Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

# From Protection to Negotiation: Socio-Ecological Dynamics of Paddy Farmland Loss in Peri-Urban Bandung, Indonesia

**Moh. Dulkiah**

moh.dulkiah@uinsgd.ac.id

Sunan Gunung Djati State Islamic University Bandung

**Rudi Kresna**

Regional Agency for Development Planning, Research and Innovation of Bandung Regency

**Anggi Saeful Majid**

Nexus Academic Indonesia

**Research Article**

**Keywords:** peri-urban farmland, socio-ecological change, human–environment interaction, negotiated governance, land-use change, Indonesia

**Posted Date:** March 12th, 2026

**DOI:** https://doi.org/10.21203/rs.3.rs-9024034/v1

**License:** This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

**Additional Declarations:** No competing interests reported.

# Abstract

Despite formal designation as protected agricultural land, paddy farmland in peri-urban regions continues to decline under rapid urbanization, raising questions about how human–environment interactions reshape protected landscapes over time. This study examines socio-ecological changes in protected paddy farmland in Bandung Regency, Indonesia, between 2010 and 2024. Using a mixed-methods approach, it combines longitudinal administrative land-use data with semi-structured interviews and focus group discussions involving government officials, farmers, developers, and community actors. Quantitative analysis reveals pronounced spatial unevenness and temporal acceleration in farmland conversion despite formal protection. Of the 16,915.76 hectares designated as protected, a cumulative net loss of 3,809 hectares occurred, with substantial inter-district variation in conversion intensity and Policy Compliance Index values, including negative outcomes in several districts. Rather than stabilizing following designation, conversion rates increased over time. Qualitative findings show that farmland protection is enacted through discretionary interpretation and everyday negotiation among actors facing development pressures, livelihood insecurity, and institutional constraints. Protection is thus experienced not as a fixed ecological boundary but as a socially mediated and situational process. The results suggest that peri-urban farmland loss reflects negotiated socio-ecological transformation rather than simple regulatory failure. By linking longitudinal land-use change with lived governance practices, this study contributes to human ecology by demonstrating how formal protection regimes are reshaped through everyday human–environment interactions, producing spatially uneven and accelerating landscape change.


# Introduction

Across rapidly urbanizing regions of the Global South, peri-urban farmland has emerged as a critical yet persistently under-theorized dimension of urban transformation. Rather than constituting residual rural space awaiting inevitable urban absorption, agricultural land at the urban fringe increasingly functions as a contested terrain where metropolitan expansion, food systems, environmental regulation, and everyday governance intersect. In Indonesia, this tension is institutionalized through the national Sustainable Agricultural Land Protection framework, a legal regime intended to safeguard agricultural land from conversion. Yet a growing body of empirical research demonstrates that formal designation alone has proven insufficient to stabilize peri-urban land use under conditions of accelerated metropolitan growth and socio-spatial restructuring (Gandharum et al., 2022; Rizqi & Manessa, 2025; Sanders et al., 2019).

While peri-urban farmland encompasses diverse agricultural forms, this study focuses on irrigated paddy fields, which occupy a particularly salient position within Indonesia's land governance regime. Paddy farmland is simultaneously a productive landscape, a legally protected land category, and a strategic infrastructure for national and regional food security. This combination renders paddy fields especially vulnerable to urban development pressures while also making them a revealing site for examining the limits of farmland protection policies in rapidly urbanizing contexts.

The Bandung Metropolitan Area, with Bandung Regency as its primary peri-urban hinterland, offers an instructive empirical setting for investigating these dynamics. As one of Indonesia's fastest-growing metropolitan regions, Bandung exemplifies polycentric urban expansion driven by infrastructure development, speculative land markets, and shifting governance priorities that increasingly rely on discretionary and negotiated arrangements (Dadashpoor & Malekzadeh, 2022; Sadewo et al., 2021). Quantitative evidence highlights both the scale and acceleration of peri-urban transformation: built-up areas expanded by more than 34 percent between 2007 and 2017, while irrigated paddy farmland experienced sustained decline. More strikingly, the rate of paddy farmland loss accelerated by a factor of 2.3 during the 2013–2020 period compared to the previous decade, indicating a structural shift in land-use dynamics rather than short-term fluctuation (Fuadina et al., 2020; Gandharum et al., 2022; Suriadikusumah et al., 2022).

These land-use changes are accompanied by intensifying environmental and food system pressures. Previous studies associate conversion under the Sustainable Agricultural Land Protection policy with rising land surface temperatures and increasing carbon emissions, reinforcing urban heat island effects across the metropolitan periphery (Buyadi et al., 2014; Paramita & Fukuda, 2014; Park et al., 2010). At the same time, the contraction of paddy farmland raises concerns regarding local and regional food security. Although urban farming initiatives and community-based responses have gained prominence, existing evidence suggests that such efforts remain insufficient to offset large-scale agricultural displacement at the metropolitan scale (Abdoellah et al., 2023; Pribadi et al., 2023; Rizqi & Manessa, 2025). These environmental and food system pressures are therefore not merely ecological outcomes, but are deeply intertwined with how farmland protection is governed in practice.

Policy debates commonly frame these outcomes as failures of enforcement, attributing farmland loss to weak monitoring, limited sanctions, or insufficient political commitment. While these explanations capture important aspects of implementation, they risk obscuring the governance processes through which farmland protection is enacted, contested, and selectively applied in practice. In Bandung Regency, the Sustainable Agricultural Land Protection policy operates within a dense field of competing interests involving farmers navigating livelihood insecurity, local governments balancing development imperatives and fiscal pressures, developers responding to market incentives, and communities negotiating environmental and social values in rapidly transforming landscapes (Dulkiah & Majid, 2025; Patiung & Dassir, 2025; Sadewo, 2017; Sanders et al., 2019; Saptutyningsih & Kamilasari, 2025).

To capture these dynamics, this study advances the concept of policy frictions, defined here as the persistent tensions that emerge when formal protection regimes encounter everyday governance practices shaped by negotiation, discretion, and unequal power relations. These frictions do not manifest solely through illegal conversion or regulatory violation, but also through negotiated compromises, informal mediation, selective enforcement, and adaptive practices that effectively rework policy implementation on the ground (Hudalah et al., 2016; Saptutyningsih & Kamilasari, 2025). Farmland protection, in this sense, operates less as a fixed regulatory outcome than as an ongoing process of contestation and accommodation.

Within this context, governance in peri-urban Bandung has increasingly shifted from a predominantly protectionist logic toward negotiation-based modes of regulation. Negotiation is understood not as a formalized participatory procedure, but as an everyday governance practice through which actors navigate competing claims over land, authority, and value. This includes discretionary enforcement, informal coordination, community-based arrangements, and the mobilization of local norms to legitimize land-use decisions and resolve conflict (Nasser et al., 2021; Patiung & Dassir, 2025; Rahmasary et al., 2021).

Community groups, youth initiatives, and urban farming networks—such as 1000kebun—have emerged as visible actors within this negotiated governance landscape. These actors mediate between formal policy objectives and lived realities while articulating alternative imaginaries of urban land use rooted in food security, environmental stewardship, and collective responsibility (Mubarak et al., 2021; Prasetiyo et al., 2016). Rather than simply implementing policy, they actively reinterpret and reassemble it, illustrating how peri-urban governance is produced through relational, negotiated, and uneven processes.

Despite increasing scholarly attention to peri-urbanization, much of the urban studies literature continues to treat farmland conversion either as a spatial outcome of urban growth or as an agrarian issue external to urban theory. This paper addresses this gap by reframing peri-urban paddy farmland protection as a constitutive element of urban governance itself—one shaped by everyday negotiation, multi-level power relations, and policy frictions that blur distinctions between urban and rural, formal and informal.

Accordingly, this study asks: how do policy frictions reshape the governance of farmland protection in peri-urban contexts, and through what everyday negotiation practices are protection policies transformed in practice? Empirically, the analysis focuses on implementation of the Sustainable Agricultural Land Protection policy in Bandung Regency, employing a mixed-methods research design that integrates longitudinal quantitative analysis of paddy farmland change (2010–2024) with qualitative examination of stakeholder experiences, negotiation practices, and everyday governance processes (Gandharum et al., 2022; Rahmasary et al., 2021; Sanders et al., 2019).

Grounded in the Bandung metropolitan region while engaging broader theoretical debates, this paper contributes to comparative urban research on peri-urbanization, land governance, and food systems in the Global South. It demonstrates that metropolitan expansion reconfigures agrarian spaces not simply through market forces or regulatory breakdown, but through negotiated governance processes that actively reshape protection outcomes over time. By foregrounding peri-urban paddy farmland as a site of everyday negotiation, the analysis shows how urban margins are not merely governed from the center, but play an active role in reconstituting metropolitan governance itself (Gandharum et al., 2022; Rizqi & Manessa, 2025; Sanders et al., 2019). This study is among the first to empirically demonstrate how temporal acceleration and spatial unevenness function as empirical signatures of negotiated farmland governance within formally protected peri-urban landscapes.

## Research Methods

# Research Design

This study employs a mixed-methods research design with an explanatory sequential logic to examine how policy frictions reshape the governance of Indonesia's Sustainable Agricultural Land Protection policy and through what everyday negotiation practices paddy farmland protection is transformed in peri-urban Bandung. The mixed-methods approach is adopted not to pursue methodological complementarity per se, but to analytically link observable longitudinal patterns of farmland change with the social, political, and institutional processes through which these outcomes are produced. This design is particularly appropriate for the study of land governance, where formal regulatory outcomes cannot be understood independently of discretion, negotiation, and everyday implementation practices (Creswell & Plano Clark, 2018).

## Quantitative Data and Longitudinal Analysis

The quantitative component is based on longitudinal administrative data documenting annual changes in the total area of irrigated paddy farmland designated under the Sustainable Agricultural Land Protection policy in Bandung Regency over the period 2010–2024. The data were obtained from the local Agriculture Office and consist of aggregated yearly records of paddy farmland extent. As the dataset does not include parcel-level coordinates, spatial geometry, or land-use classifications beyond total area, the analysis deliberately avoids spatial or geospatial techniques.

Instead, the quantitative analysis focuses on temporal dynamics, examining long-term trends, rates of change, and periods of acceleration or deceleration in farmland conversion. Trend analysis was used to identify structural trajectories of farmland decline, followed by simple linear extrapolation to generate indicative future scenarios under existing governance conditions. Linear extrapolation was conducted using standard least-squares estimation in spreadsheet-based statistical software. These projections are not intended as predictive or forecasting models in a strict sense, nor as precise estimates of future land-use outcomes. Rather, they function as heuristic analytical devices to illustrate the cumulative implications of continued policy frictions if prevailing institutional arrangements remain unchanged (McConnell, 2015).

To enhance data reliability, the administrative figures were cross-checked against publicly available regional planning documents and agricultural reports for overlapping years. While minor discrepancies in annual reporting were observed, overall trends were consistent across sources, supporting the use of the dataset for longitudinal analysis.

Qualitative Sampling Strategy and Data Collection

The qualitative component was designed to explain and contextualize the observed quantitative patterns by examining how the Sustainable Agricultural Land Protection policy is enacted, negotiated, and reshaped in everyday governance practices. Qualitative data collection combined semi-structured interviews, focus group discussions (FGDs), and document analysis.

Semi-structured interviews were conducted with approximately 15 key stakeholders. Participants were selected using purposive sampling to capture diversity across governance roles rather than statistical representativeness. Interviewees included local government officials involved in spatial planning and agricultural administration (approximately one-third of participants), paddy farmers and farmer representatives (approximately one-third), and private sector actors involved in land development or agricultural production (approximately one-third).

Interview locations were strategically selected based on longitudinal land-use trajectories rather than administrative coverage. Interviews were conducted in sub-districts experiencing high rates of farmland conversion, peri-urban zones adjacent to rapid metropolitan expansion corridors, and anomalous areas where paddy farmland area had remained stable or increased despite urbanization pressures. This sampling strategy enabled comparative insight into how policy frictions and negotiation practices vary across different governance and land-use contexts.

Interviews focused on experiences of policy implementation, perceptions of protection and enforcement, strategies for navigating development pressure, and everyday negotiation practices surrounding farmland conversion.

## Focus Group Discussions and Document Analysis

Focus group discussions were conducted with approximately 15–20 participants across multiple sessions. Each session lasted between 90 and 120 minutes and involved a mix of stakeholders, including government representatives, farmer organizations, community groups, and civil society actors. FGDs were structured around three main thematic blocks: (1) interpretations of farmland protection objectives and effectiveness; (2) experiences of negotiation and conflict in land-use decision-making; and (3) perceived trade-offs between development, food security, and environmental sustainability.

Discussions were audio-recorded with participant consent and transcribed verbatim. FGDs served not only as a data collection method but also as an analytical space for observing interactional dynamics, contestation, and the articulation of competing governance rationales (Morgan, 1997).

Document analysis complemented the interview and FGD data through systematic review of national legislation, regional regulations, spatial and development plans, and official policy reports related to farmland protection. This analysis established the formal regulatory framework and enabled identification of ambiguities and gaps between policy intent and governance practices.

## Data Analysis, Integration, and Validity

Qualitative data were analyzed thematically using NVivo software following a reflexive thematic approach (Braun and Clarke, 2006). Analysis proceeded iteratively from open coding to higher-order themes related to policy frictions, negotiation practices, power asymmetries, and everyday governance. Triangulation was conducted across interviews, FGDs, and documents to enhance analytical robustness.

Integration of quantitative and qualitative findings occurred primarily at the interpretation stage. For example, periods of accelerated farmland loss identified in the longitudinal analysis were examined alongside interview accounts from local officials and farmers describing increased discretionary approvals, development pressures, and negotiated land reclassification during the same periods. This integrative strategy enabled a relational explanation of how numerical governance outcomes are generated through socially embedded processes, rather than treating quantitative and qualitative findings as parallel analytical streams (Creswell and Plano Clark, 2018).

To enhance qualitative credibility, preliminary interpretations were discussed among the research team through peer debriefing, and consistency across stakeholder accounts was examined as an internal validity check.

## Ethical Considerations and Methodological Limitations

All participants were informed about the research objectives and provided informed consent prior to participation. Anonymity and confidentiality were maintained due to the political sensitivity of land governance and development processes.

Several limitations should be acknowledged. The absence of spatially explicit data constrains fine-grained geographic analysis, such as corridor-level or parcel-based modeling of land-use change. In addition, qualitative data may be subject to social desirability bias, particularly among officials discussing politically sensitive issues of enforcement and discretion. FGDs may also amplify dominant voices despite facilitation efforts. These limitations are analytically acknowledged and bounded.

By combining longitudinal non-spatial quantitative data with in-depth qualitative inquiry, this study provides a robust and theoretically grounded examination of how farmland protection governance outcomes emerge in practice, moving beyond descriptive accounts of farmland decline toward an analysis of policy frictions and negotiated governance in peri-urban contexts.

# Results

The Results section proceeds in three steps: first, it documents district-level and longitudinal patterns of paddy farmland change; second, it examines temporal acceleration and indicative future trajectories; and third, it presents stakeholder experiences of Sustainable Agricultural Land Protection policy implementation.

## Longitudinal Patterns of Paddy Farmland Change

This section presents longitudinal and district-level patterns of paddy farmland change under the Sustainable Agricultural Land Protection policy in Bandung Regency. The analysis draws on descriptive statistics derived from aggregated administrative data and focuses on realized protected paddy farmland area, observed land conversion, and policy performance indicators across districts. The purpose of this section is to document empirical patterns and variation in land-use outcomes, without advancing causal explanations, which are addressed in the subsequent Discussion.

### 1. District-Level Distribution of Protected Paddy Farmland and Land Conversion

Table 1 reports the extent of protected paddy farmland and observed land conversion across districts in Bandung Regency. The total area of paddy farmland designated under the Sustainable Agricultural Land Protection policy amounts to 16,915.76 hectares, with a cumulative net conversion of −3,809 hectares over the observation period.

**Table 1.** District-Level Protected Rice Field Area and Land Conversion

| No | District | Protected Rice Field Area (Ha) | Land Conversion (Ha) | % of Total Area | % of Total Conversion |
|---|---|---|---|---|---|
| 1 | Cileunyi | 80.46 | −411 | 0.48 | 10.79 |
| 2 | Kutawaringin | 279.39 | −390 | 1.65 | 10.24 |
| 3 | Cikancung | 479.16 | −386 | 2.83 | 10.13 |
| 4 | Pacet | 1,452.65 | −324 | 8.59 | 8.51 |
| 5 | Paseh | 938.12 | −309 | 5.55 | 8.11 |
| 6 | Ciparay | 2,178.58 | −293 | 12.88 | 7.70 |
| 7 | Arjasari | 893.30 | −204 | 5.28 | 5.36 |
| 8 | Pasirjambu | 730.47 | −198 | 4.32 | 5.20 |
| 9 | Cangkuang | 370.16 | −198 | 2.19 | 5.20 |
| 10 | Ibun | 897.71 | −131 | 5.31 | 3.44 |
| 11 | Baleendah | 646.93 | −123 | 3.83 | 3.23 |
| 12 | Rancaekek | 742.99 | −122 | 4.39 | 3.21 |
| 13 | Pangalengan | 393.21 | −101 | 2.33 | 2.65 |
| 14 | Solokanjeruk | 629.32 | −93 | 3.72 | 2.44 |
| 15 | Ciwidey | 942.17 | −90 | 5.57 | 2.36 |
| 16 | Nagreg | 83.43 | −82 | 0.49 | 2.15 |
| 17 | Majalaya | 641.45 | −79 | 3.79 | 2.07 |
| 18 | Cicalengka | 481.81 | −58 | 2.85 | 1.52 |
| 19 | Rancabali | 403.82 | −48 | 2.39 | 1.26 |
| 20 | Katapang | 236.80 | −46 | 1.40 | 1.21 |
| 21 | Cimenyan | 29.99 | −43 | 0.18 | 1.13 |
| 22 | Margaasih | 31.02 | −34 | 0.18 | 0.89 |
| 23 | Pameungpeuk | 513.84 | −26 | 3.04 | 0.68 |
| 24 | Cimaung | 1,285.75 | −26 | 7.60 | 0.68 |
| 25 | Kertasari | 64.18 | −20 | 0.38 | 0.53 |
| 26 | Soreang | 175.67 | −12 | 1.04 | 0.32 |
| 27 | Cilengkrang | 173.25 | −2 | 1.02 | 0.05 |

| | | | | | |
|---|---|---|---|---|---|
| 28 | Banjaran | 776.41 | +12 | 4.59 | −0.32 |
| 29 | Bojongsoang | 363.46 | +56 | 2.15 | −1.47 |
| 30 | Margahayu | – | −26 | – | 0.68 |
| 31 | Dayeuhkolot | – | −2 | – | 0.05 |
| **–** | **Total** | **16,915.76** | **−3,809** | **100** | **100** |

*Note: Negative values indicate conversion of agricultural land to non-agricultural use.*

The table reveals substantial variation across districts in both the scale of designated protected farmland and the magnitude of land conversion. Several districts with relatively limited protected areas contribute disproportionately to total conversion, while others with larger designated areas experience comparatively lower proportional losses. A small number of districts exhibit positive net changes in paddy farmland area over the observed period.

### 2. Descriptive Statistics and Policy Performance Indicators

To further characterize inter-district variation in farmland protection outcomes, Table 2 presents descriptive statistics for protected paddy farmland area, land conversion, the Policy Compliance Index (PCI), and the deviation between designated protection targets and realized land retention at the district level.

**Table 2.** District-Level Descriptive Statistics of Policy Performance Indicators

| Statistic | Protected Rice Field Area (Ha) | Land Conversion (Ha) | PCI (%) | Deviation (Ha) |
|---|---|---|---|---|
| Count | 29 | 29 | 29 | 29 |
| Mean | 583.29 | 135.07 | 49.20 | 135.07 |
| Standard Deviation | 480.18 | 126.82 | 97.12 | 126.82 |
| Minimum | 29.99 | 2.00 | −410.81 | 2.00 |
| 25th Percentile | 236.80 | 43.00 | 67.06 | 43.00 |
| Median | 481.81 | 90.00 | 80.99 | 90.00 |
| 75th Percentile | 776.41 | 198.00 | 87.96 | 198.00 |
| Maximum | 2,178.58 | 411.00 | 98.85 | 411.00 |

*Note: PCI = Policy Compliance Index. Negative PCI values indicate districts where realized land conversion exceeded designated protection targets, reflecting net losses beyond planned thresholds. Two districts are excluded from PCI calculation due to the absence of designated protected farmland.*

The descriptive statistics reveal pronounced inter-district dispersion in farmland protection outcomes. Although the average protected paddy farmland area exceeds 580 hectares per district, land conversion remains substantial, with a mean value of 135.07 hectares, indicating that formal designation has not uniformly translated into effective land retention.

PCI values exhibit particularly wide variation, including strongly negative values in several districts. This pattern signals not merely partial non-compliance, but a structural divergence between protection targets and observed land-use outcomes, where conversion exceeds planned thresholds. The large standard deviation of PCI further underscores the unevenness of Sustainable Agricultural Land Protection policy performance across districts.

The deviation measure reinforces this interpretation by highlighting persistent gaps between designated and realized protection outcomes. Taken together, these indicators suggest that policy implementation produces highly uneven governance effects across the metropolitan periphery, pointing toward localized processes of negotiation, selective enforcement, and differentiated institutional capacity rather than uniform policy execution.

### 3. Summary of Longitudinal Patterns

Taken together, the results demonstrate that paddy farmland protection outcomes under the Sustainable Agricultural Land Protection policy are unevenly distributed across districts and over time. The observed patterns indicate substantial variation in the scale of designated protection, the intensity of land conversion, and the degree of alignment between policy targets and realized outcomes. These longitudinal and spatially differentiated patterns provide the empirical foundation for examining how governance processes, negotiation practices, and institutional arrangements shape farmland protection in practice, which is explored in the Discussion section.

### Temporal Acceleration and Indicative Futures

This section examines temporal variation in the rate of paddy farmland conversion and presents indicative future trajectories derived from observed longitudinal trends. Building on the patterns documented above, the analysis employs trend-based projection as an exploratory analytical device rather than a predictive model. The purpose is to illustrate how historically observed patterns of land conversion accumulate over time under existing implementation conditions, without attributing causality or forecasting precise future outcomes.

Longitudinal analysis indicates that paddy farmland loss in Bandung Regency has not occurred at a constant rate over the study period. Comparison across temporal sub-periods reveals a clear increase in the average annual rate of farmland reduction during the 2010–2024 period relative to the preceding decade. This pattern suggests an acceleration in conversion intensity rather than short-term fluctuation, indicating a shift in the temporal dynamics of paddy farmland change within areas formally designated for protection.

The observed acceleration is evident in both cumulative loss and year-on-year decline, with recent years contributing disproportionately to total farmland reduction. Rather than stabilizing following policy designation, realized protected paddy farmland continues to contract, with the divergence between designated protection targets and actual land retention widening over time. These findings point to increasing instability in protection outcomes during the latter part of the observation period.

To contextualize the implications of this temporal pattern, an indicative projection was generated using a linear trend estimated from historical data on realized protected paddy farmland area. The projection extends observed trends over a short-term horizon and is intended solely as an illustrative representation of the trajectory implied by the continuation of existing patterns. As shown in Figure 1, the historical downward trend in protected paddy farmland area is accompanied by a projected continuation of decline if observed dynamics persist.

The trajectory depicted in Figure 1 does not constitute a predictive forecast. The projection does not incorporate potential policy reform, changes in enforcement intensity, or abrupt structural shifts, nor does it model demographic or economic drivers of land-use change. Instead, it functions as a heuristic tool to highlight the cumulative implications embedded in the observed longitudinal pattern of farmland reduction.

The indicative trajectory suggests that, under unchanged implementation conditions, the total area of protected paddy farmland would continue to decline, with cumulative losses increasing over time. While this outcome is not presented as inevitable, it underscores the scale of land loss implied by recent temporal trends and the persistence of divergence between protection targets and realized outcomes.

Importantly, the indicative futures presented here should be interpreted as governance-sensitive scenarios rather than deterministic forecasts. Temporal acceleration is treated as an empirical characteristic of the observed data, reflecting how land-use change unfolds over time within the existing policy framework. These results provide an empirical basis for examining how implementation practices, institutional arrangements, and stakeholder interactions shape farmland protection in practice.

Taken together, evidence of accelerated farmland loss and the illustrative future trajectory establish a longitudinal foundation for the subsequent qualitative analysis. The following sections examine how governance actors experience, interpret, and negotiate farmland protection in everyday practice, providing insight into the processes through which the temporal patterns observed here are produced.

### Experiences of Sustainable Agricultural Land Protection Policy Implementation Among Stakeholders

This section examines how Sustainable Agricultural Land Protection policy implementation is experienced, interpreted, and enacted by key stakeholders in peri-urban Bandung. Rather than treating implementation as a linear process through which formal regulations are translated into practice, the analysis foregrounds everyday encounters, negotiations, and institutional ambiguities that shape farmland protection on the ground. Drawing on semi-structured interviews and focus group discussions

(FGDs), the findings indicate that farmland protection operates less as a fixed regulatory instrument and more as a negotiated governance process embedded within local political–economic contexts.

The themes reported below emerged from an inductive thematic analysis of interview and FGD transcripts, focusing on recurring patterns in how different stakeholder groups describe, justify, and navigate farmland protection–related decisions. This section presents the empirical themes without interpretive evaluation, which is reserved for the Discussion.

### 1. Conditional and Situational Protection

Local government officials frequently described farmland protection not as an absolute restriction on land conversion, but as a regulatory framework that must be interpreted flexibly in relation to development pressures and administrative realities. Although formally framed as a protection policy, its implementation is widely understood as conditional and open to negotiation.

“Formally, protected farmland should not be converted. But in practice, the rules cannot be applied rigidly. There are development needs and fiscal pressures at the regional level, so there is always room for discussion,” *(Local government official, spatial planning division).*

Such accounts suggest that farmland protection is embedded within a broader governance logic that prioritizes balancing regulatory mandates with development imperatives, rather than enforcing protection as a non-negotiable boundary.

### 2. Farmers’ Perspectives: Protection Without Livelihood Security

From the perspective of paddy farmers, policy designation does not necessarily translate into a sense of security. Many farmers characterized protection as largely symbolic, offering limited economic support while constraining flexibility in land use and asset management.

“They say our fields are protected, but there is no real support. Rice prices are low, inputs are expensive. When someone offers to buy the land, farmers have to think realistically,”
*(Paddy farmer, peri-urban Bandung).*

These accounts reveal a recurrent tension between land preservation objectives and the socio-economic conditions required to sustain farming livelihoods. Protection is thus often experienced not as empowerment, but as an additional constraint layered onto existing vulnerabilities.

### 3. Discretion, Negotiation, and Informal Mediation

Across interviews, decision-making related to farmland protection was consistently described as discretionary and mediated through informal negotiation. Land conversion outcomes were rarely framed as straightforward compliance or violation. Instead, they emerged through deliberation among village authorities, district officials, landowners, and developers.

“Nothing is really black and white. Usually there is discussion first—considering impacts and who is involved. If a project is considered strategic, a compromise can always be found,” *(District-level official).*

These accounts indicate that negotiation functions as an everyday governance mechanism rather than an exception to formal regulation. Through discretionary interpretation, protection rules are continuously reworked to accommodate competing interests while maintaining procedural legitimacy.

### 4. Developers and Strategic Engagement with Farmland Protection Regulations

Private sector actors tended to interpret farmland protection as a regulatory variable rather than a fixed constraint. Developers emphasized procedural navigation—such as boundary adjustments, land reclassification, or alignment with planning revisions—as routine strategies for operating within protected landscapes.

“Farmland protection is not a hard barrier. As long as procedures are followed and there is coordination with local government, there are ways to adjust development plans,”
*(Property developer).*

This perspective illustrates how policy frictions are structurally embedded within the governance framework itself, where protection mandates coexist with development-oriented planning instruments, creating space for selective compliance and negotiated outcomes.

### 5. Community Actors and Alternative Meanings of Protection

Community groups and urban farming initiatives articulated a contrasting interpretation of farmland protection, framing it as a collective responsibility linked to food security, environmental sustainability, and social cohesion. At the same time, they recognized the limits of their influence within formal decision-making processes.

“We try to protect farmland through collective activities, education, and urban farming initiatives. But when large-scale projects are involved, community voices are often marginalized,”
*(Community activist, urban agriculture network).*

These actors operate at the margins of formal governance, translating policy objectives into everyday practices while lacking authority over large-scale land-use decisions. Their experiences highlight uneven power relations within negotiated governance processes.

### 6. Everyday Policy Frictions in Practice

Taken together, stakeholder accounts demonstrate that farmland protection is characterized by persistent policy frictions rather than straightforward policy failure. Protection is affirmed at the discursive level while diluted in practice; enforcement coexists with discretion; and formal rules are continuously reshaped through negotiation.

Stakeholders do not simply comply with or resist protection policies. Instead, they engage pragmatically—interpreting, adapting, and negotiating policy meaning in response to economic pressures, institutional constraints, and social relations. Through these everyday practices, farmland protection is transformed from a static regulatory regime into a dynamic and negotiated form of peri-urban governance.

Taken together with the quantitative findings, these results indicate that farmland protection outcomes cannot be understood solely through designation status or aggregate trends. Instead, they reflect the interaction of uneven spatial pressures, temporal acceleration, and negotiated implementation practices, which are examined analytically in the Discussion.

## Discussion

# From Formal Protection to Negotiated Governance: Explaining Persistent Farmland Loss under Sustainable Agricultural Land Protection

This study set out to explain why paddy farmland loss persists in Bandung Regency despite formal designation under the Sustainable Agricultural Land Protection policy, and how protection outcomes are reshaped through everyday governance practices. By integrating longitudinal land-use analysis with qualitative evidence from multiple stakeholder groups, the findings demonstrate that farmland protection operates less as a fixed regulatory regime and more as a negotiated governance arrangement embedded in peri-urban political–economic dynamics. Rather than indicating simple policy failure, the results reveal how spatial unevenness, temporal acceleration, and discretionary implementation practices jointly reconfigure farmland protection outcomes over time.

Figure 2 synthesizes these empirical findings by conceptualizing Sustainable Agricultural Land Protection implementation as an interaction between formal designation, peri-urban development pressures, and everyday governance practices. The framework illustrates how protection is continually reinterpreted and renegotiated, producing uneven and temporally accelerating farmland loss despite sustained policy commitment at the formal level.

# Spatial Unevenness and the Limits of Designation-Based Protection

The quantitative analysis demonstrates pronounced spatial unevenness in farmland protection outcomes across districts. While the total area designated under the Sustainable Agricultural Land Protection policy amounts to 16,915.76 hectares, cumulative conversion reaches − 3,809 hectares, with several districts contributing disproportionately to overall loss despite holding relatively small shares of protected land. The wide dispersion of Policy Compliance Index (PCI) values—including negative values in multiple districts—indicates substantial divergence between protection targets and realized land retention.

These disparities cannot be explained solely by differences in designation scale. Districts with limited protected areas often exhibit high conversion intensity, while others with extensive designations experience comparatively lower proportional losses. This pattern suggests that formal protection status alone is insufficient to stabilize land retention in peri-urban contexts. Instead, spatial outcomes reflect how designation interacts with localized development pressures, governance capacity, and discretionary interpretation at the district level.

This finding aligns with broader evidence that peri-urban districts exposed to infrastructure expansion and urban growth corridors face intensified conversion pressure. Previous analyses show that built-up areas expanded by more than 34% in some districts during earlier phases of urbanization (Fuadina et al., 2020; Suriadikusumah et al., 2022), reinforcing the argument that legal designation alone cannot counteract land market dynamics, fiscal dependence on development, and infrastructure-led spatial restructuring (Gandharum et al., 2022; Rizqi & Manessa, 2025; Sanders et al., 2019).

# Temporal Acceleration as an Empirical Signal of Governance Friction

Beyond spatial variation, the results reveal a clear temporal acceleration in farmland conversion rather than stabilization following policy designation. The increase in average annual conversion rates during 2010–2024, with acceleration reaching approximately 2.3 times during 2013–2020 compared to the preceding decade, indicates a structural shift in land-use dynamics rather than short-term fluctuation (Budiman et al., 2022; Fuadina et al., 2020; Gandharum et al., 2022; Suriadikusumah et al., 2022).

Importantly, temporal acceleration is not interpreted here as a deterministic trend or predictive outcome. Instead, it is treated as an empirical signal of cumulative governance friction. Under unchanged implementation arrangements, negotiated and discretionary practices—such as flexible interpretation of protection boundaries, procedural reclassification, and informal mediation—accumulate over time, progressively widening the gap between designation targets and realized outcomes.

As illustrated in Fig. 1, the indicative projection does not forecast future land loss but highlights the implications embedded in recent longitudinal patterns. The increasing divergence between designated protection and actual land retention underscores growing instability in protection outcomes, consistent with evidence of weak enforcement and persistent informal conversion practices (Widowaty et al., 2021). In this sense, temporal acceleration functions as a diagnostic indicator of governance strain rather than an exogenous driver of land-use change.

# From Protection to Negotiation: Everyday Governance in Practice

The qualitative findings provide insight into how these spatial and temporal patterns are produced in everyday governance. Across stakeholder groups, farmland protection is not experienced as an absolute restriction but as a conditional and situational framework. Local government officials describe

protection as flexible and negotiable, shaped by development priorities, fiscal pressures, and administrative constraints. Developers engage with the policy procedurally, navigating boundary adjustments, land reclassification, and planning revisions rather than confronting fixed regulatory barriers. Farmers, facing declining agricultural profitability and rising land values, make pragmatic land-use decisions that prioritize livelihood security over formal protection status (Hidayat, 2018; Saptutyningsih & Kamilasari, 2025).

These practices reflect a broader shift from enforcement-oriented governance toward negotiation-based implementation in complex peri-urban contexts. Rather than outright resistance or non-compliance, actors reinterpret and adapt farmland protection through routine negotiation, producing selective compliance and negotiated outcomes. This pattern is consistent with findings from other peri-urban settings where stakeholder complexity and enforcement limitations prompt governance systems to rely increasingly on deliberation and discretion (Hudalah et al., 2016; Nurcahyani & Marwasta, 2021; Patiung & Dassir, 2025; Sanders et al., 2019).

Community actors and urban farming initiatives articulate alternative meanings of protection grounded in food security, environmental sustainability, and collective stewardship. However, their influence remains limited in large-scale land-use decisions. This marginality reflects persistent power asymmetries, communication barriers, and limited institutional leverage within multi-level governance structures (Kurniadi & Sumarna, 2022; Mubarak et al., 2021; Nasser et al., 2021; Rahmasary et al., 2021).

# Policy Frictions as a Structuring Condition of LP2B Implementation

Taken together, the results suggest that Sustainable Agricultural Land Protection implementation is best understood through the lens of policy frictions rather than compliance or failure. Protection is affirmed discursively but diluted in practice; enforcement coexists with discretion; and formal rules are continuously reshaped through negotiation. These frictions are not episodic anomalies but structural conditions emerging from the coexistence of protection mandates with development-oriented planning frameworks, fiscal dependence on land conversion, and fragmented institutional coordination (Patiung & Dassir, 2025; Rahmasary et al., 2021; Rizqi & Manessa, 2025; Sanders et al., 2019).

Figure 2 conceptualizes this dynamic by showing how formal designation, peri-urban pressures, and actor practices converge to produce negotiated governance of farmland. Within this framework, spatial unevenness and temporal acceleration are not external disturbances but observable manifestations of how protection policies are enacted through everyday governance. Temporal acceleration, in particular, reflects the cumulative effects of negotiated implementation over time rather than a sudden breakdown of regulatory control.

# Implications for Food Security and Peri-Urban Sustainability

The persistence and acceleration of farmland loss under the Sustainable Agricultural Land Protection policy carry significant implications for food security and environmental sustainability. Quantitative

evidence indicates that farmland conversion correlates with increased urban heat island effects and carbon emissions, while qualitative findings suggest that community-led urban farming initiatives, although valuable, cannot fully offset large-scale land loss (Abdoellah et al., 2023; Buyadi et al., 2014; Paramita & Fukuda, 2014; Park et al., 2010; Pribadi et al., 2023; Rizqi & Manessa, 2025).

These findings highlight the limits of relying on grassroots initiatives without structural support, financial coordination, and integration into formal spatial planning frameworks (Rahmasary et al., 2021). As peri-urban regions continue to urbanize in polycentric patterns, governance approaches that rely solely on designation-based protection are unlikely to stabilize farmland retention (Dadashpoor & Malekzadeh, 2022; Liu et al., 2024; Sadewo et al., 2021).

# Theoretical Contribution and Policy Implications

This study contributes to the literature on peri-urban land governance by empirically demonstrating how farmland protection policies are reworked through negotiated implementation rather than enforced as fixed regulatory boundaries. By linking longitudinal land-use change with stakeholder experiences, the analysis shows that temporal acceleration and spatial unevenness function as empirical signatures of negotiated governance under conditions of peri-urbanization.

Rather than framing negotiation as an implementation failure, the findings position it as a structuring feature of farmland governance in rapidly urbanizing regions. This perspective extends existing work on multi-level and everyday governance by demonstrating how cumulative negotiation practices shape long-term protection outcomes, even under formal designation regimes.

Addressing farmland loss therefore requires moving beyond legal designation toward adaptive, multi-level, and participatory governance frameworks that recognize negotiation as inherent to policy implementation. Aligning protection objectives with livelihood security, institutional capacity, and peri-urban realities is essential for stabilizing farmland retention in contexts similar to Bandung (Hudalah et al., 2016; Patiung & Dassir, 2025; Rahmasary et al., 2021; Sanders et al., 2019; Xu, 2021).

# Limitations and Directions for Future Research

Several limitations of this study should be acknowledged, not as weaknesses that undermine the findings, but as boundaries that define their analytical scope and suggest directions for future research.

First, while the longitudinal land-use analysis captures temporal patterns of paddy farmland change between 2010 and 2024, the study does not model causal mechanisms statistically. The identification of temporal acceleration is therefore interpretive rather than predictive. Future research could build on these findings by integrating econometric or spatial regression models to disentangle the relative influence of infrastructure expansion, land market dynamics, and policy interventions on farmland conversion rates.

Second, although the district-level analysis reveals substantial spatial unevenness, the aggregation of land-use data may obscure micro-level variations within villages or parcels. Conversion decisions often

occur at finer spatial scales, shaped by land tenure arrangements, household strategies, and informal transactions that are not fully captured in district-level datasets. High-resolution parcel-based analysis or village-level ethnographic studies would provide deeper insight into how negotiated governance unfolds on the ground.

Third, the qualitative component focuses on key stakeholder groups but does not capture the full spectrum of power relations within peri-urban land governance. In particular, the perspectives of financial institutions, land brokers, and informal intermediaries—actors known to play significant roles in peri-urban land transformation—remain underexplored. Future studies incorporating these actors could refine the understanding of how negotiation processes are structured and whose interests are prioritized.

Fourth, this study is context-specific to Bandung Regency and its peri-urban development trajectory. While the conceptual framework of negotiated farmland protection may be transferable to other rapidly urbanizing regions, empirical generalization should be approached with caution. Comparative research across different institutional settings, governance regimes, or metropolitan regions would be valuable for assessing the broader applicability of the proposed framework.

Finally, future research could extend the analytical focus beyond land conversion outcomes to examine adaptive governance innovations. Exploring policy instruments that integrate compensation mechanisms, incentive-based protection, or co-management arrangements with farming communities may offer pathways to mitigate the cumulative effects of negotiated implementation identified in this study.

# Conclusion

This study examined why paddy farmland loss persists and accelerates in peri-urban Bandung despite formal designation under the Sustainable Agricultural Land Protection policy, and how protection outcomes are reshaped through everyday governance practices. By integrating longitudinal land-use data with qualitative evidence from multiple governance actors, the analysis demonstrates that farmland protection operates not as a fixed regulatory outcome but as a negotiated governance process embedded in peri-urban political–economic dynamics.

Empirically, the findings reveal pronounced spatial unevenness and temporal acceleration in paddy farmland conversion. Substantial inter-district variation in Policy Compliance Index (PCI) values—including negative outcomes in several districts—indicates persistent divergence between designated protection targets and realized land retention. The observed acceleration of farmland loss over time further suggests that formal protection has not stabilized land-use outcomes following designation, but has instead been progressively reworked under sustained development pressure and discretionary implementation.

Conceptually, the study advances the notion of policy frictions to explain how formal farmland protection is continually reshaped through negotiation, selective enforcement, and adaptive practices. Rather than representing implementation anomalies or simple enforcement failures, these frictions constitute a structural condition of peri-urban governance, arising from the coexistence of protection mandates, development-oriented planning, fiscal dependence on land conversion, and fragmented institutional coordination. In this context, governance shifts from a protectionist logic toward negotiation-based regulation, where land-use outcomes are produced through everyday interactions among state actors, farmers, developers, and community initiatives.

These findings contribute to urban and peri-urban governance scholarship by reframing farmland protection as an integral component of metropolitan governance rather than a residual agrarian concern. By foregrounding paddy farmland as a site of negotiation, the study highlights how urbanization reshapes regulatory authority, policy meaning, and spatial outcomes through relational and multi-level processes. This perspective extends existing debates on peri-urbanization by demonstrating that farmland loss is not merely an outcome of urban expansion, but a constitutive element of how metropolitan regions are governed.

From a policy perspective, the results caution against reliance on designation-based protection alone. Strengthening farmland retention requires governance arrangements that explicitly acknowledge negotiation as an inherent feature of peri-urban regulation. This includes improving coordination across planning and agricultural institutions, enhancing transparency in discretionary decision-making, and aligning protection objectives with farmer livelihood security and local development incentives. Community-based initiatives and urban farming networks play an important mediating role, but their impact remains limited without structural integration into formal planning frameworks.

Several limitations should be noted. The absence of spatially explicit land-use data constrains fine-grained analysis of corridor-level dynamics and localized conversion patterns. Qualitative findings are based on purposively selected districts and stakeholders and therefore do not claim statistical representativeness. Future research could address these limitations by combining spatial land-use datasets with longitudinal governance analysis, expanding comparative cases across metropolitan regions, and examining how different institutional configurations shape the intensity and form of policy frictions over time.

Overall, this study shows that peri-urban farmland protection in Bandung is not failing in isolation, but is being continuously renegotiated within broader processes of metropolitan transformation. Recognizing negotiation and policy frictions as central features of land governance is essential for designing more adaptive, equitable, and effective approaches to safeguarding agricultural land in rapidly urbanizing regions of the Global South.

# Declarations

# Ethics Approval

This study was conducted in accordance with institutional research ethics guidelines. Formal ethical approval was not required as the research did not involve medical intervention or experimental procedures involving human subjects.

# Clinical Trial Number

Not applicable.

# Funding

This research did not receive external funding.

# Author Contribution

MD conceptualized the study and developed the theoretical framework. MD and RK designed the research methodology. RK coordinated access to administrative land-use data and contributed to data validation. MD conducted the quantitative analysis. MD and ASM conducted the qualitative fieldwork, including interviews and focus group discussions. ASM assisted in data transcription and preliminary coding. MD performed the thematic analysis and integrated the quantitative and qualitative findings.MD drafted the main manuscript. RK and ASM contributed to reviewing, revising, and refining the manuscript. All authors read and approved the final version of the manuscript.

# Acknowledgement

The authors would like to express their sincere gratitude to the Regional Development Planning, Research, and Innovation Agency of Bandung Regency for their institutional support and facilitation during the research process. We also thank the Agriculture Office of Bandung Regency for providing access to administrative land-use data and policy documents that were essential for the longitudinal analysis. Our appreciation extends to agricultural stakeholders at the sub-district level, including local agricultural officers and extension workers, for sharing their insights and experiences regarding farmland protection and everyday governance practices. We are especially grateful to the farming communities and paddy farmers who generously contributed their time, knowledge, and perspectives through interviews and focus group discussions.The authors also acknowledge the academic environment and collegial support provided by Sunan Gunung Djati State Islamic University (UIN Sunan Gunung Djati Bandung), which facilitated the completion of this research. Finally, we thank all colleagues, research assistants, and collaborators who contributed—directly or indirectly—to data collection, discussion, and

refinement of the manuscript. Any remaining errors or interpretations are solely the responsibility of the authors.

# Data Availability

The authors confirm that the data supporting the findings of this study are available within the article and its supplementary materials where applicable.The quantitative data consist of aggregated longitudinal administrative records of protected paddy farmland area in Bandung Regency (2010–2024), obtained from the Regional Agriculture Office. These data are not publicly available due to institutional data-sharing restrictions but may be made available from the corresponding author upon reasonable request and with permission from the relevant local government authority.The qualitative data (interview and focus group transcripts) are not publicly available in order to protect participant confidentiality and comply with research ethics commitments. Anonymized excerpts supporting the findings are included in the manuscript.

# References


1. Abdoellah, O. S., Wulandari, I., Safitri, K. I., Fianti, N. D., Basagevan, R. M. F., Aini, M. N., Amalia, R. I., Suraloka, M. P. A., & Utama, G. L. (2023). Urban Agriculture in Great Bandung Region in the Midst of Commercialization, Food Insecurity, and Nutrition Inadequacy. *Sustainability (Switzerland)*, *15*(13). https://doi.org/10.3390/su151310241
2. Budiman, L. S., Deviana, A., Miftahurridlo, M., Saputra, D. M. A., Nurjani, E., & Rachmawati, R. (2022). Spatial Analysis of Sustainable Management Strategy in Bedog Sub-watershed Based on Carrying Capacity of Agricultural Land. In H. E., K. L., S. J., T. M., G. C., & L. J. (Eds.), *IOP Conference Series: Earth and Environmental Science* (Vol. 1039, Issue 1). Institute of Physics. https://doi.org/10.1088/1755-1315/1039/1/012038
3. Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa
4. Buyadi, S. N. A., Mohd, W. M. N. W., & Misni, A. (2014). The effects of vegetation growth on the microclimate of Urban Area: A case study of Petaling District. *Lecture Notes in Geoinformation and Cartography* (Vol. 0, pp. 151–161). Springer Science and Business Media Deutschland GmbH. https://doi.org/10.1007/978-3-319-03644-1_11
5. Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and conducting mixed methods research* (3rd ed.). Sage.
6. Dadashpoor, H., & Malekzadeh, N. (2022). Evolving spatial structure of metropolitan areas at a global scale: a context-sensitive review. *Geojournal*, *87*(5), 4335–4362. https://doi.org/10.1007/s10708-021-10435-0
7. Dulkiah, M., & Majid, A. S. (2025). Influence of Social Capital on Community Participation With Community Development as an Intervening Variable. *Changing Societies and Personalities*, *9*(2),

501–523. https://doi.org/10.15826/csp.2025.9.2.339

8. Fuadina, L. N., Rustiadi, E., & Pravitasari, A. E. (2020). The Dynamic of Land Use Changes and Regional Development in Bandung Metropolitan Area. In R. E., P. D.O., I. G.S., S. R.B., S. I., & S. K. (Eds.), *IOP Conference Series: Earth and Environmental Science* (Vol. 556, Issue 1). IOP Publishing Ltd. https://doi.org/10.1088/1755-1315/556/1/012002
9. Gandharum, L., Hartono, D. M., Karsidi, A., & Ahmad, M. (2022). Monitoring Urban Expansion and Loss of Agriculture on the North Coast of West Java Province, Indonesia, Using Google Earth Engine and Intensity Analysis. *Scientific World Journal*, *2022*. https://doi.org/10.1155/2022/3123788
10. Hidayat, A. R. T. (2018). Peri-urban farmland owner in the growing municipality, case study Kediri Municipality. *IOP Conference Series: Earth and Environmental Science*, *202*(1). https://doi.org/10.1088/1755-1315/202/1/012025
11. Hudalah, D., Winarso, H., & Woltjer, J. (2016). Gentrifying the peri-urban: Land use conflicts and institutional dynamics at the frontier of an Indonesian metropolis. *Urban Studies*, *53*(3), 593–608. https://doi.org/10.1177/0042098014557208
12. Kurniadi, K., & Sumarna, E. (2022). The Process of Collaboration in Regulating Street Vendors in Bandung City. *Qualitative Report*, *27*(5), 1439–1455. https://doi.org/10.46743/2160-3715/2022.5458
13. Liu, Z., Xia, H., & Zhang, T. (2024). A review of research methods on the coupling relationship between urban rail transit and urban space: revealing spatiotemporal relationships through big data. *International Journal of Digital Earth*, *17*(1). https://doi.org/10.1080/17538947.2024.2339363
14. McConnell, A. (2015). What is policy failure? A primer to help navigate the maze. *Public Policy and Administration*, *30*(3–4), 221–242. https://doi.org/10.1177/0952076714565416
15. Morgan, D. L. (1997). *Focus groups as qualitative research* (2nd ed.). Sage.
16. Mubarak, A. Z., Abdoellah, O. S., Withaningsih, S., & Indah, K. (2021). Management of Urban Farming Activities in A Community Case Study 1000kebun in Bandung City. In W. S., S. D., U. G.L., & M. A.D. (Eds.), *E3S Web of Conferences* (Vol. 249). EDP Sciences. https://doi.org/10.1051/e3sconf/202124901010
17. Nasser, D. M., Deliarnoor, N. A., Bainus, A., & Sujatna, E. T. S. (2021). How the local government empowers the community in local wisdom-based development? A case in bandung regency. *International Journal of Entrepreneurship*, *25*(Special Issue 1).
18. Nurcahyani, T. T., & Marwasta, D. (2021). Peri-Urbanization in DIY and Its Relationship to Sustainable Agricultural Lands Protection Program. In C. O. R., S. S. J.T., W. B., C. T. A., H. E., H. D.R., & P. R.F. (Eds.), *E3S Web of Conferences* (Vol. 325). EDP Sciences. https://doi.org/10.1051/e3sconf/202132507005
19. Paramita, B., & Fukuda, H. (2014). Heat intensity of urban built environment in hot humid climate region. *American Journal of Environmental Sciences*, *10*(3), 210–218. https://doi.org/10.3844/ajessp.2014.210.218

20. Park, J. K., Park, J. H., & Na, S. I. (2010). Summer-time thermal environment characteristics in central Korea using Landsat TM data. *Proceedings of SPIE - The International Society for Optical Engineering*, *7824*. https://doi.org/10.1117/12.864875
21. Patiung, J., & Dassir, M. (2025). Tenure Conflict Resolution Strategy For Pongtorra Protected Fores Area In North Toraja. In F. F., S. null, & P. K.T.P. (Eds.), *IOP Conference Series: Earth and Environmental Science* (Vol. 1553, Issue 1). Institute of Physics. https://doi.org/10.1088/1755-1315/1553/1/012039
22. Prasetiyo, W. H., Budimansyah, D., & Roslidah, N. (2016). Urban farming as a civic virtue development in the environmental field. *International Journal of Environmental and Science Education*, *11*(9), 3139–3146. https://doi.org/10.12973/ijese.2016.909a
23. Pribadi, D. O., Saifullah, K., Iman, L. O. S., Nurdin, M., & Putra, A. S. (2023). Urban Transition in Monsoon Asian Megacity: Will Paddy Fields in the Rural–Urban Fringe Persist? Insight from Jakarta-Bandung Mega Urban Region, Indonesia. In *Urban Sustainability: Vol. Part F3685* (pp. 107–124). Springer. https://doi.org/10.1007/978-981-99-2695-4_7
24. Rahmasary, A. N., Koop, S. H. A., & van Leeuwen, C. J. (2021). Assessing Bandung's Governance Challenges of Water, Waste, and Climate Change: Lessons from Urban Indonesia. *Integrated Environmental Assessment and Management*, *17*(2), 434–444. https://doi.org/10.1002/ieam.4334
25. Rizqi, B., & Manessa, M. D. M. (2025). Balancing Urban Growth and Food Autonomy: An Integrated Machine Learning and Agricultural Statistics Framework for Local Rice Self Sufficiency in the PNAR of Purwokerto, Indonesia. *Forum Geografi*, *39*(3), 420–437. https://doi.org/10.23917/forgeo.v39i3.11234
26. Sadewo, E. (2017). The centrifugal and centripetal force influence on spatial competition of agricultural land in Bandung Metropolitan Region. *IOP Conference Series: Earth and Environmental Science*, *70*(1). https://doi.org/10.1088/1755-1315/70/1/012011
27. Sadewo, E., Syabri, I., Antipova, A., & Hudalah, D. (2021). Using morphological and functional polycentricity analyses to study the Indonesian urban spatial structure: the case of Medan, Jakarta, and Denpasar. *Asian Geographer*, *38*(1), 47–71. https://doi.org/10.1080/10225706.2020.1737829
28. Sanders, A. J. P., Ford, R. M., Mulyani, L., Prasti, H., Larson, R. D., Jagau, A. M., Y., & Keenan, R. J. (2019). Unrelenting games: Multiple negotiations and landscape transformations in the tropical peatlands of Central Kalimantan, Indonesia. *World Development*, *117*, 196–210. https://doi.org/10.1016/j.worlddev.2019.01.008
29. Saptutyningsih, E., & Kamilasari, D. (2025). What Drives the Conversion of Agricultural Land in Peri-Urban Areas? A Hedonic Pricing Analysis from Central Java, Indonesia. In R. Z., T. null, W. null, S. null, S. M., A. A.A., T. M.M., R. A.B., S. P., bin K. M.F., S. J., B. H., P. Z., W. Y., M. J.H., & K. B. (Eds.), *E3S Web of Conferences* (Vol. 665). EDP Sciences. https://doi.org/10.1051/e3sconf/202566503006
30. Suriadikusumah, A., Mulyono, A., & Maulana, M. H. R. (2022). Prediction of Bandung District Land Use Change Using Markov Chain Modeling. *International Journal on Advanced Science Engineering and Information Technology*, *12*(1), 237–243. https://doi.org/10.18517/ijaseit.12.1.12384

31. Widowaty, Y., Triyono, & Wahid, D. A. (2021). Law Enforcement of Land Transfer from Agricultural Land to Housing in Indonesia. *E3S Web of Conferences*, *232*, 04008. https://doi.org/10.1051/e3sconf/202123204008
32. Xu, J. (2021). Conflicts in multi-level governance: an analysis of international climate policy implementation at the sub-national level. *Global Public Policy and Governance*, *1*(4), 401–420. https://doi.org/10.1007/s43508-021-00029-4

# Figures

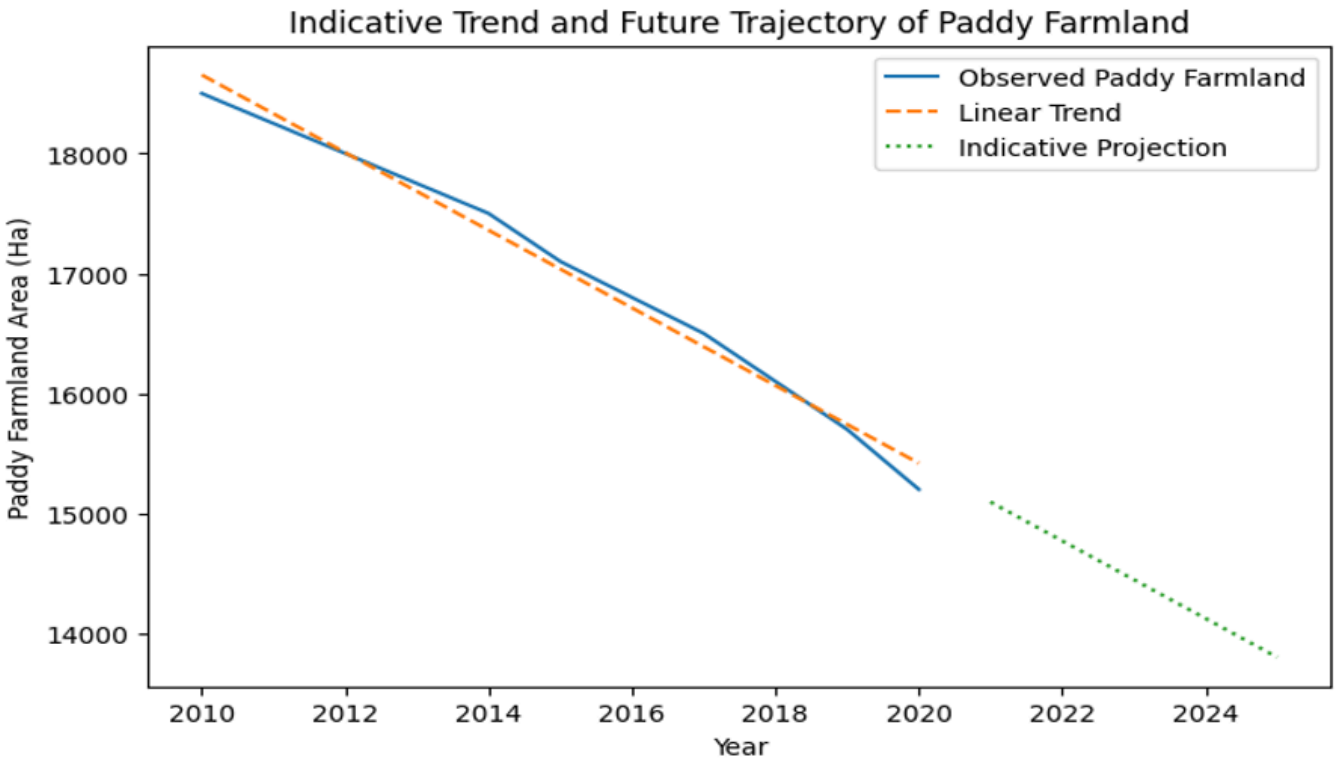



**Figure 1**

Historical Trend and Indicative Projection of Protected Paddy Farmland Area in Bandung Regency

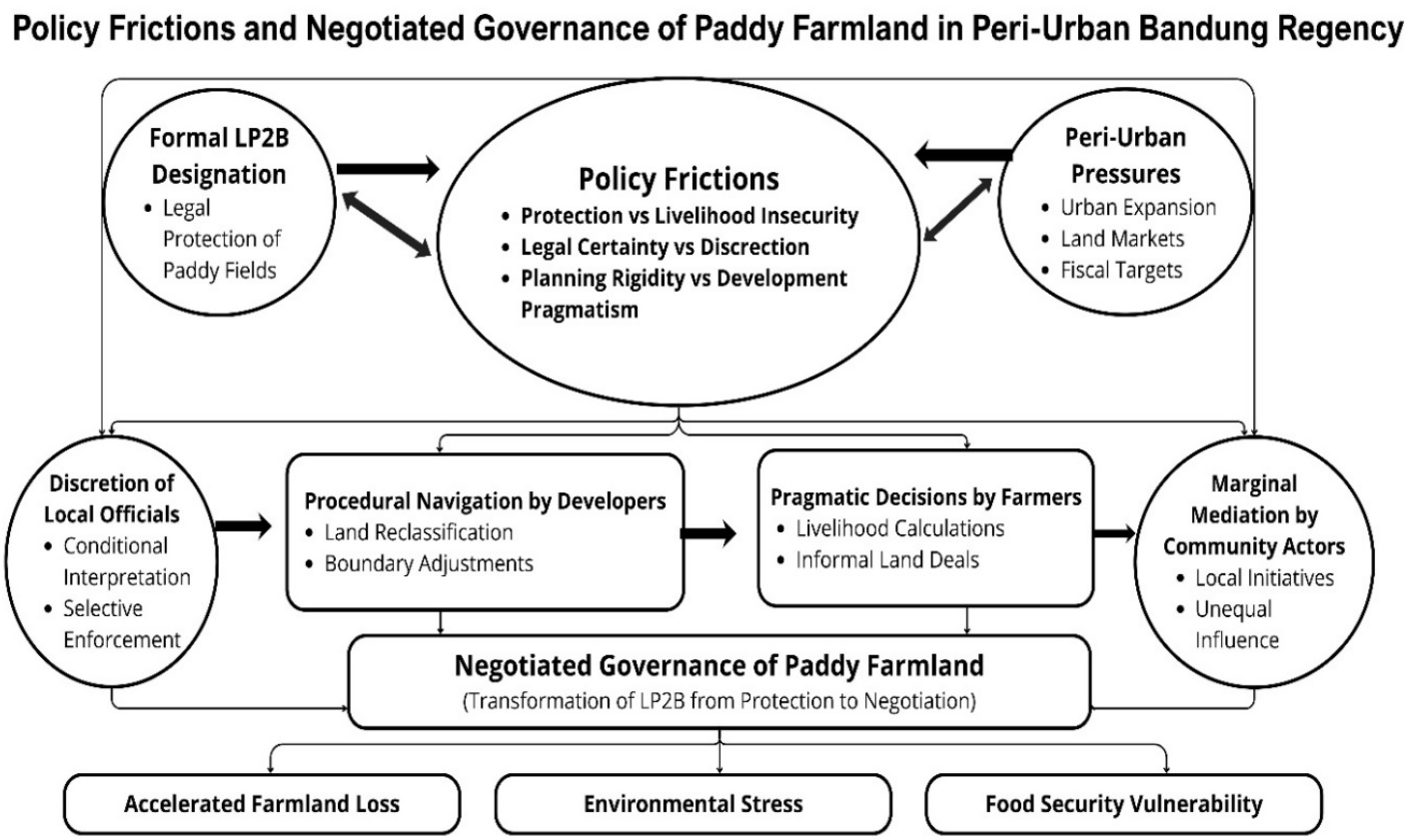



Figure 2

## Conceptual Framework of Negotiated Farmland Protection under Sustainable Agricultural Land Protection

*Note: The diagram synthesizes quantitative trends and qualitative evidence to illustrate negotiated farmland protection. It does not represent a causal or forecasting model.*