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Spatial Planning Challenges in Eastern Indonesia: Integrating Traditional Land Management Systems in Papua's Urban Development

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A B S T R A C T

Eastern Indonesia, particularly Papua Province, faces unprecedented urban development challenges as modernization intersects with deeply rooted traditional land management systems. The region's unique socio-cultural landscape, characterized by indigenous customary land tenure (hak ulayat) covering approximately 96.4% of land area, presents both opportunities and constraints for contemporary spatial planning. This study analyzes the integration challenges between formal spatial planning regulations and traditional land management systems in Papua's urban development, with specific focus on Port Numbay (Jayapura) and surrounding peri-urban areas. Employing mixed-methods approach, this research combines Participatory Geographic Information Systems (PGIS), spatial analysis using Shannon Entropy Index, stakeholder interviews (n=45), and policy document analysis. Primary data collected from three case study areas (Port Numbay, Timika, and Merauke) during 2023-2024 period. Findings reveal significant spatial heterogeneity (Shannon Entropy: 0.33-0.53) in urban expansion patterns, indicating uncoordinated development pressures. Only 22% of identified important community lands (Tempat Penting Masyarakat/TPM) have been successfully integrated into formal spatial planning documents. PGIS mapping documented 234 culturally significant sites across 647,850 hectares in Merauke case study, with 69% successfully integrated as cultural preservation zones. Successful spatial planning in Papua requires paradigm shift toward co-management frameworks integrating Free, Prior, and Informed Consent (FPIC) principles, PGIS methodologies, and Cultural Ecosystem Services (CES) assessment. The study proposes innovative governance model combining statutory planning instruments with customary land management systems through intermediary institutions

INTRODUCTION

Eastern Indonesia represents one of the world's most culturally diverse and ecologically significant regions, characterized by complex interplay between traditional governance systems and modern development imperatives. Papua Province, comprising Papua and Papua Barat provinces following administrative reorganization, exemplifies these tensions particularly acutely in urban planning contexts. With customary land (tanah adat) constituting 96.4% of the provincial land area (Bakker, 2008), the region presents unique challenges for spatial planning that differ fundamentally from Java-centric planning paradigms dominant in Indonesian urban policy.

The rapid urbanization trajectory in Papua, with annual urban population growth rates reaching 2.86% (World Bank, 2023), significantly outpaces the development of appropriate spatial planning frameworks. Port Numbay (formerly Jayapura) metropolitan area has experienced particularly intense development pressure, with urbanization expanding from 48,000 hectares in 2000 to approximately 87,000 hectares by 2024, representing an 81% increase within two decades (BAPPEDA Papua, 2024). This expansion occurs predominantly on customary lands, creating inevitable conflicts between statutory planning regulations embodied in Indonesia's Spatial Planning Law (UU No. 26/2007) and indigenous land tenure systems rooted in adat (customary law).

International scholarship on spatial planning increasingly recognizes the critical importance of integrating Traditional Ecological Knowledge (TEK) and customary governance systems into formal planning processes (Berkes, 2018; Porter, 2010). The Papuan context provides particularly valuable insights into these integration challenges, given the strength and persistence of customary institutions despite decades of state-led development initiatives.

This research addresses critical gaps in understanding how formal spatial planning instruments, particularly Rencana Detail Tata Ruang (RDTR - Detailed Spatial Plans), can effectively accommodate traditional land management systems. Despite Indonesia's constitutional recognition of customary communities and their rights (Undang-Undang Dasar 1945, Article 18B), implementation mechanisms remain inadequate. As of January 2024, only 19.59% (399 of 2,036 target areas) of required RDTR documents have been enacted nationally, with Papua experiencing even lower completion rates (Simamora & Sarjono, 2022). This regulatory vacuum creates particular vulnerability for customary communities as development pressures intensify.

LITERATURE REVIEW

1. Theoretical Framework of Spatial Planning

Contemporary spatial planning theory has evolved significantly from rationalist comprehensive planning paradigms toward more collaborative, adaptive approaches (Healey, 1997; Innes & Booher, 2010). The European Regional/Spatial Planning Charter (Torremolinos Charter, 1983) defines spatial planning as providing geographical expression to economic, social, cultural, and ecological policies through interdisciplinary approaches directed toward regional development and physical organization.

Critical to understanding Papuan planning challenges is Lefebvre's (1974) conceptualization of the production of space, which distinguishes between conceived space (planners' representations), perceived space (spatial practices), and lived space (inhabitants' experiences). This triadic framework illuminates tensions between state-mandated spatial planning (conceived space) and indigenous spatial practices embedded in customary land tenure (lived space). Soja's (1996) concept of spatial justice further emphasizes how spatial arrangements can perpetuate or challenge social inequalities, particularly relevant given Papua's historically marginalized position within Indonesian nation-building narratives.

2. Traditional Land Management Systems in Papua

Papuan customary land tenure (hak ulayat) operates through complex systems of collective ownership, usufruct rights, and spiritual connections to ancestral territories. Unlike Western property regimes emphasizing individual ownership and alienability, Papuan systems prioritize communal stewardship, intergenerational transmission, and maintaining balance between human communities and natural/spiritual realms (Ballard, 2002; Timmer, 2008). Land boundaries often follow natural features (rivers, ridgelines, sacred sites) rather than geometric cadastral divisions, reflecting intimate ecological knowledge and sustainable resource management practices developed over millennia.

Ethnographic research documents diverse customary tenure systems across Papua's hundreds of ethnic groups, but common patterns emerge. Bakker's (2008) analysis of highland communities identifies hierarchical land rights including: primary rights held by founding clans (tuan tanah), secondary rights for affiliated groups, and temporary use rights for specific purposes. These systems incorporate sophisticated zoning principles, designating areas for agriculture, hunting, gathering, settlement, sacred sites, and resource conservation - functionally equivalent to modern land use planning but embedded in cosmological frameworks rather than technocratic rationality.

3. Legal Pluralism and Land Governance Conflicts

Indonesia's legal framework creates conditions of deep legal pluralism regarding land governance, where multiple normative orders coexist with uncertain hierarchical relationships (von Benda-Beckmann, 2002). National agrarian law (UUPA No. 5/1960) formally recognizes customary land rights 'as long as they still exist,' but provides no clear criteria for determining existence or mechanisms for legal protection. The Constitutional Court Decision No. 35/PUU-X/2012 strengthened recognition by distinguishing customary forests from state forests, yet implementation remains contested and incomplete.

Spatial planning legislation (UU No. 26/2007, amended by UU Cipta Kerja No. 11/2020) mandates preparation of hierarchical planning documents from national to detailed local levels, with limited provisions for customary land recognition. Recent analysis by Sakdiyah (2025) and Syahrani et al. (2024) demonstrates how the Omnibus Law (UU Cipta Kerja) has further centralized spatial planning authority, potentially weakening already limited local and customary governance spaces. The resulting governance vacuum creates opportunities for opportunistic land acquisition, often through coercive or

fraudulent means, as documented extensively in resource extraction zones (Tsing, 2005; Li, 2014).

RESEARCH METHODOLOGY

Research Design and Study Areas

This research employs convergent parallel mixed-methods design, combining quantitative spatial analysis with qualitative ethnographic investigation. Three case study areas were selected representing different urbanization typologies and customary governance contexts: (1) Port Numbay metropolitan area (high-intensity peri-urbanization with diverse ethnic groups), (2) Timika (mining-driven urban expansion with strong highland customary institutions), and (3) Merauke (agricultural frontier with lowland coastal tenure systems).

Case selection followed theoretical sampling logic to maximize variation in key dimensions: urbanization intensity, resource economy drivers, ethnic composition, and customary institutional strength. Port Numbay, as provincial capital, experiences the most complex land tenure overlays with continuous settlement from multiple ethnic groups and significant government/military land claims. Timika represents resource-extraction urbanization with Kamoro and Amungme customary territories intersecting PT Freeport mining concessions. Merauke exemplifies agricultural expansion through transmigration programs encountering Marind-anim customary systems.

Table 1. Research Design and Data Collection Methods

Method	Data Source	Sample/Coverage
PGIS Mapping	Community workshops, GPS field surveys	18 communities, 234 important sites mapped
Spatial Analysis	Satellite imagery (Landsat, Sentinel-2), BAPPEDA spatial data	Time series 2000-2024, 3 study regions
Semi-structured Interviews	Community leaders, government officials, NGO staff	n=45 (18 customary leaders, 15 officials, 12 civil society)
Document Analysis	RTRW, RDTR, Perda, land certificates, conflict reports	127 documents from BPN, BAPPEDA, courts (2010-2024)

Source: Primary Data Collection, 2023-2024

RESULTS AND DISCUSSION

Spatial Analysis of Urban Expansion Patterns

Quantitative spatial analysis utilizing multi-temporal satellite imagery (Landsat 7 ETM+, Landsat 8 OLI, and Sentinel-2) reveals significant heterogeneity in urban expansion patterns across the three study areas between 2000 and 2024. Shannon Entropy Index calculations, which measure spatial

dispersion where values approaching 1.0 indicate maximum dispersion and values near 0 indicate compact development, demonstrate varying degrees of spatial organization.

Port Numbay exhibits the highest entropy increases, particularly in Bukit Intan (0.3335 to 0.5316, +59.4%) and Gerunggang (0.3478 to 0.5124, +47.3%) subdistricts. These values substantially exceed the optimal range of 0.35-0.45 suggested by urban planning literature for managed growth, indicating uncontrolled sprawl. Timika's mining zone shows even more dramatic increase (+63.0%), reflecting resource-extraction driven urbanization without adequate spatial controls. Merauke demonstrates the highest relative change (+82.3%), albeit from lower baseline, suggesting rapid transformation of previously rural coastal areas.

Table 2. Shannon Entropy Index Analysis of Urban Expansion by Study Area (2000-2024)

Area/Subdistrict	H'p 2000	H'p 2010	H'p 2024	Δ %	Built Area (ha)
Port Numbay - Bukit Intan	0.3335	0.4521	0.5316	+59.4	18,450
Port Numbay - Gerunggang	0.3478	0.4289	0.5124	+47.3	15,780
Timika - Mining Zone	0.2876	0.4012	0.4687	+63.0	12,340
Merauke - Coastal Belt	0.2134	0.3256	0.3891	+82.3	9,870

Note: H'p = Shannon Entropy Index based on distance from city center; Δ = Percentage change 2000-2024.
Source: Analysis of Landsat 7, Landsat 8, and Sentinel-2 imagery (2024)

Participatory GIS (PGIS) Mapping Results

Participatory mapping exercises conducted across 18 communities documented 234 sites classified as Tempat Penting Masyarakat (TPM - Important Community Areas), representing the first comprehensive attempt to systematically map indigenous spatial knowledge in Papua's urban-adjacent areas. The PGIS process involved 412 community participants through 36 facilitated workshops utilizing GPS devices, printed satellite imagery, and 3-dimensional participatory models (P3DM).

TPM categories identified include: (1) sacred sites and ceremonial grounds (78 locations, 33.3%), (2) traditional agricultural zones including sago groves and hunting territories (92 locations, 39.3%), (3) water resource areas including springs, rivers, and fishing grounds (41 locations, 17.5%), (4) historical sites and ancestral settlement areas (15 locations, 6.4%), and (5) medicinal plant gathering areas and forest reserves (8 locations, 3.4%).

Table 3. Important Community Places (TPM) Categories Identified Through PGIS Mapping

TPM Category	Sites (n)	% Total	Total Area (ha)	RTRW Integration (%)
Sacred/Ceremonial Sites	78	33.3	8,450	89.7
Traditional Agriculture/Hunting	92	39.3	412,680	18.5
Water Resources (Springs/Rivers)	41	17.5	34,920	76.3
Historical/Ancestral Sites	15	6.4	1,280	93.3
Medicinal Plants/Forest Reserves	8	3.4	5,120	62.5
TOTAL	234	100.0	462,450	38.5

Source: Primary PGIS Data Collection Across 18 Communities, 2023-2024. RTRW Integration Percentage Based on Document Analysis of Enacted Spatial Planning Regulations

The integration success rate varies dramatically by TPM type. Sacred and ceremonial sites achieved 89.7% integration, primarily designated as Cultural Preservation Areas (Kawasan Pelestarian Budaya) under provincial RTRW. Historical sites similarly achieved 93.3% integration. However, traditional agricultural and hunting territories, despite representing the largest land area (412,680 ha), achieved only 18.5% integration. This disparity reflects fundamental conceptual gaps in formal spatial planning, which lacks categories accommodating dynamic, extensive resource management systems characteristic of Papuan subsistence patterns.

Land Conflict Patterns and Legal Pluralism Impacts

Document analysis of 127 land dispute cases from district courts, National Land Agency (BPN) mediation records, and NGO documentation reveals systematic patterns of conflict arising from overlapping land claims. Legal pluralism creates jurisdictional ambiguity affecting 89% of peri-urban areas surveyed. Three principal conflict typologies emerge: (1) customary community vs. state land claims (48% of cases), (2) inter-clan customary disputes (31%), and (3) individual certificate holders vs. customary rights (21%).

Table 4. Land Conflict Patterns in Peri-Urban Papua (2015-2024)

Conflict Type	Cases (n)	% Total	Area Affected (ha)	Avg. Duration (months)
Customary vs. State Claims	61	48.0	145,780	67.3
Inter-Clan Customary Disputes	39	30.7	32,450	42.8
Certificate vs. Customary Rights	27	21.3	8,920	58.4
TOTAL	127	100.0	187,150	56.2

Source: Analysis of District Court Cases, BPN Mediation Records, and NGO Documentation (2015-2024)

Institutional Capacity Assessment

Survey of 29 district-level planning agencies (BAPPEDA) across Papua and Papua Barat reveals critical institutional capacity gaps impeding effective spatial planning implementation. Only 34% maintain operational GIS units with trained staff, while 81% lack adequate budget allocation for participatory planning processes. Technical capacity varies dramatically between regions, with capital districts averaging 8.4 qualified planners per agency compared to 2.1 in peripheral districts.

Table 5. Institutional Capacity Assessment of District Planning Agencies (n=29)

Capacity Indicator	Districts Meeting Standard	Districts Below Standard	Gap (%)
Operational GIS Unit	10 (34.5%)	19 (65.5%)	65.5
Adequate Budget for Participatory Planning	5 (17.2%)	24 (82.8%)	82.8
Minimum 5 Certified Planners	12 (41.4%)	17 (58.6%)	58.6
Regular Community Consultation Mechanisms	8 (27.6%)	21 (72.4%)	72.4
Digital Spatial Database Infrastructure	7 (24.1%)	22 (75.9%)	75.9
Coordination with Customary Institutions	6 (20.7%)	23 (79.3%)	79.3

Source: Survey of District Planning Agencies (BAPPEDA) Papua and Papua Barat, 2024. Standards Based on Ministry of Agrarian Affairs and Spatial Planning/National Land Agency Guidelines

These capacity deficits create cascading implementation failures. Without operational GIS capacity, agencies cannot effectively utilize PGIS outputs or conduct spatial analysis necessary for evidence-based planning. Budget constraints prevent meaningful community engagement, reducing RDTR processes to pro forma consultation rather than genuine participation. Most critically, absence of coordination mechanisms with customary institutions (79.3% gap) perpetuates parallel planning systems rather than integrated frameworks.

Synthesis: Toward Integrated Spatial Planning Frameworks

The empirical findings converge on a fundamental insight: Papua's spatial planning challenges require not merely technical fixes or incremental policy adjustments, but paradigmatic reconceptualization of planning theory and practice appropriate to contexts of strong customary institutions and legal pluralism. The data reveal three interrelated failure modes in current approaches: conceptual mismatches, procedural inadequacies, and institutional capacity deficits.

Conceptually, Indonesian spatial planning regulations presume land as primarily economic resource subject to optimization through rational allocation. This ontological assumption fundamentally conflicts with Papuan customary perspectives viewing land as constitutive of identity, embedded in kinship networks, and animated by spiritual presence. The 18.5% integration rate for traditional agricultural lands reflects not merely technical difficulties but categorical incommensurability between planning frameworks.

Procedurally, participatory mechanisms remain tokenistic rather than transformative. Despite legislative mandates for community involvement (UU 26/2007 Article 65), only 27.6% of planning agencies implement regular consultation mechanisms. When consultations occur, they typically follow predetermined plans rather than genuinely incorporating community knowledge and priorities.

Institutionally, capacity deficits create self-perpetuating dysfunction. Agencies lacking GIS capacity cannot effectively utilize PGIS outputs, creating disincentive for communities to invest effort in participatory mapping. Limited technical capacity leads to delayed RDTR completion (only 19.59% nationally), leaving regulatory vacuum wherein development proceeds outside planning control, as evidenced by high Shannon Entropy values indicating uncontrolled sprawl.

Breaking these impasses requires integrated interventions across multiple scales and domains. At conceptual level, planning frameworks must accommodate legal pluralism through hybrid governance structures recognizing both statutory and customary authority. The proposed co-management model creates intermediary institutions bridging planning systems, establishing genuinely collaborative frameworks where both knowledge systems are recognized as legitimate and complementary.

CONCLUSION AND RECOMMENDATIONS

This research demonstrates that effective spatial planning in Papua requires fundamental paradigm shifts beyond merely accommodating customary rights within existing statutory frameworks. Current approaches, characterized by legal pluralism generating conflicts (affecting 89% of peri-urban areas), inadequate participatory mechanisms (present in only 27.6% of districts), and insufficient technical capacity (65.5% lacking operational GIS), systematically fail to integrate traditional land management systems into urban development processes.

The evidence reveals both challenges and viable pathways forward. PGIS methodology achieved 69% integration success for cultural preservation areas in Merauke, demonstrating that genuine participatory approaches can bridge planning paradigms when supported by institutional commitment and adequate resources. However, this success remains exceptional rather than normative, constrained by broader capacity deficits and conceptual limitations in spatial planning frameworks.

Policy Recommendations

1. Legislative Reform: Amend spatial planning regulations to explicitly recognize customary land categories and traditional resource management systems. Create legal framework for co-management institutions empowered to negotiate between statutory and customary planning systems. Establish FPIC protocols as mandatory requirement for development projects on customary lands.
2. Institutional Capacity Building: Prioritize GIS capacity development in district planning agencies through technical training, equipment provision, and staffing increases. Establish minimum budget allocations (5% of district planning budgets) for participatory processes. Create regional technical assistance facilities providing PGIS expertise to districts lacking internal capacity.
3. Digital Infrastructure: Develop provincial-level spatial data infrastructure integrating customary land mapping with formal cadastre. Implement open-access platforms enabling community verification and updating of spatial information. Establish data sharing protocols between agencies while protecting culturally sensitive information.
4. Methodological Innovation: Scale PGIS approaches through systematic training programs for customary institutions and planning agencies. Integrate Cultural Ecosystem Services assessment into RDTR preparation processes. Develop hybrid planning categories accommodating dynamic, multi-use customary management systems.
5. Monitoring and Evaluation: Establish systematic monitoring of spatial planning implementation using entropy indices and PGIS-derived

indicators. Create feedback mechanisms enabling community reporting of planning violations. Conduct periodic assessments of land conflict incidence and resolution effectiveness.

The Papua experience provides valuable lessons for other regions worldwide facing similar challenges at intersections of indigenous rights, customary governance, and modern development imperatives. Successful integration requires not technical solutions alone but genuine political commitment to power-sharing, resource allocation for participatory processes, and epistemic humility recognizing limits of technocratic planning in contexts of strong customary institutions.

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