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Research Article

# Policy Incoherence and Reactive Apporoaches: Barriers to Efective Management of Land Subsidence in Semarang City, Indonesia

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***Abstract***

*Urbanization drives population growth and development in the coastal area of Semarang City, Indonesia, which in turn increases water consumption demand. To meet these demands, massive exploitation of groundwater has become a common practice. Consequently, groundwater reserves are depleting, causing damage to soil composition, particularly in the alluvial land characteristic of the area. These factors contribute to loads that exceed the land's carrying capacity, leading to extreme subsidence rates in Semarang's coastal areas. This research analyzes the obstacles faced by central and regional governments in implementing public policies to mitigate sustainable land subsidence. A qualitative approach with descriptive methods was employed, with a rigid selection of existing literature, journal articles, official documents, and news related to the research topic. The study utilizes a public policy perspective to map and analyze existing literature. The results indicate that handling land subsidence is hindered by several factors: policy incoherency, reactive policy nature, miscoordination among stakeholders, and overlapping public policies. Consequently, policy implementation in Semarang City has not yielded significant results in addressing subsidence. The study highlights the need for central and regional governments to involve business actors in formulating strategies to manage land subsidence effectively. This research contributes to expanding theoretical and practical knowledge on the implementation of land subsidence management policies by local governments in Indonesia's sustainable environmental sector.*

***Keywords***: *Coastal Area, Critical Factors: Land Subdince, Policy Implementation: Semarang.*

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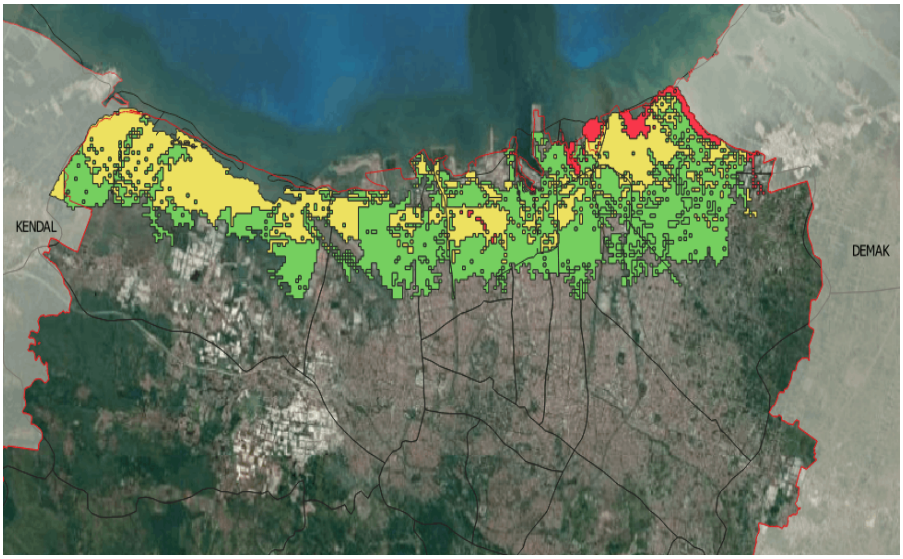
## INTRODUCTION

The coastal area in the city of Semarang has potential natural attractions if managed well (Azeriansyah et al., 2019). From a socio-economic perspective, this potential is a factor driving high population growth and the development of industrial areas in the city of Semarang (Beek et al., 2019). According to recent data, the population of Semarang has been growing 2.30% from 2021-2023, with the industrial sector expanding rapidly, particularly in the northern coastal areas (Central Bureau of Statistics, 2023). This massive development creates loads that exceed the carrying capacity of the land itself. On the other hand, the population's demand for clean water is increasing, which Municipal Waterworks (PDAM) can no longer fulfill (Beek et al., 2019). To meet the need for clean water, there has been a massive and exploitative use of groundwater since the early 1990s (Hadi et al., 2020). Extensive groundwater pumping is a significant factor affecting the sustainable use of water resources. From natural factors, young soil types originating from abrasion and sedimentation processes cause young soil structural characteristics. These factors cause land subsidence (Cao et al., 2013). The city of Semarang, Indonesia, is a coastal area that experiences land subsidence. The rate of land subsidence in the city of Semarang varies from time to time. Abidin et al. (2013) argue that the rate of land subsidence reached 19 cm/year from 1999 to 2011, 7 cm/year from 2008 to 2011, and 14–19 cm/year in recent years in certain locations. The northern part of Semarang can experience land subsidence at a rate of up to 15 cm/year and continues to spread to the surrounding areas (Yuwono et al., 2016).

Land subsidence is also the primary causal factor driving exposure to other coastal disasters (Hamdani et al., 2020). For example, it encourages coastal flooding in coastal areas (Rizkiana S. Hamdani et al., 2020; Koch et al., 2019; Yuwono et al., 2016). Existing literature states that land subsidence causes natural disasters such as tidal floods - local people call them tidal floods, often occurring in the northern part of Semarang (Denicko Roynaldi & Maryono, 2019). Tidal floods are a natural phenomenon that occurs when sea water rises towards land. As a result, the river water that should flow into the ocean becomes blocked and causes the water to overflow onto land.

Figure 1. Mapping the Threat of Rob Flood Inundation




Resource: Pratiwi (2021)

Figure 1 shows a graphic map of tidal flooding in the city of Semarang, Indonesia. The graphic mapping shows the natural phenomena that befall the coast of Semarang city. The causes are land subsidence and tidal floods (Hakim et al., 2022; Setiawan, 2023). Higher intensity and volume cause increasingly severe damage (D. Harwitasari & van Ast, 2011; Setiawan, 2023). Thus, efforts to reduce disaster risks, including physical development and increasing the capacity of stakeholders to face disaster threats, are important. Existing literature believes that the geological phenomenon of land subsidence occurs unevenly throughout urban areas, which is a classic "wicked" policy problem (R. S.-D. Zoysa et al., 2021; R. S. Zoysa et al., 2021). Various government policies have been implemented but have yet to impact land subsidence significantly. The handling of tidal flood management, which is still partial and needs to be integrated, is a factor that causes the strategic steps taken by the Semarang city government ineffective (Hakim et al., 2022). Evaluation of the implementation of subsidence prevention policies in the city of Semarang is essential. Identifying problems that hinder the implementation of subsidence management policies can provide a more comprehensive, accurate view to support more effective strategy implementation.

Existing literature on land subsidence policy research is related to the main topic of disaster mitigation (Putri et al., 2021; Saputra et al., 2017). Disaster mitigation involves actions aimed at anticipating disasters and reducing the losses they cause (Couto et al., 2021). It is an essential government policy for reducing the impact of land subsidence (Putri et al., 2021;

Saputra et al., 2017). This policy can be implemented through the development of physical infrastructure, increased awareness, and capacity building to face disaster threats and reduce disaster risks (Putri et al., 2021). The main theoretical framework guiding this research is the Top-Down and Bottom-Up Approach in public policy implementation theory (Sabatier, 1986). This approach integrates the hierarchical perspective of central authorities (Top-Down) with the local-level involvement of various stakeholders (Bottom-Up). It highlights the importance of coherent, coordinated policy measures and the roles of local actors in successful policy implementation. This framework is particularly useful for understanding the obstacles in policy implementation, such as policy incoherency, reactive policy nature, miscoordination between stakeholders, and overlapping public policies. For example, existing research has investigated the impact of public policy incoherency on the use of ground wells to meet agricultural sector needs (Couto et al., 2021), developed a theoretical and empirical framework to analyze the impact of subsidence disasters due to mining activities on cropland (Li et al., 2021), and created a measurement framework for integrated land subsidence assessment (Bucx et al., 2015). Other studies have explored democratization in enhancing the capacity for environmental disaster management (Tang & Tang, 2006), the intervention of various actors in reducing land subsidence impacts (Saputra, 2019), and the analysis of coastal vulnerability in decision-making (Prasetia, 2021). However, while the literature on land subsidence disaster mitigation has proliferated, there remains a gap in understanding the critical factors that hinder the handling of subsidence from a public policy implementation perspective. Therefore, this research offers a public policy perspective on land subsidence using the Top-Down and Bottom-Up Approach, aiming to fill this gap by identifying and analyzing the barriers to effective policy implementation. This approach will provide a more comprehensive and accurate view, supporting more effective strategy implementation for managing land subsidence in Semarang City.

This research aims to contribute significantly to multiple stakeholders. Firstly, it seeks to enrich the body of literature by providing a thorough analysis of the policy implementation barriers encountered by governments and stakeholders in addressing disaster mitigation. This analysis will serve as a pivotal resource for researchers, offering comprehensive insights into the complexities of policy implementation in this critical area. Secondly, the findings of this study are poised to provide policymakers at various government levels with valuable data. By identifying and elucidating factors that impede effective public policy responses to land

subsidence, this research equips policymakers with the knowledge needed to formulate more informed and effective policies. This dual contribution not only advances academic understanding but also supports practical efforts towards sustainable disaster management and urban resilience in regions susceptible to land subsidence, such as Semarang City.

Stakeholder involvement is crucial in policy formulation, emphasizing the author's aim to engage various stakeholders in disaster mitigation policy planning. The study is structured into five distinct parts for clarity and coherence. Initially, the research background is presented, followed by an examination of the government's policy implementation efforts to address subsidence in Semarang City, Indonesia. Subsequently, the research methods employed are detailed, and the results are discussed comprehensively. Finally, the study concludes with policy recommendations aimed at effectively managing land subsidence, offering valuable insights for stakeholders involved in urban resilience and disaster management.

## RESEARCH METHOD

To address the research questions, a qualitative approach was employed in this study. The chosen methodological framework involved conducting a case study focused on the policy implementation of subsidence in Semarang City, Indonesia. This approach was selected to thoroughly investigate the complexities surrounding urban land management and subsidence issues. The research systematically collected and analyzed data through several steps. Firstly, a comprehensive literature review was conducted, aggregating existing studies on land subsidence and land management in Semarang City. The review synthesized previous research based on relevant topics and identified key issues pertinent to land management. Secondary sources such as literature, journal papers, official documents, and news items were meticulously reviewed and selected based on their relevance to the subsidence issue in Semarang City.

The data collection process involved identifying and extracting information from these sources, focusing on critical themes such as public policy characteristics, bureaucratic structure, communication and coordination, and authority disposition. The synthesis of literature was carried out by three researchers independently categorizing and analyzing the findings related to policy implementation components. Subsequently, the researchers convened to discuss their individual analyses, leading to consensus through a rigorous scientific discourse grounded in the identified critical factors.

This methodological approach ensured a thorough exploration of the factors influencing the success of subsidence policy implementation in Semarang City, contributing valuable insights for urban resilience and disaster management stakeholders.

## RESULTS AND DISCUSSION

### A) Policy Incoherency in Semarang City

The idea of policy incoherence starts with policy issue framing. The situations can be framed in divergent and even contradictory ways depending on the stakeholders in the policy process that construct and maintain these images and ideas and change them (Yanow, 1995). Framing implies interpreting a problem and defining specific causes and implications of the problem (Sicurelli, 2008). When viewed from the perspective of different actors, policy incoherence stems from how policy issues are framed. This framing process can result in varying interpretations, depending on the stakeholders' roles in shaping, maintaining, and evolving these concepts. How problems are framed shapes how they are perceived, including their underlying causes, and emphasizes the intricate and subjective nature of the policymaking process. Within this context, our analysis focuses on how policymakers framed the policy issue surrounding soil subsidence and tidal flooding in Semarang. This examination allows us to evaluate the policy's coherence and its effectiveness in implementation, as the framing of the issue significantly influences the outcomes of the policy.

The coastal area in Semarang is facing land subsidence due to a combination of factors, including alluvium soil consolidation, extensive groundwater extraction, and heavy construction loads (Abidin et al., 2013; Marfai & King, 2007). However, this challenge exacerbates the potential presence of policy incoherency within the governance framework. The need for alignment and consistency among policies related to urban development, environmental conservation, groundwater management, and economic growth may inadvertently contribute to the intensification of land subsidence. Our research has identified instances of policy incoherency in addressing land subsidence in Semarang.

*First,* the failure to address land subsidence in Semarang may be attributed to the limited scope of the responsible authorities. Initially, land subsidence was handled based on regional autonomy, particularly within the city and district jurisdictions in the affected areas. Semarang City used specific regulations to govern groundwater management, including Semarang City Regulation 8/2011 concerning groundwater tax and Semarang City Regulation 17/2014 providing

guidelines for implementing groundwater tax. In a broader context, the Semarang city government once issued Semarang City Regional Regulation Number 2 of 2013 regarding Groundwater Management, but this regulation was revoked in 2018. There needs to be further explanation regarding the reasons for revoking that regulation. However, the provincial government of Central Java issued a regulation concerning groundwater management, governed under Central Java Regional Regulation number 3 of 2018. With these changes, the authority to implement government affairs related to groundwater management is delegated to the Department of Energy and Mineral Resources of Central Java Province.

*The transition of groundwater management authority to the Department of Energy and Mineral Resources of Central Java Province is supported due to the need for a larger administrative body to effectively address land subsidence issues in Semarang and its surrounding areas. Groundwater extraction has been observed to impact Semarang and adjacent regions, such as Pekalongan and Demak (Sidiq et al., 2021). One of the challenges in groundwater management to mitigate land subsidence is the institutional problem, characterized by limitations within existing institutions and constraints in decision-making, be* it in terms of physical capabilities, legal frameworks, or economic considerations. Hence, more competent institutions must address these issues and oversee effective water management. This centralized approach is deemed more suitable for tackling the broader and interconnected challenges associated with groundwater management and land subsidence in the affected area. However, more than the transfer of responsibility from the city/regency and provincial governments in addressing land subsidence through groundwater management is needed to resolve the issue. The subsequent problem is associated with focusing on the problem and allocating resources effectively to address the issue.

*Second,* the Semarang city government has shifted its focus away from groundwater management, as this responsibility has now been transferred to the provincial level. Presently, the city government's involvement in groundwater is limited to taxation. The local government controls excessive groundwater usage by optimizing the Municipal Waterworks (PDAM) to meet the water needs of Semarang residents (Pemerintah Kota Semarang, 2023). The local government also addresses land subsidence issues through alluvial compaction and dam construction. Existing research has revealed that the compaction of unconsolidated alluvial soil has the potential to speed up land subsidence (Antomi & Fajrin, 2022; Zhou et al., 2018), and this effect becomes even more pronounced when it intersects with government policies about alluvial soil compaction. This issue becomes particularly pressing when such policies coincide with the construction of dams on

alluvial soil, as these dual factors compound the risk of further land surface depression.

*Third,* the development priorities in the coastal areas of Central Java need to be clarified. In the urban and regional planning of the Central Java province 2009-2029, it is stated that the coastal regions of Pantura and Pansela will undergo conservation to preserve coastal functions and protect these areas from activities that may disrupt their ecological balance. However, the Regional Spatial Planning, Central Java Province, mentioned that development activities on the southern coast of Central Java aim to enhance economic growth by optimizing the potential of fisheries and marine resources, tourism, mining, and energy to capture market share.

Policies that need a clear focus on environmental revitalization and the optimal use of natural resources may lead to further damage, mainly if these areas are utilized for mining and energy industries. The key to addressing these issues lies in prioritizing solutions to the current problems faced by various stakeholders, all of whom play a role in preserving the environment for future generations (Mikulčić et al., 2019). The challenges in addressing land subsidence in Semarang reflect policy incoherency, marked by the transition of groundwater management authority to the provincial level without resolving institutional limitations. The Semarang city government's shift away from groundwater management, conflicting conservation and economic development priorities in coastal planning, and the potential compounding effect of policies on land subsidence underscore the need for a more cohesive and focused policy approach. Policy incoherency poses a barrier to practical environmental preservation and optimal resource utilization, emphasizing the importance of aligning policies to address sustainable land subsidence.

**B) The Nature of Reactive Policy**

Reactive policy refers to policies developed in response to specific events, crises, or issues after they have occurred rather than proactively anticipating and preventing them (DeLeo, 2017). Reactive policies are typically implemented to address immediate concerns, mitigate damage, or manage unexpected situations. A reactive policy is a practical approach when addressing sudden issues; however, the long-standing problem of surface flooding resulting from poor groundwater management has persisted for an extended period. There are some reactive policies that the government has already taken.

*It is* adapting ports to sea-level rise. The policy of adapting ports to sea-level rise in the coastal areas of Central Java falls short of addressing the primary issue of land subsidence caused by the mismanagement of groundwater. Constructing ports to accommodate rising sea levels is a

temporary measure to secure vital ports (Esteban et al., 2020). The substantial financial burden of such adaptation costs is compounded by the reactive nature of adaptation measures, resulting in considerable damage-related expenses. Moreover, it does not tackle the root cause of land subsidence, which requires a comprehensive approach to groundwater management. There is a critical need for policies that address the underlying problems of groundwater mismanagement, as these issues are integral to the long-term resilience of coastal infrastructure in Central Java.

*Second,* according to the statement from the Central Java provincial government, the current reactive policy involves the construction of dams to address ongoing challenges (Pemerintah Provinsi Jawa Tengah, 2023). It is important to note that such dam construction may accelerate the subsidence of the predominantly alluvial land in the coastal areas of Central Java (Sarah et al., 2020). While aimed at mitigating specific issues, this approach raises concerns about potential adverse impacts on the stability of the alluvial soil, particularly in the coastal regions of Central Java. Balancing the need for immediate solutions with long-term environmental implications remains critical in formulating effective and sustainable policies. The case of surface flooding due to poor groundwater management exemplifies the persistence of issues despite reactive measures. Two notable reactive policies implemented by the government are adapting ports to sea-level rise and constructing dams in coastal areas. However, these initiatives need to be improved, such as the temporary nature of port adaptations and the potential exacerbation of land subsidence through dam construction. The financial burden associated with reactive adaptation measures raises concerns, emphasizing the need for a more comprehensive and proactive approach to address underlying problems like groundwater mismanagement. Striking a balance between immediate solutions and long-term environmental considerations is crucial for formulating effective and sustainable policies in the coastal regions of Central Java.

**C) Miscoordination Between the Government**

The phenomenon of tidal flooding currently affects 7 out of 16 districts, with the width of the impacted area reaching 3,915.16 ha (Hadi, 2017). The latest research results must explicitly mention the coordination between the government's handling of tidal floods, land subsidence, and groundwater management. It contradicts the roadmap to address land subsidence in Central Java, developed by the Building with Nature Indonesia consortium through 'Water Dialogues,' which aims to reduce subsidence by 50% in Semarang and 13% in Denmark (Wetland International, 2021). The approach emphasizes stakeholder involvement and decentralized decision-making. Wetlands International coordinated dialogues with authorities and communities to gather input.

Recommendations on national policy and institutional frameworks are expected to facilitate implementation by local governments.

Table 1. The Resume of Government Regulation Relating Subsidence

| No | Regulation | Government Actor | Challenges |
|---|---|---|---|
| 1 | UU No. 6 Tahun 2023 tentang Sumber Daya Air | Ministry of Energy and Mineral Resources of the Republic of Indonesia | There are no guidelines in the preparation of activity plans by Regional SKPDs |
| 2 | Pergub Nomor 3 Tahun 2018 Tentang Pengelolaan Air Tanah | Central Java Provincial Government | Establishment of groundwater management in Central Java Province. The delegation of authority in the implementation of groundwater management becomes evident. |
| 3 | Pergub Nomor 47 Tahun 2015 tentang Kebijakan dan Strategi Daerah Pengembangan Sistem Penyediaan Air Minum (SPAM) Provinsi Jawa Tengah | Central Java Provincial Government | There is no continuation of SPAM policy, which affects local governments in regulating SPAM |
| 4 | Peraturan Daerah Kota Semarang Nomor 14 Tahun 2011 Tentang Rencana Tata Kota Ruang Wilayah Kota Semarang Tahun 2011-2031 | Semarang Municipal Government | -Weak monitoring and law enforcement, especially regarding groundwater governance<br>-Lack of cross-sectoral collaboration within the city government |
| 5 | Perwali Provinsi Jawa Tengah Nomor 23 Tahun | Semarang Municipal Government | -Socialization of groundwater withdrawal regulations is needed |

| | |
|---|---|
| 2023 | -Monitoring and implementation need to be improved |

Resource: Authors, (2023).

The government and local people in Semarang have taken various measures to address the issues of tidal flooding and land subsidence, even though they need to be coordinated among districts or actors. These measures include both physical and non-physical infrastructures, as well as policy initiatives. People living in coastal villages know the tidal flood inundation and have taken steps to address the hazards (Hamdani et al., 2021). The government has implemented adaptation measures such as building dykes and pumping stations. However, these efforts have been deemed temporary, as significant land subsidence persists and worsens due to rising sea levels (Dian Harwitasari & van Ast, 2011). However, the government's policies regarding land subsidence in Central Java must be clarified. For example, the government still needs to adopt policies to address the dynamics of land subsidence in Tambakrejo Semarang (Saputri & Linda, 2023).

Despite the international organization initiating dialogues on land subsidence in Central Java, neither the province nor Semarang has implemented a coordinated policy to address the issue. Currently, efforts are fragmented, with private actors, communities, and local governments working independently. There is a pressing need for comprehensive policies at both national and provincial levels that can accommodate the implementation of strategies to address tidal floods caused by land.

**D) The Overlapping Authority Structures**

The indicators showing overlapping authority structures in handling public issues can vary across contexts. However, some common indicators include conflicting decision-making, duplication of efforts, disputes and inconsistencies, lack of clarity in roles and responsibilities and multiple reporting lines (Karaseva, 2022; May 2019; Williams et al., 2023). Previous findings highlight the challenges faced in overcoming the tidal flood problem in Semarang City. These challenges fall under the indicator of overlapping authority structures, characterized by conflicts in decision-making, disputes and inconsistencies, a lack of clarity in roles and responsibilities, and multiple reporting lines. These issues indicate a complex web of governance and administrative obstacles that hinder the efficient resolution of Semarang's flood problems.

In addressing flood control in Semarang city, various strategies have been proposed based on search results. One approach suggests enhancing the capacity of the central drainage system and

installing pumps and one-way gates to mitigate the impact of tidal surges (Budinetro, 2018). The urban drainage system is essential in managing surface water and preventing flooding. The implementation of collaborative governance is also highlighted as a crucial element in flood control efforts, fostering trust and coordination among diverse stakeholders engaged in flood management (Hidayatullah et al., 2023). Specific programs related to flood control in Semarang include the "Penanganan Permasalahan Banjir di Kota Semarang" initiative, focusing on urban drainage and flood control studies. Furthermore, the program "Analisis Daya Dukung Tanah dengan Program Numerik pada Proyek Pengendalian Banjir dan Rob Kota Semarang Paket I dan II" delves into soil-bearing capacity analysis within the flood control project. Notably, more specific information must be given regarding the duplication of flood control programs in Semarang City.

Sustainable environmental governance is a shared responsibility. Stakeholder participation is needed, especially in environmental decision-making. The spatial and regional planning has been regulated in Semarang City Regional Regulation Number 5 of 2021 concerning Amendments to Regional Regulation Number 14 of 2011 concerning the Semarang City Regional Spatial Plan 2011-2031. Policies on coastal area management in Indonesia have fluctuated. Environmental protection and management in Indonesia are run by two governmental entities, namely the Regional Planning Agency and the Ministry of Fisheries and Maritime Affairs. Semarang City has environmental protection and management obstacles that planned policies do not directly affect. The responsibility for groundwater management has transferred from the local government to the provincial government (Rizkiana S. Hamdani et al., 2020). In environmental protection and management efforts, the government often needs to catch up on the planning that has been regulated in short- and long-term plans.

## CONCLUSIONS

This research investigates the barriers to implementing land subsidence policies in Semarang City, Indonesia, emphasizing public policy characteristics, bureaucratic structures, communication and coordination, and the disposition of authority. The findings highlight significant inefficiencies across these implementation factors, reflecting a challenging scenario for the government. The dilemma between promoting massive urban development for economic growth and ensuring sound environmental management exacerbates policy inconsistencies. Weak government oversight in industrial groundwater use licensing contributes to the land subsidence issue (Saputri & Linda, 2023), compounded by unclear institutional frameworks at the local level

(Moloney & Fünfgeld, 2015) and reactive policy responses from regional authorities (Saputra et al., 2017).

Despite relying on secondary data and literature review techniques, this study offers both practical and conceptual contributions to expanding knowledge on implementing sustainable land subsidence management policies in Indonesia. It underscores the complexity of natural phenomena and causal factors, necessitating a comprehensive approach and broad stakeholder engagement. In particular, involving business actors in policy formulation enhances analytical capabilities. Furthermore, stakeholder participation fosters greater awareness and commitment to addressing land subsidence issues. Effective policy implementation hinges on stakeholders' clear understanding of their roles, aligning long-term development plans with prioritized objectives for economic growth and environmental governance. This strategic alignment ensures robust policy frameworks capable of sustaining socio-economic development while preserving environmental integrity.

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