

Natural Disasters and Women's Land Rights in Indonesia Toward Inclusive and Secure Tenure Systems

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Abstract

Indonesia's exposure to frequent natural disasters, coupled with legal pluralism and patriarchal socio-cultural norms, continues to undermine women's access to land rights. This study investigates how natural disasters affect women's land tenure security and explores pathways toward inclusive and secure land governance in post-disaster settings. Using a qualitative literature review, the analysis draws on legal frameworks, institutional reports, and case studies from disaster-affected regions, such as the 2016 Bantul and 2018 Lombok earthquakes. A thematic content analysis identifies systemic barriers, including loss of documentation, unregistered marriages, discriminatory inheritance practices, and exclusion from resettlement and recovery programs. Findings reveal that women face persistent legal and institutional challenges in reclaiming land after disasters, which often results in displacement and economic insecurity. The study highlights the critical importance of digital land certification and participatory spatial planning to enhance transparency, reduce disputes, and ensure legal recognition for women's ownership. It argues that gender-responsive land governance, supported by digital innovation and integrated spatial data systems, can significantly strengthen post-disaster resilience. The research concludes that securing women's land rights is essential not only for equitable recovery but also for building inclusive and sustainable disaster governance systems in Indonesia.

Keywords: Women, Disasters, Land and tenure security, Indonesia

1. Introduction

Living in Indonesia means residing in one of the world's most disaster-prone regions, where the intersection of geophysical vulnerability and socio-economic inequality amplifies risks for already marginalized populations—particularly women. According to Indonesia's National Disaster Management Agency (BNPB), as of December 2024, the country experienced 1,936 natural disasters, resulting in 469 fatalities, 58 missing persons, 1,157 injured, and more than 5.6 million people affected or displaced. Globally, the Center for Research on the Epidemiology of Disasters (CRED, 2024) ranked Indonesia fifth in disaster frequency, following the United States, China, India, and Brazil.

Disasters not only result in loss of life and property but also deepen existing gender inequalities, especially in relation to land access and tenure security. Women often face higher mortality and vulnerability due to limited mobility, unequal access to information and resources, caregiving responsibilities, and exclusion from decision-making processes (Neumayer & Plümper, 2007). Post-disaster recovery phases can reinforce patriarchal systems, where land ownership and assistance are typically registered under male heads of households. Despite legal recognition of women's land rights in Indonesia, bureaucratic hurdles and entrenched cultural norms continue to limit their ability to access, claim, or retain land—especially in the aftermath of disasters (Rohini, 2021; ARKN, 2020).

Evidence from major disasters such as the 2004 tsunami in Aceh and the 2018 earthquakes in Lombok and Palu shows that women frequently encounter legal and social barriers when asserting land claims. Challenges are particularly acute for those in informal marriages or communal land tenure arrangements, where legal proof of ownership is lacking or collective rights overshadow individual entitlements (Errico, 2021; Hamidazada et al., 2019). These barriers have long-term consequences, affecting women's livelihoods, housing security, and economic recovery. Although women play key roles in recovery processes—such as organizing community resources—their

contributions often go unrecognized in formal land governance frameworks (Rahayu, 2023).

Natural disasters also impact land value. Land damaged by disasters often depreciates significantly, complicating recovery for women who rely on land for housing or agricultural production (Saputra et al, 2021). Devaluation, combined with legal insecurity, can perpetuate economic vulnerability for women during and after crises. The security of land tenure is central to recovery and resilience. Post-disaster recovery is more effective when individuals have clear and secure rights to their land. Secure tenure empowers women to make informed decisions, engage in economic activities, and access aid and reconstruction programs (Pinuji and Vries, 2023). In contrast, insecure or undocumented tenure increases the risk of exclusion and displacement. These challenges call for comprehensive, gender-sensitive land governance strategies integrated into disaster risk reduction (DRR) frameworks.

Theoretical models such as the Sustainable Livelihoods Framework and FAO's Gender and Land Rights Database provide important insights into how land access, gender equity, and disaster resilience intersect. Addressing gender disparities in land governance enhances not only individual resilience but also the broader capacity of communities to recover. Empowering women with land rights contributes to more inclusive, effective disaster management and recovery (Chisty et al, 2021; Moreno and Shaw, 2018).

2. Method

This study employs a qualitative literature review approach to examine the impact of natural disasters on women's access to land and land value in Indonesia. The literature review method allows for a comprehensive exploration of existing scholarly works, legal documents, government reports, and institutional publications relevant to the intersection of gender, land rights, and disaster management.

A thematic content analysis was conducted to identify recurring themes and patterns across the selected literature. The analysis focused on:

- 1.The legal framework governing women's access to land
- 2.Socio-cultural and customary factors affecting land inheritance and tenure
- 3.Post-disaster land governance and reconstruction processes
- 4.Gender-disaggregated impacts of natural disasters on land value and tenure security

Themes were organized according to three levels of analysis:

- 1.Normative framework (laws, policies, and regulations)
- 2.Institutional practices (implementation and gaps)
- 3.Socio-cultural dynamics (local customs, patriarchal norms, and gender roles)

This qualitative synthesis enables a contextualized understanding of how the intersection of gender, disaster, and land governance affects women's access to land in post-disaster Indonesia. This study is limited to secondary data and does not include primary fieldwork or interviews. As such, the findings rely on the validity and scope of existing literature and may not reflect real-time conditions on the ground. However, the multiple case studies aim to strengthen the credibility and relevance of the analysis

3. Results

3.1 Post-Disaster Land Governance and Reconstruction in Indonesia

Indonesia has faced both achievements and persistent challenges in post-disaster land governance. The 2004 Indian Ocean tsunami in Aceh stands as a notable example of successful recovery. Through the Agency for the Rehabilitation and Reconstruction of Aceh and Nias (BRR), the government coordinated with international donors and NGOs to rebuild over 140,000 houses, along with vital infrastructure. The reconstruction process also contributed to peace-building in the region.

However, subsequent disasters have exposed recurring weaknesses in institutional coordination, bureaucratic delays, and community exclusion, particularly among women. Following the 2018 Central Sulawesi earthquake and tsunami, gender-sensitive approaches were largely absent. Women struggled to access aid and were rarely involved in planning processes, resulting in infrastructure and housing solutions that did not meet their specific needs.

The 2018 Lombok earthquake further highlighted systemic problems in post-disaster land governance. In both North Lombok and Lombok Barat, unresolved land tenure issues left thousands in temporary shelters for extended periods. Residents in areas such as Desa Genggeling and Kekait were ineligible for housing assistance due to unregistered land or unclear ownership. Land consolidation and resettlement efforts faced public resistance due to poor transparency, limited compensation, and a lack of inclusive planning. Women were disproportionately affected, especially those without legal land titles or whose land rights were dependent on male relatives (Wahyuni, 2023; Suryawan et al., 2023).

These issues were compounded by cultural practices such as *nikah siri*—unregistered religious marriages—which are common in Lombok. Women in such unions lacked legal documentation to prove their marriage, leaving them unable to claim inheritance, access housing support, or assert land ownership after losing spouses in the disaster. Komnas

Perempuan (2020) identified legal invisibility as a key barrier to post-disaster aid for women, especially within patriarchal land registration systems that favor male ownership. This situation was exacerbated by the physical destruction of land boundary markers, creating disputes over land claims and further disadvantaging undocumented women.

The experience of Lombok is echoed in Palu, where the 2018 liquefaction disaster resulted in widespread land displacement. The altered physical landscape and loss of cadastral references disrupted land verification processes. As in Lombok, affected women struggled to secure recognition of their land rights. In both cases, the combination of informal tenure arrangements, loss of documentation, and male-centric land systems created major barriers to recovery for women. These recurring patterns underscore the absence of integrated, transparent, and gender-responsive land administration systems capable of protecting vulnerable populations during post-disaster recovery.

3.2 Land Access, Value, and Gendered Economic Recovery

Beyond governance, access to land and its value are fundamental to women's post-disaster economic and social recovery. Case studies in Aceh, Lombok, and Palu illustrate how disasters not only destroy land records but also devalue property, especially in areas prone to repeated shocks. Depreciated land values disproportionately impacted women who relied on land for agricultural production or housing security (Saputra et al, 2021).

Despite these challenges, Aceh provides a rare example of progress. Following the 2004 tsunami, the Reconstruction of Aceh Land Administration System (RALAS) project issued over 230,000 new land titles—approximately 30% of which were granted to women. This marked a significant step toward gender equity, although it also highlighted tensions between customary systems and conservative religious interpretations that often favored male heirs.

In contrast, legal recognition in Lombok and Palu remains limited. In Lombok, patriarchal norms and low legal awareness hindered women's ability to formalize land ownership. In Palu, land displacement from liquefaction made land rights difficult to verify. National data supports this disparity: only 24.2% of land certificates in Indonesia are registered under women's names. However, promising initiatives such as the One Map Project and participatory mapping efforts have started to reverse this trend, with some areas reporting 50% of parcels registered to women (WRI).

These cases emphasize that land ownership is not just a legal or economic matter—it is tied to empowerment, social status, and recovery potential. Land provides women with a pathway to stability, autonomy, and active participation in rebuilding their communities after disasters.

3.3 Legal Frameworks and Implementation Gaps

Indonesia has developed a robust legal framework to safeguard land rights in disaster contexts. Key instruments include the 1945 Constitution (Article 33), the Basic Agrarian Law (Law No. 5 of 1960), and disaster-specific legislation such as Law No. 24 of 2007 on Disaster Management. Additional provisions in Ministerial Regulations No. 9 and No. 10 of 2016 support land registration and recognition of communal rights. Other relevant laws—on environmental protection, health, and job creation—reinforce this legal infrastructure, as do commitments to international frameworks like CEDAW.

However, these protections often remain aspirational due to critical implementation gaps. Laws are not consistently enforced at the local level, especially in post-disaster settings.

Bureaucratic inefficiencies, fragmented institutional responsibilities between BPN, BNPB, and local governments, and a lack of legal awareness among citizens all hinder effective outcomes.

3.4 Ongoing Challenges in Practices

Despite legal advances, six core challenges persist in practice:

1. **Legal Awareness and Access:** Many women, especially in rural or disaster-affected areas, lack knowledge of their legal rights or access to legal assistance post-disaster.
 2. **Customary vs. National Law:** In many communities, customary norms override statutory law, often favoring men and reinforcing discriminatory inheritance practices.
 3. **Loss of Documentation:** Disasters frequently destroy land certificates. Women not named on original titles face greater obstacles in reclaiming land.
 4. **Exclusion from Resettlement:** Resettlement programs often marginalize women from land allocation and decision-making processes.
 5. **Patriarchal Institutions:** Land offices and disaster agencies are typically male-dominated, lacking gender-sensitive training and representation.
 6. **Data Deficiencies:** The absence of sex-disaggregated data on land rights and recovery outcomes prevents accountability and evidence-based policy responses.
- These challenges highlight that laws alone are insufficient. Effective land governance requires not only strong legal instruments but also local institutional capacity, inclusive planning processes, grassroots legal empowerment, and integrated monitoring systems. Without these components, women remain at risk of losing access to land—a critical asset for resilience, economic recovery, and long-term well-being..

3.5 Digital Land Governance as a Pathway to Resilience

In response to persistent barriers surrounding women's land rights—especially in post-disaster scenarios—Indonesia's adoption of electronic land certificates (Sertipikat Elektronik or Sertipikat-el) offers a transformative opportunity to promote equity, resilience, and legal certainty. This innovation strengthens the security of land records, particularly for vulnerable populations who are at risk of losing physical documents due to disaster-related destruction or displacement. An electronic land certificate is a digitally issued proof of land ownership stored securely in a digital vault (brankas elektronik) managed by the Ministry of Agrarian Affairs and Spatial Planning/National Land Agency (ATR/BPN). The certificate is issued in PDF format and can be accessed by the rightful owner through government-provided applications such as Sentuh Tanahku. Individuals, institutions, and even customary legal communities can use these applications to view, verify, or reprint certificates without requiring reissuance from land offices—even if the official printed copy is lost or damaged. This system represents a major advancement in land administration transparency and accessibility. For women, particularly those who are often excluded from land titling processes or whose ownership is undocumented due to informal marriages (nikah siri), the Sertipikat-el system offers a reliable and accessible means to verify and retain ownership status—even after the loss of a spouse or family head during a disaster. Moreover, the legal strength of Sertipikat-el lies in its formal recognition as equivalent to conventional physical certificates. Unlike paper documents that can be easily destroyed, misplaced, or manipulated, these digital certificates are tamper-proof and legally enforceable, ensuring stronger protection against disputes, fraud, or exclusion from aid and reconstruction

programs. Women who previously faced hurdles in transferring ownership or proving inheritance rights can now access and manage their land records independently, supported by the Ministry's system, which includes automatic account registration support at local land offices.

As of July 12, 2024, 280 Land Offices (Kantor Pertanahan) across Indonesia have already implemented the electronic certificate system, with more to follow. The expansion of this digital infrastructure, especially in disaster-prone regions, aligns directly with national disaster risk reduction goals and the promotion of inclusive recovery frameworks.

This initiative also complements geospatial integration efforts such as the One Map Policy and applications like the Jabar Command Center, which use real-time data to enhance response strategies. When embedded into these broader systems, Sertipikat-el enhances Indonesia's capacity to not only manage land but also protect rights and enable more gender-equitable reconstruction and resilience-building efforts.

However, digitalization must be inclusive as can be seen in Figure 1. The government must ensure that women—especially those in rural, low-literacy, or socio-economically marginalized groups—can access and use these platforms effectively. Outreach programs, legal literacy campaigns, and assistance at the local level are essential to ensure that digital transformation in land governance does not leave women behind but rather empowers them.

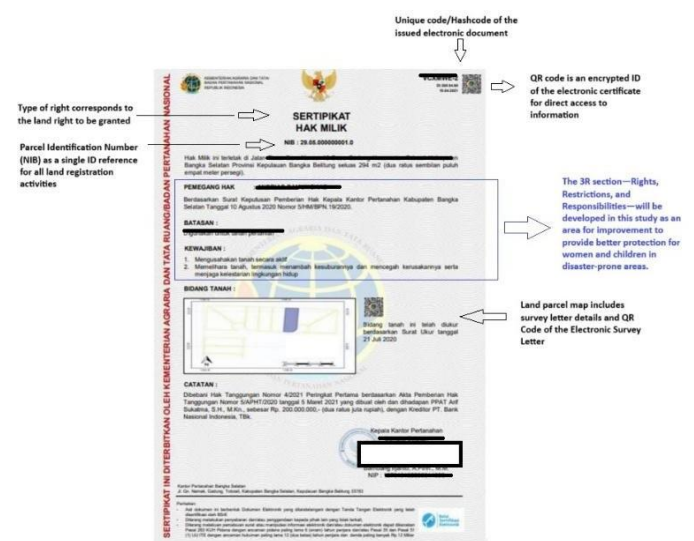


Figure 1. Indonesian Electronic Land certificate (Sertipikat Tanah Elektronik) structure.

The digital structure of the Rights, Restrictions, and Responsibilities (RRR) data field in Indonesia's electronic land certificate system should be updated to allow for entries that more accurately reflect and protect the rights of women and children, specifically the inclusion of gender-sensitive components such as:

1. **Right of Joint Tenure (Co-ownership):** Ensuring that land ownership can be registered under both spouses' names, acknowledging the equal contribution and legal rights of women in household land assets.
2. **Restriction on Unilateral Sale Without Spousal Consent:** Preventing one party from selling or transferring land without the knowledge and approval of the other spouse, thereby safeguarding the housing and livelihood security of women and children.

3. Responsibility Clauses Related to the Welfare of Dependents: Including responsibilities that recognize the social function of land, such as ensuring continued access to shelter and resources for children and other dependents, particularly in the event of disaster, divorce, or inheritance disputes.

3.6 SWOT and PESTEL Analysis

Indonesia's post-disaster land governance presents a complex landscape of strengths, weaknesses, opportunities, and threats, particularly concerning women's land rights and inclusive recovery. A major strength lies in the country's robust legal and institutional framework, including laws such as the Basic Agrarian Law and the Disaster Management Law, which together provide a foundation for safeguarding land rights in disaster contexts. Success stories like the Aceh reconstruction after the 2004 tsunami, where land titling programs such as RALAS included women in property ownership, also demonstrate the government's capacity to collaborate with international partners and deliver large-scale, inclusive recovery efforts. Furthermore, recent innovations like the electronic land certificate (Sertipikat-el) reflect a forward-looking approach to improving land governance through digitalization and legal certainty.

However, persistent weaknesses continue to hinder equitable outcomes. These include fragmented institutional coordination between agencies such as BPN and BNPB, lack of gender-sensitive planning, limited legal literacy—especially among rural women—and ongoing exclusion from resettlement programs. Customary norms that favor male ownership often override statutory law, particularly in regions like Lombok and Palu, where unregistered marriages and patriarchal systems limit women's legal visibility. The destruction of land documents in disasters, coupled with unclear tenure and poorly enforced regulations, further exacerbates land insecurity and marginalization of women.

Amid these challenges, several opportunities emerge. The expansion of digital land administration through Sertipikat-el provides a pathway to legal recognition, transparency, and resilience, especially for women vulnerable to document loss and exclusion. Additionally, participatory mapping and programs under the One Map Policy offer promising approaches to improve spatial justice and gender parity in land ownership. Legal reforms to strengthen joint tenure, inheritance rights, and disaster-responsive land clauses can also transform land into a tool for empowerment and post-disaster recovery. Capacity-building programs and gender mainstreaming in land offices and disaster agencies can help institutionalize inclusive governance practices.

Nonetheless, Indonesia faces significant threats that could undermine progress. Cultural resistance to women's land ownership, coupled with systemic data deficiencies and bureaucratic inertia, could stall implementation of equitable land policies. Without sustained political commitment and adequate resources, even the best-intentioned legal frameworks and technologies may fail to reach the most marginalized. Additionally, climate change and the increasing frequency of disasters pose ongoing risks to land security, especially in hazard-prone, socioeconomically vulnerable communities where women are already disadvantaged.

PASTLE stands for Political, Administrative, Social, Technological, Legal, and Environmental factors. It is a strategic tool used to examine the macro-environmental influences that affect a particular issue or policy. In the context of post-disaster land governance in Indonesia, a PASTLE analysis helps unpack the broader systemic and structural

conditions shaping access to land, particularly for vulnerable groups like women, in the aftermath of disasters.

From a Political perspective, Indonesia has shown considerable will in reforming its disaster response mechanisms and land governance structures. The decentralization of authority has empowered local governments to take more active roles in recovery and land administration. However, inconsistencies in political commitment and fluctuating priorities at both national and local levels often result in fragmented or delayed implementation of inclusive land policies, especially in times of crisis.

The Administrative domain reveals issues related to institutional coordination, capacity, and data integration. While agencies like BPN (National Land Agency) and BNPB (Disaster Management Agency) are central to post-disaster land governance, their overlapping mandates, siloed operations, and limited gender expertise create gaps in service delivery. The lack of disaggregated land ownership data, especially by gender, impairs inclusive planning and monitoring efforts. Moreover, challenges in resettlement documentation, verification, and dispute resolution hinder efficient recovery.

On the Social front, cultural norms, patriarchal inheritance systems, and low levels of legal literacy significantly limit women's access to land, even when legal frameworks support gender equality. These social dynamics are amplified in disaster contexts where the loss of male household members may paradoxically both open up and threaten women's claims to land. Stigma, marginalization, and lack of representation in decision-making forums further restrict their voice in recovery processes.

The Technological environment is evolving, offering both opportunities and challenges. Tools like the electronic land certificate (Sertipikat-el) and participatory mapping techniques under the One Map Policy are helping to improve transparency, documentation, and spatial justice. However, digital divides, uneven access to technology, and insufficient technical training—especially in rural or disaster-affected areas—can reinforce exclusion rather than address it.

From a Legal standpoint, Indonesia has made strides with frameworks such as the Basic Agrarian Law, Disaster Management Law, and laws supporting women's rights and land titling. However, enforcement remains inconsistent, and customary practices often override statutory provisions. In disaster settings, the loss of documentation, lack of legal recognition for informal settlements, and difficulty proving ownership or inheritance rights complicate land tenure security—especially for women and minority groups.

Lastly, the Environmental factor is increasingly urgent. Indonesia's vulnerability to earthquakes, tsunamis, floods, and land subsidence poses recurring threats to land stability and habitability. These hazards not only displace populations but also alter land use patterns, complicate spatial planning, and exacerbate inequalities in land access. Environmental degradation, such as erosion and saltwater intrusion, further limits viable resettlement areas and makes sustainable land governance a growing challenge.

The SWOT and PASTLE analyses are complementary tools that, when combined, provide a holistic understanding of post-disaster land governance in Indonesia. While the SWOT analysis identifies the internal strengths and weaknesses of the existing system—such as legal frameworks supporting women's land rights (strength) or weak coordination between agencies (weakness)—the PASTLE analysis explores the broader external context, including political, legal, and environmental forces that shape these internal dynamics. For example, a strength like progressive legal provisions for gender equality

can be undermined by a legal or social barrier identified in the PASTLE, such as patriarchal inheritance customs or poor law enforcement. Likewise, a weakness such as lack of gender-disaggregated data can be better understood in light of the technological and administrative constraints revealed through the PASTLE. Opportunities identified in the SWOT—like digital land registration or participatory mapping—are directly shaped by technological and political drivers highlighted in the PASTLE analysis. Threats such as recurring disasters or land disputes are intricately linked with environmental volatility and legal ambiguity, as emphasized in the PASTLE dimensions. By connecting the two, we can not only diagnose systemic issues but also align interventions with macro-structural realities, ensuring that disaster recovery and land governance become more inclusive, resilient, and responsive to the needs of women and marginalized groups.

4. Discussion

Gender disparities in land tenure and access are deeply exacerbated in post-disaster contexts in Indonesia, primarily due to inadequate legal frameworks, social norms, and fragmented institutional responses. Our analysis of the 2016 Bantul earthquake and the 2018 Lombok earthquake confirms that women's access to land is disproportionately affected by both the immediate impacts of disasters and the subsequent recovery processes. This study introduces new insights into how legal invisibility—especially among women in informal marriages or with undocumented inheritance claims—creates a long-term vulnerability that hampers both individual and community recovery.

The findings confirm that the research goals were largely achieved: we were able to identify key structural and institutional factors that limit women's land rights post-disaster and highlight specific legal, cultural, and administrative gaps. Through a review of case-specific impacts in Bantul and Lombok, as well as comparative literature, the study revealed a clear trend: women's land claims are more easily denied or ignored when proof of ownership is lost in the disaster or when land administration systems are not gender-responsive. This aligns with prior findings from Enarson and Morrow (1998) and Tavenner et al. (2019), which document women's marginalization in recovery due to weak tenure security.

However, our research goes beyond previous studies by situating land access issues within the broader context of post-disaster governance and valuation dynamics. Unlike most literature that focuses primarily on tenure insecurity, this study also examined how the depreciation of land value after disasters further disenfranchises women—especially those in peri-urban or rural communities where land is critical to livelihoods. Data from Saputra et al. (2021) shows that disaster events often lead to a decline in land market value and undermine women's ability to leverage land for recovery, credit, or future security. This aspect has received limited attention in prior gender and disaster literature and represents an important contribution of this study.

Another important finding is the role of legal pluralism and the failure to reconcile customary, religious, and state law in protecting women's rights post-disaster. Women in *nikah siri* marriages—common in many affected regions—are routinely excluded from inheritance or compensation claims due to their unregistered status. Although earlier studies (e.g., Zen, 2018; Yiftachel, 2020) have pointed to legal pluralism as a source of conflict, our research provides empirical illustrations of how this translates into tenure insecurity during recovery operations. The lack of harmonization across legal systems is not merely a

theoretical challenge but a practical barrier for thousands of women attempting to rebuild their lives.

These findings also highlight the critical role of spatial and gender-sensitive land administration systems. Damage to land boundaries, titles, and spatial data during disasters leads to administrative backlogs that disproportionately affect women, particularly those without formal land documents. In both Bantul and Lombok, the absence of pre-disaster spatial data and poor post-disaster coordination slowed down the revalidation of ownership, echoing the conclusions of Rahayu et al. (2023) but also highlighting the need for more anticipatory systems.

One major solution emerging from this study is the urgent need to implement digital land certification systems in Indonesia. The availability of accurate and accessible land data is instrumental in disaster risk mitigation. As noted by Pinuji and Vries (2023), effective land record systems not only improve vulnerability assessments but also streamline resource distribution and reduce land disputes—especially when conflicting claims over land titles emerge in the recovery phase. Electronic land certificate can facilitate swift name transfers from deceased husbands to surviving wives, a process that is often stalled in manual systems due to the absence of integrated data and rigid administrative requirements. This function is critical in contexts where disasters cause sudden loss of male heads of households and where many women lack formal legal representation of their ownership.

Moreover, digital land certification aligns with national efforts to improve property registration and the Ease of Doing Business (EoDB) in Indonesia (Widyastuti, 2021). By enhancing clarity and security of tenure, digital systems strengthen the entire disaster management framework and promote more equitable post-disaster reconstruction. Integrating digital land data with broader geospatial platforms further enhances disaster preparedness and response. As illustrated by the Jabar Command Center and supported by findings from Darmawan et al. (2024) and Maulana & Sakir (2024), such integration supports informed and rapid decision-making in crisis conditions.

The necessity for synergistic strategies involving digital governance, gender equity, and spatial systems is especially pronounced in Indonesia's socio-economically diverse landscape. Harmonized and inclusive digital platforms ensure representation of vulnerable groups—including women in informal arrangements or undocumented tenure—thus fostering a more just recovery (Unger et al., 2016). Coordination between legal, land, and disaster agencies, as stressed by Ruswandi et al. (2021), will be essential for such innovations to succeed.

An advantage of this study is its integration of gendered land issues with disaster risk reduction, land valuation, and digital innovation—a triangulation rarely pursued in the Indonesian context. By linking socio-legal exclusion with geospatial, economic, and technological dimensions, this research offers a holistic approach to post-disaster land governance that is both practical and policy-relevant.

This research confirms that while Indonesia has made considerable legal and institutional progress toward recognizing women's land rights, significant gaps remain in the implementation and integration of gender-responsive land governance, particularly in post-disaster contexts. Through a combination of SWOT and PASTLE analyses, this study reveals how systemic internal weaknesses and external structural forces intersect, often hindering women's access to land after disasters. A major contribution of this research is the development of an integrated SWOT-PASTLE framework, which provides a novel approach for diagnosing both internal capacities and external constraints in post-disaster land administration.

The SWOT analysis highlights that Indonesia possesses robust legal frameworks (e.g., Agrarian Law, Disaster Management Law) and growing political will to integrate gender equality into disaster recovery strategies. However, weaknesses such as poor interagency coordination, lack of gender-disaggregated data, and limited local capacity impede implementation. These findings echo prior studies (e.g., Fan et al., 2016; Yuliani et al., 2021), which also identified governance fragmentation as a persistent barrier to effective disaster response. Nevertheless, this study expands upon previous work by emphasizing how opportunities like digital innovation and community-based land registration can be strategically mobilized to address gender disparities.

The PASTLE analysis reveals that socio-cultural norms and legal ambiguities remain significant hurdles. For example, although laws affirm women's land rights, patriarchal inheritance customs and unclear land tenure often override formal statutes during post-disaster reconstruction, especially in rural or customary areas. This aligns with findings by UN-Habitat (2018), which noted that women's land tenure security is frequently undermined by customary practice despite legal protection. However, the PASTLE analysis here contributes new insight by linking environmental and technological trends—such as the intensifying climate-related disasters and the growing accessibility of geospatial tools—to opportunities for reform. In doing so, the study proposes a more dynamic understanding of how macro-drivers can either exacerbate or alleviate post-disaster land governance challenges.

Compared to previous studies, this research offers several key advantages. First, it goes beyond descriptive or legalistic reviews by systematically mapping strengths, weaknesses, opportunities, and threats within the broader political, economic, and environmental landscape. Second, it proposes a conceptual framework that links internal governance dynamics with external structural forces, providing practical entry points for targeted intervention. For instance, findings suggest that capacity-building for local officials in disaster-prone areas, combined with community-driven spatial planning, could significantly enhance the enforcement of women's land rights after disasters.

Importantly, this study demonstrates that the research goals were largely achieved: we identified not only the institutional and legal constraints affecting women's land rights in post-disaster recovery but also highlighted actionable strategies for improvement. However, some exceptions emerged—particularly in data availability. For example, the lack of consistent gender-disaggregated land ownership data across regions limited the analysis of specific case studies. This points to an urgent need for improved data collection and monitoring mechanisms at both national and local levels.

Overall, the findings hold significant implications for policy, practice, and further research. They suggest that gender-sensitive land governance must move beyond tokenistic inclusion toward structural reform. This includes ensuring women's participation in post-disaster spatial planning, integrating gender-responsive indicators into land administration systems, and aligning recovery policies with technological and environmental realities. The proposed SWOT–PASTLE framework can serve as a diagnostic tool for government agencies, NGOs, and international partners, aiding in the design of more equitable and resilient recovery strategies.

5. Conclusion

This study has examined the gendered dimensions of land access and tenure security in post-disaster contexts in Indonesia,

focusing on the 2016 Bantul earthquake and the 2018 Lombok earthquake. The findings reveal that women are disproportionately impacted by weak land governance systems, legal pluralism, and the absence of gender-responsive policies during disaster recovery. Key challenges include the loss of land documentation, exclusion from inheritance and compensation claims—particularly among women in informal or unregistered marriages—and declining land values that further reduce their ability to recover and rebuild.

One of the major contributions of this research is the integration of land governance, disaster management, and digital innovation within a gender equity framework. It underscores the necessity of implementing digital land certification in Indonesia as a transformative measure to minimize land disputes, improve administrative efficiency, and facilitate the transfer of ownership—especially from husbands to wives in the event of disaster-related deaths. By linking this technological solution with broader disaster risk reduction strategies, the study presents a comprehensive and forward-looking approach to inclusive recovery.

The study also contributes to the existing body of knowledge by expanding the discourse on post-disaster recovery beyond infrastructure and logistics to include spatial justice and tenure security for marginalized groups. It bridges gaps in the literature by exploring how legal and institutional arrangements, combined with socio-cultural norms, shape women's access to land after disasters. This research affirms that land tenure is not merely a technical issue but a deeply social and political one with long-term implications for equity and resilience.

The findings have important implications for policy and practice. There is an urgent need for integrated governance frameworks that harmonize customary, religious, and statutory laws, while embedding gender-sensitive approaches in all stages of disaster management. Additionally, investments in geospatial and digital land information systems should be prioritized to support transparent, equitable, and responsive land administration—especially in disaster-prone areas.

Future research should explore the scalability of digital land certification models in diverse socio-cultural settings across Indonesia, assess the long-term impact of secure land tenure on women's recovery trajectories, and examine how inclusive land governance can be embedded in climate adaptation and resilience-building strategies. There is also room to further investigate the role of community-based customary practices that may promote or hinder women's land rights post-disaster. This study reinforces the critical role of gender-responsive land governance in disaster recovery and resilience, offering both empirical evidence and actionable pathways to address persistent inequalities. By focusing on women's tenure security and the integration of digital innovations, it provides a timely and relevant contribution to national and global efforts aimed at building more just, inclusive, and disaster-resilient societies.

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