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Exploring GIS Database and Mechanism to Improve Development Control Practices in Port Harcourt Metropolis

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Abstract

The study assessed development control practices using Geographic Information System (GIS) database mechanisms in Port Harcourt metropolis, Rivers State. The study examined the existing development control mechanisms employed by physical planning agencies and local authorities, investigated the extent of GIS application in development control activities, identified the challenges affecting GIS adoption, evaluated the impact of GIS on development control practices, and assessed the policy framework supporting GIS integration. The study adopted a mixed-methods approach and sequential explanatory research design. The study employed purposive and stratified sampling techniques for collection of data. A total of 176 respondents were determined applying Taro Yamane formula at 5% precision level and were sampled from physical planning agencies, government institutions, private planning professionals, and academics using a structured questionnaire. Subsequently, for qualitative data collection, 10 key informants were selected and interviewed which are professional Town Planners and Surveyors. The data were analysed using the SPSS Version 27. Descriptive statistics comprising mean, standard deviation, ranking, and decision levels were used to analyse the data, while the Friedman Test and Kendall's Coefficient of Concordance (W) were employed to determine differences in respondents' rankings and the level of agreement at 5% significance level while content analysis was used to analyse the qualitative data. The findings revealed that development control mechanisms were implemented at moderate to high levels. Site inspection before development approval recorded the highest mean score ($\bar{x}$ = 4.57, SD = 0.58), whereas inter-agency collaboration recorded the lowest ($\bar{x}$ = 3.15, SD = 1.08). GIS application was also moderate to high, with inter-departmental coordination ranking highest ($\bar{x}$ = 3.92, SD = 1.02) and digital cadastral mapping ranking lowest ($\bar{x}$ = 3.14, SD = 1.01). Respondents also agreed that GIS improved urban expansion monitoring ($\bar{x}$ = 4.44, SD = 0.69) and urban planning outcomes ($\bar{x}$ = 4.40, SD = 0.55). Government policy support for GIS integration was moderate ($\bar{x}$ = 3.45, SD = 1.12). The Friedman Test showed statistically significant differences in respondents' rankings ($p < 0.001$), while Kendall's W (0.066–0.286) indicated weak agreement among respondents. The study concludes that GIS has improved development control practices in Port Harcourt, although institutional, technical, and policy constraints continue to limit its effective application. It recommends increased investment in technical capacity, geospatial

infrastructure, institutional collaboration, and policy implementation to support sustainable urban development.

Keywords: *GIS Database and Mechanism, Development Control Practices, Port Harcourt Metropolis*

Introduction

Urbanisation is a major global trend that drives economic growth and population expansion, yet it also creates significant challenges for urban planning, land use management, and environmental sustainability (Shah, 2023). In many developing countries, including Nigeria, the rate of urban growth has exceeded the capacity of planning institutions to monitor and regulate development effectively, making development control essential for ensuring orderly expansion and compliance with planning regulations (Smith & Jones, 2022). Port Harcourt metropolis one of rapidly growing urban centres in Nigeria, exemplifies these challenges due to its rapid population increase, large-scale industrial activities, and growing demand for land, housing and urban infrastructure. As one of Nigeria's leading commercial and industrial centres, the metropolis is experiencing uncontrolled land conversion, proliferation of informal settlements, environmental degradation, and widespread non-compliance with physical planning regulations and standards (Onokala & Olajide, 2021; Owei, Erhabor & Ekerekwe, 2018; Ibisiki & Eyenghe, 2021; Brown, Dapa & Eyenghe, 2022).

A major factor weakening effective development control in Port Harcourt metropolis is the lack of accurate and up-to-date spatial data, as planning authorities often rely on outdated maps, inconsistent land use records, and occasional field surveys that limit their ability to monitor development activities or detect violations in a timely manner (Abiodun, Umeh & Okoye, 2020; Eyenghe, Brown & Ibisiki, 2022). To address these challenges, many cities worldwide have adopted Geographic Information Systems (GIS) as an innovative tool to strengthen development control practices. GIS provides accurate spatial data, enables real-time monitoring of urban expansion, enhances enforcement of planning regulations, and supports evidence-based land use decision-making (Goodchild, 2022; Jibril & Muhammad, 2019). In Port Harcourt, integrating a GIS database mechanism can improve the efficiency, transparency, and responsiveness of development control by enabling early detection of unauthorised developments, protecting environmentally sensitive areas such as mangroves and wetlands, and ensuring compliance with zoning regulations and building codes (Uduma & Esobe, 2020). However, despite its proven advantages, the level of GIS adoption within development control institutions and agencies in Port Harcourt metropolis remains limited and poorly documented. Therefore, this research is necessary to evaluate current development control mechanisms, and explore how GIS database mechanism can strengthen development control practices to improve plan approval, monitoring and regulation of urban growth and promote sustainable urban development in Port Harcourt metropolis.

Statement of the Problem

The development control procedures in Port Harcourt metropolis have long been marred by inefficiencies that hinder effective physical planning activities and sustainable urban development practices. These inefficiencies manifest in various ways, such as slow response times to development applications, lack of transparency in the approval processes, and inconsistent enforcement of building regulations and standards as affecting plan approval, monitoring of development and regulation of urban growth. This has resulted the proliferation of unregulated

developments, contributing to urban sprawl, proliferation of informal settlements and disorderly growth and development. Thus, GIS-based database mechanisms offer the potential to development control processes, thereby enhancing transparency and enforcement through exploring GIS techniques for physical planning activities to promote sustainable urban development but its utilisation in the metropolis remains minimal. Physical planning agencies and local authorities in the metropolis struggle with managing and integrating GIS techniques in development control process affecting decision-making and poor coordination of activities. The lack of a comprehensive GIS database mechanism exacerbates these issues. Therefore, the study intent to explore the utilisation of GIS database mechanisms to improve development control practices in Port Harcourt metropolis, Rivers State.

Aim and Objectives of the Study

The aim of the study is to explore GIS database and mechanism to improve development control practices in Port Harcourt metropolis.

To achieve the aim of the study, the following study objectives are stated:

1. Identify and assess the existing development control mechanisms employed by physical planning agencies and local authorities for plan approval, monitoring, and regulation of urban development in the study area;
2. Examine the extent and manner in which GIS tools and database mechanisms are currently applied in development control activities within the study area; and
3. Evaluate the effectiveness and contribution of GIS-based mechanisms in improving accuracy, decision-making, monitoring, and overall efficiency of development control practices in the study area.

Literature Review

The Concepts of Development and Development Control

Development is a multifaceted concept encompassing economic progress, infrastructural advancement, environmental sustainability, and social well-being. Within urban planning, it refers to the physical transformation of space through land use, infrastructural expansion, and housing development. Without guided policies, regulations and standards, such development and growth can result in unplanned settlements, traffic congestion, and environmental degradation (Das & Pal, 2022). Therefore, development must be strategically planned and regulated to ensure sustainability and resilience. These activities require development control by physical planning agencies and municipal authorities in urban areas to control, manage and direct urban growth and development. Hence for this study development control involves the strategic regulation of physical development within a defined urban space. It comprises the formulation and enforcement of planning regulations, zoning laws, building codes, and land use policies to ensure orderly and efficient urban expansion (Nedovic-Budic & Williams, 2022). These controls are typically implemented through physical planning agencies and must be adaptive to spatial dynamics and socioeconomic realities.

Development Control Practice and Geographic Information System

Development control practice refers to the practical implementation of regulatory tools by urban planning agencies. This includes activities like land use approval, construction permitting, zoning enforcement, and monitoring of urban development through field inspections. In many Nigerian

cities, including Port Harcourt, these practices face operational challenges such as insufficient human and technical capacity, absence of reliable data, and bureaucratic inefficiencies (Nedovic-Budic & Williams, 2022). These constraints often hinder the effectiveness of enforcement, leading to violations such as unauthorised developments and informal settlements. The integration of GIS technologies can enhance these practices by introducing automation, spatial accuracy, and real-time monitoring capabilities. GIS is a computer-based tool used to collect, manage, analyse, and visualise spatial and geographic data. It allows urban planners to generate maps, analyse patterns of development, and predict future urban expansion based on current trends (Wu & Zhang, 2023). GIS is particularly useful in identifying zoning violations, monitoring environmental changes, and managing land resources. In urban governance, it supports proactive decision-making by integrating data from multiple sources, providing a holistic view of city dynamics and configurations. GIS database mechanism is the backbone of GIS functionality. It enables the storage, retrieval, and analysis of vast quantities of spatial and attribute data in a centralised system. The ability of GIS databases to provide real-time data on land use and zoning compliance makes them invaluable for effective monitoring and enforcement (Wu & Zhang, 2023). Moreover, spatial overlays and predictive models can help forecast urban pressures, thus allowing planning authorities to intervene early in high-risk areas.

Extant Development Control Mechanism Used by Physical Planning Agencies to Plan, Monitor and Regulate Urban Growth and Development

Traditionally, in most developing countries including Nigeria development control has relied on manual and paper-based systems. They include filing written applications for building permits, approval of physical development plans by planning authorities, physical site monitoring, and enforcement through the use of planning notices or demolition orders where developments contravene regulations. These conventional approaches, as basic as they are, have long been criticised for being ineffective, subjective, and corruption-prone (Mabogunje, 2015; Owei & Ikpoki, 2019). Nigerian physical planning authorities tend to utilise static land use maps and outdated master plans that are unable to capture the rapid pace of urbanisation. In Lagos and Port Harcourt, for example, urban sprawl, informal settlements, and incursion into environmentally sensitive areas have outpaced the ability of the planning authorities to monitor and control development effectively (Owei, 2019). Inadequate institutional capacity, scarcity of human resources, and poor record-keeping systems have also undermined the effectiveness of development control. Further, planning approval processes are typically bureaucratic and time-consuming, discouraging compliance and promoting informal construction (Ogunleye & Akinluyi, 2017). The identical challenges are also evident in other developing urban centres globally. It is in Sub-Saharan Africa, Asia, and Latin America that traditional development control systems are unable to cope with high population growth rates, informal settlements, and weak urban governance institutions. In Nairobi, Kenya, for instance, fragmented urban administration and lax enforcement have resulted in the expansion of slums (United Nations Human Settlements Programme (UN-Habitat), 2020). In Dhaka, Bangladesh, manual planning monitoring systems have been stretched by the city's rapid expansion, initiating poor coordination between planning agencies and widespread non-compliance with zoning rules (Rahman, 2021). In Indian cities such as Delhi and Mumbai, automated planning approvals and inspections on the basis of a manual nature have a tendency to leave scope for delays and corruption, while informal settlements increase uncontrolled (Roy, 2009).

One of the key weaknesses of such traditional mechanisms lies in inadequate data collection and management. The majority of urban centres lack comprehensive spatial databases, and therefore it is difficult to monitor land use change, building compliance, or predict infrastructure needs. Limited public access to planning information also reduces transparency and accountability, and thereby leads to the lack of trust between citizens and planning authorities. This challenge is especially acute in Nigeria, where urban residents are used to viewing planning authorities as reactive rather than proactive, moving in after irregularities have occurred (Nedovic-Budic & Williams, 2022). Globally, the failures of traditional development control have motivated a shift to more advanced approaches that incorporate technology and participatory governance. Geographic Information Systems (GIS), remote sensing, and digital land administration systems are increasingly being utilised to bring more efficiency, spatial accuracy, and responsiveness to planning processes. South Africa, for example, has embraced the application of GIS in real-time building process and land use monitoring, thus reducing manual inspection requirements (Musakwa & van Niekerk, 2014). In India, e-governance platforms for online building permit applications and automatic plan scrutiny implemented by some state governments have improved compliance and reduced approval delays (Sharma & Rajasekar, 2021). Adoption in Nigeria has been patchy and slow, mostly due to inadequate funding, low technical capacity, and poor inter-agency coordination (Owei, 2019). Generally, while the traditional development control tools have a legal and institutional foundation, their inefficiencies necessitate urgent reforms in Nigeria and other developing situations. These mechanisms can be made stronger with the integration of geospatial technologies, online platforms, and greater public involvement to enhance transparency, accountability, and the capacity of the planning authorities to control urban growth more effectively. Without such modernisation, physical planning agencies in cities like Port Harcourt will remain ill-equipped to address the complexities of rapid urbanisation, informal development, and environmental challenges.

Application of GIS Mechanism in Development Control Practice by Physical Planning Agencies

The use of GIS in development control practice is a paradigm shift from a reactive to a proactive style of urban management. Compared to traditional manual processes, GIS provides physical planning authorities with more spatial analysis, monitoring, and decision-support capabilities. By facilitating real-time data capture, analysis, and visualisation, GIS enhances the ability of urban managers to identify, prevent, and regulate non-compliant developments more effectively (Wu & Zhang, 2023). Globally, GIS has also been adopted in the majority of developing urban areas as a way of addressing the issues of fast urbanisation. In Nairobi, Kenya, GIS has been used for mapping informal settlements, monitoring land encroachments, and supporting slum upgrading initiatives (UN-Habitat, 2020). In Dhaka, Bangladesh, planners make use of GIS and remote sensing to detect unauthorised land use change and flood hazard, thereby improving environmental and development control (Rahman, 2021). In India, several cities, such as Bangalore and Delhi, have implemented GIS-based automated building permit systems that enable online review of development applications and do away with approval delays (Sharma & Rajasekar, 2021). All these global experiences demonstrate how GIS tools enhance regulatory efficiency, transparency, and accountability in contexts where rapid urbanisation has a tendency to outpace traditional planning procedures.

In the Nigerian context, the application of GIS in development control is still evolving but becoming more and more established as a fundamental tool for sustainable urban management. The Lagos State Government (LSG) through the Lagos State Physical Planning Permit Authority (LASPPPA), has started incorporating GIS into its building permit system with a view to allowing georeferenced approvals and enhancing monitoring of building construction activities (Ogunleye & Akinluyi, 2017). Abuja and Kaduna have also experimented with GIS in land use planning and monitoring urban sprawl. Lack of technical capacity, costliness of geospatial technologies, inter-agency coordination weakness, and institutional weakness have, however, limited large-scale adoption (Owei, 2019). In Port Harcourt, the applicability of GIS is increasingly being appreciated against the backdrop of the city's rapid rate of urbanisation, informal housing developments, and environmental vulnerability to flooding. GIS mapping enables planners to overlay zoning boundaries with high-resolution satellite imagery, recognising illegal developments and encroachments on floodplains and wetlands right away. This is particularly critical in Port Harcourt, where informal development is often beyond formal approval processes. Second, GIS enables long-term planning via its capability to model scenarios and test impacts, enabling planners to anticipate infrastructure needs, simulate population growth patterns, and test the implications of different policy options. Aside from regulation enforcement, GIS also increases public participation and transparency in development control. By creating open-access planning portals and geoportals, municipalities are able to make zoning maps, approved development plans, and building regulations more easily accessible to the public, and hence improve compliance and reduce conflict. Lessons from South Africa, where municipalities use GIS-based dashboards for public monitoring of urban growth (Musakwa & van Niekerk, 2014), show how the introduction of similar initiatives in Nigeria could promote accountability and inclusiveness in planning processes. Overall, GIS mechanisms are transforming development control practice from paper-based, static processes into dynamic, evidence-based systems. While adoption in Nigeria remains nascent compared to other developing countries, the growing awareness of GIS in Port Harcourt and other Nigerian cities points to its potential as a strategic tool for sustainable urban management. To entrench these gains, capacity development, institutional reconfiguration, and integrated digital infrastructures must be invested in to mainstream GIS into the daily operations of physical planning agencies.

Implication of Implementation of GIS Mechanism in Development Control Practice to Plan, Monitor and Regulate Urban Growth and Development

Effective utilisation of GIS in development control has far-reaching implications, transforming urban management through enhanced efficiency, transparency, and sustainability. Perhaps the most powerful contribution of GIS is real-time monitoring of urban development activity that minimises regulatory failure and illegal construction. GIS enables planners to identify zoning violations, track land invasions, and enforce planning controls more effectively, thereby facilitating ordered spatial development and preventing unauthorised housing construction (Li, Sun, & Zhang, 2024; Wu, Liu, & Hou, 2025). Globally, the impact of GIS in improving decision-making and facilitating management of urban development is widely documented.

In India, GIS application in computerised building permit assessment systems have reduced delays, prevented corruption, and improved zoning compliance through transparent digital approval processes (Sharma & Rajasekar, 2021). Similarly, in South Africa, municipalities are using GIS-based dashboards to track land use changes and identify infrastructure requirements,

improving the provision of resources in a fair manner and governance (Musakwa & van Niekerk, 2014). GIS has been a central factor in participatory planning in Latin America, particularly Bogotá, by making spatial information available to the public, thus enhancing public participation and accountability in development control (UN-Habitat, 2020).

GIS is also very significant in environmental protection and disaster risk reduction. By geospatial mapping of green areas, wetlands, and floodplains, GIS assists urban planners in defending sensitive environmental areas and integrating ecological considerations into decisions (Wu, Liu & Hou, 2025). In Addis Ababa, Ethiopia, geospatial data analysis has identified uncontrolled urban sprawl as destroying essential ecosystem services, providing concrete evidence of the environmental costs of uncontrolled development (Adugna, Assefa, & Zeleke, 2024). In Dhaka, Bangladesh, GIS has widely been applied to map flood hazard zones and guide planning for relocation of vulnerable communities, and thus imply development control and climate resilience strategy (Rahman, 2021). Equity and justice are also an important element in GIS adoption. In Tehran, spatial analysis using GIS has been used to visualise unequal access to green spaces in informal settlements and the strength of spatial technology in making urban services inclusive (Kamjou, Scott, & Lennon, 2024). In Jordan, GIS-supported spatial planning has been utilised to enhance walkability, social cohesion, and resilience in peri-urban neighborhoods, showing the potential of the technology in pursuing environmental and social sustainability goals (Al-Zghoul & Al-Homoud, 2025). These figures identify that not just does GIS enhance regulatory impact but also social outcomes in rapidly developing cities.

In Nigeria, the impacts of GIS are increasingly becoming manifest. Its potential to improve enforcement, openness, and cadastral accuracy in land administration has already been demonstrated by research (Abubakar, Murtala, Mbamara & Popoola, 2025). The LSG has invested funds in e-GIS technologies, including orthophoto mapping and remote sensing equipment, to improve its cadastral infrastructure, improve monitoring, and accelerate land transactional approvals. In Abuja, GIS has been used in urban growth management and coordination of infrastructure provision in peri-urban settlements, though there are institutional capacity deficits (Abubakar *et al.,* 2025). In Port Harcourt, for instance, where rapid urbanisation, expansion of slums, and recurrent flooding create extreme conditions, GIS integration is particularly vital. GIS has the potential to enable better coordination among split planning institutions, improve enforcement of zoning regulations, and promote accountability through evidence-based decision-making (Owei, 2019). Thus, the impacts of GIS application in development control go far beyond efficiency and compliance with regulations. These include environmental sustainability contributions, participatory governance, risk management for disasters, social inclusion, and economic efficiency (Li *et al.,* 2024; Wu *et al.,* 2025). For Port Harcourt, such an effect would be transformative if supported by institutional reforms, capacity-building initiatives, and enabling policy structures. The city would be able to overcome existing constraints and adopt GIS as a basis of sustainable and inclusive urban development.

Methodology

The study adopted mixed-methods research approach, employing sequential explanatory research design where both quantitative and qualitative approaches are synchronised in the research (Creswell & Plano Clark, 2018). This approach and design were appropriate to address the aim and objectives of the study. The study employed purposive and simple random sampling techniques for selection of respondents and collection of data. Furthermore, Taro Yamane formula

at 5% precision level was employed to determine a sample size of 179 from 314 population for quantitative data collection (see Table 1). Purposively, 10 key stakeholders key stakeholders directly involved in development control in the study area were identified and their population was ascertained before Taro Yamane formula was employed to determine the sample size for quantitative data. They include staff of Rivers State Ministry of Physical Planning and Urban Development, (professionals), Rivers State Ministry of Physical Planning and Urban Development (administrative staff), Rivers State Ministry of Physical Planning and Urban Development (casual staff), Rivers State Ministry of Lands (professionals), Rivers State Ministry of Lands (administrative staff), Rivers State Ministry of Lands (consultants), Rivers State Ministry of Lands (finance), Rivers State Ministry of Lands (casual staff), Rivers State Estate Developers Association (members), and South-South Zonal Advanced Space Technology Application Laboratory (SS-ZASTAL) (staff). Sequential, to 10 key informants of registered Town Planners and Surveyors were identified, selected and interviewed for collection of qualitative data to support the quantitative data aspect of the research. Structured questionnaire and key informant interview schedule were designed and used to collect data from respondents while both descriptive (mean scores, standard deviations, mean rankings, and decision levels) and inferential (Kendall's Coefficient of Concordance (W) was computed alongside the Friedman Test to determine the degree of agreement among respondents in ranking the various indicators) statistics techniques were used to analysed the data collected using SPSS version 27.0. Mean scores were computed using a five-point Likert scale, where 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree. Consecutively, thematic analysis was used to analysed the qualitative data.

Table 1: Proportional Allocation of Sample Size

S/No.	Stakeholders Interviewed	Population (Ni)	Proportional Sample (ni)
1	Rivers State Ministry of Physical Planning and Urban Development (professionals)	7	5
2	Rivers State Ministry of Physical Planning and Urban Development (administrative staff)	27	15
3	Rivers State Ministry of Physical Planning and Urban Development (casual staff)	66	37
4	Rivers State Ministry of Lands (professionals)	13	7
5	Rivers State Ministry of Lands (administrative staff)	4	2
6	Rivers State Ministry of Lands (consultants)	2	1
7	Rivers State Ministry of Lands (finance)	4	2
8	Rivers State Ministry of Lands (casual staff)	42	24
9	Rivers State Estate Developers Association (members)	102	57
10	South-South Zonal Advanced Space Technology Application Laboratory (SS-ZASTAL) (staff)	47	26
	Total	**314**	**176**

Source: RSMPPUD, 2026; RSML, 2026; RSEDA, 2026; SS-ZASTAL, 2026; Researchers' Compilation and Computation, 2026

Results and Discussion of Findings

Existing Development Control Mechanisms Employed by Physical Planning Agencies and Local Authorities for Plan Approval, Monitoring, and Regulation of Urban Development in the Study Area

The result from the study findings on the existing development control mechanisms employed by physical planning agencies and local authorities for plan approval, monitoring, and regulation of urban development in the study area from the respondents showed that there is a mechanism applied by extant physical planning agencies. However, findings on Mean, Standard Deviation, Ranking, and Decision Levels of Development Control Mechanisms in the study area indicated that available development control mechanisms employed in the study area as shown in Table 2 are generally implemented at a moderate to high level. Site inspection before approval recorded the highest mean ($\bar{x}$ = 4.57, SD = 0.58), indicating very strong enforcement mechanism procedure. This is followed by enforcement notices ($\bar{x}$ = 4.33, SD = 0.79), manual plan review ($\bar{x}$ = 4.05, SD = 0.93), demolition of illegal structures ($\bar{x}$ = 3.74, SD = 1.04), zoning regulations ($\bar{x}$ = 3.65, SD = 1.20), and development monitoring ($\bar{x}$ = 3.56, SD = 1.14), all at a high level. Environmental compliance checks ($\bar{x}$ = 3.49, SD = 1.07) were moderate, while inter-agency collaboration was the lowest ($\bar{x}$ = 3.15, SD = 1.08). Thus, findings from the key informants interviewed equally revealed that the physical planning agencies and local authorities that employing charting of survey plan, using Arc map and strat map, and physical inspection of site are applied, issuant of development and planning permits. They also narrated that documentation of proponents' documents are requested including special technical reports, reporting, periodic review of building plan approval, on-site inspection for compliance of approved plan, issuant of enforcement notices and control of illegal and non-conforming development are crucial procedures in the process in the development control practices (see Tables 2 and 3). The findings of the study in using GIS mechanisms differed with Mabogunje (2015) and Owei and Ikpoki (2019) assertions that many physical planning agencies still adopt unconventional approaches development control leading to ineffective and corrupt practices in the physical planning activities in Nigerian cities.

Overall, the findings further showed operational mechanisms are relatively strong, but institutional coordination and environmental enforcement remain weak areas. Using Kendall's Coefficient of Concordance (W) on Development Control Mechanisms also indicate a statistically significant level of agreement among respondents regarding development control mechanisms (χ^2 = 352.116, df = 7, $p < 0.001$). However, the Kendall's W value of 0.286 shows a weak level of agreement, suggesting variations in respondents' perceptions of how these mechanisms are implemented (see Table 3). This implies that, although development control measures are recognised, their application is not perceived as uniform across the study area which has made inter-governmental agency collaboration recording the lowest mean score ($\bar{x}$ = 3.15, SD = 1.08), ranked 8th and rated moderate, indicating weak institutional coordination among relevant physical planning agencies involved in development control activities in the study area. This finding suggested a weak collaboration among the relevant agencies. Hence, Roy (2009) stated that automated planning approvals and inspections on the basis of a manual nature have a tendency to leave scope for delays and corruption, while informal settlements increase uncontrolled in cities in India such as Delhi and Mumbai. These assertions collaborate with the findings of the study that the adoption of GIS mechanisms in the study area has improve development control practices and physical planning activities.

Table 2: Existence of Use of Development Control Mechanisms by Physical Planning Agencies and Local Authorities in the Study Area

Existing Development Control Mechanisms	Mean ($\bar{x}$)	Std. Deviation (SD)	Mean Rank	Decision Level
Site inspection is conducted before building approval for development	4.57	0.58	1st	Very High
Enforcement notices are issued for violations of development approval process	4.33	0.79	2nd	High
Manual plan submission and review system is actively used	4.05	0.93	3rd	High
Demolition of illegal structures is implemented	3.74	1.04	4th	High
Zoning regulations guide approval decisions	3.65	1.20	5th	High
Development activities are monitored regularly	3.56	1.14	6th	High
Environmental compliance checks are enforced	3.49	1.07	7th	Moderate
Current development control mechanisms support inter-governmental agency collaboration	3.15	1.08	8th	Moderate

Source: Researcher's Field Survey, 2026

Table 3: Test of Agreement Among Respondents Using Kendall's Coefficient of Concordance (W) on Development Control Mechanisms by Physical Planning Agencies and Local Authorities in the Study Area

Test Statistics	
N	176
Kendall's W[a]	0.286
Chi-Square	352.116
Df	7
Asymp. Sig.	0.000
a. Kendall's Coefficient of Concordance	

Source: Researchers' Field Survey, 2026

Extent and Manner in which GIS Tools and Database Mechanisms are Currently Applied in Development Control Activities Within the Study Area

Subsequently, the investigation of the extent and manner in which GIS tools and database mechanisms are currently applied in development control activities within the study area showed

significant utilisation. The findings from the mean scores, standard deviations, rankings, and decision levels of the GIS mechanisms used in development control practice within the study area indicated that GIS mechanisms are applied at moderate to high levels in development control practices as showed in Table 4. The findings further revealed that the used of GIS for inter-departmental coordination ($\bar{x} = 3.92$) was ranked highest, followed by spatial databases ($\bar{x} = 3.85$) and satellite imagery for urban growth monitoring ($\bar{x} = 3.70$). These activities are major contributing factors to the used of GIS in physical planning and development control activities that required to automate development control practices in the study area.

Thus, adoption of GIS support for zoning compliance and site suitability analysis that recorded high ratings is significant activity in the development control process and necessary for plan approval, monitoring of physical development and managing urban growth and development as revealed by the study finding. However, GIS for monitoring illegal developments ($\bar{x} = 3.48$), decision-making support ($\bar{x} = 3.29$), and digital cadastral mapping ($\bar{x} = 3.14$) were only moderately applied, indicating gaps in the comprehensive adoption of GIS technologies in physical planning and development control activities in the study area. The key informants responses from findings demonstrated that the GIS tools and database mechanisms currently applied in development control activities within the study area include survey of acquired land for development, charting of surveyed land, site investigation, technical report writing, mapping and spatial analysis of sites for evidence-based decision-making, regulating zoning of land uses and granting of approval for development plans (see Tables 4 and 5) are some of the activities carried out using GIS mechanisms in development control practices in the study area collaborating with the data analysed in Table 4.8. Thus, Musakwa and van Niekerk (2014) noted that cities in South Africa have embraced the application of GIS in real-time building process and land use monitoring, thus reducing manual inspection requirements. Also, Sharma and Rajasekar (2021) identified e-governance platforms for online building permit applications and automatic plan scrutiny implemented by some state governments have improved compliance and reduced approval delays in India. This information collaborates with the study findings that the extent and manner of use of GIS mechanisms and technologies in development control practices improve physical planning processes and decision-Making. Sequentially, the findings on the Friedman Test and Kendall's Coefficient of Concordance revealed a statistically significant difference in respondents' rankings of the development control mechanisms ($\chi^2 = 125.565$, $df = 7$, $p < 0.001$). However, the Kendall's W value of 0.102 indicates a very weak level of agreement among respondents (see Table 5). This suggests that although respondents acknowledged the use of development control mechanisms by physical planning agencies and local authorities, their perceptions of the extent of implementation varied considerably, reflecting inconsistencies in development control practices across the study area. The information showed that there is significant used of GIS in physical planning and development control activities by the extant physical planning agencies in the study area, though there are variances in procedures adopted to apply GIS technologies and mechanisms in their processes of plan approval, monitoring of development and regulating urban growth and development since the agencies are managing different parts of the study area with different management styles. This finding revealed a limited extent of use of GIS mechanisms for development control activities by physical planning agencies and local authorities in the study area.

Table 4: GIS Mechanisms Used in Development Control Practice

GIS Mechanism	N	Mean	Std. Deviation	Mean Rank	Decision Level
GIS improves coordination between Departments	176	3.92	1.02	1st	High
Spatial databases support land information management	176	3.85	0.92	2nd	High
Satellite imagery is used to track urban growth	176	3.70	1.13	3rd	High
GIS supports zoning compliance verification	176	3.63	1.05	4th	High
GIS is used for site suitability analysis	176	3.57	1.08	5th	High
GIS is used to monitor illegal developments	176	3.48	1.12	6th	Moderate
GIS tools are regularly used to support decision-making during development control process	176	3.29	1.15	7th	Moderate
Digital cadastral maps are used in approval processes	176	3.14	1.01	8th	Moderate

Source: Researchers' Field Survey, 2026

Table 5: Friedman Test and Kendall's Coefficient of Concordance for GIS Mechanisms

Test Statistics	
N	176
Kendall's W[a]	0.102
Chi-Square	125.565
Df	7
Asymp. Sig.	0.000
a. Kendall's Coefficient of Concordance	

Source: Researchers' Field Survey, 2026

Evaluate the Effectiveness and Contribution of GIS-Based Mechanisms in Improving Accuracy, Decision-Making, Monitoring, and Overall Efficiency of Development Control Practices in the Study Area

Similarly, the analyses of impact of the application of GIS mechanism in development control practice and trends to approve plans, monitor and regulate urban growth and development in the study area further described benefits of adopting such technologies and mechanisms. From the findings as analysed on the impact of application of GIS mechanism in development control practice and trends to approve plans, monitor and regulate urban growth and development in the study area indicate that respondents perceived the application of GIS mechanisms as having a high positive impact on development control practices as shown in Table 6. The use of GIS for

monitoring urban expansion ranked highest ($\bar{x}$ = 4.44, SD = 0.69), followed by strengthening urban planning outcomes ($\bar{x}$ = 4.40, SD = 0.55). The study further found that GIS also enhanced evidence-based decision-making process, site verification, regulatory efficiency, transparency, and approval processes, all with high mean scores. The responses further showed that GIS application is reducing illegal developments that is ranked the lowest ($\bar{x}$ = 3.94, SD = 0.85), it was still rated highly, demonstrating that GIS is widely perceived as an effective tool for improving physical planning activities and development control practices. The findings as narrated by the key informants on how effective GIS-based mechanisms can contribute to improving accuracy, decision-making, monitoring, and overall efficiency of development control practices in the study area revealed that the mechanisms will enhance the accuracy of site location and development management, efficiency in monitoring physical development, time saving, yield better result for decision-making especially in site suitability, and flood vulnerability assessment. They further narrated that it will enhance transparency of the process, transformation from outdated system to newer, efficient and effective system, improve intelligence and real-time monitoring of development and enforcement planning regulations in the study area.

Consequently, Li, Sun and Zhang (2024); Wu, Liu and Hou (2025) have all identified some positive impacts of applying GIS mechanisms in development control practices and physical planning activities on aspects of plan approval, monitoring physical development regulation of urban growth and development to include identifying zoning violations, track land invasions, and enforce planning controls effectively which facilitate the ordering of spatial development and preventing unauthorised housing construction to prevent information settlements (squatters and slums) manifestation. These impacts outlined aligned with respondents' responses improving development control practices and physical planning decisions. However, the Indian case as noted by Sharma & Rajasekar (2021) further highlighted the use of GIS mechanisms reduces delays, prevented corruption, and improved zoning compliance through transparent digital approval processes enhancing the efficiency and effectiveness of development control practices.

However, the Friedman Test also revealed a statistically significant difference in respondents' rankings of the perceived impacts of GIS mechanisms on development control practice (χ^2 = 108.777, df = 7, $p < 0.001$). Hence, the Kendall's Coefficient of Concordance (W = 0.088) indicated a very weak level of agreement among respondents as seen in Table 7. This suggests that although respondents generally recognised the positive impacts of GIS on plan approval, monitoring physical development, and regulating urban growth and development as their perceptions of the magnitude of these impacts varied considerably across the study area. The findings have shown from analyses that there are divers' beneficial impacts of the application of GIS mechanisms and technologies in activities of development control and physical planning from monitoring, decision-making, efficiency and transparency in plan approval that manifest to improved governance system physical planning administration in the study area. In South Africa, municipalities in the utilisation of GIS-based dashboards have enhanced the tracking land use changes and identifying infrastructure requirements, improving the provision of resources in a fair manner and governance (Musakwa & van Niekerk, 2014). Similarly, UN-Habitat (2020) has noted that the application of GIS-based mechanism has improved participatory planning process in Bogotá, Colombia making spatial information available and accessible to citizens thereby enhancing public participation, transparency and accountability in development control practices and physical planning activities. These impacts aligned with the study findings as there are several positive impacts in the use of

GIS-based mechanisms for development control and physical planning in term of approval, monitoring and regulation of urban growth and physical developments.

Table 6: Impact of Application of GIS Mechanism in Development Control Practice and Trends to Approve Plans, Monitor and Regulate Urban Growth and Development in the Study Area

Impacts	N	Mean	Std. Deviation	Mean Rank	Decision Level
GIS enhances monitoring of urban expansion	176	4.44	0.69	1st	High
GIS strengthens urban planning outcomes	176	4.40	0.55	2nd	High
GIS enhances evidence-based decision-making	176	4.31	0.56	3rd	High
GIS improves accuracy in site verification	176	4.31	0.71	4th	High
GIS improves efficiency in development regulation	176	4.27	0.69	5th	High
GIS improves transparency in development control	176	4.15	0.71	6th	High
GIS reduces processing time for approvals	176	4.12	0.84	7th	High
GIS reduces incidences of illegal developments	176	3.94	0.85	8th	High

Source: Researchers' Field Survey, 2026

Table 7: Friedman Test and Kendall's Coefficient of Concordance on Impact of Application of GIS Mechanism in Development Control Practice and Trends to Approve Plans, Monitor and Regulate Urban Growth and Development in the Study Area

Test Statistics	
N	176
Kendall's W[a]	0.088
Chi-Square	108.777
Df	7
Asymp. Sig.	0.000
a. Kendall's Coefficient of Concordance	

Source: Researchers' Field Survey, 2026

Conclusion

This study assessed the exploration of GIS database mechanisms in development control practices in Port Harcourt metropolis, Rivers State. The study identified and assessed existing development control mechanisms employed by physical planning agencies and local authorities, examined

extent and manner in which GIS tools and database mechanisms are currently applied in development control activities, and evaluated the effectiveness and contribution of GIS-based mechanisms in improving the efficiency of development control practices. The findings revealed that development control mechanisms such as site inspections, manual plan reviews, zoning regulations, enforcement notices, and routine monitoring are widely implemented. However, environmental compliance monitoring and inter-agency collaboration require improvement to ensure more effective and coordinated development control. The study also found that GIS has been adopted to a moderate and high extent in development control activities, particularly in spatial database management, urban growth monitoring, zoning compliance, and inter-departmental coordination. In conclusion, GIS has significant potential to improve development control practices in Port Harcourt metropolis which has contributed to improve accuracy and transparency in decision-making, monitoring, and overall efficiency of development control practices especially site specific and real-time monitoring of development and enforcement planning regulations in the study area. Addressing these areas will strengthen development control, improve urban governance, and promote sustainable urban growth in Port Harcourt metropolis and other rapidly growing cities in Nigeria.

Recommendations

i. Physical planning agencies and local authorities in Port Harcourt metropolis should strengthen inter-agency collaboration and incorporate GIS mechanisms and technologies into the existing development control system. This will enhance plan approval, monitoring development and regulate urban growth and development processes in the study area;

ii. Rivers State Government and its physical planning agencies should expand the use of GIS technologies, digital cadastral systems, and spatial databases to improve plan approval, monitoring of development and regulating urban growth in the development control practices in the study area; and

iii. Physical planning agencies in Rivers State should fully integrate GIS into development control processes to improve planning accuracy, efficiency and effectiveness in monitoring development, and enhance the transparency, accountability in plan approval and regulatory processes.

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