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FRAGMENTASI JARINGAN DAN KOALISI ADVOKASI DALAM TATA KELOLA DAERAH ALIRAN SUNGAI: PELAJARAN DARI DAS PAGUYAMAN, INDONESIA

(Network Fragmentation and Advocacy Coalitions in Watershed Governance: Lessons from the Paguyaman Basin, Indonesia)

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ABSTRACT

Watershed management in developing countries often faces persistent implementation gaps, despite the existence of sound environmental policies. This study investigates how stakeholder structure and coalition dynamics contribute to governance challenges in the Paguyaman Watershed, Gorontalo, Indonesia. Using a descriptive-exploratory approach, the MACTOR method was applied to analyze the relational structure among 15 key actors and 22 strategic objectives, based on a structured questionnaire, focus group discussions, and influence mapping. The results reveal a polarized stakeholder network divided into two coherent coalitions: a Government-Academic coalition oriented towards technocratic goals and a Civil Society coalition focused on socio-ecological justice. Divergence scores between the coalitions ranged from 0.81 to 0.87, indicating a high significant ideological conflict. Industry actors are found structurally isolated, with low convergence scores (<0.3), undermining collaborative efforts. The influence-dependence analysis identified four Driving Actors, seven Linking Actors, one Dependent Actor, and three Autonomous Actors. These imbalanced relational explain the failure of institutional coordination and the limited policy legitimacy. These findings emphasize that technical solutions alone are insufficient; effective watershed governance requires strategic interventions to bridge polarized coalition, engage isolated industry sectors, and strengthen coordinating actors to promote inclusive, and collaborative governance.

Keywords: stakeholder analysis; watershed governance; MACTOR; coalition dynamics; implementation gap

ABSTRAK

Tata kelola daerah aliran sungai (DAS) di negara berkembang sering menghadapi kesenjangan implementasi, meskipun telah tersedia kebijakan lingkungan yang baik. Studi ini mengkaji bagaimana struktur pemangku kepentingan dan dinamika koalisi berkontribusi terhadap tantangan tata kelola di DAS Paguyaman, Gorontalo, Indonesia. Dengan pendekatan deskriptif-eksploratif, metode MACTOR digunakan untuk menganalisis hubungan antar 15 aktor kunci dan 22 tujuan strategis, berdasarkan kuesioner terstruktur, diskusi kelompok terfokus, dan pemetaan pengaruh. Hasil penelitian menunjukkan bahwa jaringan aktor terpolarisasi menjadi dua koalisi utama: koalisi Pemerintah-Akademisi yang berorientasi teknokratis, dan koalisi Masyarakat Sipil yang menekankan keadilan sosial-ekologis. Skor divergensi antara koalisi mencapai 0,81–0,87, menandakan potensi konflik ideologis yang tinggi. Aktor industri berada dalam posisi terisolasi secara struktural, dengan skor konvergensi rendah (<0,3), sehingga menghambat upaya kolaboratif. Analisis pengaruh-ketergantungan mengidentifikasi empat Aktor Penggerak, tujuh Aktor Penghubung, satu Aktor Tergantung, dan tiga Aktor Otonom. Ketimpangan relasi ini menjelaskan lemahnya koordinasi institusional dan rendahnya legitimasi kebijakan. Temuan ini menekankan bahwa solusi teknis saja tidak cukup; tata kelola DAS yang efektif memerlukan intervensi strategis untuk menjembatani polarisasi koalisi, melibatkan sektor industri yang terisolasi, serta memperkuat aktor pengoordinasi dalam membangun tata kelola yang kolaboratif dan inklusif.

Kata kunci: analisis pemangku kepentingan; tata kelola DAS; MACTOR; dinamika koalisi; kesenjangan implementasi

I. INTRODUCTION

Since the early 2000s, watershed management has increasingly shifted from a hydrological–engineering focus to a socio-ecological systems perspective, triggered by global water governance reforms emphasizing participation, decentralization, and adaptive management (Saraswat & Gupta, 2024; Waldt, 2025; B. Wang, Wang, Zeng, & Li, 2022). This paradigm shift has driven watershed management beyond a narrow focus on water quantity and quality, moving toward holistic governance approaches that must integrate ecological integrity, social equity, and economic viability (GWP (Global Water Partnership), 2021; B. Wang et al., 2022). Yet, translating the concept of integrated watershed management into practical, effective implementation remains a persistent global challenge, particularly in developing countries where economic acceleration intersects with environmental conservation imperatives (Gebregergs, Teka, Taye, Gidey, & Dikinya, 2022; Narendra et al., 2021; Tinoco et al., 2022). This challenge is also reflected nationally in water governance in Indonesia, which still faces the problem of institutional fragmentation and multi-stakeholder coordination (Mulyana & Prasojo, 2020; Sulistyaningsih, Nurmandi, Kamil, et al., 2021; Valette, 2024).

A major difficulty stems from the constellation of stakeholders involved in

watershed governance, including government agencies, private industries, academic institutions, Non-Governmental Organization (NGOs), and local communities. They have divergent interests that shape policy interpretation and implementation (Kadoma, Perry, & Renaud, 2023; R. Y. Wang, van Rijswick, & Dai, 2022). Watersheds are increasingly understood as "wicked problems" (Cao, Wang, Luo, Xie, & Zhu, 2022; Rittel & Webber, 1973; van den Ende, Hegger, Mees, & Driessen, 2023), due not only to ecological complexity but also to conflicting stakeholder worldviews, making purely technical solutions insufficient (Ben-Daoud et al., 2023; Bianchi, Nasi, & Rivenbark, 2021; Esmailzadeh, Bagherzadeh, Dehkordi, & Mianabadi, 2025; Fallon, Lankford, & Weston, 2021; Weible, Ingold, Nohrstedt, Henry, & Jenkins-Smith, 2020). In Indonesia, previous studies have documented institutional fragmentation and regulatory contradictions in regions such as DAS Citarum and DAS Brantas, revealing persistent coordination failures across agencies (Sulistyaningsih, Nurmandi, Salahudin, et al., 2021).

This has created an implementation gap where well-designed policies fail to make effective field outcomes which are consistent with findings in other watershed governance contexts (Hudson, Hunter, & Peckham, 2019; Supangat et al., 2023; Ulibarri, Imperial, Siddiki, & Henderson, 2023; Valette, 2024). This gap is often rooted in an inadequate understanding of stakeholder dynamics, especially their power relations, strategic alignments, and latent conflicts (Newig, Jager, Challies, & Kochskämper, 2023; Stout & Love, 2018). Although stakeholder participation is widely promoted to enhance environmental governance, its effectiveness depends heavily on political and structural conditions of governance networks (Rivera-Torres & Gerlak, 2021).

Although many studies list relevant actors or map their roles, a major gap persists in structural analysis that reveals how stakeholder relationships and network positions either support or hinder collective governance (Ulibarri et al., 2023). Although the literature on stakeholder analysis has advanced to include tools for analyzing power asymmetries and coalition behavior, applications of these tools in Indonesian watershed contexts remain rare (Basuki et al., 2022; Roestamy & Fulazzaky, 2022; Warastuti, Sitopu, & Heka Ardana, 2025).

Without a clear understanding of stakeholder structures, governance often fragments into isolated "silos" that limit information exchange, reduce trust, and hinder coordinated action (Musacchio, Re, Mas-Pla, & Sacchi, 2020). These governance barriers are not merely administrative; rather, they stem from the relational and political structure of stakeholder networks, where power asymmetries and misaligned values shape decision-making (Fischer & Ingold, 2020; Hu, Medina, Siciliano, & Wang, 2023).

The Matrix of Cross-Impact Multiplications Applied to Classification (MACTOR) method is a robust tool for capturing these dynamics by mapping actor influence, dependence, convergence, and divergence (Godet, 1991, 2000). Despite its widespread use in strategic

foresight, MACTOR application in watershed governance studies in Indonesia remains limited (Darmastuti, Rustiadi, Fauzi, & Purwanto, 2023), representing a missed opportunity to uncover the structural roots of governance failure and reveal intervention points.

The Paguyaman watershed, located in Gorontalo Province, is designated as a strategic area in the Provincial Spatial Plan (Pemerintah Provinsi Gorontalo, 2024) and is included in the national list of priority watersheds (Kementerian Pekerjaan Umum dan Perumahan Rakyat, 2015). It faces increasing pressure from land-use conversion and illegal gold mining. Despite its strategic importance, no structural stakeholder analysis has been conducted to date.

We hypothesize that governance failures in Paguyaman partly arise from stakeholder polarization, reflecting the formation of competing advocacy coalitions documented in other contested natural resource systems (Gabehart, Nam, & Weible, 2022; Hank C. Jenkins-Smith, Daniel Nohrstedt, Christopher M. Weible, & Karin Ingold, 2018; Morales-Giner et al., 2023; Weible et al., 2020; Wesche, Dütschke, Negro, & Hekkert, 2025). To address this issue, this study applies a prospective structural analysis using the MACTOR method to: (1) identify the structural roles of key actors in the governance network, (2) map potential alliances and axes of conflict based on strategic priorities, and (3) discuss how this structure contributes to implementation gaps and how it might be addressed to support collaborative watershed governance.

II. MATERIALS AND METHODS

A. Research Time and Study Area

This research was conducted from March–July 2025 in the Paguyaman watershed, located in Gorontalo Province, Indonesia (Figure 1). The watershed is nationally designated as a regional priority area for agricultural development, water supply, and biodiversity conservation. It includes the upstream Nantu Wildlife Reserve and is increasingly threatened by land-use conversion, illegal gold mining, and conflicting development-conservation interests (Kementerian Pekerjaan Umum dan Perumahan Rakyat Republik Indonesia, 2019; Pemerintah Provinsi Gorontalo, 2014), making it an ideal case for analyzing stakeholder dynamics.

B. Materials and Tools

The study utilized both human and documentary resources, including:

1. Respondents:

   Fifteen representatives from government, academia, private industry, NGOs/community groups, and media selected via purposive sampling.

2. Documents Reviewed:

   NationalRegulatory and planning documents from Gorontalo Province, including Provincial development plans (RPJMD), and relevant legal documents include Law No. 37/2012 (Pemerintah Indonesia, 2012) and Law No. 274/2019 on Paguyaman River Basin Water Resources (Kementerian Pekerjaan Umum dan Perumahan Rakyat Republik Indonesia, 2019)

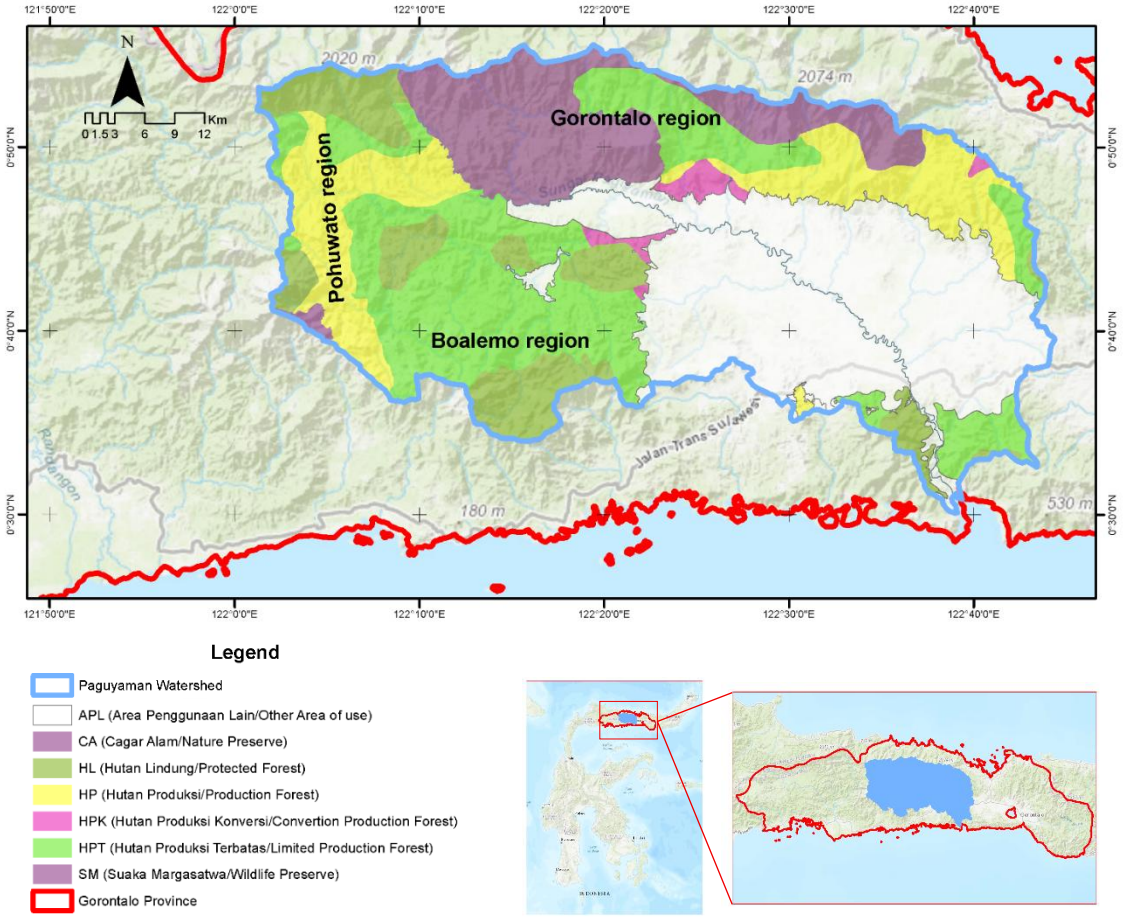

Figure 1. Paguyaman Watershed in Gorontalo Province-Indonesia

3. Instruments:
   - Structured questionnaire
   - Semi-structured interview guide
   - Focus Group Discussion (FGD) protocol.
4. Software and tools:
   - MACTOR version 6 developed by the French Computer Innovation Institute Institut d'Innovation Informatique pour l'Entreprise (3IE), under the supervision of its conceptual creators, the LIPSOR Prospective (foresight) Strategic and Organisational Research Laboratory (http://en.laprospective.fr/ (Godet, 2000)).
   - MS Excel used for supplementary data coding and triangulation.

C. Research Methodology

This study adopted a descriptive-exploratory research design using a prospective structural analysis approach. This methodology was chosen due to its ability to model influence relations and strategic alignments (Darmastuti et al., 2023).

1. Research design.

   The MACTOR method was used to analyze strategic influence and alliance patterns among stakeholders. This method is suitable for identifying actor typologies (drivers, linkages,

dependents, and autonomous actors) and the axes of convergence and divergence regarding shared strategic objectives (Darmastuti et al., 2023; Godet, 1991, 2000). It has been proven to be effective for analyzing complex actor systems in the context of watershed governance, as shown by Ben-Daoud et al. (2023) in the R'Dom sub-watershed in Morocco.

2. Actor and objective determination.

   Initial actor and objective lists were generated through:

   - A review of local regulatory and planning documents, such as th RPJMD Gorontalo (2017–2022), the RTRW Provinsi of Gorontalo (Perda No. 10/2019), and Government Regulation No. 37/2012 on Watershed Management.
   - A literature review of 42 publications (2015–2024) on watershed governance, social-ecological systems, and stakeholder analysis was conducted using a narrative review approach.
   - Preliminary consultations with key informants.

     These yielded 17 initial actor groups across the Pentahelix framework (Government, Academia, Industry, Community/NGOs, and Media) and 18 strategic objectives. After validation, the final framework included 15 key actors and 22 objectives (see Appendix A).

3. Data collection.

   - Respondent**:** Selected purposively based on organizational role, influence, and knowledge of watershed governance.
   - Main instrument**:** Structured questionnaire (see Appendix D), pre-tested with 3 representatives.
   - Technique**:** Face-to-face interviews and supervised self-completion of questionnaires.

4. Types of data collected.

   - Actor validation and expansion.
   - Organizational profiling (roles, partnerships, and conflicts).
   - Matrix of Direct Influences (MDI): 0–4 scale of actor-to-actor influence.
   - 2MAO (Valued Position Matrix): Actor stance (+1, 0, -1) and priority (0–4) for each objective.
   - FGD: Consisted of 18 respondents or participants from five stakeholder categories (pentahelix), while the remaining two were additional stakeholders selected to triangulate and the validate quantitative results.

5. Data analysis (including MACTOR outputs)

   We used MACTOR via LIPSOR-MACTOR software to analyze:

   - Influence-Dependence Mapping: Actor typology.
   - 2CAA (Valued Convergence Analysis): Assessment of potential alliances using convergence value thresholds (Table 1).
   - 2DAA (Valued Divergence Analysis): Assessment of potential conflict zones using divergence thresholds (Table 2).

Table 1. Classification and Value Scale of Convergence (2CAA)

Value Range	Interpretation	Meaning in this Study
>0.70	Very High Convergence	Strong strategic alignment; potential stable coalition
0.50–0.70	High Convergence	Shared objectives but possible differences in priorities
0.30–0.50	Moderate Convergence	Partial alignment; issue-specific collaboration
<0.30	Low Convergence	Weak alignment; unlikely coalition

Table 2. Classification and Value Scale of Divergence (2DAA)

Value Range	Interpretation	Meaning in this Study
>0.70	Very High Divergence	Strong conflict potential and value-based opposition
0.50–0.70	High Divergence	Significant differences; contested issues
0.30–0.50	Moderate Divergence	Mild disagreements; manageable through coordination
<0.30	Low Divergence	Minimal opposition

The analyses were based on the following matrices:

- MDI Matrix: 15×15 influence assessment (see Appendix B).
- 2MAO Matrix: 15×22 objective evaluation (see Appendix C).

6. Incomplete data handling.

   Incomplete data (e.g., missing MDI rows) was estimated using institutional roles, other respondent inputs, and proxy data. If priority ratings were missing in 2MAO but support (+1) was given, the conservative value of "3 = Important" was assigned. These estimations are acknowledged as a limitation of the study.

7. Ethical consideration.

   The study received institutional ethics approval. Written informed consent was obtained from all participants. Identities of non-government sectors have been anonymized to maintain confidentiality.

8. Flowchart of the research procedure (Figure 2)

III. RESULT AND DISCUSSION

A structural stakeholder analysis using the MACTOR method revealed a highly polarized governance landscape in the Paguyaman watershed. The final analytical framework consisted of 15 actors and 22 strategic objectives, providing insight into power asymmetries, coalition dynamics, and potential conflicts. The findings are organized in relation to the objectives of the study.

The Influence-Dependence Map (Figure 3) categorizes stakeholders into four structural roles: Drivers occupied the upper-left quadrant (high influence, low dependence); Linkages in the upper-right quadrant; Dependent actors in the lower-right quadrant; and Autonomous actors in the lower-left quadrant. Four actors were identified as Drivers: The Watershed Forum (COL1), the River Basin Authority (GOV5), the Watershed Management Agency (GOV4), and the NGO1. These actors exert high influence while maintaining relative autonomy, making them key drivers of governance change. Seven actors, including GOV1, GOV2,

GOV3, GOV6, GOV7, ACD1, and COM1, were classified as Linkages due to their centrality in both influencing and being influenced by others. The media (PERS) emerged as a Dependent actor, with low influence and high susceptibility to external dynamics. Industrial actors (IND1, IND2, IND3) were found to be structurally Autonomous, indicating weak integration in the governance network.

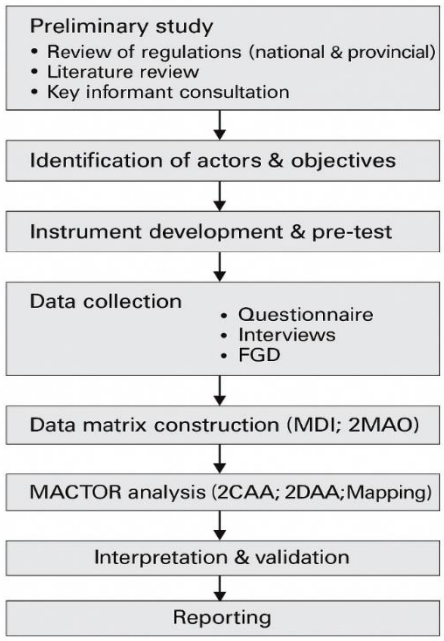

Figure 2. Research Procedure Flowchart

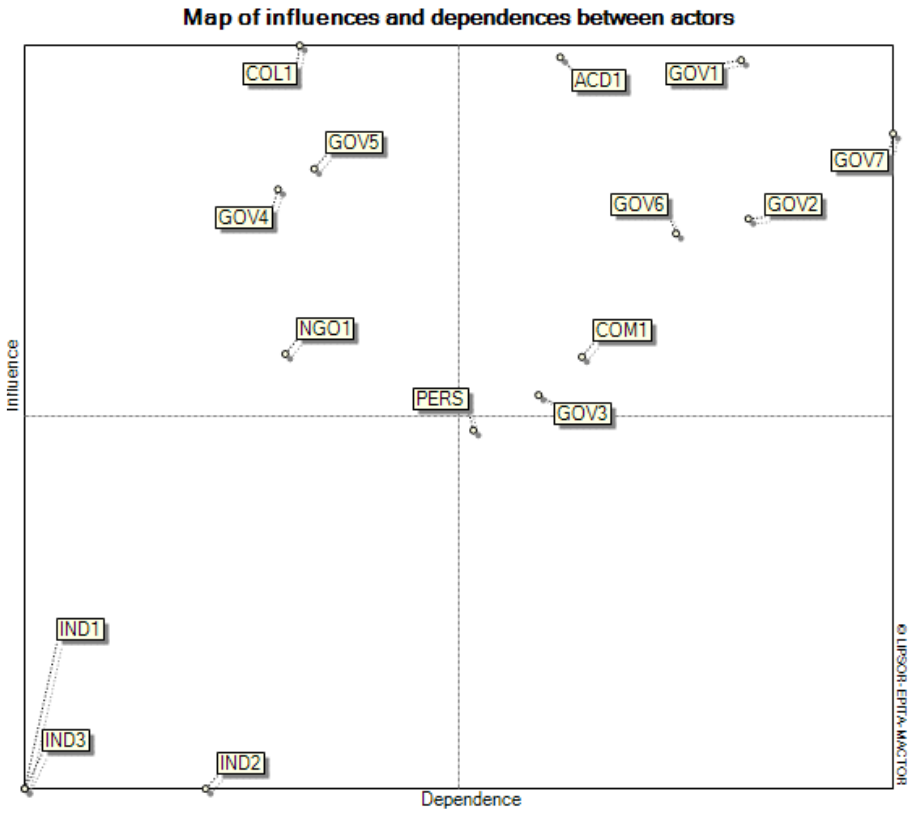

Figure 3. Influence-Dependence Map of Paguyaman Watershed Stakeholders.
Source: *Primary data analysis, 2025*

Two stakeholder coalitions were identified using the 2CAA analysis based on shared objectives and alignment patterns (Figure 4). The Government-Academia Coalition comprising GOV1, GOV2, GOV4, GOV5, GOV3, ACD1, and COL1, with high internal convergence (0.72–0.89), indicating a technocratic orientation. In contrast, the Civil Society Coalition, including NGO1, COM1, and PERS, shares a socio-ecological justice perspective with moderate internal convergence (0.68–0.76). Industrial actors showed weak convergence (<0.3) with either bloc, reinforcing their marginal role in collaborative governance. Conflict potential was assessed using 2DAA analysis. As shown in Table 1, the highest divergence was between NGO1 and government actors (e.g., 0.87 with GOV5; and 0.84 with GOV4), indicating deep ideological divides. Divergence with industrial actors was also high (0.73 with IND3), pointing to overlapping conflict zones. Internal coalition divergence remained low (<0.2), validating coalition coherence. These results confirm a sharply bipolar stakeholder structure with significant barriers to consensus.

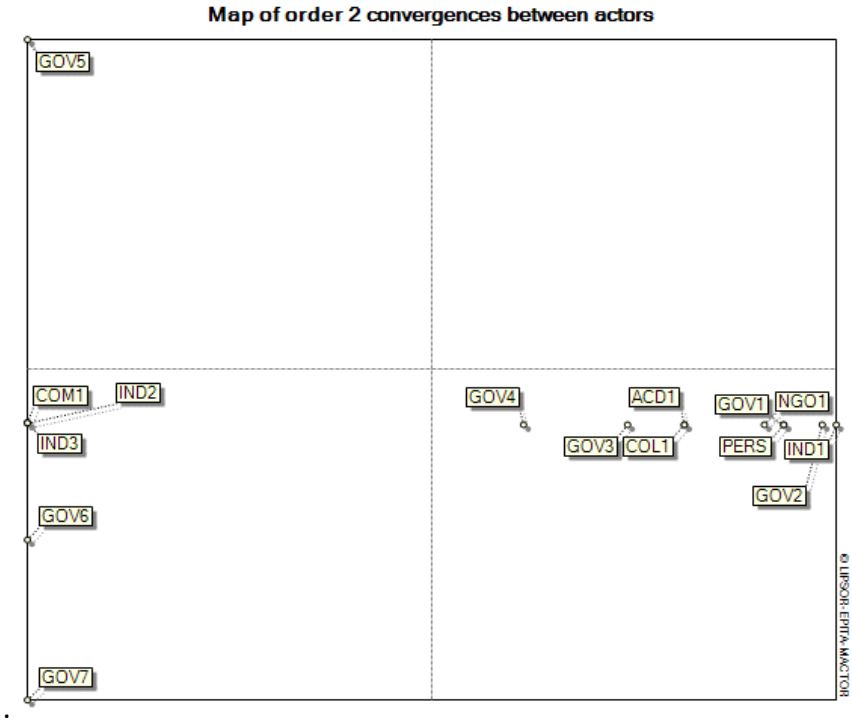

Figure 4. Valued Convergence Map among Actors (2CAA).
Source: *Primary data analysis, 2025*

Table 3. Divergence Scores among Key Stakeholders (2DAA).

Actor/Coalition 1	Actor/Coalition 2	Divergence Score	Type of Conflict Potential
Civil Society (NGO1)	Government-Academia (GOV5)	0.87	Very High
Civil Society (NGO1)	Government-Academia (GOV4)	0.84	Very High
Civil Society (NGO1)	Industry (IND3)	0.73	High
Civil Society (COM1)	Industry (IND1)	0.69	High
Government-Academia Internal	Average member score	<0.2	Very Low
Civil Society Internal	Average member score	<0.2	Very Low

Source: *Primary data analysis, 2025.*

These structural findings offer a compelling explanation for the implementation gap observed in watershed management in Indonesia. The fragmentation of stakeholders into disconnected blocs, or "governance silos," impedes trust-building and policy alignment (Chatalova, Djanibekov, Gagalyuk, & Valentinov, 2017; Cotler, Cuevas, Landa, & Frausto, 2022). It confirms the patterns reported by Musacchio et al. (2020) and Nonet et al. (2022). The exclusion of industrial actors from decision-making may further undermine sustainability because their cooperation is essential in mitigating land-based pollution and illegal resource extraction (Koebele, 2020; K. Wang, Han, & Tan, 2025). Such network fragmentation has been identified as a major inhibitor of collaboration in cross-regional water governance (Ji, Wan, & Ke, 2024; Rojas, Bennison, Gálvez, Claro, & Castelblanco, 2020), and has also emerged in the Paguyaman watershed system through the coalition separation and isolation of industry actors. Similar evidence has been reported in other transboundary water governance networks (Lee, Yoon, Yang, Namkoong, & Kim, 2024; Mdleleni et al., 2025; Nava, 2025; Offutt, 2022).

While coherent, the Government-Academia coalition's technocratic model risks legitimacy deficits unless inclusive mechanisms are adopted (Maas, Pauwelussen, & Turnhout, 2022). Tthe GOV6 and GOV7 can play the role of boundary spanners, which are bridging actors in complex socio-ecological systems (Roengtam, Agustiyara, & Nurmandi, 2023). Conversely, the Civil Society bloc plays a critical role in contesting dominant narratives, representing marginalized interests, and holding formal institutions accountable—functions consistent with adversarial participation models (Jalal, 2025). The conflict between the economic development agenda and socio-ecological justice (Leal Filho, Dinis, & Ben Hassen, 2025; Menton et al., 2020), reflects similar dynamics in the marine economy as outlined in the blue justice framework by Bennett et al. (2021). The pattern of coalition formation is in accordance with the Advocacy Coalition Framework (ACF) which has been updated by Cisneros (2021), where the trust system is the main foundation in the formation of policy blocks (Malkamäki, Ylä-Anttila, Brockhaus, Toppinen, & Wagner, 2021; Schmid, Sewerin, & Schmidt, 2020). However, it is not the only solution (Löhr, Markard, & Ohlendorf, 2024; Van Dyke & Amos, 2017).

Strategically, the Watershed Forum (COL1) has potential as a bridging actor, given its Driver status and semi-neutral orientation (Peña-Campello, Espín-Gallardo, López-Sánchez, & Sánchez, 2024). The existence of a multi-stakeholder platform like the Watershed Forum is important; however, its effectiveness depends on the dynamics of internal learning and collaboration (Hovis et al., 2025; Rivera-Torres & Gerlak, 2021). In its formal role as chair of the Water Council (TKPSDA), GOV1 could function as an "orchestrator," but it requires enhanced bridging capacity to connect polarized blocs. NGO1 emerges as a critical "challenger," whose oppositional stance

spotlights ideological and justice-oriented concerns often ignored in formal planning (Kahil et al., 2025; Laraswati et al., 2022), although not all NGOs play such a role (Dzhengiz, Barkemeyer, & Napolitano, 2021).

The study's limitations include reliance on respondent judgment and potential exclusion of informal actors. Nevertheless, it contributes to the empirical literature on stakeholder analysis in natural resource governance and aligns with the broader challenges of water governance in Indonesia as identified by (Mulyana & Prasojo, 2020). Future work should explore targeted interventions to bridge coalition divides, activate the industrial sector, and build coordination platforms that promote long-term collaborative engagement (Thapa, Vermeulen, & Deutz, 2022).

IV. CONCLUSION

This study showed that the core challenges of watershed governance in the Paguyaman watershed are not just technical but also deeply embedded in the political and relational configurations among key stakeholders. Using the MACTOR method, the research systematically mapped the structural roles, potential alliances, and conflict lines of 15 actors and 22 strategic objectives. This approch offered an empirical explanation for the persistent implementation gap in watershed policy.

The findings highlight the presence of two polarized and internally coherent coalitions: the Government–Academia Coalition (GOV1: Regional Planning, Research, and Development Agency (Bapppeda) of Gorontalo Province, GOV2: Sulawesi II River Basin Center (BWS), GOV3: Bone-Limboto River Basin Management Center (BPDAS), GOV4: Natural Resources Conservation Agency (BKSDA) Region II Gorontalo, GOV5: Gorontalo Province Environment and Forestry Service (DLHK), ACD1: Academics, and COL1: Watershed Forum (Forum DAS), which converges on technocratic and formal governance objectives; and the Civil Society Coalition (NGO1: Local Environmental Non-Governmental Organization, COM1: Local Forest Farmers Group (KTH), and the PERS: Environmental Media/Journalist), which emphasizes socio-ecological justice and public oversight. The industrial sector remains isolated, showing minimal alignment with either coalition. This condition hampers comprehensive governance integration.

Structurally, the Watershed Forum (COL1), GOV5, GOV4, and NGO1 act as Drivers with high influence and low dependence, while actors such as GOV1 and the Regency Government serve as Linkages that are central to coordination and negotiation. The PERS was identified as a Dependent actor, while industrial actors were deemed Autonomous and detached from the influence network.

These results suggest that the implementation gap stems from governance fragmentation, high divergence scores between coalitions (0.81–0.87), and the absence of bridging mechanisms. The structural map identifies opportunities for strategic intervention, such as strengthening the coordinating role of GOV1, empowering COL1 as a neutral facilitator, and developing engagement models for the industrial sector.

The findings highlight that improving watershed governance in Paguyaman requires strengthening relationships among actors, building cross-coalition trust, and integrating currently isolated groups such as the private sector. Policy reforms and technical interventions will remain limited unless they directly address political misalignment and weak coordination within the stakeholder network.

This study contributes to the literature on environmental governance by demonstrating how structural stakeholder analysis can reveal the underlying political dimensions contributing to institutional failures. The MACTOR-based approach offers a replicable methodology for analyzing multi-actor systems in complex socio-ecological settings and it can serve as a reference for other watershed contexts facing similar fragmentation.

Despite its contributions, this research has limitations. It presents a static snapshot of stakeholder configurations based on expert input, focusing primarily on formal actors, potentially overlooking informal but influential networks. Future research should incorporate dynamic modeling approaches and in-depth qualitative inquiry to track coalition evolution and design practical mechanisms for cross-coalition collaboration and inclusive industrial participation.

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CONTRIBUTIONS

Ivan Taslim prepared the initial concept of the research, designed the methodology design, collected and analyzed data using the MACTOR approach, and prepared an initial draft of the manuscript. Sambas Basuni contributed to the literature review, deepening the context of natural resource management, and input on the structure of analysis and synthesis of findings. Yanuar Jarwadi Purwanto plays a role in validating instrument design, interpreting the results of actor analysis, and providing critical input in writing and editing methods and discussions. I Putu Santikayasa contributed to the development of a systemic approach in the framework of analysis, as well as improving the narrative of the discussion and conclusion section. All authors have read and approved the final version of the manuscript submitted for this publication.

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APPENDIX A. ACTOR LIST and STRATEGIC GOALS

APPENDIX A1. List of Actors in Stakeholder Analysis

Kode	Brief Description of Actor	Penta helix Category	Number of Informants
GOV1	Development Planner	Government	1
GOV2	Environment and Forestry Service	Government	1
GOV3	Natural Resources Conservation Authority	Government	1
GOV4	Watershed and Protected Forest Management	Government	1
GOV5	River Basin Center	Government	1
GOV6	Forest Management Unit	Government	1
GOV7	District Government (multi-unit technical sector)	Government	2
ACD1	Academics from Higher Education	Academics	2
IND1	Timber Sector Companies	Industry	1
IND2	Sugar Sector Companies	Industry	1
IND3	Palm Oil Sector Companies	Industry	1
NGO1	Non-Governmental Organization	NGO/Public Community	1
COL1	Watershed Management Multi-Stakeholder Forum	NGO/Public Community	1
COM1	Forest Farmer Group	NGO/Public Community	2
PERS	Environmental Journalists	Media/Pers	1

APPENDIX A2. List of Strategic Objectives in Paguyaman Watershed Management

Code	Strategic Objectives
OBJ1	Spatial planning based on watershed carrying capacity
OBJ2	Strengthening environmental law enforcement
OBJ3	Reducing land conflicts among stakeholders
OBJ4	Improving policy and budget transparency
OBJ5	Determination of River Water Class
OBJ6	Environmental Carrying Capacity & Capacity Study
OBJ7	Multi-Stakeholder Collaboration
OBJ8	Improving the welfare of communities around watersheds
OBJ9	Promoting green economic growth
OBJ10	Reducing land conflicts between communities
OBJ11	Optimizing community participation in watershed management
OBJ12	Raising public awareness through environmental education
OBJ13	Maintaining local wisdom in watershed management
OBJ14	Ensuring sustainable clean water availability
OBJ15	Monitoring environmental quality
OBJ16	Preserving biodiversity and watershed ecosystems
OBJ17	Reducing water pollution from domestic/industrial waste
OBJ18	Coastal Conservation
OBJ19	Reducing the risk of floods and droughts
OBJ20	Improving watershed resilience to climate change
OBJ21	Building environmentally friendly infrastructure
OBJ22	Developing research and innovation in watershed management technology

APPENDIX B. MATRIX OF DIRECT INFLUENCES / MDI

This matrix shows the direct influence score of each actor on other actors based on the perceptions and results of filling out the questionnaire instrument by the informants.

Scale Description:
0: No influence
1: Operating procedures
2: Projects
3: Missions
4: Existance

MDI	GOV1	GOV2	GOV3	GOV4	GOV5	GOV6	GOV7	ACD1	IND1	IND2	IND3	NGO1	COL1	COM1	PERS
GOV1	0	4	3	3	3	3	4	3	2	2	2	2	3	2	2
GOV2	4	0	4	3	3	4	4	2	1	1	1	1	1	1	1
GOV3	2	2	0	2	2	2	2	2	0	0	0	0	0	2	1
GOV4	2	2	2	0	2	2	2	2	1	1	1	2	2	2	2
GOV5	3	3	2	2	0	2	3	2	2	2	2	1	2	2	1
GOV6	2	2	2	2	2	0	3	1	1	1	1	2	2	3	1
GOV7	3	3	2	2	3	3	0	2	3	3	3	2	2	4	2
ACD1	3	3	2	3	3	3	3	0	2	2	2	3	3	3	3
IND1	1	2	0	0	0	0	1	1	0	0	0	0	0	0	1
IND2	1	2	0	0	0	0	1	1	0	0	0	0	0	0	1
IND3	1	2	0	0	0	0	1	1	0	0	0	0	0	0	1
NGO1	2	2	2	0	0	2	2	2	0	4	0	0	2	2	2
COL1	3	3	2	3	3	3	3	3	2	2	2	3	0	3	3
COM1	1	1	1	1	1	2	3	1	1	1	1	2	2	0	2
PERS	2	0	2	0	0	2	2	2	0	0	0	3	2	2	0

Notes: Rows indicate influencing actors, while columns indicate influenced (dependent) actors

APPENDIX C. MATRIKS POSISI DAN PRIORITAS TUJUAN STRATEGIS (2MAO / VALUED POSITION MATRIX)

The matrix of valued positions Actor X Objective (2MAO) provides information on the actor's stance on each objective (pro, against, neutral, or indifferent) and the hierarchy of its objectives.

2MAO	OBJ1	OBJ2	OBJ3	OBJ4	OBJ5	OBJ6	OBJ7	OBJ8	OBJ9	OBJ10	OBJ11	OBJ12	OBJ13	OBJ14	OBJ15	OBJ16	OBJ17	OBJ18	OBJ19	OBJ20	OBJ21	OBJ22
GOV1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
GOV2	4	4	4	4	4	4	3	3	3	4	3	4	3	4	4	4	4	4	4	4	3	3
GOV3	2	0	2	0	2	2	2	3	2	2	3	3	2	0	0	4	2	2	3	2	2	0
GOV4	0	3	0	0	0	0	3	3	3	0	3	0	3	3	0	3	3	0	3	3	3	0
GOV5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOV6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOV7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ACD1	3	3	3	3	3	3	3	0	3	0	3	3	3	0	3	3	0	3	0	3	3	3
IND1	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3	4	3	4	4	4
IND2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IND3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NGO1	4	4	4	3	-4	-4	3	4	0	4	4	4	4	4	4	4	3	3	4	3	4	4
COL1	3	3	3	3	3	3	3	0	3	0	3	3	3	0	3	3	0	3	0	3	3	3
COM1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PERS	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

The sign indicates whether or nor the actor is likely to reach the objective.

0 : Objective has a bleak outcome

1 : Objective jeopardises the actor's operating procedures (management, etc.) / is vital for its operating procedures

2 : Objective jeopardises the success of the actor's projects / is vital for the success of its projects

3 : Objective jeopardises the accomplishment of the actor's mission / is indispensible for its missions

4 : Objective jeopardises the actor's existence / is indispensible for its existence

-1 to -4 : Reject, the more negative = the stronger the rejection and high priority

APPENDIX D. RESEARCH INSTRUMENT (IN BAHASA INDONESIA)

The research instrument used in this study was a structured questionnaire written in Bahasa Indonesia. It was developed to collect data on stakeholder validation, actor profiles, direct influence matrices (MDI), and strategic objective prioritization (2MAO). The instrument was pre-tested and administered through interviews and self-completion.

To ensure transparency and reproducibility, the full version of the questionnaire (in Bahasa Indonesia) is archived and openly accessible at the following link: https://doi.org/10.5281/zenodo.16736905. Researchers working in similar Indonesian contexts are encouraged to consult and adapt this instrument accordingly.