Inform land management strategies through evidence-based spatial insights.

Record Management Models and Existing Literature

Two well-known models in the field of Records Management include: the Record Life Cycle concept and Records Continuum Model. On the one hand, the record life cycle concept focuses on the creation of records, using them for as long as they are valuable and relevant, and finally disposing of them by transferring them to an archival institution or destroying it completely. It is therefore based on

the creation, maintenance, and disposal of records. This concept is only effective with hard-copy records and would not be applicable in the same manner in the digital environment.

The records continuum model, on the other hand, deals mainly with electronic records. It comprises the entire extent of a record's existence. In an electronic environment, records are dynamic and recursive in nature and may exist in more than one stage of the life cycle simultaneously (Barry, 1994); hence, the nature of electronic records does not make them subject to following a serial path from creation to disposal and this is also aided by the recent developments in management systems. For instance, at the stage of record disposal, upon reappraisal, the electronic environment enables a record to return to an earlier stage. Cox (1997) therefore states that the developments in electronic management systems necessitate a change in the core concept; hence, the need to replace the record life cycle with the continuum.

Land has been described in many ways by different fields based on perception and land use (Vink, 1975). From a geographical viewpoint, says that a tract of land is a specific area of the earth's surface whose characteristics embrace all reasonably stable or predictably cyclic attributes of the biosphere vertically above and below this area, including those of the atmosphere, the soil and underlying rocks, the topography, the water, the plant and animal populations. Land is central to all human activities because it is the source of all material wealth.

Babette (2005) observed that land conflict can be understood as a misuse, restriction or dispute over property rights to land. Viewed this way, land is an object of competition. Nigeria is a country rife with conflict, and disputes over land issues constitute a significant number of conflict events and the violent deaths that result from them. Land conflicts that last for a long time could result in a legacy of conflict that may be very difficult to resolve (Mienye, 2016). Landed property, being a key investment in Ibadan—an asset and a status symbol as well, even for non-indigenes, is always highly sought after, leading dubious landowners and fraudsters to capitalize on and exploit or dupe land buyers. According to Albert et al. (1995) in Ibadan, there is a hierarchical option for conflict resolution which starts with disputants trying to solve the problems themselves and through a third party, if it fails, then they proceed to involving traditional and informal conflict resolution bodies, if it also fails, they then employ the services of the customary court; the final step in the hierarchy is to appeal the case to the formal legal institution. (It should be noted that Customary Courts do not have the jurisdiction to hear land matters.

Land Conflict Issues

Land conflict, as redefined by Eniye (2016), is a social phenomenon involving two or more parties with differing interests over property rights to land; that is, the rights to use and manage the land, generate income from it, exclude others from the land, and transfer it to another for compensation when deemed fit. Babette (2005), in summary, says a land conflict can be understood as a misuse, restriction, or dispute over property rights to land. This shows that Land is an object of competition, as USAID (2005) puts it; it serves as an economic asset, a connection with identity groups that could be on the basis of ethnicity, religion, class, gender, or generation. Land, therefore, could either be the cause of conflict or other factors could contribute to its escalation. Land conflict may occur between single parties, such as boundary disputes between neighbours or family members over the use of a piece of land. It may also occur between several parties, with the most violent conflicts arising between two different ethnic groups. This includes evictions of the entire settlements and group invasions of a settlement. Land conflict may also occur as a result of corrupt land administration and poor state management of land.

Stone Conroy (2014) explains that land conflict according to the Malthusian and Neo-Malthusian conception is a result of population growth and increasing scarcity, but from the perspective of political ecology, conflicts over resources and lands are usual due to distribution, management, and control, rather than scarcity, and yet still another school of thought about natural resources and conflict argues conflict over resources may arise not as a result of scarcity but from the relative abundance of such resource, this is known as the "resource curse" and it is championed by scholars such as Mehlum and Ross. In Nigeria, this can be readily seen, for instance, as Gausset et al. (2005) point out that the abundance of resources in the

Adamawa Region of north-western Cameroon and south-eastern Nigeria "has never prevented the existence of Agro-pastoral conflicts, just as it has never prevented tenure conflict among agriculturalists or among pastoralists."

Generally, Nigeria is a country rife with conflict, and disputes over land issues constitute a significant number of conflict events and the violent deaths that result from them (Mienye, 2016), more so because access to land is important to poverty reduction as well as economic growth. Land conflicts that last for a long time could result in a legacy of conflict that may be very difficult to resolve (Mienye, 2016).

Right from pre-colonial Nigerian societies, land already had economic importance and in addition, it also served various purposes such as payment of dowries, reparation for serious crimes, as collateral, as medium of exchange, and overall, a symbol of wealth and social standing, so, right from there and then, there had been occasional outbreak of conflicts. Also, the acquisition of land by European trading companies, colonial government, and missionaries, for the establishment of churches, schools, administrative infrastructure, and residential quarters, brewed inter-communal conflicts in most communities (Nwachukwu, 2016), and there were cases of grants and counter-grants, sales and counter-sales to the Europeans.

Land Conflict in Ibadan

Ibadan, being the economic nerve centre of Yorubaland and having various opportunities, experiences massive emigration from other states in Nigeria to add to its already bulging population. Landed property, being a key investment in Ibadan, an asset as well as a status symbol, even for non-indigenes, is always up for competition, which dubious landowners and fraudsters have capitalized on and have exploited or duped land buyers. Some reasons for land conflict may also stem from the sale of properly acquired land to more than one buyer, especially if one buyer buys land and delays development on it. Other cases of land conflicts may arise from people encroaching on another person's land deliberately or accidentally (Albert et al., 1995).

The magnitude of land disputes in the city can be gauged from the number of cases brought by members of the public to such informal arbitration television programmes as 'So Da Bee' of the Broadcasting Corporation of Oyo State (BCOS) and Agborandun of Nigerian Television Authority (NTA). Almost every week, people appear on these programmes to seek conflict resolution for land disputes. When reconciliation efforts fail at the traditional level, people either stubbornly remain on the land or eventually resort to the formal court to argue their case. This may even reach the Supreme Court (the highest court in the country) as a result of appeals and counter-motions filed by the parties (Albert et al., 1995).

It can therefore be said that not all land conflicts resulting from violations of the law in Ibadan get to the formal court. Conflicts tend to be first addressed using the informal and traditional methods (Albert et al., 1995). This is because of the perceived complex nature of formal courts, ranging from the extremely formal setting to strict dress codes and use of highly technical legal vocabulary among the lawyers, the judges and the court personnel; unpredictability of judgments to the ordinary man, and ignorance of when and how to appeal to higher courts in a case of lack of satisfaction with judgments in lower courts. Other reasons include numerous courts, mismanagement of case files, denial of justice, high cost of legal proceedings, and perceived cases of corruption involving the lawyers and the judges. The Customary courts, which are regarded as a bridge between the formal and informal court system in Nigeria are the most readily acceptable formal legal system because of their simplicity, less formality and their incorporation of religious and ritual beliefs and practices in determining legal responsibility. Hence, in Ibadan, there is a hierarchical option for conflict resolution which starts with disputants trying to solve the problems themselves and through a third party, if it fails, then they proceed to involving traditional and informal conflict resolution bodies, if it also fails, then they employ the services of the customary court, and the final step is to appeal the case to the formal legal institution.

Structure and Procedure in the Legal Institution in Nigeria and Ibadan

The Nigerian legal system can be described as essentially a composition of English law obtained from the British legal system, Nigerian common law, which includes domestic legislation, customary law derived from traditional norms and

practices and the Sharia/Islamic law used only in Northern Nigeria. The system works by means of a constitution which was enacted on 29th May 1999 through which all courts in the Nigerian federation derive their jurisdiction or competence.

According to the constitution, a court is either a Federal court, a State court, an Election Tribunal, or other Tribunals.

Federal Courts: Federal courts in Nigeria are in three categories: Tier 1, Tier 2, and Tier 3.

The Supreme Court: is a Tier 1 court, regarded as the highest court as well as the court of last resort. The Court of Appeal, The Federal High Court, The High Court of the Federal Capital Territory, Abuja, The Sharia Court of Appeal of the Federal Capital Territory, Abuja, The Customary Court of Appeal of the Federal Capital Territory, Abuja.

State Courts: The High Court of the State, The Sharia Court of Appeal, The Customary Court of Appeal, Magistrate Courts, Customary Courts.

The Election Tribunals: The National Assembly Election Tribunals, The Governorship and Legislative Houses Election Tribunals (Section 6(5) of the 1999 Constitution (as amended).

Other Tribunals - Tax Appeal Tribunal comes after (Ladan, 2014) pointed out that the continuous production of legal records has become a major problem confronting judicial institutions in Nigeria and there is always the problem of organizing, retrieval, accessing and utilization of information in these records. Odeyemi et al. (2011) states that while current records are being managed fairly well by the legal departments, not so can be stated as per semi-current and non-current records and according to (Abioye & Popoola, 1998), these records in paper format are in bad, deplorable and very chaotic state and managed by non-professional record managers with no record management policy, also, there is a lack of ICT facilities to aid the course and the storage spaces were inadequate. What ensures as a result is that files and records go misfiled, misplaced, hidden, mutilated or even stolen, which leads to continuous adjournment of cases since the case files are not produced on time or not produced at all, this means that accused persons will remain incarcerated without trial, criminal cases are discontinued, dangerous criminals are set free, innocent people are jailed and denied justice (Kerrigan et al., 2010). With all these, the public soon loses trust in the judiciary to be a source of justice for them, occasioned by the non-maintenance of reliable records (Millar, 1999).

ICT provides the platform on which GIS is able to work, such as the technological infrastructure, digital and wireless networks, database management systems, Internet, and various peripherals that allow information to be collected, integrated, managed, transmitted, and used. GIS is a computer-based tool for mapping and analysing geographic phenomena and events that occur on Earth. What distinguishes GIS from other information systems is its ability to integrate common database operations such as query and statistical analysis with the unique visualization and geographic benefits offered by maps. This makes GIS valuable to a range of private and public enterprises for explaining events, predicting outcomes and planning strategies. According to (French & Wiggins, 1990) and (Diffusion and Use of Geographic Information Technologies, 1993), from the late 1980s, the availability of user-friendly and affordable geospatial technologies, including geographic information systems (GIS), remote sensing (RS), and global positioning systems (GPS) has prompted their intensified adoption by both public and private organizations at all levels, and local governments in particular.

Singh (2017) points out that in ELK, maps can be used to locate geographic locations based on geographic coordinates supplied in data as "geo_point" with inputs of latitude and longitude. The visualization displays the data points captured in the form of circles or as shaded geohash grids displayed as rectangular cells. The size is decided by the precision chosen, and colour signifies the actual value computed. The mapping function of ELK, therefore, allows data to be visualized in different layers. Hence, for the court judgments, information is accessed easily by geographical visualization in map format, in which one can easily find the location of the conflict or any other places mentioned in the court's decision, which will then aid easy retrieval of the law report.

Materials and Methods

Study Area

The city of Ibadan, the capital of Oyo State, is located in the southwestern part of Nigeria. It lies between Longitudes 3o5' to 4o36' East of Greenwich, and between Latitudes 7o23' to 7o 55'

North of the Equator. Ibadan Metropolis covers an area of about 250km2 of the total Ibadan area of about 30,080km2. The population in 2016 is estimated to be 3.16 million (Central Intelligence Agency, 2016). Ibadan metropolis consists of five urban Local Government Areas- Ibadan North, Ibadan South, Ibadan Northwest, Ibadan Southwest and Ibadan Northeast local governments, while the semi-urban local government areas are Akinyele, Oluyole, Egbeda, Ido, Lagelu and Ona-Ara Local Government Areas. According to Ayeni (1994), residential land use is the most predominant among all land uses in the built-up areas of Ibadan. Other land use is dominated by moderate to low residential, industrial, recreational, and agricultural land uses.

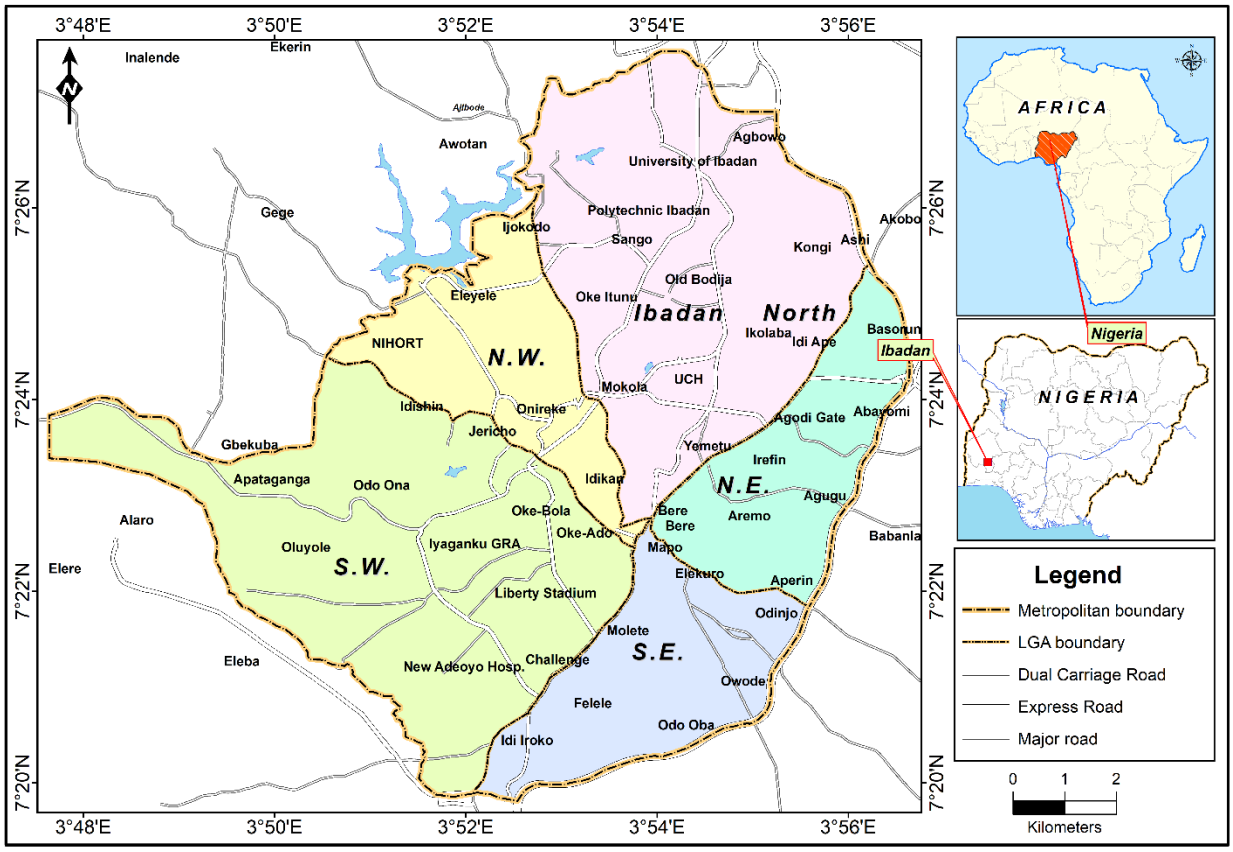

Figure 1: Map of Ibadan Metropolis (Study Area)
Source: Oyo State Ministry of Urban Development and authors' analysis, 2019

Methodology

The research followed a multi-stage geospatial workflow involving data collection, database development, and spatial analysis.

Data Collection

Geographical coordinates of court locations were obtained using a hand-held GPS. Further still, published law reports for the year range of 1972–2018 were downloaded from the Law Pavilion website (http://www.lawpavilion.com/), while a vector dataset of Ibadan localities obtained from Open Street Map provided information on streets and address locations. The content of the law reports in PDF format includes: the name of the applicant, date and place of conviction, the offence, sentence, type of appeal, status of cases (whether they led to an appeal and whether legal aid was granted), and the outcome of the judgment. Relevant information from the report was extracted and linked with the coordinates obtained into a database. The database was saved in CSV (comma-delimited) and TXT (text) formats for spatial join and analysis in ArcGIS and imported into ELK using Kibana's interface (modern ELK versions allow bypassing Logstash). Data included court locations (gathered via GPS) and law report information (extracted from Law Pavilion and

Open Street Map). Although Logstash is traditionally used to parse and ship data into Elasticsearch, Kibana can now directly import structured datasets (CSV/JSON), which are then indexed in Elastic search, the stack's central data repository.

All reported land conflict locations were established by geocoding land addresses extracted from the Law Reports with their spatial location to create a geodatabase as a shapefile.

Data Analysis

The spatial pattern of land conflicts in the study area from 1972-2018 was analysed using the average nearest neighbour tool and the standard deviational ellipses tool. The average nearest neighbour tool calculates the nearest neighbour index for the data based on the average distance from each feature to its nearest neighbouring feature; it derives the values for the Observed Mean Distance, Expected Mean Distance, Nearest Neighbour Index, z-score, and p-value. The Standard deviational ellipses tool is used to create a standard deviational ellipse to summarize the spatial characteristics of the geographic features, namely: central tendency, dispersion, and directional trends.

The temporal pattern of land conflicts in the study area for the selected years was analyzed using the Emerging Hot Spot Analysis using the Space Time Pattern Mining tool in ArcMap software. The Emerging Hot Spot Analysis tool identifies trends in the clustering of point densities in the data. It uses the Neighbourhood Time Step and Neighbourhood Distance parameter values provided to calculate the Getis-OrdGi* statistic (Hot Spot Analysis) for each potential point value. The potential point values have associated z-scores, p-values, and hot spot classifications (e.g., new, consecutive, intensifying, persistent, diminishing, sporadic, oscillating, and historical), which were further evaluated using the Mann-Kendall trend test. The outputs of the analysis are visualized in a map with the corresponding hot spot categories and a summary of the analysis.

Data Visualization and Query in ELK stack and Standard Deviational Ellipse (SDE)

The database created was ingested into the ELK stack through the Kibana (K) interface (Newer versions of the ELK stack), which allows data to be imported directly from the software rather than through Logstash (L). The data was thereafter transferred to Elasticsearch (E), which stores the data and makes it ready for viewing and querying in the Kibana (K) application.

The Standard Deviational Ellipse (SDE) was used to measure the trend of the land conflict location by calculating the standard distance separately in x and y directions (the two measures that define the axes of an ellipse encompassing the distribution of land conflict points). SDE was calculated using the locations of the land conflict points influenced by selected attribute values associated with the features, known as the weighted standard deviational ellipse. The Distributional Trend creates a new feature class containing an elliptical polygon centered on the mean center for all cases using a provided case field. The attribute values for the output ellipse polygons include two standard distances: long and short axes, the orientation of the ellipse, and the case field.

Results and Discussion

Spatial Pattern Analysis of the Land Conflict

The index of Nearest Neighbour Ratio (Rn) for the land conflicts in the study area is 0.733293, indicating a cluster pattern. The Rn value also indicates a low degree of clustering, tending more toward 1 than 0 (Figure 2). The statistical significance of the results is stated in the obtained z-score of -3.95222029788, indicating that there is less than 1% likelihood that this clustered pattern could be the result of random chance. This implies that the locations of land conflicts in Ibadan Metropolis are fairly concentrated around the same geographical enclaves, but tend more towards randomness (Figure 3). This further highlights the significant role of informal community governance and traditional institutions in resolving land disputes in Ibadan (Olaniyan, 2023).

The spatial distribution map shows the concentration of legal land disputes within major urbanized areas of Ibadan North, Ibadan South-West, Ibadan North-West, and Ibadan North-East Local Government Areas. Prominent conflict locations include Gbagi, Adamasingba, Inalende, Foko Asaka, Oke Ado, Agbokojo, Yemetu Igosun, Oke Adu, and Aremo.

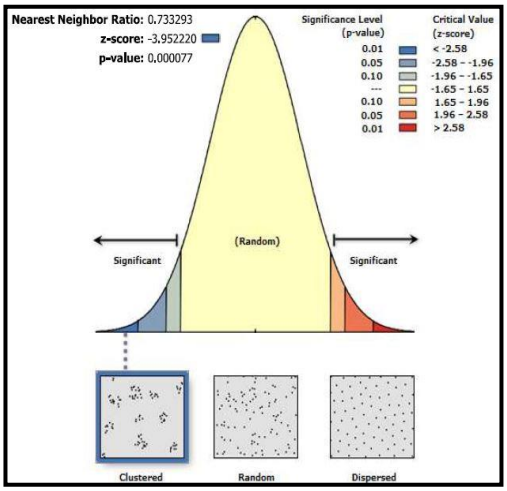

Figure 2: Result of Nearest Neighbour analysis

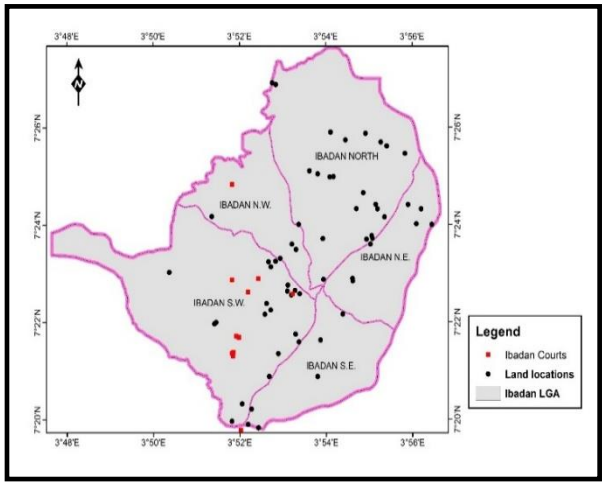

Figure 3: Spatial location of the land conflict
Source: Authors' analysis, 2019

Distributional trend of Land Disputes using Standard Deviational Ellipses

Figure 4 shows that the general distributional trend of land conflict in Ibadan Metropolis is oriented diagonally: northeast to southwest, with most occurrences centered in the following areas: Ibadan North-West-Gbagi, Adamasingba, and Inalende; Ibadan South-West-Foko Asaka, Oke Ado, Agbokojo, and Seventh Day; Ibadan North-Yemetu Igosun, Oke Are, and Oniyanrin; Ibadan North-East-Oke Adu, and Aremo; Ibadan South-East-Elekuro.

Figure 5 shows the distributional trend of land conflicts that were settled in the Court of Appeal versus land conflicts settled in the Supreme Court. The ellipse for land conflicts settled in the Court of Appeal is longer and narrower than that for conflicts settled in the Supreme Court. It, therefore, stretches from the far end of Ibadan South-West LGA to the far end of Ibadan North-West LGA. This shows that the majority of land conflict cases in these regions are resolved at the Court of Appeal.

The ellipse of these cases (Figure 5) settled in the Supreme Court is rounded and centrally positioned around land conflict cases at the center of all five local governments. Specific locations in these areas include: Gbagi, Adamasingba, Inalende, Foko Asaka, Oke Ado, Agbokojo, Seventh Day, Yemetu Igosun, to mention a few. Land conflicts in these areas are usually very intense to the extent that they have gone to the Supreme Court before they are finally resolved.

Figure 6 also shows the distributional trend of land conflict cases appealed that ended in failure and success. The ellipse of both land conflict appeal outcomes spans the entire LGA and both have a similar trend. However, the ellipse of success is narrower, which means that there are fewer judgments at the appeal court that were successful than appeals that failed throughout the five LGAs in Ibadan metropolis. This indicates that most of the time, the judgment of the lower courts is fair and accurate, but when litigants proceed further in appealing their cases to the Federal Courts, the appeal ends in failure in most cases.

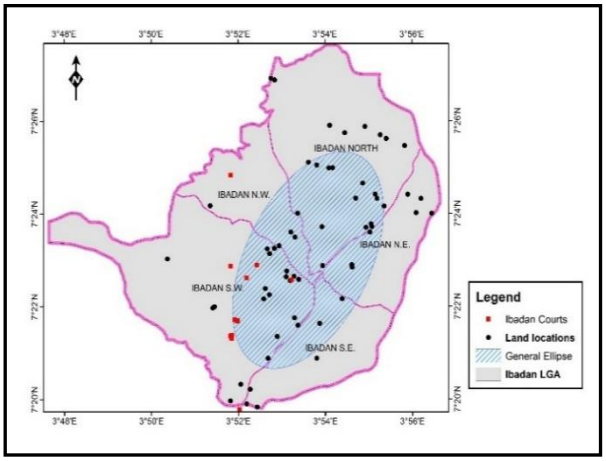

Figure 4: Temporal trend of land conflict in Ibadan Metropolis

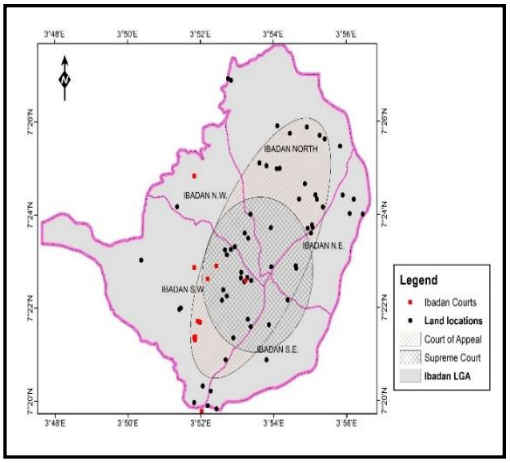

Figure 5: Trend of land conflict that was finally settled in the Court of Appeal and the Supreme Court in Ibadan Metropolis

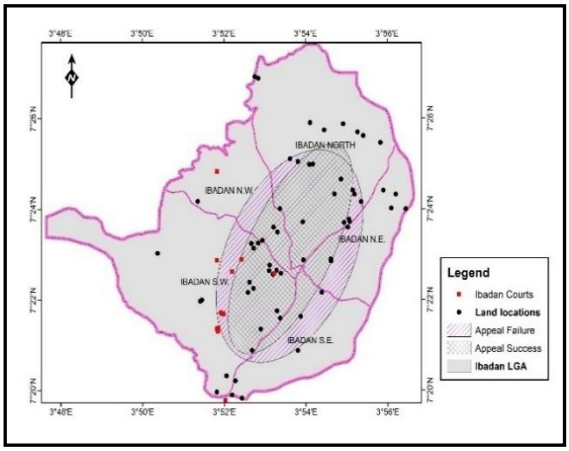

Figure 6: The trend of land conflict whose appeal failed, and those whose appeal ended successfully

Temporal Pattern Analysis of the Land Conflict

Emerging Hot Spot Analysis of land conflicts using Space Time Pattern Mining with land conflict locations was analysed over space and time (1982–2018) to reveal interesting trends of the events of land conflict in Ibadan Metropolis. Clustering patterns of point densities or summary fields across the study area were analysed. We symbolized the results with seventeen different categories describing the statistical significance of hot or cold spots and the locational trend over time. We observed three prominent categories, namely: consecutive hotspot, sporadic hotspot, and New Hotspot (Figure 7). This is discussed in sections.

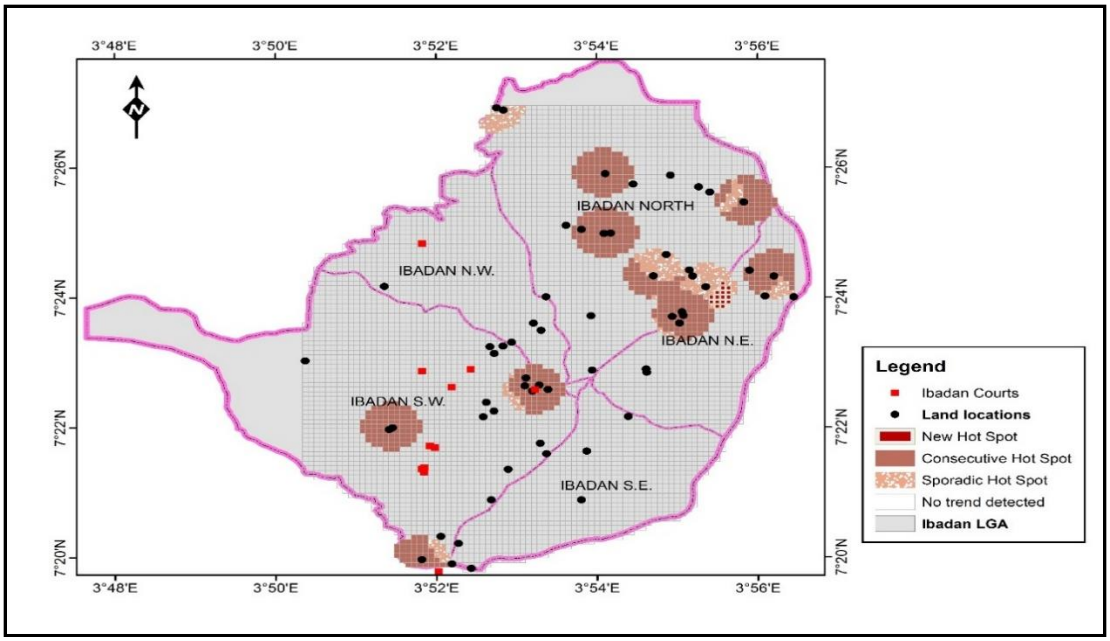

Figure 7: Emerging hotspot analysis of the land conflict locations
Source: Authors' Analysis, 2019

Consecutive Hotspot

The Consecutive Hotspot area shows consistent land conflict per year from 1972 to 2018 based on the cases that were appealed to the Supreme Court or the Court of Appeal (Figure 7). These are mostly dominant in the following localities within five LGAs: Ibadan North-Ashi, Oluwo Nla, Agodi GRA, Yemetu Igosun, UCH, Secretariat, Old Bodija, Emmanuel College, and Samonda; Ibadan North East-Basorun, and Oke Adu; Ibadan South West-Oke Irefin, Planning Authority, Ile Oba, Isale Osi, Foko Asaka, Orita Ikereku, Ring Road, Agbokojo, and D-Rovans; Fewer consecutive hotspots were observed in Ibadan North West, specifically in Agbeni and Ayeye, while Ibadan South East has no consecutive hotspot at all.

Sporadic Hotspot

Sporadic hotspots show where there are few land conflicts and occurrences are infrequent (Figure 7). These areas experienced a wide gap before another conflict happened. This is dominant in the following localities of the five LGAs: Ibadan North- University of Ibadan, Ashi, Oluwo Nla, Ikolaba, Agodi GRA, Yemetu Igosun, and Secretariat; Ibadan North-East: Basorun, Abayomi, and Oke Adu;
Ibadan South-West: Foko Asaka, Anfanu Layout, Orita Ikereku, Oke Ado, Oke Bola, and Agbokojo. Ibadan South-East and Ibadan North-West had no sporadic hotspot at all.

New Hotspot

The area of New Hotspot shows where land conflicts are only recent but have been continuous (Figure 7). The 'New Hotspot' was only found in Abayomi and Holy Trinity areas in Ibadan North-East LGA. This is due to an increase in land conflict cases in that area, which could be a result of growth in the economic value of such areas. Furthermore, Olaniyan (2023) and Lamidi et al. (2023) suggest that spatial hotspots in Ibadan might also represent areas where informal community governance, which traditionally resolves land disputes, has failed. No other LGA in Ibadan Metropolis has a New Hotspot.

ELK-Based Spatial Query Results

The mapping function of ELK was used in this study to visualize the locations of land conflict as well as the Ibadan courts in map format (Figure 8). Geospatial techniques will aid in finding the locations of land disputes mentioned in the courts' decisions. This will aid in the easy retrieval of the specific law report. Discussing the limitations of 'poor address systems' and the potential of alternative geocoding frameworks, such as Plus Codes or what3words, as suggested by Agunbiade et al. (2019), could show how to improve the

geocoding success rate and further enhance the utility of tools like ELK. Hovering the mouse pointer above any locational point will bring up a tooltip with predetermined information regarding land conflict locations based on court pronouncements in the Ibadan courts.

Table 1: Result of Selected Spatial Queries

Selected Query	Freq.	%
Selected Query	5	8.3
Query showing where Appellants or Respondents are greater than 5	28	46.7
Query showing where the total years of resolution are greater than or equal to 10 years	22	36.7
Query showing where the Appeal outcome is successful	38	63.3
Query showing where the Appeal outcome is failure	40	66.7
Query showing where the final court is the Court of Appeal	20	33.3

Source: Authors' Analysis, 2019

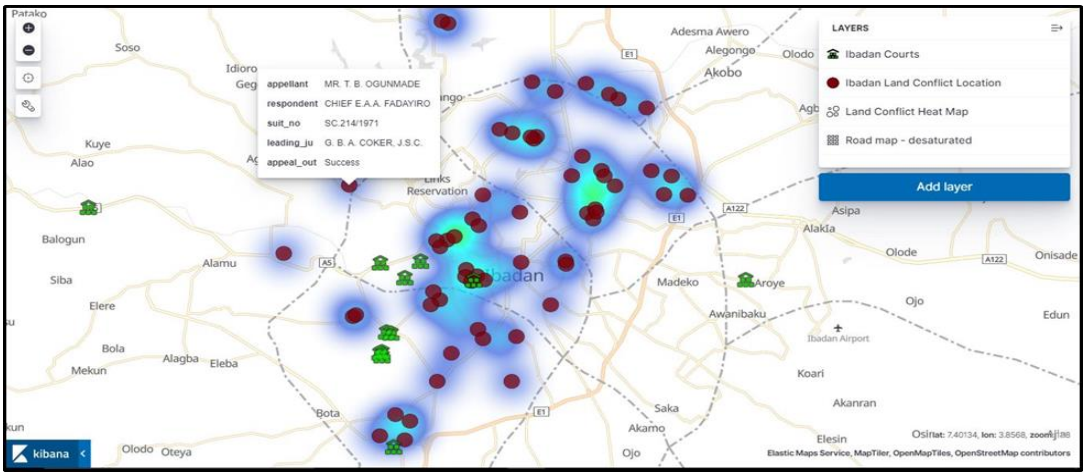

Figure 8: Kibana showing the Land Conflict Locations surrounded by Ibadan Courts

The query was performed on land conflict locations using the ELK stack. Based on the results of the queries and in conjunction with the previously produced map, the status of judgments on land dispute matters was determined. Table 1 shows selected queries and frequency data of the results:

Land dispute locations where the Appellants or Respondents are greater than five persons

The result of the query in Figure 9 shows that there are only five cases where the Appellants or Respondents number more than five at a time. Five (8.3%) out of the total of 60 cases were observed in this regard. The cases were found in the following Localities within only two LGAs out of the five LGAs of Ibadan metropolis: Ibadan North-West-Gbagi, Adamasingba, and Jericho GRA; Ibadan North-Old Bodija, and Emmanuel College.

This query shows that most land conflict that occurs in Ibadan Metropolis is between individuals, and it occurred between groups of people in Ibadan North-West and Ibadan North LGAs only.

Land dispute locations where the total years of resolution are greater than or equal to 10 years

Figure 10 shows the result of the query showing where the total years of resolution are greater than or equal to 10 years. The result of the query shows that there are 28 cases (46.7%) of the total of 60 cases where the total years of resolution is greater than or equal to 10 years. The locations of such land dispute cases were found in the following Localities within the five LGAs of Ibadan metropolis: Ibadan North East-Basorun, Abayomi, Aremo; Ibadan North - University of Ibadan, Ikolaba, Agodi GRA, Old Bodija, Emmanuel College, New Bodija,

Samonda; Ibadan NorthWest- Gbagi, Adamasingba; Ibadan South West-UMC, Ososami, Anfani Layout, Orita Ikereku, Oke Ado, Agbokojo, Moor Plantation, Seventh Day; Ibadan South East - Elekuro, Kudeti, Odo Oba.

This query shows that most land conflict cases have been accurately judged by the lower courts and the litigants who were adamant in appealing to the federal courts saw their appeals end in failure. Ngige et al. (2023) developed one of the largest publicly documented Nigerian judicial datasets, comprising 5,585 Supreme Court appeal cases (both civil and criminal) decided between 1962 and 2022, with 13 predictor variables and one decision outcome variable, providing a valuable resource for legal analytics and judicial outcome prediction research. The data were coded numerically into Nigeria's geopolitical/senatorial regions only, without proper geographical coordinates attached to the location of land conflict and relevant court. This would have impacted the result of this analysis.

Land dispute locations where cases' outcomes at the Appeal court were successful

The result of the query in Figure 11 shows that there were 22 cases (36.7%) of the total of 60 cases in which the appeal ended in success. These cases were found in the following Localities within four LGAs out of the five LGAs of Ibadan metropolis: Ibadan North: Oluwo Nla, Agodi GRA, Yemetu, Igosun, Oniyanrin, Old Bodija, and New Bodija; Ibadan North East-Oke Adu; Ibadan NorthWest-Gbagi, Adamasingba, and Jericho GRA; Ibadan SouthWest-Oke Ado, and Agbokojo.

This query shows that these cases were not accurately and fairly judged by the lower courts. Consequently, their appeal against the ruling of the lower court to the federal courts was successful.

Land dispute locations where the Appeal court's outcome failed

Figure 12 visualizes the results of the query on failed appeal outcomes. The query results show that 38 (63.3%) out of 60 cases ended in appeal failure. This indicates that more than half of such cases failed at the appeal court level. These cases were found in the following localities within the five LGAs of Ibadan metropolis: Ibadan North-East: Basorun, Abayomi, and Aremo; Ibadan North - University of Ibadan, Ikolaba, Agodi GRA, Old Bodija, Emmanuel College, New Bodija, and Samonda; Ibadan North-West- Gbagi, Adamasingba, Basorun, Abayomi, and Aremo; Ibadan South-West: UMC, Ososami, Anfani Layout, Orita Ikereku, Oke Ado, Agbokojo, Moor Plantation, Planning Authority, and Seventh Day; Ibadan South-East -Elekuro, Kudeti, and Odo Oba. This query shows that most land conflict cases have been accurately judged by the lower courts and the litigants who were adamant about appealing to the federal courts saw their appeals end in failure.

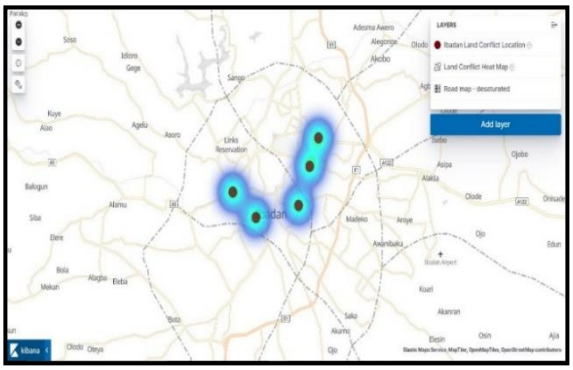

Figure 9: Spatial distribution showing where Appellants or Respondents are greater than 5

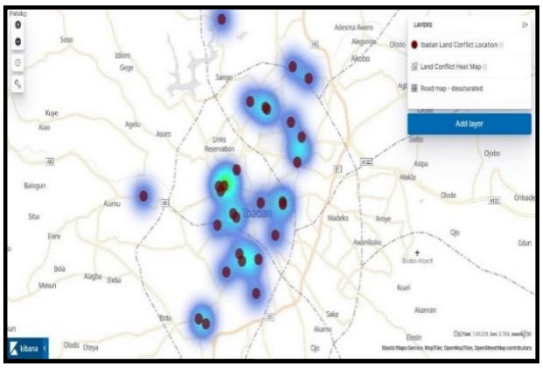

Figure 10: Spatial distribution showing where the tota years of resolution are greater than or equal to 10 years

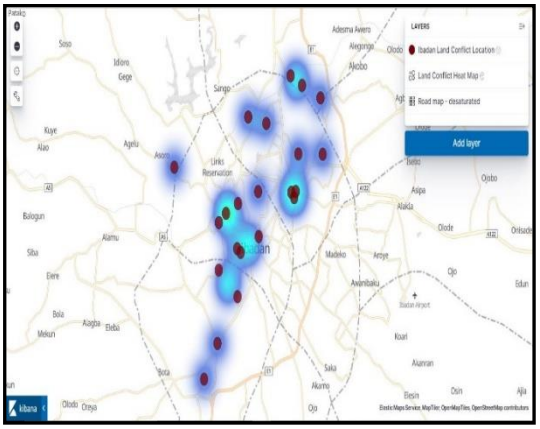

Figure 11: Spatial distribution showing where the Appeal outcome is successful

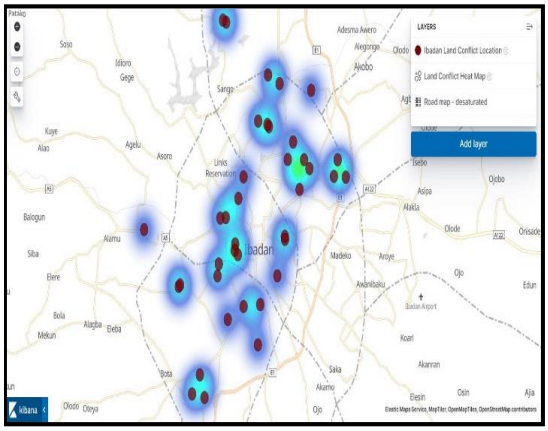

Figure 12: Spatial distribution showing where the Appeal outcome has failed

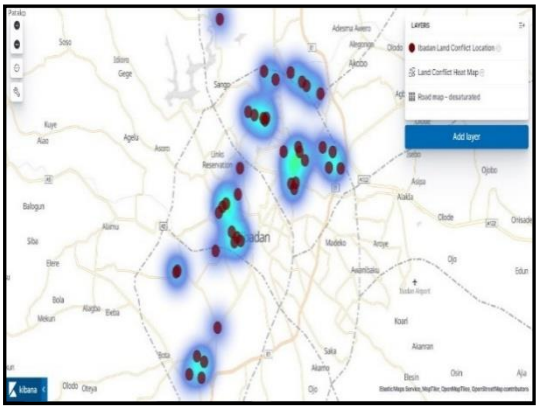

Figure 13: Spatial distribution showing where the final court is the Court of Appeal
Source: Authors' analysis, 2019

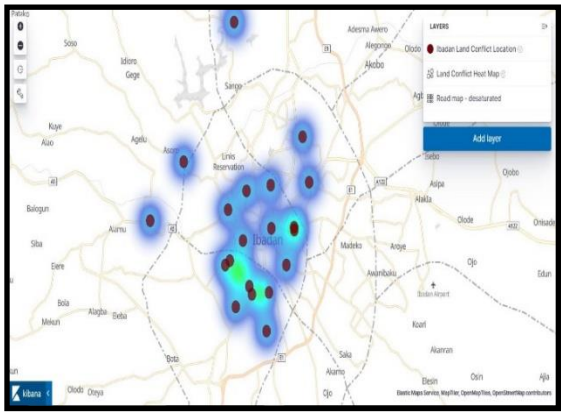

Figure 14: Spatial distribution showing where the final court is the Supreme Court
Source: Authors' analysis, 2019

Land dispute locations where final cases were decided at the Court of Appeal

Figure 13 shows the result of the query where the final court of dispute resolution is the Court of Appeal. It found that there were 40 cases (66.7%) of the total of 60 cases concluded at the Court of Appeal. These cases were found in the following localities within the five LGAs of Ibadan metropolis: Ibadan North East - Basorun, Abayomi, Oke-Adu; Ibadan North- University of Ibadan, Agodi GRA, Old Bodija, Emmanuel College, New Bodija, Samonda, Oluwonla, Yemetu-Igosun, Oremeji, Samonda; Ibadan NorthWest-Gbagi, Adamasingba, and Inalende; Ibadan SouthWest - Anfani Layout, Orita Ikereku, Oke Ado, Agbokojo, Planning Authority, Seventh-Day, Foko Asaka, and Elewura.

This query shows that the majority of land conflict cases terminated at the level of the Court of Appeal in Ibadan Metropolis.

Land dispute locations where final cases were decided at the Supreme Court

Figure 14 is the result of the query where the final court of dispute resolution is the Supreme Court. The query results show that 20 cases (33.3%) of the total 60 cases were concluded at the Supreme Court. These cases were found in the following localities within the five LGAs of Ibadan metropolis: Ibadan North East–Aremo; Ibadan North - University of Ibadan, Ikolaba, Agodi GRA, Oke Are, and Oniyanrin; NorthWest-Adamasingba, and Jericho; Ibadan South West-UMC, Ososami, Oke Ado, Agbokojo, and Moor

Plantation; Ibadan South East-Elekuro, Kudeti, and Odo Oba. This query shows that there are fewer land conflict cases where the Supreme Court is the final court for land dispute resolution.

Discussions of Research Findings

The spatial clustering of legal land disputes observed in Ibadan Metropolis reflects the growing pressure on urban land resources resulting from population increase, commercialization of landed property, and weak land administration practices. The concentration of disputes in Ibadan North, Ibadan North-West, and Ibadan South-West aligns with the rapid urban expansion and increasing economic value of land in these areas. It is also characterised by intensive residential and commercial land use activities, leading to an increase in land ownership and control. This finding is consistent with earlier observations by Albert et al. (1994), who reported that rapid urban expansion and increasing land commodification contribute significantly to land disputes in Ibadan. The finding also supports the observations of Shiyanbola et al. (2024), who identified land governance challenges and stakeholder competition as major drivers of land conflicts in Oyo State. Finally, the observed clustering also aligns with the findings of Muhammed and Babalola (2025), who identified the concentration of land disputes within rapidly urbanizing sections of Oyo Metropolis.

The northeast–southwest directional orientation revealed by the Standard Deviational Ellipse analysis reflects the historical urban growth axis of Ibadan metropolis. The concentration of Supreme Court cases around central urban districts indicates that disputes in these areas are often highly contested and legally complex.

The broader spatial spread of Court of Appeal cases compared with Supreme Court cases further suggests that many disputes are resolved before reaching the apex court. This may indicate increasing judicial confidence in appellate decisions or financial constraints associated with prolonged litigation. The finding is consistent with the study of Olorunfemi et al. (2021), who observed that most land disputes in southwestern Nigeria are resolved through intermediary judicial or customary arbitration systems before escalation to higher judicial institutions.

The Emerging Hot Spot Analysis revealed persistent and sporadic hotspots across several neighbourhoods. Consecutive hotspots suggest long-standing litigation pressure and recurring ownership disputes, while new hotspots indicate emerging urban development corridors characterized by rising land values and informal transactions. Similar findings were reported by Muhammed and Babalola (2025), who identified urban growth and inadequate documentation as major contributors to land disputes in Oyo State. Furthermore, the emergence of new hotspots within Abayomi and Holy Trinity may reflect increasing urban expansion, rising land values, and changing land use patterns in Ibadan North-East LGA. These findings are consistent with Shiyanbola et al. (2024), who emphasized that rapid urban growth and weak institutional coordination contribute significantly to persistent land conflicts in Oyo State.

Nevertheless, the finding that was nearly half of the disputes required ten years or more for resolution reflects procedural delays and inefficiencies within the judicial system. Prolonged litigation may discourage investment, increase financial burdens on litigants, and intensify social tensions. The high proportion of unsuccessful appeals further suggests that lower courts generally provide legally sustainable judgments. However, litigants frequently pursue prolonged appeals due to dissatisfaction, emotional attachment to land, or expectations of reversal. This finding supports the observations of Kerrigan et al. (2010) and Abubakar (2014), who linked weak judicial records management and procedural inefficiencies to delays in justice delivery across African judicial systems.

The integration of ELK Stack technologies demonstrated substantial potential for legal record indexing, geovisualization, and spatial querying. Unlike traditional legal record systems that depend largely on manual retrieval processes, ELK-enabled systems facilitate rapid filtering, visualization, and analysis of judicial data. This finding aligns with (Sachdeva, 2017), who emphasized the suitability of ELK frameworks for large-scale geospatial data indexing and visualization. Similarly, this finding further supports the argument of Boella et al. (2022) that AI-assisted legal information systems can significantly improve legal research efficiency and decision-making. If properly integrated into GIS

environment, geospatial analysis would be seamlessly achieved.

The study further highlights the importance of integrating geospatial technologies into judicial administration and land governance frameworks. Accurate geocoding of dispute locations and digital management of court records would improve transparency, reduce record loss, and support evidence-based policy interventions for land administration in Nigeria.

Conclusion and Recommendations

This study shows that the pattern of land conflict locations is clustered. This indicates that some areas in Ibadan Metropolis are more prone to land disputes than others.

Also, the ELK Stack offers a flexible and scalable approach for integrating legal data and geospatial intelligence. By combining Elasticsearch's powerful indexing, Logstash/ Kibana ingestion, and Kibana's mapping capabilities, the ELK Stack enables meaningful legal data storytelling — especially when complemented by traditional GIS tools. The Ibadan case demonstrates its real-world application in justice system analysis and record management.

The study suggests the need to include more accurate and reliable information related to the location of the conflicts in law reports. For instance, in most of the cases, while there is a description of the location of the conflict, most often, they are too broad and incomplete and none of them provides a geographic coordinate reference. Amendment of various laws and courts' rules to accommodate the use of GIS and electronic methods in managing legal records will enhance data storage and visualization.

Limitations and Future Research

The address system of law reports for land disputes was documented in a way that it was not easy for the location of the land to be linked. In other words, no coordinates for the locations at all. Where the locations are being described, some addresses were too broad, such that only the approximate location for the land could be established; this made geocoding almost impossible.

Also, the records available for the 46 years were too few, indicating that not all land conflicts were documented or available on the Law Pavilion. This study was thus limited to the data that were properly documented and formatted for geospatial analysis of this nature.

Although the Ngige et al. (2023) dataset contains location-related attributes in the form of trial and appeal districts, these variables are aggregated to senatorial districts and do not provide precise geographic coordinates or address information. Consequently, the dataset is suitable for regional comparative analysis but is not inherently designed for detailed geospatial or GIS-based investigations. The detail of land dispute data available for geospatial analysis was hindered; hence, this study recommends that the dataset needs improvement for easy adaptability of the spatial component.

Future studies could investigate the disaggregation of law judgments across various case categories at various levels of court in developed and developing countries of the world using an artificial intelligence tool (Law Pavilion AI).

Comprehensive Geodatabases for geospatial legal analysis with AI potential will be another research focus. This will largely improve the operation of the judicial system in Nigeria and other parts of the world.

Funding

No funding was received for conducting this research. This research was carried out independently by the authors without any external financial assistance.

Acknowledgements

Sincere thanks go to the Department of Geography, Faculty of Social Sciences, University of Ibadan, for providing an environment that facilitated this research. Thanks, are equally due to the Law Pavilion for allowing access to the published judicial law reports used in this research, and the OpenStreetMap community for releasing geospatial data for free use online. Appreciation goes to the anonymous reviewers and the editorial board of the Ibadan Journal of the Social Sciences, whose comments and suggestions have helped improve this manuscript significantly.

Conflicts of Interest

The authors declare no conflicts of interest in relation to this study.

Data Availability Statement

Data used to support the findings of this research is available on reasonable request from the corresponding author. Data used from publicly available sources includes OpenStreetMap data and published law reports from Law Pavilion.

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