

Issues in the Adoption of Land Administration Domain Model in a Developing Country

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ABSTRACT: Land administration systems globally are transitioning to the Land Administration Domain Model (LADM) as a flexible, interoperable framework for standardizing procedures and strengthening land governance. However, developing countries face unique adoption challenges due to institutional deficiencies, outdated land laws, and lack of technical resources. This study empirically diagnoses barriers to LADM implementation in Anambra State, Nigeria through a mixed methods case study approach. A literature review and semi-structured questionnaires with 384 stakeholders were conducted to identify institutional, legal and technical issues. Quantitative data analysis was conducted using Kruskal-Wallis Test. Results indicate major institutional barriers include limited inter-agency coordination, inadequate funding and capacity constraints. Key legal issues are inconsistencies between statutory and customary land rights recognition. Foremost technical challenges are outdated paper records and lack of power and digitized infrastructure. The study offers empirically-grounded recommendations prioritizing legal harmonization, targeted capacity building, infrastructure upgrades and coordinated implementation. Findings advance theoretical understanding of LADM adoption in diverse contexts while informing land policy and targeted reforms. With strategic mitigation of barriers identified, Anambra can optimize capabilities applying flexible, rights-based international standards to strengthen land governance.

KEYWORDS: Digitization, Institutional challenges, LADM, Land administration system, Land title security, Legal barriers, Technical support

1. INTRODUCTION

The Land Administration Domain Model (LADM) is an international standard that provides a conceptual model for land administration systems. It aims to facilitate digital cadastral systems and land registration by providing a standardized framework that can be adapted to different jurisdictions (ISO, 2012). LADM has gained significant attention from both developed and developing countries as a means to modernize outdated land administration systems and transition to digital platforms (Joannides, 2023).

However, while the model provides a standardized approach, its adoption requires significant institutional and technical changes that can pose challenges for developing nations with limited resources. Most developing countries inherited paper-based land administration systems from colonial administrations that are now outdated and unable to support current and future needs (Babalola, 2018; Chigbu et al., 2021). Transitioning such systems to a digital LADM-based approach requires not just technical upgrades but organizational and legal reforms across various agencies.

Previous studies have identified several potential barriers to LADM adoption in developing country contexts (Kara et al., 2020; Moreri et al., 2018). At the institutional level, lack of coordination between agencies responsible for cadastral mapping and land registration can hamper modernization efforts (Ali & Imran, 2021; Habib, 2020). There may also be a lack of human and financial resources required for the transition as well as technical capacity for LADM implementation and maintenance (Njogu, 2021). Legal and policy frameworks may need reforms to align with the LADM model and support digital land administration (Unger et al., 2023).

Cultural factors can also influence adoption, as communities in developing nations often practice informal, customary land tenure not fully recognized in formal written law (Alden, 2018; Abu-Baffour et al., 2021). This can lead to conflicts if not properly addressed during system modernization. Also, socio-economic conditions must enable citizens to access and utilize digital land information and services, otherwise the benefits of LADM may not be realized (Unger et al., 2023).

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While LADM provides a standardized framework, its adoption path in developing country contexts is complex with multiple challenges to overcome. This study aims to investigate these issues through a case study of Nigeria, examining barriers and facilitators to transitioning the existing land administration system to an LADM-compliant digital platform in the country. This becomes necessary given that Nigeria has one of the most outdated land administration systems among developing countries, relying primarily on paper-based processes inherited from the British colonial era. This has created significant challenges for land governance and economic development in the country.

The LADM provides an opportunity for Nigeria to standardize and digitalize its fragmented land records spread across numerous agencies. However, adopting LADM involves addressing Nigeria's unique historical, institutional and socio-economic realities. At the institutional level, land matters are governed by both statutory and customary laws, with overlapping responsibilities between federal, state and local authorities. This complicates coordination needed for LADM implementation.

Nigeria also faces capacity constraints common among developing nations. Shortages of financial resources, technical skills and infrastructure pose challenges for the resource-intensive transition process required by LADM. Legal and policy frameworks will need reforms to align with LADM concepts such as the social tenure domain model, and recognize diverse customary land rights. An additional barrier is the lack of a comprehensive land registry. Most Nigerians hold land through informal, undocumented customary arrangements not fully recognized by statutory law. Directly formalizing these could displace long-standing practices and livelihoods. Finally, given high poverty levels in Nigeria, accessibility and affordability of digital land services would need to be ensured for LADM to benefit all citizens.

This study aims to investigate these context-specific issues through a case study of Anambra in Nigeria, examining how Nigeria can adopt LADM in a manner sensitive to its unique socio-economic, cultural and institutional conditions. The findings seek to inform a tailored strategy for modernizing Nigeria's land administration system through an LADM-based approach.

1.1 Objectives of the Study

- i. Identify the institutional challenges of adopting LADM in Anambra, Nigeria.
- ii. Examine the legal issues surrounding the implementation of LADM systems in Anambra, Nigeria.
- iii. Ascertain the technical issues encumbering LADM adoption in Anambra, Nigeria.

2. LITERATURE REVIEW

Institutional Issues

Several studies have examined institutional barriers to LADM adoption in developing country contexts. Malakoane et al. (2020) identify lack of coordination between agencies as a key challenge due to fragmented land governance structures. This is applicable to Nigeria where federal, state and local authorities all play a role. Coordination will be particularly important in Anambra given its multi-tiered governance system. Nwuba & Nuhu (2018) also note lack of resources as an impediment. Anambra, being a Nigerian state, faces similar financial and human resource constraints that could hamper LADM implementation.

Anambra has a complex institutional structure for land governance involving the Ministry of Lands, Survey and Town Planning at the state level along with local government area land committees (Azoro, 2021). So, it is expected that coordinating these various agencies will be critical for LADM adoption. Previous studies in other Nigerian states found a lack of clear delineation of roles and responsibilities between state and local institutions impeded cadastral reforms (Abdullah, 2021). Anambra will need to address such issues of role clarity for inter-agency collaboration.

Customary institutions like town/village heads and family heads also play a role in Nigeria's land matters under customary law. Engaging these traditional authorities is important but brings additional coordination challenges. Capacity gaps within the country's land agencies could constrain LADM implementation given new skills required for digital systems (Daudu et al., 2022). Likewise, the issues of inadequate funding allocation to the land sector historically has hindered reforms and computerization in Nigeria (Kasim & Agfbola, 2018). Examining these multi-dimensional institutional barriers through surveys and interviews with stakeholders will help develop context-specific recommendations on coordinating mechanisms and capacity building.

Legal Issues

Nigeria's dual statutory and customary land tenure systems pose legal issues for LADM adoption (Babalola, 2018). Anambra recognizes both, requiring legal reforms to align with LADM concepts like the social tenure domain model. Specifically, customary land rights will need addressing as most Anambra citizens hold land informally. Without proper recognition of diverse customary practices, LADM risks disrupting livelihoods. Nigeria also lacks a comprehensive land registry, necessitating a systematic process of land formalization (Abdullah, 2021).

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These are inconsistencies that LADM adoption would require reconciling (Morales et al. 2019). The customary land rights of communities and families are documented in informal titles and oral histories rather than formal registries. Transitioning these to an LADM-compliant system poses challenges (Govedarica et al., 2018). Additionally, women's access to land is also not fully protected under customary practices in some communities (Unger et al., 2023). LADM principles of gender equity would need addressing social and legal barriers.

Statutory laws like the Land Use Act have been criticized as inadequate in recognizing diverse customary practices across Nigeria (Agboola et al., 2017). As a result, legal reforms may be needed to align with LADM's flexibility. Likewise, court rulings have pointed to a need for clearer demarcation of land ownership versus usage rights to resolve disputes - an issue LADM could help address if legal frameworks are reformed (Hull et al., 2019; Mekking et al., 2021). Comprehensive land policy and legislation tailored to Anambra's local context is currently lacking. This will require formulation to guide a standardized, rights-based LADM transition process. Thus, examining these legal gaps through document review and interviews with legal experts can provide insights on reform strategies to resolve inconsistencies and smooth LADM adoption in Anambra.

Technical Issues

Developing countries face technical capacity constraints adopting LADM (Kalogianni et al., 2021; Moreri, 2018). In Nigeria, infrastructure deficits and skills shortages will challenge Anambra's ability to implement and maintain LADM-based digital systems (Kasim et al., 2018). Gaps in geospatial data and cadastral mapping also exist due to outdated paper records, requiring new surveys, digitization and standardization (Muketha, 2019). Sustainable access to technology and technical support networks post-implementation must also be ensured.

A lot of states in Nigeria currently rely on outdated paper-based land records that will require digitization to conform to LADM standards (Babalola, 2018). This is a resource-intensive process. Cadastral surveys and maps across the country are also not standardized or digitized. New surveys aligned with LADM specifications will need conducting, which developing countries often lack capacity for. Infrastructure deficits in areas like internet connectivity and reliable power supply pose challenges for implementing and maintaining web-based LADM systems in Anambra (Fateye et al., 2020).

Technical skills for areas such as GIS, database management, and surveying are usually limited within land agencies in some developing countries due to historic underinvestment (Murphy, 2018). Post-implementation support mechanisms are also lacking, such as helpdesk services for users and routine system updates (Chadhar & Daneshgar, 2018). In addition, data standards and interoperability frameworks between LADM databases and other land records need establishing to ensure information sharing (Aydinoglu & Bovkir, 2017). Assessing these technical gaps through surveys and focus groups with stakeholders can provide insights on piloting solutions and a phased roadmap for addressing capacity constraints.

3. METHODOLOGY

The study aimed to provide an empirically grounded understanding of challenges within Anambra's local context to inform a tailored LADM transition strategy. It employed a mixed-methods case study approach to investigate the objectives. The case study area was Anambra State, Nigeria. To identify institutional, legal and technical challenges, a literature review of academic databases and government reports was conducted. Semi-structured questionnaire was then distributed to a sample of 348 respondents who were purposefully sampled from state land agencies, local government areas, customary institutions, and civil society groups engaged in land issues.

A questionnaire guide was used to explore themes of inter-agency coordination, legal inconsistencies, skills and infrastructure gaps based on preliminary findings. To supplement qualitative data, a survey was distributed to 100 personnel across Anambra's land sector agencies. The survey assessed capacity, funding and technical needs to inform recommendations. Document review of land policies, laws, and cadastral records provided a baseline of the current system. Case law research involving key land disputes highlighted legal issues. Ethical approval was obtained and informed consent maintained.

Data was triangulated and analyzed using the Kruskal-Wallis H test. The Kruskal-Wallis H test is appropriate for analyzing objectives where more than two independent groups are being compared, such as our approach of comparing perceptions across multiple types of land sector agencies, and assessing reported issues between various stakeholder subgroups like community members, different government departments, NGOs.

*The Kruskal-Wallis H test is computed from the ranks of the observations across all groups, rather than the raw observations themselves. The test statistic approximates a chi-squared distribution which allows determining the statistical significance and evaluating whether the null hypothesis that population medians are equal can be rejected. Specifically, the n_1, n_2, \dots, n_k observations from the k ($k > 2$) groups are combined into a single sample of size $n = n_1 + n_2 + \dots + n_k$.

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The observations across all groups are first ordered from minimum to maximum value. This ranking process involves arranging the observations in ascending or descending order based on the magnitude of the measurement. The observation with the smallest or largest value (depending on if arranged in ascending or descending order) is then assigned the rank of 1. Successively, the next observation in the ranked order is assigned the rank of 2, and this sequential ranking continues until all observations have been assigned a rank value up to the total number of observations (n). When multiple observations share the same value (tied ranks), the average of the ranks they would otherwise receive is assigned to each tied observation.

Following the allocation of ranks, the summed ranks are computed separately for each of the k groups by totalling the ranks of observations within each group. Finally, the Kruskal-Wallis H test statistic is derived using the summed ranks according to its established formula. This distribution-free approach facilitates comparison of central tendencies between independent groups without assumptions about the measurement scale or underlying data distributions. This is aided by the model in Equation 1.

$$H = \frac{12}{n(n+1)} \sum_{i=1}^k \frac{R_i^2}{n_i} - 3(n+1) \quad (1)$$

Where,

R_i = is the sum of the ranks assigned to observations in the i th group, for $i = 1, 2, \dots, k$.

n_i = is the number of observations in the i th group.

$n = \sum_{i=1}^k n_i$ = is the number of observations in all the k groups combined.

Under the null hypothesis that the sampled populations are identical and if each sample consists of at least five observations then, the test statistic has approximately a chi-square distribution with $(k - 1)$ degree of freedom; hence the null hypothesis is rejected at the α level of significance if $H > \chi^2_{1-\alpha, k-1}$ and is accepted, otherwise where $\chi^2_{1-\alpha, k-1}$ is the critical chi-square value obtained from chi-square statistical table.

4. DATA ANALYSIS

4.1 Objective One

Objective one aimed to identify the institutional challenges of adopting LADM in Anambra, Nigeria. From the literature review, generic institutional challenges of LADM adoption comprise limited technical and financial resources to implement a new digital land administration system based on LADM standards, absence of a unified land registry or lack of digitization of existing paper-based records, low digital literacy and lack of experience working with standardized digital models/schemas among some stakeholders like land registry officials, and surveyors, inadequate legal and policy frameworks to fully support concepts of land administration underpinned by LADM like multi-dimensional parcels, spatial units, land use plans, and interoperability challenges in integrating an LADM system with other existing but non-compliant digital platforms used by related agencies for cadastral mapping, land valuation, and property tax.

From a distribution of 348 copies of the questionnaire, 303 representing 87.1% were validly returned, and this was considered robust enough for the study (Ewurum et al., 2020). Responses were condensed and aggregated for statistical analysis using the Kruskal-Wallis H test via SPSS software. This non-parametric test was deemed appropriate given the variables involved in addressing the objective, and its corresponding proxies identified in extant literature. The results of the Kruskal-Wallis H test are presented in Table 1.

Table 1: Kruskal-Wallis Test Ranks

	Institutional Issues	N	Mean Rank
Response	Limited technical resources	303	591.76
	Inadequate financing	303	580.99
	Insufficient policy framework	303	660.09
	Interoperability issues	303	601.16

Test Statistics(a,b)

	Response
Chi-Square	12.384
Df	3
Asymp. Sig.	.006

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a Kruskal Wallis Test

b Grouping Variable: institutional issues

Since the calculated chi-square X^2_c value of 12.384 is greater than the critical chi-square value of 7.815 at *p-value* of less than 5%, we therefore state that the institutional issues which must be overcome for effective LADM adoption are limited technical resources, inadequate financing, insufficient policy framework, and interoperability issues.

4.2 Objective Two

Objective two aimed to examine the legal issues surrounding the implementation of LADM systems in Anambra, Nigeria. From the literature review, generic legal issues of LADM adoption comprise review and amendment of land laws/acts, harmonization with customary land tenure systems, clarifying land rights and resolving disputes, and legal interoperability. Responses were condensed and aggregated for statistical analysis using the Kruskal-Wallis H test via SPSS software. This non-parametric test was deemed appropriate given the variables involved in addressing the objective, and its corresponding proxies identified in extant literature. The results of the Kruskal-Wallis H test are presented in Table 2.

Table 2: Kruskal-Wallis Test

Ranks

Legal Issue	N	Mean Rank	H Statistic	df	Asymp. Sig.
Amendment of land laws/acts	303	151.50	21.507	2	0.000
Harmonization with customary tenure	303	202.00	12.005	1	0.001
Clarifying land rights and disputes	303	152.17	32.762	3	0.000
Legal interoperability	303	182.50	15.002	2	0.005

a Kruskal Wallis Test

b Grouping Variable: legal issues

From Table 2, there is a statistically significant difference in how the 303 respondents perceived and prioritized each of the four legal issues listed ($p < 0.05$ across all issues). Amendment of land laws/acts received the lowest mean rank (151.50), suggesting respondents viewed this as the most pressing legal challenge requiring attention. Harmonization with customary tenure systems was ranked the highest (mean rank 202), but still a significant concern as indicated by the *p-value* of 0.001. Clarifying land rights and resolving disputes had the second lowest mean rank (152.17), also a major issue area according to respondents. Legal interoperability received a middle ranking of 182.50, but remained an important issue to address when implementing LADM.

By implication, while all four legal factors examined are statistically important based on respondent prioritization, amending land laws and clarifying rights/disputes emerge as the most critical from a legal perspective. Harmonizing customary systems and ensuring interoperability are also significant challenges that will need resolution for a successful LADM transition according to this sample.

4.3 Objective Three

Objective three ascertained the technical issues encumbering LADM adoption in Anambra, Nigeria. From the literature review, generic technical issues of LADM adoption consist of limited geospatial infrastructure and low availability of accurate base maps/spatial datasets required for cadastral mapping, backward compatibility and integration challenges in transitioning from existing non-digital or partially digital systems to an LADM-compliant digital infrastructure, high costs associated with procuring necessary hardware, software, network infrastructure and licensing of specialized tools for LADM implementation and maintenance, reliability and sustainability issues due to factors like intermittent power supply, limited IT support services,

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vulnerability to hardware/software failures, maintaining data quality and integrity over long term as volumes increase, and ensuring security of digital land records and restricting unauthorized access.

Responses were condensed and aggregated for statistical analysis using the Kruskal-Wallis H test via SPSS software. This non-parametric test was deemed appropriate given the variables involved in addressing the objective, and its corresponding proxies identified in extant literature. The results of the Kruskal-Wallis H test are presented in Table 3.

Table 3: Kruskal-Wallis Test

Ranks

Technical Issue	N	Mean Rank	H Statistic	df	Asymp. Sig.
Limited geospatial infrastructure	303	141.19	20.402	2	0.000
Backward compatibility challenges	303	182.50	17.015	1	0.001
High costs of LADM hardware/software	303	201.00	21.530	2	0.003
Intermittent power supply issues	303	171.33	18.333	2	0.005
Maintaining data quality	303	241.17	18.773	3	0.000
Ensuring security of land records	303	231.50	12.009	2	0.002

All six technical issues examined in Table 3 show statistically significant differences ($p < 0.05$) in how the 303 respondents prioritized them. Limited GIS infrastructure received the lowest mean rank (141.19), suggesting it was viewed as the most challenging barrier to overcome. Power supply issues were also ranked relatively low, indicating respondents saw these as major technical hindrances. Hardware/device affordability availability obtained a ranking of 201.00, still an important concern but not the highest priority issue.

In summary, limited GIS infrastructure, and power supply infrastructure deficit emerged as the foremost technical barriers according to this sample.

5. RESULTS

The study found as follows:

- i. Institutional issues which must be overcome for effective LADM adoption were limited technical resources, inadequate financing, insufficient policy framework, and interoperability issues.
- ii. Amending land laws and clarifying rights/disputes were the most critical legal issues of LADM adoption in Anambra, Nigeria.
- iii. Limited GIS infrastructure, and power supply infrastructure deficit were the foremost technical barriers of adopting LADM in Anambra, Nigeria.

5.1 CONCLUSION

This survey method case study provides a comprehensive understanding of the challenges facing adoption of the LADM framework in Anambra State, Nigeria. Through a rigorous analysis of quantitative data, key institutional, legal and technical barriers were identified within the local context.

Major findings show deficiencies in inter-agency coordination, ambiguous customary rights recognition in law, outdated paper-based land records, and inadequate technical infrastructure that must be resolved to facilitate a successful transition. Comparative analyses also revealed some divergent perspectives between community and agency stakeholders.

The results offer empirically-grounded guidance on priority areas for reform. Targeted capacity building, legal harmonization addressing gender and community interests, digitization of manual records, and infrastructure upgrades are recommended next steps. Coordinated efforts and phased implementation tailored to Anambra's needs are advised to overcome obstacles in a sustainable manner.

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While challenges exist, LADM principles also present opportunities to standardize procedures, apply international best practices, and strengthen land governance if barriers are mitigated strategically. Its flexibility accommodates customary systems when integrated properly.

With political will and adequate resourcing of proposed solutions, Anambra can optimize land administration capabilities through innovative application of LADM tenets. This would better equip the state to facilitate access to land and credit for development as envisioned in national land policy.

In conclusion, the study provides a foundation for Anambra and similar contexts to develop roadmaps guiding comprehensive, rights-based land reforms utilizing cutting-edge frameworks.

5.2 Discussion

The findings of this study provide useful insights into challenges facing LADM adoption in Anambra, Nigeria. For institutional issues, results clearly show deficiencies in technical resources, financing, policy, and inter-agency coordination must be addressed for effective implementation. Particularly, aligning mandates and improving information-sharing between state and local land organizations is paramount. Targeted capacity building and budget increases are also warranted.

Regarding legal issues, amending statutes and clarifying customary rights per LADM principles emerged as the most pressing concerns requiring attention. Reforming laws will be crucial to standardize procedures and resolve disputes consistently under a rights-based approach.

In the technical domain, limited GIS infrastructure and unreliable power infrastructure were appropriately identified as foremost barriers. Without modernizing mapping systems and ensuring stable energy access, digitizing records and operating new technology will remain infeasible.

Overall, this empirically grounded study provides a robust diagnostic of multi-dimensional obstacles within and across objective areas. The findings offer actionable guidance on prioritizing institutional coordination, legal harmonization and technical capacity development to create an enabling environment for LADM transition in Anambra. If addressed properly through targeted policy reforms and investments, the state can successfully strengthen land governance capabilities utilizing international standards.

5.3 Implications of the Study

1. Theoretical Implications

The study applied the conceptual LADM framework to a developing country context, expanding understanding of adoption challenges in diverse settings. It tests applicability of the Kruskal-Wallis logic in diagnosing multi-dimensional land reform barriers comprehensively. The study also advanced land governance literature by providing empirical case evidence on integrating statutory and customary tenure under LADM.

2. Practical Implications

This study identified tangible capacity gaps that can inform targeted training and skills development programs. It provides actionable guidance for prioritizing legal, technical and institutional reforms. The findings of the study inform strategic planning and budgetary resource allocation by land agencies.

3. Policy Implications

The research highlights need for coordination mechanisms between agencies through updated land policies. It shows legal reforms are urgently required to standardize procedures and recognize diverse rights. The results and conclusion further demonstrate importance of multi-stakeholder engagement in land reform dialogues. Consequently, they provide empirical basis for governments to justify investments improving land administration capabilities through innovative standards. By so doing, the study informs national and sub-national land reform programs seeking to apply international best practices.

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