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Regulatory Compliance and Institutional Effectiveness in Urban Drainage Governance: An Empirical Study of Semarang City

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Abstract

This study aims to evaluate the effectiveness of urban drainage governance in Semarang City by examining the institutional performance of the Public Works Agency in implementing Minister of Public Works Regulation No. 12/PRT/M/2014, as well as identifying the key constraints affecting its implementation. Urban flooding and waterlogging remain persistent issues, indicating a gap between regulatory mandates and practical outcomes. Employing an empirical juridical approach with a descriptive design, this research integrates normative legal analysis with field data obtained through interviews, observations, and literature review, which are analyzed qualitatively. The results show that although drainage management programs have been formally implemented in accordance with regulatory provisions, their effectiveness remains partial, as evidenced by recurring flooding caused by limited infrastructure capacity, sedimentation, delayed budget allocation, and low levels of community participation. The novelty of this study lies in its integrative analytical framework that connects regulatory compliance with institutional performance, demonstrating that legal effectiveness in infrastructure governance is contingent upon implementation capacity rather than merely normative existence. These findings imply that strengthening urban drainage governance requires performance-based maintenance planning, improved procurement mechanisms, enhanced inter-agency coordination, and institutionalized community participation to ensure sustainable flood risk mitigation.
Keywords: Flooding; Semarang City; Urban Drainage System

1. INTRODUCTION

Regional autonomy in Indonesia constitutionally mandates local governments to manage public affairs and deliver essential public services within their respective jurisdictions.[1] Articles 1, 18, and 18A of the 1945 Constitution collectively establish the legal foundation for decentralization by granting local governments the authority to administer governmental functions aimed at improving public welfare, service delivery, and regional competitiveness.[2] Within this framework, the provision and maintenance of urban infrastructure constitute a fundamental public service obligation that must be implemented in accordance with principles of good governance and public accountability.

In urban areas, drainage systems represent a critical component of public infrastructure that directly affects environmental safety, economic productivity, and community mobility.[3] As a coastal city with rapid population growth and complex topographical characteristics, Semarang faces recurring waterlogging and flooding during the rainy season, particularly in areas such as

[1] Simandjuntak, Reynold. "Sistem Desentralisasi Dalam Negara Kesatuan Republik Indonesia Perspektif Yuridis Konstitusional." *De Jure: Jurnal Hukum dan Syar'iah* 7.1 (2015): 57-67. https://doi.org/10.18860/j-fsh.v7i1.3512.

[2] Wibawa, Kadek Cahya Susila. "Penegasan politik hukum desentralisasi asimetris dalam rangka menata hubungan pemerintah pusat dengan pemerintah daerah di Indonesia." *Administrative Law and Governance Journal* 2.3 (2019): 400-412. https://doi.org/10.14710/alj.v2i3.400-412.

[3] Wahda, Jamalia, Abdul Sadad, "Kinerja Dinas Pekerjaan Umum dan Penataan Ruang (PUPR) dalam Mengelola Drainase di Kota Pekanbaru," *Journal of Social Science Research* 3, no. 3, (2023): 9178–9188. https://doi.org/10.31004/innovative.v3i3.

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Kaligawe, Tlogosari, Genuk, and Trimulyo between October 2025 and early 2026.[4] These incidents indicate not merely technical deficiencies in drainage capacity but also challenges in the governance and maintenance of urban infrastructure systems. Ineffective drainage management disrupts transportation networks, damages residential areas, and generates material losses, thereby undermining the fulfillment of local governments' public service responsibilities.[5]

From an administrative law perspective, the effectiveness of drainage management should not be viewed solely as an engineering matter but as an issue of institutional performance in implementing regulatory mandates.[6] The maintenance of urban drainage infrastructure therefore, becomes a governance function requiring compliance with established policy frameworks, sustainable operational planning, and accountability in public resource utilization.[7] In Semarang, the Public Works Agency (Dinas Pekerjaan Umum) holds primary responsibility for planning, operating, and maintaining the drainage system in accordance with Minister of Public Works Regulation No. 12/PRT/M/2014 concerning the Implementation of Urban Drainage Systems.[8] Nevertheless, empirical conditions suggest that drainage governance remains suboptimal due to both technical constraints, such as sedimentation and limited infrastructure, and non-technical factors, including budget limitations and low levels of public participation.[9]

The maintenance of drainage infrastructure, therefore, constitutes a critical aspect of urban drainage system management. Proper maintenance ensures that drainage channels, complementary structures, and supporting facilities continue to function effectively throughout their service life. Without consistent and systematic maintenance, drainage systems are prone to damage and blockage, which directly increases the risk of waterlogging and flooding. Consequently, effective drainage management is not merely a technical necessity but also a prerequisite for safeguarding public services, economic activities, and urban safety.[10]

Several recent studies have discussed issues related to urban drainage and flooding in Indonesia. Rahma finds that urban drainage channels often fail to accommodate flood discharge due to inadequate channel dimensions, sedimentation, and blockage, resulting in recurrent

[4] Muhammad, Z., H. Edi, F. F., dan Nessa, "Pelaksanaan Fungsi Controlling Dewan Perwakilan Rakyat Daerah dalam Pembangunan Drainase Kota Bukittinggi," *Unes Law Review* 6, no. 1 (2023): 1–8. https://doi.org/10.31933/unesrev.v6i1.829.

[5] Theresia, Putri, and R. Slamet Santoso. "Analisis Kinerja Dinas Pekerjaan Umum Dan Penataan Ruang (PUPR) Kabupaten Kudus Dalam Pengelolaan Drainase Sebagai Strategi Pencegahan Banjir." *Journal of Public Policy and Management Review* 14, no. 3 (2025): 514-530. https://doi.org/10.14710/jppmr.v14i3.53539.

[6] Firdausy, F. A., & Alia, R. S. P.. Program Pencegahan Banjir: Tinjauan Efektivitas Dinas Pekerjaan Umum Sumber Daya Air Dan Penataan Ruang Provinsi Jawa Tengah. *Jurnal Ilmiah Wahana Pendidikan* 10, no. 11 (2024): 170–186. https://doi.org/10.5281/zenodo.12577755.

[7] Anirwan, Anirwan, and Almuhajir Haris. "Upaya pemerintah Kota Makassar dalam mewujudkan ketahanan kota pascabencana banjir." *Journal of Governance and Local Politics (JGLP)* 5.2 (2023): 187-195. https://doi.org/10.47650/jglp.v5i2.999.

[8] Rizqi, Muhammad, dan Faza Fatkhun, "Implementasi Kebijakan Dinas Pekerjaan Umum Kota Semarang dalam Transparansi dan Kendala Pengelolaan Proyek Jalan Raya di Kota Semarang," *Jurnal Ilmiah Wahana Pendidikan* 10, no. 12, (2024): 570–584. https://doi.org/10.5281/zenodo.12542063.

[9] Ibrahim, Nilam Ismi, Petrick Th Berhitu, and Ferad Putuhuhu. "Evaluasi Sistem Drainase Dalam Upaya Penanggulangan Banjir (Studi Kasus Kelurahan Honipopu Kota Ambon)." *Jurnal Geografi Geografi dan Pengajarannya* 20.2 (2022): 131-143. https://doi.org/10.26740/jggp.v20n2.p131-143.

[10] Putri Wulandari, Andini, dan Andriyus, "Evaluasi Pelaksanaan Tugas Dinas Pekerjaan Umum dan Penataan Ruang Kota Pekanbaru dalam Pemeliharaan Saluran Drainase di Pekanbaru," *Jurnal Mahasiswa Pemerintahan* (2024): 378–389, https://doi.org/10.25299/jmp..18035.

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inundation. The strength of this study lies in its detailed technical evaluation of channel capacity; however, it does not examine the role of local government institutions or assess drainage management performance based on regulatory compliance, leaving institutional and juridical aspects unexplored.[11]

Similarly, Barus highlights that drainage systems in urban areas are frequently unable to handle peak runoff because channel capacity is smaller than flood discharge. This study contributes valuable empirical data on drainage performance and structural limitations, yet its analysis remains predominantly technical. It does not integrate drainage management practices with normative regulations or evaluate how responsible agencies implement maintenance obligations in accordance with existing legal frameworks.[12]

Meanwhile, Miftahudin emphasizes that poor drainage connectivity, clogging, and insufficient maintenance are major causes of urban inundation, while also acknowledging the importance of community participation in drainage management. Although this study offers a broader perspective by incorporating non-technical factors, it does not specifically assess institutional performance nor relate empirical findings to the implementation of national regulations governing urban drainage systems.[13]

Previous studies on urban drainage management in Indonesia have predominantly adopted a technocratic approach that focuses on hydraulic capacity, channel dimensions, and runoff performance. Rahma identifies inadequate channel capacity and sedimentation as key causes of recurrent inundation but does not examine institutional responsibility or regulatory compliance in drainage governance. Similarly, Barus emphasizes structural limitations in drainage channels without integrating management practices within the framework of legal obligations assigned to local governments. Miftahudin introduces community participation as a non-technical variable; however, the study remains largely operational and does not evaluate the performance of implementing agencies in fulfilling normative maintenance duties.

These studies demonstrate a prevailing emphasis on physical system performance while overlooking the institutional-regulatory dimensions of drainage governance. Consequently, the relationship between regulatory compliance, organizational capacity, and infrastructure effectiveness remains insufficiently examined in existing literature. This research addresses that gap by positioning urban drainage management within an institutional-regulative framework that integrates empirical field conditions with normative policy mandates. By employing an empirical juridical approach, this study evaluates the effectiveness of the Semarang City Public Works Agency's performance in managing the urban drainage system based explicitly on Minister of Public Works Regulation No. 12/PRT/M/2014.

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[11] Rahma, Sukma Laksita. "Assessing Urban Flooding and Drainage System Performance in Urban Area: A Mononobe Equation and Manning Formula Approach." *Jurnal Pengelolaan Sumberdaya Alam Dan Lingkungan (Journal of Natural Resources and Environmental Management)* 14.3 (2024): 463-463. https://doi.org/10.29244/jpsl.14.3.463.

[12] Barus, F., T. E. Sutarto, and D. D. Widiawati. "Evaluation of Drainage System Performance in Urban Areas at Risk of Flooding: A Case Study on Prima Street to Sungai Buun, West Kotawaringin Regency". *Civil and Environmental Science Journal (CIVENSE)*, vol. 8, no. 1, (2025). 58-69, https://doi.org/10.21776/ub.civense.2024.008.01.7.

[13] Miftahudin , Miftahudin, et al. "The Phenomenon of Waterlogging Due to Poor Drainage in the Tanjung Duren Area, West Jakarta". *Journal of Engineering, Electrical and Informatics*, vol. 5, no. 3, (2025), 83-90, https://doi.org/10.55606/jeei.v5i3.5659.

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This study aims to analyze the effectiveness of the Semarang City Public Works Agency's performance in managing the urban drainage system, identify the obstacles encountered in its implementation, and examine the efforts undertaken by the Semarang City Government to overcome drainage problems in accordance with Minister of Public Works Regulation No. 12/PRT/M/2014 concerning the Implementation of Urban Drainage Systems.

2. METHOD

This study employs a descriptive research design using an empirical juridical approach aimed at examining the implementation of legal norms governing urban drainage management within their practical administrative context.[14] The empirical juridical approach is utilized to analyze the application of regulatory provisions in real governance practices, particularly in relation to the performance of local government institutions in fulfilling their public service obligations in urban infrastructure management. The data used in this study consist of primary and secondary data. Primary data were obtained through semi-structured in-depth interviews with key informants from the Semarang City Public Works Agency (Dinas Pekerjaan Umum), particularly those directly involved in the planning, operation, and maintenance of the urban drainage system. Informants were selected using purposive sampling techniques based on their institutional roles and technical responsibilities in drainage management. In total, several officials and technical staff from the Water Resources and Drainage Division were involved as informants, including personnel responsible for drainage operation, maintenance, and rehabilitation programs.

Secondary data were collected through literature studies comprising legal regulations, academic books, scientific journal articles, and official policy documents related to urban drainage governance. The primary regulatory framework used as the normative evaluation parameter in this research is the Minister of Public Works Regulation No. 12/PRT/M/2014 concerning the Implementation of Urban Drainage Systems. This regulation serves as the benchmark for assessing institutional compliance and performance in the implementation of drainage maintenance programs, including routine maintenance, periodic maintenance, special maintenance, and rehabilitation activities carried out by the Semarang City Government. To ensure data validity and reliability, triangulation techniques were applied by comparing interview results with documentary data and relevant regulatory provisions. The collected data were then analyzed qualitatively using the interactive analysis model developed by Miles and Huberman, which consists of data reduction, data display, and conclusion drawing/verification. In this context, data reduction was conducted by categorizing field findings based on normative indicators stipulated in Ministerial Regulation No. 12/PRT/M/2014, followed by thematic data presentation to identify patterns of institutional performance and implementation constraints.

Furthermore, the evaluation of drainage management effectiveness in this study is based on a normative-regulative framework, which emphasizes the extent to which legal norms are implemented in practice by responsible institutions. Accordingly, the analysis focuses on

[14] Aksa, Fauzah Nur, Siska Mona Widia, and Silfia Hanani. "Perbandingan Metode Penelitian Yuridis Normatif Dan Yuridis Empiris: Penelitian Di Uin Sjech M Djamil Djambek." *Nusantara: Jurnal Ilmu Pengetahuan Sosial* 12.6 (2025): 2226-2236. https://doi.org/10.31604/jips.v12i6.2025.2226-2236.

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examining the conformity between regulatory mandates and their empirical implementation by the Semarang City Public Works Agency in managing the urban drainage system.

3. RESULTS AND DISCUSSION

3.1 Institutional Performance of Urban Drainage Governance in Semarang City

Goal Attainment, the primary objective of urban drainage management, is to prevent waterlogging and flooding by ensuring optimal channel functionality. Empirical findings indicate that the DPU has implemented routine weekly maintenance, sediment dredging, rehabilitation, and river normalization programs. However, recurring flooding in areas such as Kaligawe, Tlogosari, Genuk, and Trimulyo between October 2025 and early 2026 suggests that the intended policy goal of minimizing urban flooding has not been fully achieved.[15]

Although maintenance activities are formally conducted, repeated inundation indicates a gap between program implementation and outcome effectiveness. This condition reflects partial goal attainment, where administrative actions exist but have not yet produced consistent flood mitigation results. From a governance perspective, recurring floods may signal limitations in strategic planning, infrastructure capacity, or prioritization mechanisms.

Regulatory Compliance (Normative Evaluation of Article 22), Article 22 of Ministerial Regulation No. 12/PRT/M/2014 requires structured maintenance consisting of: 1) Routine maintenance (e.g., weekly cleaning and sediment removal), 2) Periodic inspection and flushing, 3) Special maintenance for urgent damage, and 4) Rehabilitation of degraded infrastructure.[16]

Interview data confirm that weekly cleaning and dredging are conducted. However, the effectiveness of these routine activities must be examined critically: flooding recurrence indicates that maintenance frequency may not always correspond to the actual sedimentation rate and runoff volume. In several cases, sediment buildup and clogged secondary channels persist despite scheduled cleaning. Rehabilitation efforts, including pump replacement and polder system development, are implemented. Nevertheless, procurement delays, particularly for imported pumps, demonstrate structural limitations that affect regulatory compliance in practice. Thus, while formal compliance with Article 22 exists administratively, substantive compliance remains constrained by budgetary and logistical barriers. This finding reveals a distinction between formal compliance (program existence) and functional compliance (effective regulatory realization).

Responsiveness, responsiveness refers to the institution's capacity to respond to emerging public needs and complaints. The DPU has undertaken river normalization, sediment dredging, drainage repair, and development of polder systems as reactive measures to recurring floods. Community involvement in river cleaning also indicates collaborative responsiveness. However, responsiveness appears largely reactive rather than preventive. Flood control measures are often intensified after major flooding events rather than based on predictive risk

[15] Theresia, Putri, and R. Slamet Santoso. "Analisis Kinerja Dinas Pekerjaan Umum Dan Penataan Ruang (PUPR) Kabupaten Kudus Dalam Pengelolaan Drainase Sebagai Strategi Pencegahan Banjir." *Journal of Public Policy and Management Review* 14, no. 3 (2025): 514-530. https://doi.org/10.14710/jppmr.v14i3.53539.

[16] Rizqi, Muhammad, dan Faza Fatkhun, "Implementasi Kebijakan Dinas Pekerjaan Umum Kota Semarang dalam Transparansi dan Kendala Pengelolaan Proyek Jalan Raya di Kota Semarang," *Jurnal Ilmiah Wahana Pendidikan* 10, no. 12, (2024): 570–584. https://doi.org/10.5281/zenodo.12542063.

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mapping and long-term capacity forecasting. This reactive pattern suggests that drainage governance still emphasizes operational handling rather than anticipatory infrastructure management.

Sustainability, sustainability concerns the long-term capacity of the drainage system to function effectively under environmental and demographic pressures. Rapid population growth, reduced infiltration areas, and increased household waste significantly increase runoff volume. Meanwhile, limited budget allocation and delayed equipment procurement hinder sustainable system upgrading. Structural interdependence between factors is evident: budget constraints delay pump procurement; delayed procurement weakens water discharge capacity; reduced capacity increases flood risk. This demonstrates that technical constraints cannot be separated from fiscal governance and procurement systems. Without integrated budget planning and long-term infrastructure investment, maintenance programs risk becoming repetitive short-term interventions rather than sustainable solutions.[17]

Critical Governance Assessment: The persistence of flooding despite routine, periodic, and special maintenance programs raises a critical governance question: Does recurrent flooding indicate ineffective governance? From an administrative law perspective, effectiveness is measured not only by program implementation but by the degree to which regulatory objectives are realized. The findings show that although the Semarang City Public Works Agency has implemented maintenance programs in accordance with the normative structure of Ministerial Regulation No. 12/PRT/M/2014, outcome-based effectiveness remains limited.[18]

This condition does not necessarily indicate total governance failure, but it demonstrates incomplete policy effectiveness, characterized by: 1) Administrative compliance without optimal outcome realization, 2) Reactive responsiveness rather than strategic prevention, 3) Budgetary constraints affecting sustainability, and 4) Structural linkage between institutional capacity and infrastructure performance. Drainage governance in Semarang can be categorized as formally compliant yet substantively constrained, where regulatory mandates are institutionally acknowledged, but operational capacity limits their full effectiveness.

Drainage comes from the English word drainage, which means to flow, drain, remove, or divert water.[19] A drainage system is a method of water flow using tertiary channels to collect rainwater flowing on the ground surface, which is then channeled into larger systems (secondary and primary) and subsequently flows into rivers and the sea.[20] Drainage plays a very important role in creating a clean and healthy environment, especially for densely populated areas such as urban areas.

Drainage system management is implemented as an effort to drain water, especially rainwater, so that it does not cause excessive flooding in certain areas and can maintain the proper

[17] Muhammad, Alam Maulana, et al. "Analisis dan Evaluasi Sistem Saluran Pembuangan Air Hujan dan Drainase pada Masjid Al-Furqan UPI." *Reka Karsa: Jurnal Arsitektur* 9.3 (2021). https://doi.org/10.26760/rekakarsa.v9i3.8437.
[18] *Ibid*.
[19] Andayani, Reni, dan Ayu Marlina, "Analisis Saluran Drainase Sekunder Kecamatan Ilir Timur I Palembang," *Jurnal Deformasi* 5 (2020): 69–85. https://doi.org/10.31851/deformasi.v5i2.4962.
[20] *Ibid*.

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functioning of the area.[21] Drainage management in Semarang City is handled by the Semarang City Public Works Agency (DPU) as the main authority in managing the drainage system. The Semarang City Public Works Agency is the agency that technically has the authority to plan, implement, and maintain the urban drainage system. Therefore, to overcome flooding caused by suboptimal drainage, it is necessary to further examine the performance of the Semarang City Public Works Agency in managing the urban drainage system.

Drainage itself is regulated in Minister of Public Works Regulation No. 12/PRT/M/2014 concerning the Implementation of Urban Drainage Systems, which stipulates that the implementation of urban drainage systems is an effort to plan, construct, operate, maintain, monitor, and evaluate physical and non-physical urban drainage systems. Meanwhile, an urban drainage system is an integrated technical and non-technical system of urban drainage infrastructure and facilities. In the development of urban drainage systems, it is the responsibility of the city government to maintain this urban infrastructure, namely the Semarang City Public Works Agency. Drainage in the city of Semarang itself is specifically regulated in Regional Regulation Number 7 of 2014 concerning the 2021-2031 Master Plan for the Semarang City Drainage System.[22]

The Master Plan for the existing drainage system in Semarang City is divided into four drainage systems, including a. The Mangkang Area Drainage System with a watershed area of approximately 9,272.02 hectares; b. The West Semarang Area Drainage System with a watershed area of approximately 3,104.30 hectares; c. The Central Semarang Drainage System has a watershed area of approximately 22,307.41 hectares; d. The East Semarang Drainage System has a watershed area of approximately 20,161.91 hectares.

The Semarang City Public Works Agency (DPU) carries out its duties in accordance with Mayor Regulation No. 96 of 2021 concerning the Position, Organizational Structure, Duties and Functions, and Work System of the Semarang City Public Works Agency. Article 29 paragraph (1) The Head of the Water Resources and Drainage Division has the task of planning, coordinating, fostering, supervising, and controlling, as well as evaluating Drainage Development and Rehabilitation, Drainage Operation and Maintenance, and Irrigation and Water Source Management.

Based on the Minister of Public Works Regulation No. 12/PRT/M/2014 concerning the Implementation of Urban Drainage Systems, the technical implementation of urban drainage systems is categorized into several types of drainage channels based on their functions. The following are several types of drainage channels: a. Primary Drainage Channels: These are the main channels that receive water from secondary channels, tertiary channels, and local channels, then channel it to large bodies of water such as the sea, which functions as the final water receiver. Examples of primary channels are rivers, tributaries, and the sea as the final water receiver; b. Secondary Drainage Channels: are drainage channels that receive water from tertiary channels, and these secondary channels then flow into primary channels. Examples

[21] Muhammad, Alam Maulana, et al. "Analisis dan Evaluasi Sistem Saluran Pembuangan Air Hujan dan Drainase pada Masjid Al-Furqan UPI." *Reka Karsa: Jurnal Arsitektur* 9.3 (2021). https://doi.org/10.26760/rekakarsa.v9i3.8437.

[22] Lubis, Marwan, Darlina Tanjung, and Muhammad Amin Ashari. "Analisa Standar Pelayanan Minimal (Spm) Jalan Provinsi Di Kota Medan." *Jurnal Teknik Sipil* 3.2 (2024): 104-111. https://doi.org/10.30743/jtsip.v3i2.10585.

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include culverts or ditches along roads in the city of Semarang; c. Tertiary drainage channels: these are drainage channels that receive water from local drainage channels to be channeled to secondary drainage channels. Examples include ditches or small gutters that are usually built in front of houses to drain water into larger secondary channels; and d. Local drainage channels: these are channels that collect rainwater and then drain it into tertiary drainage channels.

To reduce waterlogging or flooding in several areas of Semarang, the Semarang Public Works Agency, through Agung Pramono, S.T., as Staff Member for Water Resources and Drainage, stated that drainage management can be optimized through the implementation of routine performance programs. These programs include routine maintenance, periodic maintenance, rehabilitation, and special maintenance. From an interview with Agung Pramono, S.T., as a staff member in the Water Resources and Drainage Division, he said that this rehabilitation is already included in special maintenance.

Drainage maintenance activities are in accordance with Minister of Public Works Regulation No. 12/PRT/M/2014 concerning the Implementation of Urban Drainage Systems in Article 22. The following are drainage maintenance activities: a. Routine Maintenance: Maintenance carried out by the public works agency by performing routine activities such as cleaning trash from drainage channels and dredging sediment from drainage channels. Routine maintenance is usually carried out once a week; b. Periodic Maintenance: Periodic maintenance carried out by the Public Works Agency involves periodically checking drainage infrastructure for damage, such as loose bolts or other issues. This maintenance is carried out by flushing clogged drainage channels, cleaning culverts, cleaning retention ponds, cleaning reservoir ponds, and performing mechanical and electrical maintenance; c. Special Maintenance: Special maintenance carried out by the Public Works Agency is performed when sudden or significant damage is found that requires immediate repair; d. Rehabilitation: Rehabilitation is usually carried out through activities such as replacing or repairing channels, pumps or floodgates, repairing embankments, or repairing retention ponds and reservoir ponds that have experienced a decline in function due to natural disasters such as high rainfall, resulting in flooding.

To maintain drainage, the Semarang Public Works Agency usually invites the community to work together in cleaning primary drainage channels, namely rivers, by bringing in heavy equipment to remove trash and dredge sediment from the riverbanks to prevent narrowing of the river flow, which increases the risk of overflowing water and flooding. This river sediment dredging also aims to restore the function of the river and facilitate river flow, especially during the rainy season.

3.2 Challenges Faced and Efforts to Overcome Problems with the Urban Drainage System in Semarang

The implementation of urban drainage management by the Semarang City Public Works Agency in accordance with Minister of Public Works Regulation No. 12/PRT/M/2014 encounters various obstacles that affect policy effectiveness at the operational level.[23] Based

[23] Hartini, Mira Ismilia, et al. "Characteristics and management of drainage infrastructure in Medan Sunggal District, Medan City." *International Journal Papier Advance and Scientific Review* 4.4 (2023): 62-90. https://doi.org/10.47667/ijpasr.v4i4.259.

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on empirical findings from field interviews, these challenges can be analytically classified into structural, managerial, and social constraints that collectively influence institutional performance in infrastructure governance.

Structural Constraints, structural constraints primarily relate to fiscal limitations and technological dependency.[24] Interview data indicate that delayed budget disbursement often hampers the procurement of drainage infrastructure equipment necessary for maintenance and rehabilitation activities. In addition, the operation of polder pump systems essential for managing water discharge in low-lying coastal areas, relies heavily on imported mechanical components.

When pump systems experience technical failure, replacement procedures are significantly delayed due to import dependency, particularly from foreign manufacturers such as Germany.[25] This dependency creates a time lag between infrastructure damage and system restoration, thereby reducing drainage capacity during peak rainfall periods. Consequently, structural constraints in fiscal planning and procurement mechanisms directly affect flood mitigation performance. These findings suggest that drainage governance is not merely constrained by physical infrastructure limitations but also reflects the limited institutional capacity of local government in ensuring technological self-sufficiency and timely resource allocation.

Managerial Constraints and managerial challenges are reflected in the coordination and planning processes within drainage governance. Although routine and periodic maintenance programs are formally implemented, preventive planning mechanisms remain limited. Flood control interventions are often intensified after flood events occur rather than being based on anticipatory risk assessment or predictive infrastructure planning.[26]

Furthermore, coordination across operational units responsible for drainage maintenance, rehabilitation, and water resource management is occasionally hindered by procedural delays associated with budget approval and procurement processes. As a result, infrastructure rehabilitation, particularly pump replacement and retention pond maintenance, cannot always be executed based on priority needs. This condition indicates that drainage management in Semarang still exhibits reactive administrative patterns, which may undermine long-term infrastructure resilience. From a governance perspective, such limitations demonstrate weaknesses in institutional planning capacity and inter-sectoral coordination mechanisms.

Social Constraints, social constraints are primarily associated with low levels of public participation in maintaining drainage infrastructure. Community practices such as littering in primary and secondary drainage channels and covering culverts for private access contribute to sedimentation and water flow obstruction. Rapid population growth in densely populated

[24] Mullins, Daniel R., and Philip G. Joyce. "Tax and expenditure limitations and state and local fiscal structure: An empirical assessment." *Public Budgeting & Finance* 16.1 (1996): 75-101. https://doi.org/10.1111/1540-5850.01061.

[25] Deane, J. Paul, BP Ó. Gallachóir, and E. J. McKeogh. "Techno-economic review of existing and new pumped hydro energy storage plant." *Renewable and Sustainable Energy Reviews* 14.4 (2010): 1293-1302. https://doi.org/10.1016/j.rser.2009.11.015.

[26] Qiao, Xiu-Juan, Anders Kristoffersson, and Thomas B. Randrup. "Challenges to implementing urban sustainable stormwater management from a governance perspective: A literature review." *Journal of Cleaner Production* 196 (2018): 943-952. https://doi.org/10.1016/j.jclepro.2018.06.049.

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areas further exacerbates runoff volume due to reduced infiltration capacity and increased household waste.[27]

Although community engagement initiatives have been implemented, persistent blockages in drainage channels indicate that public awareness and participation remain insufficient to support sustainable infrastructure management. This demonstrates that institutional effectiveness in drainage governance is also influenced by societal compliance with environmental maintenance norms.

Institutional Capacity Assessment, the interrelation between structural, managerial, and social constraints indicates that recurring flooding in Semarang cannot be attributed solely to technical deficiencies but also reflects limitations in institutional governance capacity.[28] Budget constraints delay infrastructure procurement; delayed procurement weakens pumping performance; weakened performance reduces system discharge capacity during heavy rainfall. Such structural interdependence suggests the presence of weak institutional capacity in implementing drainage policies effectively, despite the existence of a comprehensive regulatory framework under Ministerial Regulation No. 12/PRT/M/2014.

Adaptive Governance and the Polder System, in response to these challenges, the Semarang City Government has implemented several mitigation measures, including river normalization, drainage channel repair, and the development of polder systems in flood-prone areas such as the Sringin River basin.[29] The polder system integrates drainage networks, retention ponds, embankments, and pump installations into a unified water management mechanism designed to regulate surface runoff in coastal zones.

Conceptually, the polder system reflects elements of adaptive urban governance by introducing infrastructural flexibility to accommodate fluctuating hydrological conditions. However, its effectiveness remains contingent upon institutional readiness in budget planning, maintenance scheduling, and equipment procurement. Without adaptive managerial capacity to support system operation, the polder mechanism risks functioning as a short-term technical intervention rather than a sustainable governance solution.[30] Therefore, while structural mitigation efforts have been initiated, their success in enhancing drainage system resilience depends on strengthening institutional capacity in fiscal management, preventive planning, and community engagement.

Of course, in dealing with problems related to the urban drainage system, obstacles are often encountered in the implementation of the drainage system based on Minister of Public Works

[27] Meshack, M. "Potential and limitations of stakeholders' participation in community-based projects: The case of Hanna Nassif roads and drains construction and maintenance in Dar es Salaam, Tanzania." *International Development Planning Review* 26.1 (2004): 61-82. https://doi.org/10.3828/idpr.26.1.4.

[28] Haque, C. Emdad. "“We are more scared of the power elites than the floods”: Adaptive capacity and resilience of wetland community to flash flood disasters in Bangladesh." *International Journal of Disaster Risk Reduction* 19 (2016): 145-158. https://doi.org/10.1016/j.ijdrr.2016.08.004.

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Regulation No. 12/PRT/M/2014 concerning the Implementation of Urban Drainage Systems.[31] Agung Pramono, S.T., as a staff member of Water Resources and Drainage, explained that in maintaining the drainage system, there are several obstacles faced by the Semarang City Public Works Agency, including two obstacles that are often encountered, both technical and non-technical.

Technically, first, there is a lack of budget. The Semarang City Public Works Agency's water resources and drainage division mentioned that there are obstacles related to the government budget, which is often delayed in disbursement for the purchase of infrastructure equipment to support the maintenance and management of damaged drainage systems, so that they can be used effectively again. This delay hinders the drainage maintenance process.

Second, the lack of adequate infrastructure, usually in drainage management, the Public Works Agency mentioned that in several points in the city of Semarang, there are drainage supports in the form of complementary structures such as polder pump systems and retention ponds to temporarily store water. These water pumps are usually used to pump water into primary channels, such as rivers, to prevent flooding. Each pump has a specific capacity for pumping water. If a pump breaks down and needs to be replaced, the process often takes a long time because the pump must be ordered from Germany. This is because the budget allocation process also takes a long time, so repairs must wait for the new equipment to arrive.

In non-technical terms, first, there is a lack of public awareness. People often litter in primary and secondary drainage channels, causing blockages in the water drainage system and resulting in flooding in several areas of Semarang. Many people are also unwilling to maintain secondary drainage channels, such as the culverts in front of their houses. Especially in residential areas and commercial districts, drainage systems near roads are sometimes covered, making it difficult to dismantle them if they become blocked.[32]

Second, the rate of population growth in densely populated areas has the potential to increase household waste.[33] This situation may not be handled properly, and the dense population may reduce the water absorption area, thereby increasing rainwater runoff, which can cause drainage clogging and trigger flooding if not balanced with adequate drainage system management and maintenance.

Given the obstacles and constraints described above, the Public Works Agency has also made various improvements and evaluations to optimize drainage management so that it can function as it should, namely by carrying out routine, periodic, and special maintenance. Furthermore, if any members of the public block drainage access for personal reasons, the Public Works

[31] Budiyanto, Muchamad Arif, Muhamad Arifin, and Nilla Rahmania Fajar. "Penilaian Prioritas Penanganan Banjir Kota Yogyakarta Menurut Peraturan Menteri Pekerjaan Umum Nomor 12/PRT/M/2014." *CivETech: Civil Engineering and Technology Journal* 7.2 (2025). https://doi.org/10.47200/civetech.v7i2.3103.

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[33] Saitullah, Muhammad Ilham, "Correlation of Population and the High Pollution of Household Waste in Fakkie Village, Pinrang Regency," *Indonesia Journal of Islamic Community Development* X (2022): 8–20. https://doi.org/10.35905/continuum.v1iI.3380.

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Department can take firm action by issuing a warning letter instructing them not to block the drainage access, so that if a blockage occurs, it will not be necessary to dismantle the channel.[34]

In handling floods and tidal flooding in the city of Semarang, the polder system is a flood management method based on physical structures consisting of a drainage network, retention ponds, embankments surrounding the area, and pumps and/or floodgates that function as a single unit in water management. This system is used to control and drain water from low-lying areas and protect delta areas and river basins from potential flooding.[35]

According to Agung Pramono, S.T., a staff member in the Water Resources and Drainage Division, the efforts made by the Semarang City Public Works Agency involve several programs to address several obstacles and constraints:

First, river normalization programs: these involve widening and deepening rivers that have narrowed due to sedimentation and illegal construction. River normalization is carried out to restore the function of rivers so that they can optimally collect and drain water.

Second, repair and cleaning of drainage channels: this is an effort to maintain drainage channels so that they continue to function optimally. Repairs are carried out on drainage channels that have suffered infrastructure damage, while cleaning of drainage channels is carried out on drainage channels that are blocked by sediment, waste, or weeds, so they must be cleaned regularly to prevent obstruction of water flow.

Third, construction and development of drainage systems: this involves efforts to construct new drainage systems or develop existing drainage systems, such as the development of a polder system as implemented in the Sringin River area to control flooding in low-lying areas or coastal areas that are prone to tidal flooding (rising sea water).

Thus, river normalization, drainage channel repair and cleaning, as well as drainage system construction and development, are programs implemented by the Semarang City Public Works Agency in an effort to improve the effectiveness of urban drainage system management. The implementation of these programs reflects the active role of local government in addressing various drainage issues, both technical and non-technical. Through integrated planning and implementation of programs, it is hoped that the performance of the Semarang City Public Works Agency in managing the drainage system can be optimized, thereby reducing the risk of flooding and providing positive impacts on the comfort and safety of the community.

4. CONCLUSION

This study demonstrates that the effectiveness of urban drainage governance in Semarang City remains limited despite formal compliance with Minister of Public Works Regulation No. 12/PRT/M/2014, as evidenced by the persistence of flooding during the 2025–2026 rainy season. The findings reveal a critical gap between normative regulatory compliance and

[34] Putri, Arini Hermiyanti Eka. "Responsivitas Pelayanan Dinas Pekerjaan Umum Dan Penataan Ruang Kota Surakarta Dalam Penanganan Permasalahan Prasarana Drainase Di Kelurahan Sewu, Kecamatan Jebres, Kota Surakarta." *Ji@ p* 10.1 (2021). https://doi.org/10.33061/jp.v10i1.5107.

[35] Adi, Henny Pratiwi, dan Slamet Imam Wahyudi, "Edukasi Partisipasi Masyarakat Kelurahan Pandean Lamper dalam Pemeliharaan Bantaran Sungai Banjir Kanal Timur Semarang," *Indonesian Journal of Community Services* 4, no. 1 (2022): 41–48, https://doi.org/10.30659/ijocs.4.1.41-48.

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outcome-based effectiveness, indicating that legal frameworks alone are insufficient without adequate institutional capacity. Structural constraints, including delayed budget disbursement and dependency on imported infrastructure, managerial limitations in preventive planning, and low community participation collectively hinder optimal performance. The novelty of this research lies in its integration of regulatory compliance analysis with institutional performance evaluation within an empirical juridical framework, offering a more comprehensive understanding of infrastructure governance beyond technocratic approaches. Theoretically, this study reinforces the argument that legal effectiveness in decentralized governance is contingent upon the alignment between normative mandates and implementation capacity. Practically, it suggests the need for governance reform through performance-based and multi-year budgeting, strengthening anticipatory maintenance strategies, enhancing inter-agency coordination, and institutionalizing community-based participation mechanisms. Future research is recommended to explore comparative adaptive governance models in other coastal cities to further refine sustainable urban drainage policy frameworks.

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