# Assessing Institutional Readiness and Willingness of Philippine LGUs to Adopt Geospatial Land Use Monitoring Tools

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**Abstract**

Land use planning and monitoring are central to sustainable development, yet many Local Government Units (LGUs) in the Philippines face limited technical capacity, outdated tools, and weak institutional systems. This study assessed the institutional willingness and capacity of LGUs to adopt geospatial land use monitoring technologies using six indicators: Comprehensive Land Use Plan (CLUP) status, GIS capacity, remote sensing capacity, enforcement tools, data management systems, and willingness to adopt new technologies. Expert-derived weights for these indicators, elicited through the Analytic Hierarchy Process (AHP) with DHSUD central and regional staff, were applied to compute readiness scores from a nationwide survey of 666 LGUs. Findings show that most LGUs fall within the Transitioning category, with fewer classified as Advanced and only a small number Limited. Weighted readiness scores cluster between 0.5 and 0.6, with GIS and remote sensing capacities particularly low (41.75% and 12.31%), though willingness to adopt is high at 84%. The readiness score distribution is left-skewed, suggesting that most LGUs already demonstrate moderate-to-high capacity and are closer to readiness than not. Radar chart analysis highlights uneven progress: CLUP updating and willingness are strong, while gaps persist in remote sensing, data management, and enforcement. Viewed through the IAD framework, these patterns underscore how institutional rules, resources, and organizational arrangements influence LGU performance, with structural bottlenecks limiting adoption. Recommendations include: foundational training and shared services for Limited LGUs; structured pathways for Transitioning LGUs to integrate geospatial monitoring; incentives and peer-learning platforms for Advanced LGUs; and embedding readiness-based pathways into national policy.

## 1. Introduction

### 1.1. Background of the Study

Effective land use planning and monitoring are fundamental for sustainable urban expansion, environmental conservation, disaster risk reduction, and equitable development. In the Philippines, LGUs implement land use policies through CLUPs and zoning codes, yet many still face difficulties in monitoring compliance, enforcing regulations, and regularly updating spatial information. These challenges are compounded by rapid urbanization, climate risks, and competing land use demands. At present, monitoring practices in most LGUs rely heavily on manual inspections, citizen reports, and paper-based files—processes that are time-consuming, labor-intensive, and geospatially imprecise. Only a handful of LGUs, often wealthier ones or those with external support, utilize remote sensing and GIS. For instance, Darilek, Soriano, and Hilvano (2019) demonstrated how GIS and remote sensing can effectively detect land use and land cover change and assess urban sprawl in ecologically sensitive areas of the Philippines, underscoring the untapped potential of these technologies in strengthening LGU land use monitoring.

Geospatial technologies such as GIS and remote sensing have transformational potential for land use monitoring. Globally, these tools are increasingly embedded in governance systems to improve urban planning, environmental management, and regulatory enforcement. Governments in Europe, Asia, and Africa have demonstrated the value of spatially enabled decision-making, harnessing geospatial data to strengthen public service delivery and promote sustainable urban growth. Geospatial technologies—such as GIS and remote sensing—are transforming land use monitoring worldwide, empowering urban governance systems to enhance planning, environmental stewardship, and enforcement (Oppong et al., 2023; Li et al., 2024). This global trend offers a valuable backdrop for examining geospatial adoption in the Philippines, where utilization remains limited to more capacitated LGUs due to budgetary, technical, and institutional constraints.

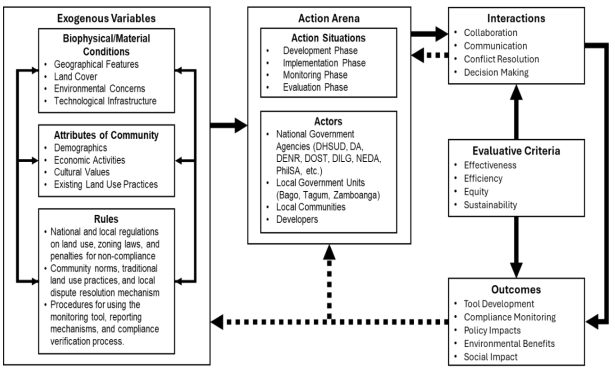


Figure 1. Institutional Analysis and Development Framework for Digital Transformation in Land Use Monitoring.

To analyze these dynamics, this study is guided by a framework shown in Figure 1, based on Ostrom's Institutional Analysis and Development (IAD) framework, which provides a systematic lens for understanding how institutions shape collective decision-making (Ostrom, 2005). The framework emphasizes three dimensions: the institutional environment (external rules, national policies, and governance setting), institutional arrangements (internal rules and organizational mechanisms within LGUs), and institutional capacities (human, technical, and financial resources). By applying the IAD framework, the study situates LGUs within the broader "action arena" of land use governance and assesses how institutional conditions influence their readiness to adopt digital geospatial monitoring systems. This framing underscores that technology adoption is not simply a technical issue, but also a governance and institutional one.

### 1.2. Objectives

This study aims to understand the institutional capacity and openness of Philippine LGUs toward adopting geospatial land use monitoring technologies. Specifically, it seeks to:

1. Assess the current status of geospatial and institutional capacity of Philippine LGUs.
2. Evaluate the willingness of LGUs to adopt geospatial land use monitoring tools.
3. Derive indicator weights through expert consultation using the AHP.
4. Compute and analyze a composite Readiness Score using key indicators.
5. Provide recommendations for enhancing geospatial readiness across LGUs.

## 2. Methodology

This study operationalizes the IAD framework introduced in the Introduction to design and interpret the national LGU survey. Specifically, the six readiness indicators (CLUP status, GIS capacity, RS capacity, enforcement teams, data management systems, and willingness to adopt new technologies) were mapped onto the three IAD dimensions: institutional environment, arrangements, and capacities. This mapping provided coherence in linking survey results to institutional theory and allowed for a structured assessment of LGU readiness for geospatial monitoring.

### 2.1. Survey Instrument Design

The institutional survey was developed to collect comprehensive data across five domains: GIS and remote sensing capacity, land use monitoring practices, institutional and organizational challenges, existing data systems, and willingness to adopt a tool for geospatial land use monitoring. The instrument included both closed-ended questions for quantitative analysis and open-ended questions to capture qualitative insights and recommendations directly from LGU respondents.

### 2.2. Data Collection Process

The survey was administered online using Google Forms, allowing for broad reach, ease of response, and efficient data consolidation. This mode of administration enabled the research team to engage LGUs from geographically diverse regions while minimizing logistical costs and administrative delays. Participation was coordinated through regional planning offices and local planning and development coordinators to ensure authenticity and completeness of responses.

### 2.3. Sampling Framework

The sample frame was derived from the total number of cities and municipalities in the Philippines, excluding those in the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM). Based on an estimated population of 1,515 LGUs, the sample size was calculated using the standard formula for finite populations with a 95% confidence level, 4% margin of error, and a proportion estimate of 0.5:

$$n = \frac{Z^2_{0.975} * p(1-p)}{e^2} = 601 \quad (1)$$

where $n$ = required sample size
$Z$ = z-score corresponding to the desired confidence level
$p$ = estimated population proportion
$e$ = margin of error

To account for the finite LGU population, the finite population correction (FPC) was applied:

$$n' = \frac{n*N}{n+N-1} = 430 \quad (2)$$

where $N$ = total LGU population
$n$ = required sample size
$n'$ = adjusted sample size after applying FPC

This yields an adjusted sample size of approximately 430. The sample was then proportionally distributed across regions using the relative share of total LGUs per region. Table 1 reflects the recomputed distribution per region:

| Region | Total LGUs | Proportion | Sample LGUs |
|---|---|---|---|
| NCR | 17 | 1.12% | 5 |
| CAR | 77 | 5.08% | 22 |
| I | 125 | 8.25% | 35 |
| II | 93 | 6.14% | 26 |
| III | 130 | 8.58% | 37 |
| IV-A | 142 | 9.37% | 40 |
| IV-B | 73 | 4.82% | 21 |
| V | 114 | 7.52% | 32 |
| VI | 101 | 6.66% | 29 |
| VII | 101 | 6.66% | 29 |
| VIII | 143 | 9.44% | 41 |
| IX | 72 | 4.75% | 20 |
| X | 93 | 6.14% | 26 |
| XI | 49 | 3.23% | 14 |
| XII | 49 | 3.23% | 14 |
| XIII | 73 | 4.82% | 21 |
| NIR | 63 | 4.16% | 18 |
| **Total** | **1,515** | **100%** | **430** |

Table 1. Computed sample size per region

This stratified sampling approach ensured proportional representation across geographic regions while accommodating logistical and resource constraints.

### 2.4. Institutional Readiness Score Computation

To quantify the institutional readiness of LGUs to adopt geospatial monitoring instruments, a Readiness Score was developed based on six survey measures: (1) status of CLUP (updated or in progress), (2) technical GIS capacity, (3) remote sensing (RS) capability, (4) presence of a special land use enforcement team, (5) land use data management system (physical, digital, or hybrid), and (6) willingness to adopt new systems.

The Analytic Hierarchy Process was employed to establish the relative importance of these indicators. AHP was selected for its robustness in multi-criteria decision-making and its ability to generate consistent weights from expert judgments. A total of 37 staff from the Department of Human Settlements and Urban Development (DHSUD), representing both the Central and Regional Offices, participated in the exercise. Using Saaty's pairwise comparison scale, participants assessed the relative priority of the six indicators. Their responses were aggregated into a consolidated decision matrix, which was then used to compute normalized weights for each indicator.

For the computation of readiness scores, each indicator was scaled from 0 (low readiness) to 1 (high readiness) and standardized across LGUs. The scoring framework is summarized in Table 2. Indicator scores were assigned based on their practical contribution to institutional readiness. This approach ensures the readiness index reflects meaningful differences in LGU capacity and capability.

| Indicator | Response Categories Score |
|---|---|
| CLUP Status | Updated (1.00), Outdated (0.50), No CLUP (0.00) |
| Geographic Information System Capacity | Excellent (1.00), Good (0.75), Fair (0.50), Poor (0.25), Very Poor (0.00) |
| Remote Sensing Capacity | Excellent (1.00), Good (0.75), Fair (0.50), Poor (0.25), Very Poor (0.00) |
| Dedicated Enforcement Team | Yes (1.00), No (0.00) |
| Data Management System | Digital or Hybrid (1.00), Physical files only (0.50), None (0.00) |
| Willingness to Adopt | Very Open (1.00), Open (0.75), Neutral (0.50), Reluctant (0.25), Very Reluctant (0.00) |

Table 2. Scoring of readiness indicators

The weighted sum of these standardized scores produced the institutional readiness score for each LGU. Based on their composite scores, LGUs were then classified into three readiness levels: Limited (0.00–0.33), which reflects low institutional and geospatial capacity and a high need for external support; Transitioning (0.34–0.66), which reflects moderate readiness with partial systems in place and opportunities for scaling up; and Advanced (0.67–1.00), which reflects strong institutional and geospatial capacity, making them suitable for piloting advanced monitoring tools. This classification provides a diagnostic tool for visualizing the relative institutional capacity of LGUs and identifying entry points for targeted interventions to strengthen land use planning and compliance monitoring systems.

## 3. Results and Discussion

### 3.1. Respondent Profile

There were 666 LGUs participating in the Philippines for the national institutional survey. Respondents are a representative cross-section of local governments with representation of different income classes, administrative types, and geographic areas. The majority response was from municipalities (89.04%), followed by component cities (7.81%) and highly urbanized cities (3.15%). By income class, more than two thirds (67.12%) were from 1st –2nd class LGUs, 3rd – 4th class LGUs were 30.03%, and 5th LGUs were 2.85%. There were 17 regions represented in the dataset. This representation enables examination of the institutional environment for the adoption of geospatial monitoring to be robust and grounded.

### 3.2. CLUP Status

Among the surveyed LGUs, 341 (51.2%) reported having updated CLUPs, while 300 (45.0%) indicated that their CLUPs are outdated or due for updating. A smaller subset, 25 LGUs (3.8%), reported having no CLUP at all (Figure 2).

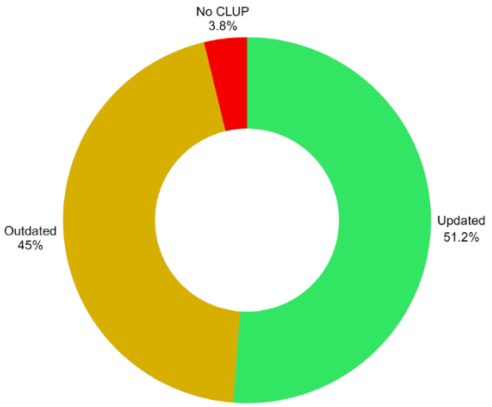


Figure 2. Status of the CLUPs of the respondent LGUs

CLUP status refers to the current condition of an LGU's land use plan in terms of its existence and relevance. An updated CLUP is one that has been recently formulated or revised within the planning cycle prescribed by the DHSUD, usually covering a 9–12-year horizon, and thus reflects present socio-economic, environmental, and physical development conditions. An outdated CLUP is one that has lapsed beyond its intended period or has not been revised despite significant changes in local circumstances, while the absence of a CLUP signifies that the LGU has yet to prepare its foundational land use plan.

The process of CLUP formulation and updating is critical to effective land use governance. Updated CLUPs enable LGUs to align spatial strategies with current demographic pressures, infrastructure requirements, environmental constraints, and climate-related risks. Conversely, delays in updating CLUPs often stem from limited technical capacity, inadequate access to spatial data, financial constraints, or lack of external support—challenges that are particularly acute in smaller or less-resourced municipalities. LGUs with updated CLUPs are in a stronger position to implement zoning regulations, guide investment programming, and ensure alignment with national and regional development priorities.

### 3.3. GIS and Remote Sensing Capacity

Geographic Information System capacity among LGUs is notably uneven. In the survey, 41.75% of LGUs reported high GIS capacity (ratings of 4 or 5), indicating that they possess some level of access to GIS tools. However, capacity in this context refers not only to the availability of infrastructure (hardware, software, data) but also to the presence of trained personnel who can operate and maintain GIS platforms for planning and monitoring purposes. Many LGUs, particularly smaller and resource-constrained municipalities, lack in-house GIS officers or technical experts and often depend on third-party consultants or DHSUD Regional Offices for spatial analysis and mapping support.

GIS capacity is central to the adoption of digital land use monitoring tools, as it enables data visualization, spatial analysis, and integration with remote sensing products. The uneven distribution of GIS expertise reveals a significant institutional gap: while some LGUs are well-positioned to implement geospatial monitoring, a large number—especially lower-income municipalities—face barriers that hinder them from fully benefiting from emerging digital planning tools.

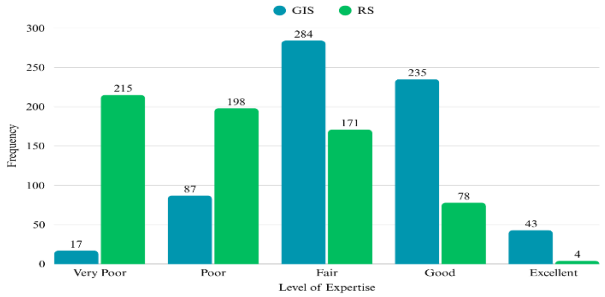


Figure 3. Level of GIS and RS Expertise Among LGUs

Remote sensing capacity is even more limited as seen in Figure 3. Only 12.31% of LGUs indicated high capacity in remote sensing, highlighting a substantial readiness gap. Remote sensing involves the processing and interpretation of satellite imagery for tasks such as land cover mapping, change detection, and environmental monitoring. Unlike GIS, which is more commonly used in planning offices, RS requires specialized training, advanced software, and technical expertise. The low levels of reported RS capacity suggest that many LGUs have limited exposure to these technologies, lack personnel with specialized skills, and perceive high technical difficulty in adopting such methods.

The absence of adequate remote sensing capacity restricts LGUs' ability to independently verify geospatial changes, making them reliant on external agencies for information. This dependency limits their autonomy in zoning enforcement, monitoring land use compliance, and climate risk assessment. Addressing these gaps requires targeted capacity-building programs, provision of accessible training modules, and the development of user-friendly platforms that simplify complex geospatial processes.

### 3.4. Land Use Enforcement and Monitoring Practices

The presence of a dedicated enforcement team emerged as one of the most critical determinants of land use policy implementation. Slightly less than a third of LGUs (29.88%) reported having such a team, typically mandated to issue violation notices, conduct on-site inspections, and impose local zoning rules. These LGUs consistently demonstrated higher levels of institutional preparedness, underscoring that enforcement capacity is not just a procedural add-on but a core component of effective land administration. However, the successful functioning of these teams depends on adequate staffing, clear institutional mandates, and close coordination with planning offices. The absence of special enforcement units—especially in lower-income and rural municipalities—reflects a structural deficiency that constrains routine policy implementation regardless of technological availability.

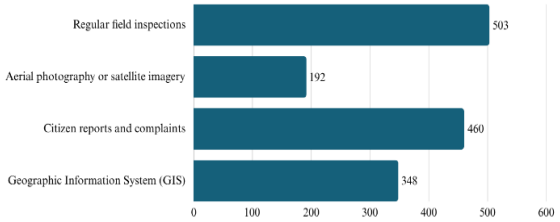


Figure 4. Different Monitoring Practices of LGUs

Despite this, most LGUs still rely on conventional monitoring mechanisms. Field inspection remains the default tool, employed by 75.53% of LGUs to identify and quantify zoning violations as seen in Figure 4. While routine or complaint-driven inspections are important, they are labor-intensive and insufficient for tracking rapid land use changes, particularly in geographically large or rapidly urbanizing areas. The lack of a dedicated team exacerbates these limitations, since monitoring becomes reactive rather than proactive.

Citizen participation also supplements enforcement, with 69.07% of LGUs reporting the use of community complaints or reports. This points to civic engagement, but the reliability of citizen monitoring is often constrained by low public awareness, limited access to reporting mechanisms, and inconsistent follow-through. Technology-based approaches, meanwhile, remain underutilized. Only 28.83% of LGUs reported using aerial or satellite photos, while 52.25% used GIS programs for compliance monitoring. This low adoption rate reflects ongoing capacity gaps but also signals a major opportunity: where enforcement teams are in place, digital tools can exponentially expand their effectiveness by enabling real-time detection, streamlined data sharing, and more systematic monitoring. Without enforcement units to operationalize these tools, however, the benefits of technology remain largely untapped.

Percentages presented for the monitoring practices reflect the proportion of LGUs selecting each monitoring method. Because respondents could select more than one option, totals exceed 100%. This approach provides a fuller picture of the range of monitoring practices adopted by LGUs.

### 3.5. Land Use Data Management Systems

Effective land use regulation rests on the foundation of a well-structured, accessible, and continuously updated land use data management system. Such a system serves not only as the backbone of zoning enforcement and spatial planning but also as a crucial mechanism for coordination with national agencies and integration into broader geospatial monitoring platforms.

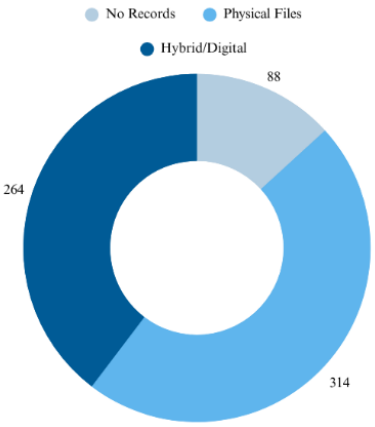


Figure 5. Distribution of LGUs by Type of Land Use Data Management System

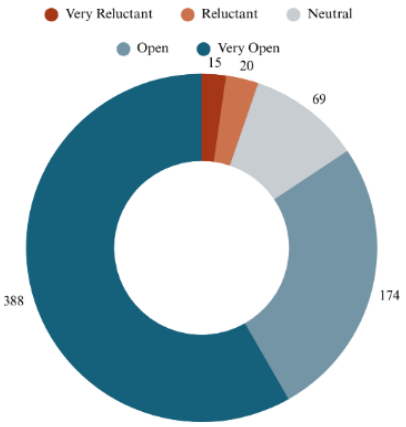


Figure 6. LGU Willingness to Adopt a Geospatial Monitoring Tool

Survey results revealed significant disparities in the status of LGU land use data systems as seen in Figure 5. Specifically, 13.21% of LGUs reported having no systematic land use data records at all, 47.15% still rely exclusively on physical files, and only 39.64% maintain either a fully digital or hybrid (digital–physical) database.

The presence of a digital or hybrid database is indispensable for transitioning toward automated compliance monitoring. Digital systems offer clear advantages: they enable efficient archiving, faster retrieval, and analytic processing of spatial data, while also being inherently compatible with GIS platforms and other geospatial applications. Notably, LGUs with digital or hybrid systems also tended to report higher levels of GIS capacity, highlighting a reinforcing relationship between digitization and technical preparedness.

In contrast, reliance on physical-only systems introduces several drawbacks: risk of data loss, duplication of records, delayed retrieval processes, and minimal interoperability with geospatial monitoring tools. These deficiencies severely restrict the ability of LGUs to integrate with automated compliance assessment platforms and undermine opportunities for inter-agency cooperation and data sharing.

As the Philippines moves toward the national expansion of geospatial land use monitoring, the digital transformation of LGU data systems must be treated as a core institutional reform. Building resilient digital infrastructures, standardizing data formats, and enhancing staff capacity in data management are critical steps to ensure consistency, reliability, and efficiency in the enforcement of land use regulations. Without this foundation, advanced monitoring technologies—no matter how capable—will not be fully operationalized at the local level.

### 3.6. Willingness to Adopt a Geospatial Monitoring Tool

Despite technical and infrastructure limitations, LGUs expressed a remarkably high openness to adopting geospatial land use monitoring systems. Survey findings reveal that 84.26% of respondents reported being "open" or "very open" to the use of such tools, even in the absence of full technical capacity at present as shown in Figure 6. This demonstrates a strong foundation of institutional readiness for innovation and digital transformation in land governance.

This openness serves as a critical entry point for digital transformation. It reflects a growing recognition among LGUs of the value of geospatial technologies, particularly in enabling more efficient compliance monitoring, faster detection of land use violations, and enhanced spatial planning. Notably, several LGUs also indicated interest in extending the use of these tools beyond compliance functions—to climate resilience planning, disaster risk reduction, and infrastructure development.

Importantly, the high willingness score indicates that perceived barriers—such as limited funding, staff training requirements, and technical assistance gaps—are not absolute inhibitors of adoption. Instead, LGUs appear to be seeking avenues for collaboration and support that would enable them to transition into digital land use monitoring. Qualitative remarks from respondents underscored the need for national government assistance, targeted capacity-building programs, and cost-effective, locally adaptable technologies.

However, willingness by itself is insufficient to guarantee adoption. Without structured support mechanisms—such as sustainable funding arrangements, systematic training programs, and continued technical backstopping—even the most willing LGUs may fail to transition successfully. For this reason, openness must be viewed as institutional momentum that requires strategic intervention from national agencies, development partners, and civil society organizations.

The findings emphasize that institutional culture in many LGUs is already aligned toward innovation. With the right enabling environment, this openness can be translated into durable capacity and scalable adoption of geospatial monitoring technologies across the country.

### 3.7. Expert-Derived Weights for Institutional Readiness

The results of the AHP summarized in Figure 7, show that among the six indicators of institutional readiness for geospatial land use monitoring, CLUP Status emerged as the most critical factor, receiving the highest priority weight of 20.6 %. This indicates that experts consider the existence of a CLUP as the fundamental foundation of readiness. Without a current and legally supported CLUP, efforts to institutionalize geospatial monitoring are seen as less effective.

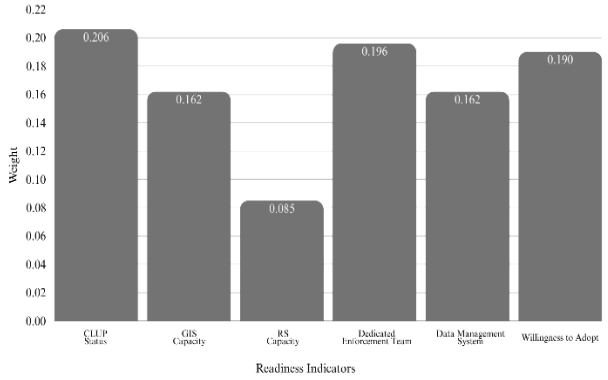


Figure 7. Consolidated Indicator Weights.

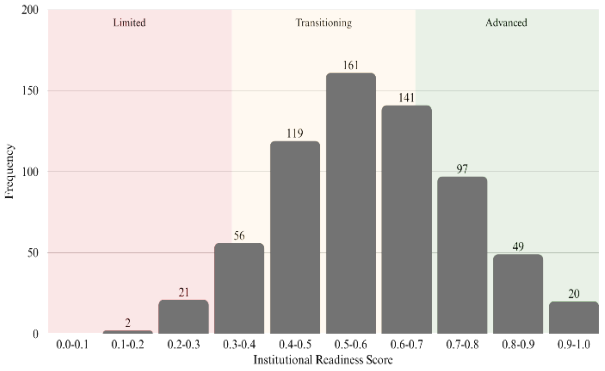


Figure 8. Distribution of Institutional Readiness Scores Among LGUs.

The second and third highest priorities are Dedicated Enforcement Team (19.6 %) and Willingness to Adopt (19.0 %). These findings highlight that institutional readiness is not only dependent on the presence of plans and technical tools but also on the organizational structures and human resources dedicated to enforcement, as well as the openness of local governments to adopt new technologies and processes. This underscores the importance of strengthening institutional commitment and ensuring that local governments are motivated and capable of operationalizing compliance monitoring.

Meanwhile, Data Management System (16.2 %) and Geographic Information System (GIS) Capacity (16.2 %) are both viewed as moderately important enablers. Although they do not rank as highly as enforcement capacity or willingness to adopt, they remain essential components that support data-driven decision-making and spatial analysis. These indicators ensure that land use data can be efficiently stored, managed, and visualized, thereby providing the technical backbone for monitoring compliance.

Finally, Remote Sensing Capacity (8.5 %) was given the lowest weight, suggesting that while it is a valuable technical capability, it is not as central to institutional readiness compared to governance, enforcement, and willingness-related factors. This implies that technology alone cannot drive readiness without a strong institutional framework and local commitment.

The consistency of the judgments was assessed to ensure the reliability of the comparisons. The computed consistency ratio is 0.0033, which is well below the commonly accepted threshold of 0.1. This indicates that the pairwise comparisons are highly consistent, and the derived weights can be confidently used in subsequent analyses.

### 3.8. Institutional Readiness Score and Interpretation

To better understand the spread of institutional preparedness among LGUs, a histogram of the readiness score (ranging from 0 to 1) was generated (Figure 8). The distribution of readiness scores among participating LGUs is left-skewed, meaning a larger number of LGUs are clustered toward the higher end of the readiness spectrum. This suggests that while a minority of LGUs remain in the Limited category (0–0.33), most are concentrated in the Transitioning (0.34–0.66) and Advanced (0.67–1.0) ranges. Such a distribution is an encouraging sign: rather than being uniformly constrained, many LGUs have already built substantial foundations in planning, data systems, and technical capacity.

The skewness also implies the presence of "pace-setters" — LGUs in the Advanced group that can serve as models and knowledge-sharing hubs — while only a small share of lagging LGUs will require more intensive, foundational support. Overall, the distribution highlights that institutional readiness for geospatial land use monitoring is uneven, but the momentum tilts toward higher levels of preparedness.

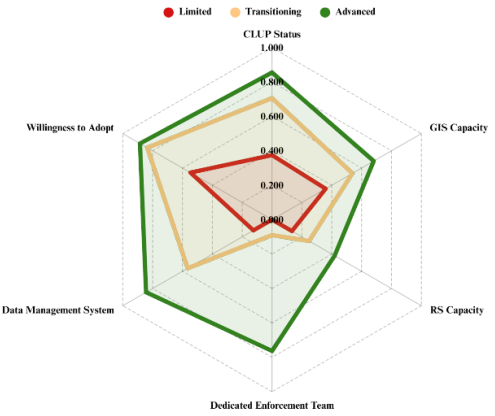


Figure 9. Radar Plot of Average Readiness Indicator Scores of Different Categories

Within this context, the results reveal distinct differences across the three categories as seen in Figure 9. LGUs classified as Limited exhibit very low capacity across most indicators. While their willingness to adopt new systems is moderate (0.547), they lag significantly in critical institutional dimensions, particularly the absence of a dedicated enforcement team (0.000) and weak data management systems (0.125). Their GIS (0.359) and RS (0.133) capabilities remain minimal, and even their CLUP status (0.375) suggests many plans are outdated or not fully developed. These findings highlight that Limited LGUs are constrained by both technical and organizational barriers, which hinder their ability to integrate geospatial monitoring tools. The implication is clear: interventions for this group should prioritize the basics—strengthening enforcement structures, improving data systems, and providing foundational GIS/RS training—before advanced monitoring can be adopted.

In contrast, Transitioning LGUs present a more balanced profile, with noticeable improvements in technical capacity and institutional systems. Their CLUP status (0.706) indicates that many have updated or in-progress land use plans, while GIS (0.538) and RS (0.248) capacities are modest but clearly

advancing. Importantly, these LGUs demonstrate stronger foundations in data management (0.565) and a high degree of willingness to adopt (0.836). However, their institutional enforcement capacity remains weak (0.090), which could undermine compliance monitoring even with better tools and data. This suggests that while Transitioning LGUs are on the path toward readiness, targeted interventions are still needed to build enforcement mechanisms and enhance remote sensing applications. With the right support, these LGUs could quickly progress toward advanced readiness.

LGUs classified as Advanced reflect the highest levels of readiness, with consistently strong scores across all dimensions. Their CLUP status (0.855) confirms that comprehensive and updated plans are in place, supported by robust GIS (0.681) and RS (0.419) capacities. Advanced LGUs also stand out for having dedicated enforcement teams (0.763) and well-established data management systems (0.844), enabling them to operationalize monitoring effectively. Moreover, their willingness to adopt (0.885) underscores both technical preparedness and institutional openness to innovation. These strengths indicate that Advanced LGUs are not only ready to integrate geospatial monitoring tools but are also positioned to serve as demonstration sites or champions for scaling adoption nationwide.

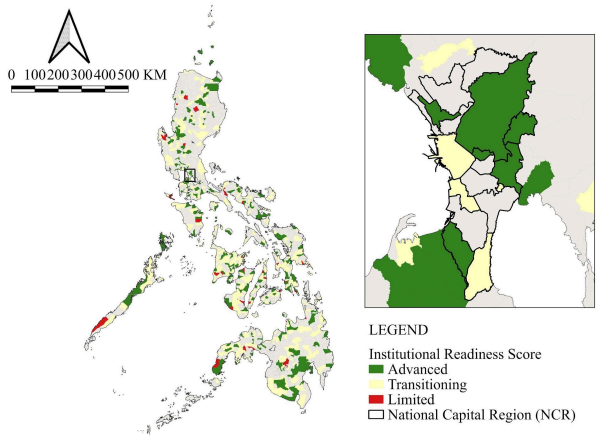


Figure 9. Map of LGUs According to Readiness Level

In addition to the radar and histogram plots, the spatial distribution of LGUs by readiness level is illustrated in Figure 9. This national map categorizes LGUs into three levels—Advanced, Transitioning, and Limited—based on their computed readiness scores. At the regional level, NCR stands out with 60% of institutions classified as advanced and none at the limited stage, underscoring its relatively higher institutional maturity and resource availability. Region XII and IV-A also demonstrate comparatively higher levels of readiness, with nearly half of their institutions already advanced. In contrast, Regions IX, VII, and XIII remain heavily concentrated in the transitioning category (over 70%) with only a small share reaching advanced status, suggesting that these areas may face challenges such as limited technical infrastructure, training, or funding support.

## 4. Conclusion and Recommendations

This research probed the institutional willingness and capacity of Philippine LGUs to embrace geospatial land use monitoring technologies through an examination of six essential indicators: status of CLUP, GIS capacity, remote sensing capacity, enforcement tools, data management systems, and adoptability for new technologies. Results of a survey of 666 LGUs across the country shows that most LGUs are positioned within the Transitioning category, with fewer classified as Advanced and only a small number remaining Limited. The readiness score distribution is left-skewed, indicating that the majority of LGUs already demonstrate moderate-to-high capacity and are closer to readiness than not. This is an encouraging finding, as it suggests a strong baseline for scaling up automated land use compliance monitoring nationwide. However, the radar chart analysis reveals uneven progress across dimensions: while willingness to adopt new systems and CLUP updating are relatively strong, persistent gaps remain in remote sensing capacity, data management systems, and the presence of dedicated enforcement teams. These gaps reveal the structural and technical bottlenecks that must be addressed to transition LGUs from readiness to sustained adoption.

Viewed through the lens of the IAD framework, these patterns underscore how existing rules, resource endowments, and organizational arrangements influence the capacity of LGUs to act within the compliance monitoring arena. The uneven distribution of readiness reflects structural barriers that limit many LGUs, while also pointing to opportunities for policy interventions that can strengthen collective outcomes. The clustering of LGUs into different readiness levels signals the need for differentiated strategies that are responsive to their institutional contexts.

Based on these insights, the following recommendations are proposed:

First, capacity building for Limited LGUs must focus on strengthening the basic foundations of compliance monitoring. This includes targeted training programs on GIS and remote sensing, access to standardized tools, and provision of technical assistance. National government agencies should also consider establishing regional support hubs to provide shared services to resource-constrained LGUs.

Second, Transitioning LGUs require structured pathways to scale up adoption. This may involve institutionalizing geospatial monitoring into their zoning and enforcement processes, developing protocols for integrating remote sensing data into regular reporting, and aligning local initiatives with national guidelines. Strengthening collaboration with academic institutions and private providers can also accelerate technology transfer.

Third, Advanced LGUs should be supported in sustaining and deepening their innovations. Incentives for continued innovation, peer-to-peer mentoring programs, and the establishment of knowledge-sharing platforms can amplify their role as frontrunners. Their success stories should be documented and disseminated to serve as models for replication.

Finally, national agencies such as DHSUD, in partnership with oversight bodies, should integrate differentiated support mechanisms into policy frameworks while also addressing the limitation on field validation. Embedding readiness-based pathways into national programs, complemented by localized case studies and on-the-ground validation, will ensure that policies are both evidence-based and responsive to the varying capacities of LGUs.

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**Appendix**

Appendix A. Consolidated Decision Matrix

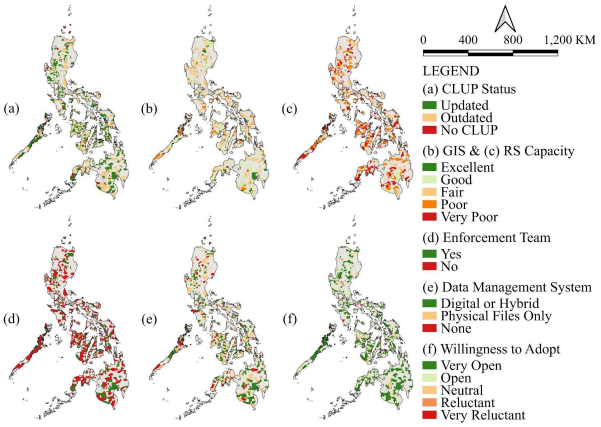
Aggregation of individual judgments for 37 Land Use Planning and Monitoring Experts

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| **1** | 1 | 1.47 | 2.59 | 1.06 | 1.13 | 0.97 |
| **2** | 0.68 | 1 | 2.18 | 0.85 | 0.95 | 0.88 |
| **3** | 0.39 | 0.46 | 1 | 0.45 | 0.56 | 0.50 |
| **4** | 0.94 | 1.18 | 2.22 | 1 | 1.36 | 1.00 |
| **5** | 0.88 | 1.06 | 1.79 | 0.73 | 1 | 0.86 |
| **6** | 1.03 | 1.14 | 2.00 | 1.00 | 1.17 | 1 |

Indicators:

1: CLUP Status
2: GIS Capacity
3: RS Capacity
4: Dedicated Enforcement Team
5: Data Management System
6: Willingness to Adopt

Appendix B. Spatial Distribution of LGU scores by indicator




High-Resolution Images of the Maps can also be accessed here: https://bit.ly/Maps_InstitutionalReadiness

Appendix C. Key Survey Questions

CLUP Status (Institutional Environment)
- What is the status of your LGU's Comprehensive Land Use Plan (CLUP)? (Updated, Outdated, No CLUP)
- Are you currently in the process of updating the CLUP? (Yes, No)

GIS Capacity (Institutional Capacity)
- How would you rate your LGU's expertise in using Geographic Information Systems (GIS) for land use and zoning monitoring? (Very Poor, Poor, Fair, Good, Excellent)

RS Capacity (Institutional Capacity)
- How would you rate your LGU's expertise in using remote sensing technologies for land use and zoning monitoring? (Very Poor, Poor, Fair, Good, Excellent)

Dedicated Enforcement Team (Institutional Arrangements)
- Currently, does your LGU have a dedicated enforcement team for land use violations? (Yes, No)
- What are the primary methods used by your LGU to monitor land use compliance? (Check all that apply) (Regular field inspections, Aerial photography or satellite imagery, Citizen reports and complaints, GIS)
- What are the usual challenges faced by your LGU in monitoring and enforcing land use compliance? (open ended)

Data Management System (Institutional Capacities)
- Does your LGU maintain a record of land use decisions? (Yes, No)
- If yes, how are these records maintained? (Check all that apply) (Physical Files, Digital Database, Not Applicable)

Willingness to Adopt (Institutional Capacities)
- How open is your LGU to adopting new technology solutions which utilizes satellite imagery, GIS, and machine learning to improve zoning enforcement, land use planning, and community safety? (Very Reluctant, Reluctant, Neutral, Open, Very Open)
- What are the key factors that would influence your decision to implement such a tool in your LGU? (open ended)

The full questionnaire can also be accessed here: https://bit.ly/InstitutionalSurvey

Appendix D. Regional Readiness to Adopt Geospatial Tools for Land Use Monitoring and Enforcement

| Region | Limited | Transitioning | Advanced |
|---|---|---|---|
| NCR | 0.00% | 40.00% | 60.00% |
| CAR | 6.90% | 65.52% | 27.59% |
| I | 7.89% | 55.26% | 36.84% |
| II | 0.00% | 61.29% | 38.71% |
| III | 2.63% | 60.53% | 36.84% |
| IV-A | 1.96% | 54.90% | 43.14% |
| IV-B | 6.38% | 61.70% | 31.91% |
| V | 2.22% | 71.11% | 26.67% |
| VI | 4.23% | 70.42% | 25.35% |
| VII | 7.69% | 73.08% | 19.23% |
| VIII | 8.62% | 62.07% | 29.31% |
| IX | 6.82% | 75.00% | 18.18% |
| X | 3.45% | 62.07% | 34.48% |
| XI | 0.00% | 64.71% | 35.29% |
| XII | 2.56% | 48.72% | 48.72% |
| XIII | 3.57% | 71.43% | 25.00% |
| NIR | 7.69% | 58.97% | 33.33% |
| **Total** | **4.80%** | **63.51%** | **31.68%** |