

Article

Stakeholder Analysis of Sustainable Wastewater Management: A Case Study of Bogor, Indonesia

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Abstract: Wastewater management in Bogor, Indonesia faces significant challenges in achieving sustainability. The success of the development of wastewater management requires an analysis of the characteristics of the actors related to the relationship between actors, the attitude of actors toward development goals, and the possibility of alliances and conflicts that arise. The research aims to identify the actors' typologies based on the strengths and relationships between the actors' and the actors' attitudes toward managing fast-growing areas in self-help settlements based on domestic wastewater management for the area of Bogor Town, Indonesia. This research uses a case study approach, and data were collected through observation, interviews, and focus group discussions. Data analysis used the MACTOR method (Matrix of Alliances and Conflicts Tactics, Objectives, and Recommendations) to identify the stakeholder actors' strengths, relationships, and patterns of alliances. The results showed that the most influential actors in wastewater management are the Housing and Settlements Agency (DISRUMKIM), Regional Drinking Water Companies (PDAM), entrepreneurs (PUSAHA), MEDIA, the Regional People's Representative Council (DPRD), Regional Development Planning Agency (BAPPEDA), Public Works and Spatial Planning Service (DPUPR), and the Health Service (DINKES). In addition, the highest divergence value was 35, which occurred in Sub-District Tanah Sareal (KEC. TANSAR) to PUSAHA. There are four actors with a high level of ambivalence, namely Sub-District Bogor Selatan (KEC BOSEL), Regional Disaster Management Agency (BPBD), MEDIA, and Environment Service (DLH). These findings form the basis for developing a pattern of collaboration between all stakeholders necessary for the development of sustainable wastewater management in Bogor, Indonesia. In addition, this finding allows it to be used as relevant information, and it can be implemented in other cities with the same characteristics as Bogor Town is facing similar challenges in wastewater management.

Keywords: actor; MACTOR analysis; policy; strategy; sustainable wastewater management



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1. Introduction

Water, sanitation, and hygiene (WASH) have long been recognized as essential determinants of human health. Inadequate WASH is one of the main factors increasing the risk of diarrheal disease, a leading cause of death and disability worldwide (GBD Diarrheal Diseases Collaborators 2017). In addition, inadequate water and sanitation have been linked to several serious diseases such as worm infections, malnutrition in children, and impaired cognitive development [1,2].

Wastewater management helps keep the water clean and safe, and also helps protect a healthy environment that focuses on monitoring various environmental factors to prevent

diseases based on the environment that can affect human health [3]. Despite the importance of the role of the clean water and sanitation sector and the inclusion of WASH in the Millennium Development Goals (MDGs) and the United Nations (UN) International Decade of Action “Water for Life” 2005–2015 (UN 2015), there are still significant gaps in various countries. For example, in 2015, 2.3 billion people still lacked basic sanitation, and 844 million did not have essential drinking water services [3]. The Sustainable Development Goals (SDGs), which replaced the MDGs, aim to further increase the attention to WASH by working to ensure safe drinking water and basic sanitation for all [4]. Within a country, urban populations are far more likely to have sewer connections and piped water supply. However, the fact remains that in some developing countries, access to urban areas has stagnated or increased only slightly, especially in informal settlements, which are growing in many developing countries.

In developing countries, especially Indonesia, most settlements in urban areas are informal. Self-help settlements or informal settlements are settlements built by the community themselves; houses in self-help settlements are generally built by the community on the initiative of the community itself, which is carried out individually [5] or involves local institutions [6]. Self-help settlements have limited basic facilities in the form of services and infrastructure and public utilities or housing infrastructure [4,5]. The quality of the buildings and infrastructure needs to meet government technical standards [4] including the condition of building materials [5], design and construction [7], and the physical condition of unstructured buildings [5]. In several locations, self-supporting settlements occupy land that does not follow spatial planning, for example, standing in river-border areas, along railroad tracks, and disaster-prone areas [4,8], violating state regulations in terms of land ownership and urban planning [7], unclear land ownership [4], and development without planning [8].

Housing and settlement areas have yet to accommodate the needs of housing developments and self-help settlements, which low-income people mostly inhabit. If the government cannot control, direct, and foster the growth of self-help settlements, it will result in slums [9]. Slum self-help settlements generally lack proper and safe sanitation facilities [10]. Inadequate sanitation facilities can cause various diseases caused by infections such as diarrhea [11]. Poor sanitation results in the stunted growth of children; it is predicted that 50% of child malnutrition cases are closely related to diarrhea and intestinal infections caused by poor water, sanitation, and hygiene conditions, where access to proper sanitation interventions can reduce stunting [12].

Nowadays, there are few self-help settlements in Indonesia, especially in Bogor Town, where building and sanitation arrangements in the slums are incomplete. The growth of self-help settlements, which are sporadic, unplanned, unorganized, and very dense, has had an impact on the government’s difficulties in providing sustainable sanitation and drinking water services. In addition, in the implementation of sustainable wastewater management, the valuable elements in wastewater should be recovered, and flotation is a useful method to recover minerals containing heavy metals and heavy metals from wastewater [13,14]. However, there must be a clear strategy for managing sanitation and wastewater in Indonesia, especially in Bogor Town. In addition, the stakeholders in the sanitation and wastewater management system have yet to identify the role of each stakeholder. The problem of self-help settlements is also caused by the stakeholders’ need for optimal participation in the management of self-help settlements including the government, community leaders, non-governmental organizations, the role of women, and other community groups. This can be reflected in the low sustainability of domestic wastewater management including financing, technical, and environmental aspects [15]. Therefore, stakeholder analysis is an essential instrument for determining the direction and strategy of sanitation and wastewater management policies appropriately in the future. The research aims to identify the actors’ typologies based on the strengths and relationships between the actors’ and the actors’ attitudes toward managing fast-growing areas in

self-help settlements based on domestic wastewater management for the area of Bogor Town, Indonesia.

2. Literature Review

2.1. Wastewater Management

The problems of domestic wastewater management problems are related to technical barriers and physical environmental conditions [16], soil conditions [17], uncertain housing conditions [17], economic and financial barriers [16,17], institutional barriers [16], and structural barriers that come from the government. In addition, structural obstacles are the most difficult to overcome due to conflicts of interest and policies [16] as well as political factors [18]. In addition, the process of making government policies that are centralized influences the sanitation conditions and clean water supply [18].

The strategy for managing sanitation in self-help settlements is necessary for sustainability including careful planning, appropriate technology, scope of service, and ability to operate and maintain. In addition, it is necessary to plan for sanitation development in the long-term with clear development and financing targets [19]. From the community's point of view, the success of sustainable sanitation can be measured by independent and programmed management. Therefore, it is necessary to empower the community to increase their self-reliance to actively maintain and manage domestic wastewater treatment facilities [20]. In addition, Afandi et al. [21] reported that the strategy for sustaining a communal domestic wastewater management system is building community and institutional wastewater management capacity, developing alternative financing for partnership-based wastewater management, and increasing the coordination and division of roles in sanitation working groups.

Mitchell et al. [22] reported the sustainability of activity management in the context of the daily functioning of community-based sanitation through informal and formal institutional arrangements (governance) to improve governance by paying attention to the aspects that need attention and the actors in charge. Mitchell et al. [23] recommended collaboration or formal collaboration to establish roles and responsibilities based on the sanitation risks. The role of local government in managing sanitation in Indonesia includes ensuring the treatment of domestic wastewater according to quality standards and providing understanding to the public to pay for wastewater management, providing support at the construction stage, carrying out intensive socialization on environmental impacts caused by water pollution by domestic waste, and implementing pollutant tariffs pays with affordability considerations [19].

Domestic wastewater management in urban areas recommends the use of septic tanks and a combination of a centralized and local wastewater management system, in contrast, in locations that are densely populated and inhabited by low-income people, community-based sanitation is the most suitable, namely domestic wastewater treatment facilities in the form of septic tanks that can accommodate waste from many households (maximum 200), or one septic tank equipped with several toilets and used together [24]. The community-based management approach is carried out through a community-based communal septic tank system that serves informal self-help settlement areas, preferably in slum areas [25].

2.2. Matrix of Alliance, Conflicts, Tactics, Objectives, and Recommendations (MACTOR) Analysis

MACTOR analysis explores the strengths between the actors, similarities, differences, and problems to achieve the goals of the studied system, which are influenced by issues or factors; this analysis interacts between actors and factors [26,27]. The relationship between actors and factors is influenced by several variables including (a) position, the variable that represents the actor's preference for the desired goal; (b) salience, namely the priority of an objective to the achievement of the overall objectives of the actor; (c) clout, namely the power of actors to directly influence objectives in various ways; (d) influence, namely the power possessed by actors to influence the behavior of other actors. The output of MACTOR is mapping the role and influence of stakeholders, identifying and knowing

the interactions of factors and actors that play a role in sustainability, mapping actors or entities to influence the desired outcomes on other actors, and identifying issues/problems in domestic wastewater management faced by the actors.

Actor analysis is a set of methods to identify the actors' strengths, weaknesses, and attitudes, rank actor positions on various strategic issues, assess convergence and divergence, and anticipate possible coalitions and conflicts among actors [28]. Through a reasonably comprehensive analysis, a multi-actor model is an approach that is of great interest to analysts because of its comprehensiveness and practicality [29]. MACTOR can help make decisions so that actors can apply their policies, MACTOR is very precise for strategy development involving many actors using a specific set of objectives, and MACTOR is interactive, easy, and can be interpreted [26,28].

The multi-actor model aims to gain an in-depth understanding of the system and its possible evolution by emphasizing the perspectives and interests of actors as well as the pattern of connectedness between all actors [30]. The multi-actor model will assist decision-makers in recognizing the leading roles that actors play concerning their ability to influence important factors shaping the system's future. Multi-actor models are beneficial for identifying actor strategies that tend to be coherent and knowing the effects of actor actions on critical factors in the development of a system [31].

In the multi-actor approach, the system is formalized as a game pattern between actors who have positions, different interests (salience), and influence the results (influence) through the use of personal preferences (clout) [32]. In this approach, actors are defined as entities that have a position in the system being studied and play a role in mobilizing their resources to influence outcomes directly or indirectly through their influence on other actors [29]. By understanding the playing patterns of system actors, the system development process can be carried out in a directed manner to anticipate current and future conditions (Figure 1).

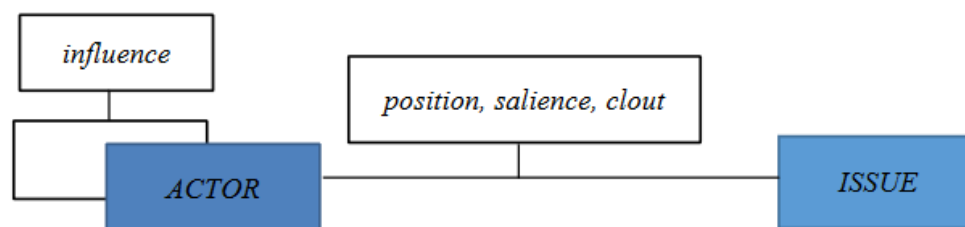


Figure 1. The basic concept of multi-actor method without modification [26].

MACTOR analysis conducts a relative strength analysis between actors or stakeholders and explores the similarities and differences in the various problems and objectives to be achieved [26]. In addition, Bendahan et al. [26] identified several variables that link actors/stakeholders and issues (factors) including: (1) position, namely the variable that represents the actor's preference for the desired outcome/goal; (2) salience, namely the priority that shows how vital the realization of an outcome is to achieving the overall goals of the actor/stakeholder; (3) clout, which describes the power of actors to directly influence the outcome/objectives of an issue in their various ways; (4) influence, namely the power possessed by actors/stakeholders to influence the behavior of other actors.

3. Materials and Methods

3.1. Study Site

Bogor, Indonesia, is geographically located at 106°48' East Longitude and 6°36' South Latitude with a distance of ±56 km from the capital city of Jakarta (Figure 2). Administratively, Bogor is divided into six districts and 68 sub-districts, of which the built-up area of Bogor has reached 4994 Ha. The topography of Bogor Town area varies between flat and hilly (0–300 m above sea level). The slopes in Bogor range from 0–40%: slope 0–2% (flat) for 1763.94 ha, 2–15% (sloping) for 8091.27 ha, 15–25% (slightly steep) for 1109.89 ha, 25–40%

(steep) for 764.96 ha, and >40% (very steep) of 119.94 ha. The population density of Bogor Town itself reached 10,791 people per square kilometer in 2019. The total number of households in Bogor in 2019 increased by 49,250 to 310,035 from the initial 260,785 households in 2014.



Figure 2. The geographical position of the study area within Indonesia, especially Bogor, West Java Province.

3.2. Data Collection

This research used a case study approach. Data were collected through observation, interviews, and focus group discussions (FGDs). Observation activities were intended to obtain an overview of the stakeholders involved in wastewater management in the Bogor area. The observation activity aimed to describe the sanitation and wastewater management stakeholders in the Bogor area. In-depth interviews were conducted with informants who were determined purposively based on the informants' involvement and understanding of wastewater management in Bogor, West Java. Interviews were conducted by visiting the informant's location and supported by an assistant. The interview asked about the informant's sanitation and wastewater management knowledge in Bogor, West Java. Meanwhile, the focus group discussion (FGD) aimed to find out the interests and strengths of each stakeholder and the strategic goals that could be achieved in the development of wastewater management in Bogor, West Java. FGDs with actors were held five times, namely two FGDs at the sub-district level (Mekarwangi Sub-District and Mulyaharja Sub-District) and one FGD at the town level.

There were 38 stakeholders (divided into three groups) involved in the data collection process including: (1) stakeholders from the government such as the Ministry of Public Works and Human Settlements (KPUPR), West Java Province Housing and Settlements Agency, Bogor Town Regional Development Planning Agency, Bogor Town Public Works and Spatial Planning Agency (DPUPR), Health Service (DINKES) Bogor Town, Bogor Town Housing and Settlement Service (DISRUMKIM), Bogor Town Environment Service (DLH), Regional Technical Implementation Unit (UPTD) Wastewater Management (PAL) at the Public Works and Spatial Planning Office (DPUPR) Bogor Town, District, and Sub-District; (2) stakeholders in the form of groups whose members are a mixture of government and community including the Bogor Town Sanitation Working Group (Pokja), while professional stakeholders include sanitarians, Sanimas field facilitators, Kotaku field facilitators; (3) stakeholders from non-governmental organizations including non-governmental organizations (NGOs), Bogor Town Aksansi, USAID IUWASH PLUS in Bogor Town, sanitation microfinance institutions (LKM), Islamic boarding schools, religious institutions, and political parties. Stakeholders from the community at the grassroots level, both in the form of institutions/groups and individuals, include village community empowerment institutions (LPMK), family empowerment and welfare mobilization teams (Sub-District TP PKK), community self-reliance agencies (BKM), community self-help groups (KSM) sanitation,

sanitation non-governmental groups (KSM), sanitation utilizers and maintainers of communal waste water treatment plant/ WWTP (KPP) groups, youth organizations, Posyandu Cadres, housewives, community leaders, youth leaders, religious leaders, and female leaders. Other stakeholders include the media, universities (PT), and companies/private sector.

3.3. Data Analysis

All data in this study were analyzed using MACTOR (Matrix of Alliances and Conflicts Tactics, Objectives, and Recommendations). MACTOR is a software that was developed by Michel Godet in 1991 to deeply analyze the power relations between actors, the actors' competitiveness, and the actors' attitudes toward goals. MACTOR is based on inter-actor influence, distinguished as direct, indirect, and competitive [33].

The stages of MACTOR analysis consist of: (1) identifying actors; (2) determining a set of goals; (3) describing the power relations of actors as measured by a scale of 0 (no influence) to 4 (powerful influence); (4) describing the attitude (level of resistance) of actors towards goals as measured by a scale of (+) supports, (0) neutral, and (-) opposes and the importance of goals for actors as measured by a scale of 0 (not important) to 4 (very important) [28].

Input data were obtained from the workshop and arranged in the form of matrices (matrix direct influence (MDI) and matrix actor and objective (MAO)) that were then processed by MACTOR 5.3.0 to produce different analysis results. The analysis results are presented in graphs and tables, which describe the competitiveness of actors in sanitation and wastewater management in Bogor Town, Indonesia, and provides descriptions of the alliance patterns and possible conflicts between these actors as well as descriptions of actor support for the goals to be achieved and realized from the development of sanitation and wastewater management.

4. Results and Discussion

4.1. Actor Identification

Twenty-three stakeholders are involved in wastewater management in Bogor, Indonesia: the Bogor Regional People's Legislative Council (DPRD), Bank Regional (BANK), Regional Drinking Water Company (PDAM), Bogor Town Family Empowerment and Welfare Mobilization Team (TPPKK), Regional Development Planning Agency (BAPPEDA), Education Office (DISDIK), Health Service (DINKES), Public Works and Spatial Planning Service (DPUPR), Environment Service (DLH), Housing and Settlements Service (DISRUMKIM), Communication and Information Service (DISKOMINFO), Women and Children Empowerment and Protection Service (DPMPPA), Civil Service Police Unit (POLPP), Regional Disaster Management Agency (BPBD), Sub-District Tanah Sareal (KEC. TANSAR), Sub-District Bogor Selatan (KEC. BOSEL); fecal desludging operators are represented by the Regional Technical Implementation Unit for Wastewater Management at the Public Works and Spatial Planning Service (OPERATOR), Healthy City Forum (FKS), KSM Sanitation Association (AKSANSI); universities are represented by Ibnu Khaldun University (PT); media are represented by Pakuan Raya (MEDIA); microfinance institutions are represented by Baytul Ihtiyar Cooperative (LKM); entrepreneurs are represented by Bukit Cimanggu City Developers (PUSAHA).

4.2. The Goal of Sustainable Wastewater Management

The goal of sustainable wastewater management must consider the issues, problems, and constraints in domestic wastewater management [34]. Based on the results of previous study, the objectives of wastewater management in Bogor, Indonesia, can be classified into five aspects including social aspects, financial aspects, technical aspects, institutional aspects, and policy aspects [35].

Based on the social aspect, the objectives of wastewater management in Bogor, Indonesia include: (1) the community being increasingly aware of how to manage domestic wastewater (SPAHAM) properly; (2) realization of the culture and habits of clean and

healthy living (free open defecation) (SBUDAYA). Meanwhile, the financing aspect included: (1) ease of access to financing for the construction of domestic wastewater infrastructure (DBANGUN); (2) easy access to operation and maintenance financing in the form of non-financial assistance (DOM) [35].

In addition, the objectives of wastewater management in Bogor, Indonesia based on technical aspects included (1) the availability of a spatial plan based on domestic wastewater management in medium- and long-term informal self-help housing (TRUANG); (2) control/supervision of buildings and the environment based on domestic wastewater management in informal self-help settlements (TKENDALI); (3) increasing the construction of domestic wastewater treatment facilities that meet the technical requirements in informal self-help settlements (TBANGUN); (4) increased maintenance of domestic wastewater treatment infrastructure (TPELIHARA); (5) increased accessibility for the disposal/absorption of feces sludge (TSEDOT); (6) reducing water and soil pollution due to domestic wastewater (TMONEV); (7) preventing disasters in the form of landslides or ground collapses due to the flow of domestic wastewater that enters the ground (TLONGSOR) [35].

Based on the institutional aspect, the objectives of managing wastewater management in Bogor, Indonesia include: (1) increasing the role of community institutions in managing domestic wastewater that can accommodate various aspects of management (LEMBAGA); (2) increasing the capacity of the government (regional apparatus organizations) in managing domestic wastewater that can accommodate various aspects of management (LKAPEM); (3) increased government assistance to the community in managing domestic wastewater in informal self-help housing (LDAMPEN); (4) increased partnerships between stakeholders in domestic wastewater management (LMITRA) [35].

Furthermore, based on the policy aspect, the objectives of wastewater management in Bogor, Indonesia include: (1) a policy that supports the ease of implementation of domestic wastewater management plans in informal self-help housing (BIJAK); (2) increased security for land assets and domestic wastewater treatment infrastructure (BASET); (3) increasing the adequacy of funds to manage domestic wastewater in informal self-help housing (BDANA); (4) the existence of implementation rules as a derivative of regional regulations regarding the provision of incentives, disincentives, awards, and sanctions (BATURAN) [35].

4.3. Direct and Indirect Influence between Actors

The FGD produced an initial matrix from the MACTOR analysis in the form of matrix direct influence (MDI) and matrix valued of position (2MAO) (Figure 3). These two matrices are inputs for MACTOR overall analysis. Stakeholders in the first column are assessed for their influence on the actors in the first row. The level of influence of actors on each other is measured with 0 (no influence), 1 (influence on operational procedures), 2 (influence on work), 3 (influence on actor's mission), and 4 (very influence on actor's mission) (Figure 3a). The actor's attitude and judgment reflect the actor's position toward this goal on whether to support or reject the goal. This matrix is filled with 0 (goal has a dismal outcome), 1 (goal interferes with the actor's operational procedures), 2 (goal interferes with the success of the actor's work), 3 (goal interferes with the achievement of the actor's mission), and 4 (goal interferes with the actor's existence) (Figure 3b).

The direct and indirect influences between actors are presented in Figure 4; the far right column (Ii) shows the value of the net effect (both direct and indirect effects) [36]. The bottom row (Di) denotes the net dependencies (both direct and indirect dependencies). From the results of this matrix, the Housing and Settlements Agency (DISRUMKIM) has the most influence, followed by the Regional Drinking Water Company (PDAM), and the Regional People's Representative Council (DPRD). DISRUMKIM is influential because it is an agency that has a considerable budget to handle development and repairs, especially settlement infrastructure and the repair of uninhabitable houses including the development of domestic wastewater infrastructure. PDAM ranked number two with the most substantial influence because it intervenes in drinking water/clean water to

support domestic wastewater management. It also provides corporate social responsibility by contributing to giving septic tanks. DPRD occupies the third position, which is very influential because the duties and functions of the DPRD, together with the government, determine and approve the amount of the regional budget and various policies.

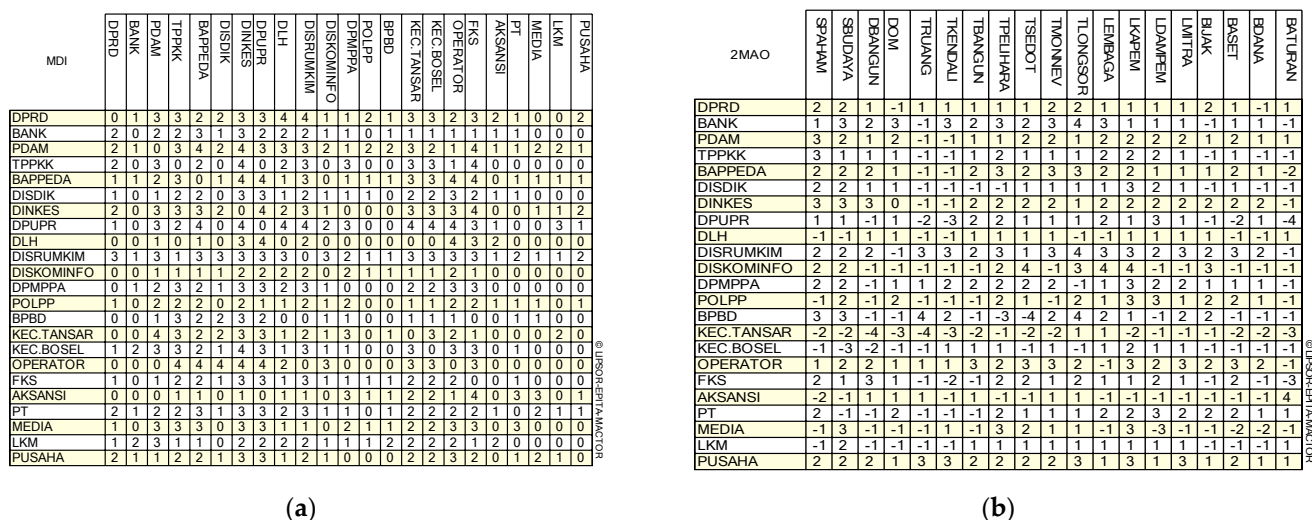


Figure 3. (a) Matrix of direct influence between actors (MDI). (b) Matrix valued of position (2MAO).

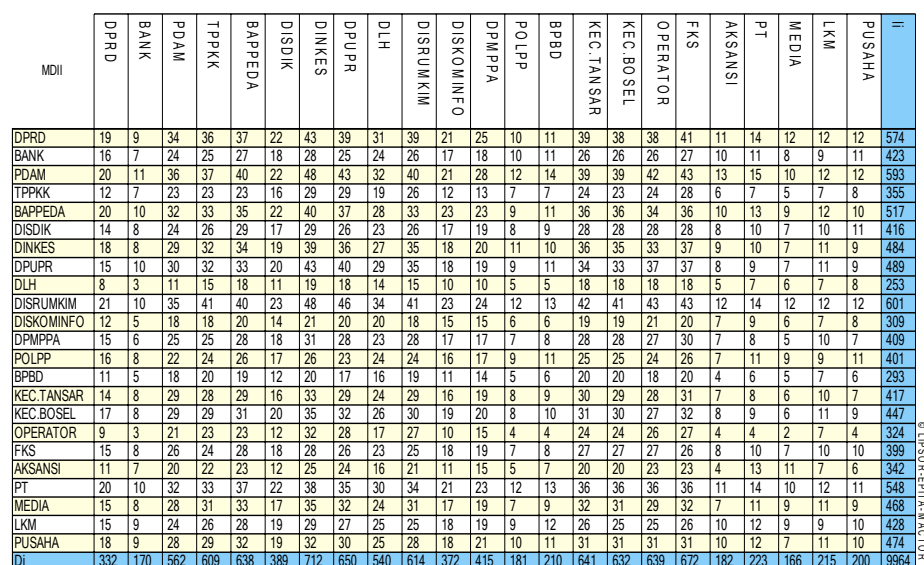


Figure 4. Matrix of the direct and indirect influence between actors (MDII).

The map of influence and dependence between actors is presented in Figure 5. Quadrant I are actors with strong influence but low dependence [37,38]. In this study, the actors in Quadrant I include the DPRD, universities (PT), entrepreneurs (PUSAHA), and the media (MEDIA). (Figure 5). DPRD is an institution that determines and approves the budget. Universities (PT) have a strong influence as institutions that greatly help the government and provide input, suggestions, and counseling to the community through field visits and actual work lectures related to domestic wastewater management. The media are stakeholders that can disseminate information and influence community. Furthermore, entrepreneurs as stakeholders can provide corporate social responsibility (CSR) to the community. On the other hand, there is a low dependency because it is not directly in contact with domestic wastewater management.

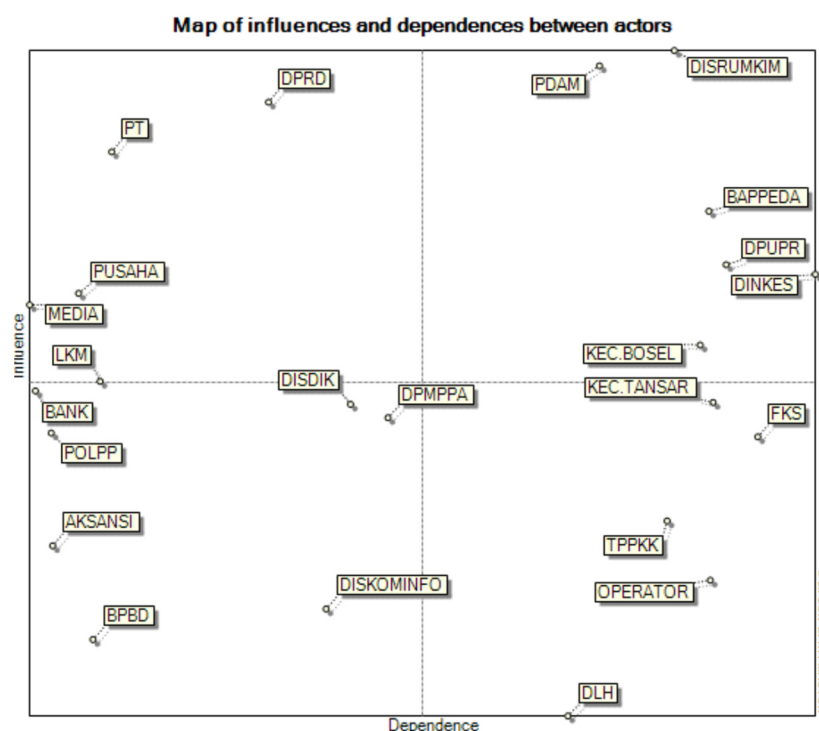


Figure 5. Map of the influences and dependences between actors.

Quadrant II is a stakeholder with strong influence and dependency [37,38]; in this study, these were PDAM, DISRUMKIM, BAPPEDA, DPUPR, and Health Office (DINKES). These actors have the tasks of planning and budgeting as well as coordinating development related to domestic wastewater management.

Quadrant III comprises stakeholders with low influence but high dependency [37,38]. In this study, quadrant III consisted of Tanah Sareal District (KEC. TANSAR), Healthy Town Forum (FKS), the Bogor Town Family Empowerment and Welfare Mobilization Team (TPPKK), Regional Technical Implementation Unit (UPTD), Wastewater Management (PAL) at the Public Works and Spatial Planning Service (DPUPR) as the desludging operator (OPERATOR), and the Environment Service (DLH). The low influence is due to budget constraints; thus, there is a high dependency on the budget, which results in low community assistance performance. In addition, operators of feces cleaning from the DPUPR as actors have low influence due to the community's need for greater utilization of desecration operators.

Quadrant IV comprises actors with low influence and dependence [37,38]. The Office of Education (DISDIK), Service for Empowerment and Protection of Women and Children (DPMPPA), Office of Communication and Information (DISKOMINFO), Civil Service Police Unit (POL PP), Regional Disaster Management Agency (BPBD), microfinance institutions (LKM), banks in Bogor Town (BANK), and the KSM Sanitation Association (AKSANSI) are included in quadrant IV. These actors are included in quadrant IV because the management of domestic wastewater has not been integrated with the duties and functions of the organization, for example, DISDIK; by increasing/strengthening curriculum related to the environment, DPMPPA is related to increasing the role of women; DISKOMINFO by increasing/strengthening the role of social media in campaigning for a culture of clean and healthy living; POL PP by increasing/strengthening the function of space supervision/control and the orderly use of water bodies; BPBD by increasing/strengthening the function of disaster mitigation caused by uncontrolled/absence of domestic wastewater management, which can cause a disaster (landslide).

The scale of net influence among actors is presented in Figure 6. The actors who exerted more influence than they received were universities (PT), media, entrepreneurs

(PUSAHA), banks, and DPRD. Stakeholders who had less influence than they received were OPERATOR, DLH, and the Healthy Town Forum (FKS). Recommendations to increase the role of DLH in managing domestic wastewater by expanding its duties, not being limited to testing the processed results of communal WWTP, monitoring houses where feces is still open, and strengthening community capacity in managing domestic wastewater together with other local government apparatus organization as well as increasing the desludging of sludge by desludging operators and increasing the role of the Healthy Town Forum (FKS) to provide more advocacy to the community. Actors with high competitiveness were universities (PT), followed by DPRD and media. Thus, the role of DPRD, media, and universities is needed as a lever to improve domestic wastewater management (Figure 7).

The maximum direct and indirect influence matrix (MMDII) is presented in Figure 8. The maximum level of influence a stakeholder can have on other stakeholders (calculated from the far right column), is shown, where the most substantial influence in this study was DPUPR, BAPPEDA, and DINKES. The maximum level of dependence that a stakeholder can have on other stakeholders (calculated from the bottom row), is also presented, where the highest dependency in this study was shown by FKS, DPUPR, and DINKES. Based on this, the actors who had the maximum influence and dependency were DPUPR and the Health Office. According to the duties and functions of the agency, it is directly related to improving the performance of domestic wastewater management in the community.

Stakeholders who showed competitiveness with a score >1 included the media, universities (PT), DPUPR, DPRD, BAPPEDA, PUSAHA, DINKES, DLH, PDAM, BANK, OPERATOR, and AKSANSI (Figure 9). Based on the results of the histogram of the competitiveness of the MDII matrix and the MMDII matrix (Figures 7 and 9), MEDIA's position in the MDII matrix was at number 3, below PT and DPRD. In contrast, MEDIA's position in the MMDII matrix was at number 1; this shows that the MEDIA's competitiveness was higher than that of PT and DPRD.

The actors who experienced obstacles in achieving the SBUDAYA goal (realizing a culture and habit of clean and healthy living) were DLH, TANSAR KEC, BOSEL KEC, AKSANSI, and PT (Figure 10). Based on interviews with these actors, this goal could not be achieved because the habit of open defecation has become a culture, and many people do it; on the other hand, there are limited government resources (budget) to eliminate open defecation. However, in this SBUDAYA goal, more actors agreed, and the position scale tended to the left, which illustrates that more actors are optimistic that this goal will be achieved (with a positive sign (+)) (Figure 10).

NS	DPRD	BANK	PDAM	TPPKK	BAPPEDA	DISDIK	DINKES	DPUPR	DLH	DISRUMKIM	DISKOMINFO	DPMPA	POLPP	BPBD	KEC.TANSAR	KEC.BOSSEL	OPERATOR	FKS	AKSANSI	PT	MEDIA	LKM	PUSAHA	Sum
DPRD		-7	14	24	17	8	25	24	23	18	9	10	-6	0	25	21	29	26	0	-6	-3	-3	-6	242
BANK	7		13	18	17	10	20	15	21	16	12	12	2	6	18	18	23	19	3	1	0	0	2	253
PDAM	-14	-13		14	8	-2	19	13	21	5	3	3	-10	-4	10	10	21	17	-7	-17	-18	-12	-16	31
TPPKK	-24	-18	-14		-10	-10	-3	-3	4	-15	-6	-12	-17	-13	-4	-6	1	4	-16	-26	-26	-19	-21	-254
BAPPEDA	-17	-17	-8	10		-7	6	4	10	-7	3	-5	-17	-8	7	5	11	8	-13	-24	-24	-16	-22	-121
DISDIK	-8	-10	2	10	7		10	6	12	3	3	1	-9	-3	12	8	16	10	-4	-12	-10	-9	-8	27
DINKES	-25	-20	-19	3	-6	-10		-7	8	-13	-3	-11	-15	-10	3	0	1	9	-16	-28	-28	-18	-23	-228
DPUPR	-24	-15	-13	3	-4	-6	7		11	-11	-2	-9	-14	-6	5	1	9	11	-16	-26	-25	-16	-21	-161
DLH	-23	-21	-21	-4	-10	-12	-8	-11		-19	-10	-13	-19	-11	-6	-8	1	-5	-11	-23	-18	-18	-17	-287
DISRUMKIM	-18	-16	-5	15	7	-3	13	11	19		5	-4	-12	-6	13	11	16	18	-9	-20	-19	-13	-16	-13
DISKOMINFO	-9	-12	-3	6	-3	-3	3	2	10	-5		-2	-10	-5	3	0	11	2	-4	-12	-11	-11	-10	-63
DPMPA	-10	-12	-3	12	5	-1	11	9	13	4	2		-10	-6	9	8	12	11	-8	-15	-14	-9	-14	-6
POLPP	6	-2	10	17	17	9	15	14	19	12	10	10		6	17	17	20	19	2	-1	2	0	1	220
BPBD	0	-6	4	13	8	3	10	6	11	6	5	6	-6		11	10	14	12	-3	-7	-4	-5	-5	83
KEC.TANSAR	-25	-18	-10	4	-7	-12	-3	-5	6	-13	-3	-9	-17	-11		-2	4	4	-13	-28	-26	-16	-24	-224
KEC.BOSSEL	-21	-18	-10	6	-5	-8	0	-1	8	-11	0	-8	-17	-10	2		3	5	-12	-27	-25	-14	-22	-185
OPERATOR	-29	-23	-21	-1	-11	-16	-1	-9	-1	-16	-11	-12	-20	-14	-4	-3		0	-19	-32	-27	-18	-27	-315
FKS	-26	-19	-17	-4	-8	-10	-9	-11	5	-18	-2	-11	-19	-12	-4	-5	0		-15	-26	-25	-16	-21	-273
AKSANSI	0	-3	7	16	13	4	16	16	11	9	4	8	-2	3	13	12	19	15		2	4	-3	-4	160
PT	6	-1	17	26	24	12	28	26	23	20	12	15	1	7	28	27	32	26	-2		-1	0	-1	325
MEDIA	3	0	18	26	24	10	28	25	18	19	11	14	-2	4	26	25	27	25	-4	1		2	2	302
LKM	3	0	12	19	16	9	18	16	18	13	11	9	0	5	16	14	18	16	3	0	-2		-1	213
PUSAHA	6	-2	16	21	22	8	23	21	17	16	10	14	-1	5	24	22	27	21	4	1	-2	1		274

Figure 6. Net influence matrix.

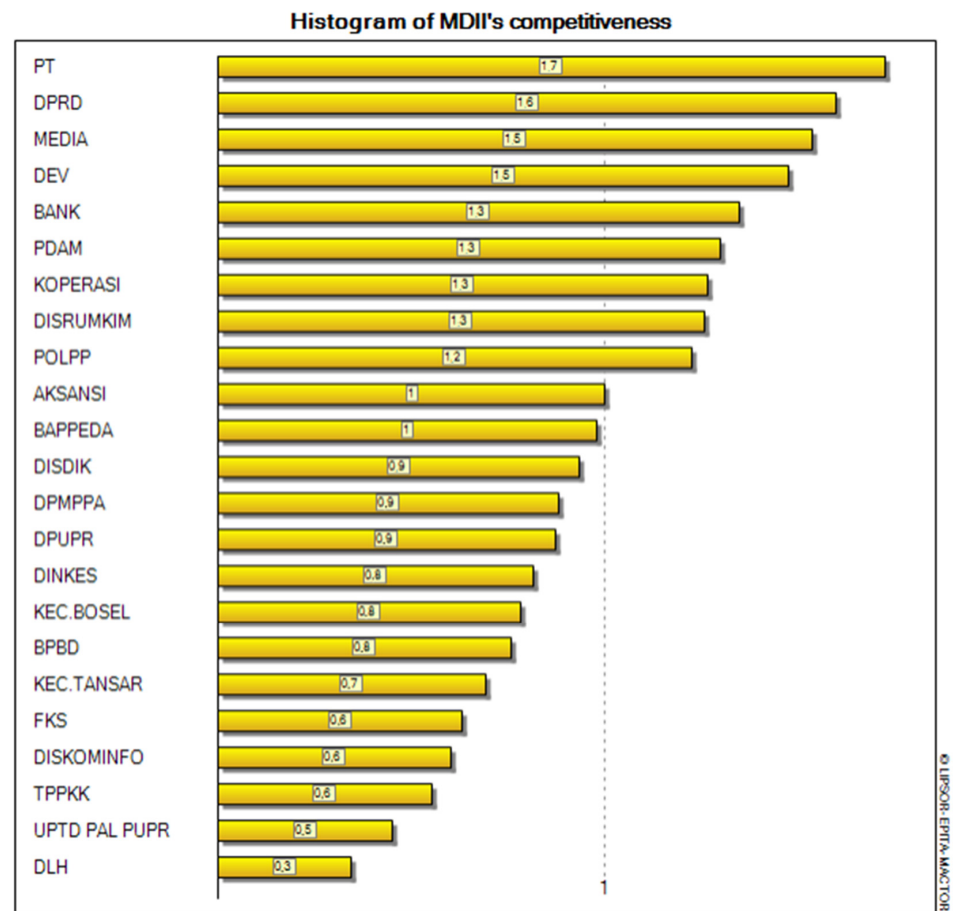


Figure 7. Histogram of competitiveness between actors.

	IMAXI	PUSAHA	LKM	MEDIA	PT	AKSANSI	FKS	OPERATOR	KEC.BOSEL	KEC.TANSAR	BPBD	POLPP	DPMPPA	DISKOMINFO	DISRUMKIM	DLH	DPUPR	DINKES	DISDIK	BAPPEDA	TPPKK	PDAM	BANK	DPRD
DPRD	63	2	3	2	2	2	3	3	4	3	3	2	2	3	3	4	4	3	3	3	3	3	2	0
BANK	54	2	2	2	2	2	3	3	2	3	3	2	2	2	3	2	2	3	2	4	3	0	0	
PDAM	64	2	3	2	2	2	4	4	2	3	3	2	2	3	3	4	4	4	3	3	0	0	2	
TPPKK	61	2	2	2	2	2	4	3	2	3	3	2	2	3	3	3	4	3	3	4	0	3	2	
BAPPEDA	68	2	3	2	2	1	4	4	1	4	4	2	2	3	3	4	4	4	0	4	4	2	3	
DISDIK	54	2	3	1	2	2	3	3	3	3	3	1	1	3	3	3	3	0	3	3	3	2	2	
DINKES	67	2	3	2	2	2	4	4	2	4	4	2	2	3	3	4	4	0	3	4	3	3	2	
DPUPR	70	2	3	2	2	2	4	4	2	4	4	2	2	3	3	4	0	4	4	4	4	2	3	
DLH	64	2	3	2	2	2	4	4	3	4	4	1	1	3	3	0	4	4	4	4	3	1	2	
DISRUMKIM	59	2	3	2	2	2	3	3	3	3	3	2	2	3	3	3	3	3	3	3	3	2	3	
DISKOMINFO	40	2	2	2	2	2	2	2	2	2	1	1	2	2	3	2	2	2	2	2	2	1	2	
DPMPPA	59	2	3	2	2	2	3	3	2	2	2	2	2	3	3	3	3	3	3	3	3	3	2	
POLPP	42	2	2	2	2	1	2	2	2	2	2	0	2	2	2	2	2	2	2	2	2	1	2	
BPBD	50	2	2	1	1	1	3	3	3	3	0	3	1	3	2	3	2	3	2	3	3	1	3	
KEC.TANSAR	60	2	3	2	2	2	4	3	2	0	3	2	2	3	3	3	3	4	3	4	4	2	4	
KEC.BOSEL	61	2	3	2	2	2	4	3	4	3	0	3	2	3	3	3	4	3	3	3	3	3	2	
OPERATOR	64	2	3	1	1	2	4	0	4	4	4	1	3	3	3	4	4	4	4	4	4	2	2	
FKS	55	2	3	3	2	2	3	3	0	3	3	1	1	3	3	3	3	3	3	3	3	2	3	
AKSANSI	52	2	3	3	3	0	4	3	4	2	2	1	3	1	2	3	3	3	3	3	3	3	2	
PT	60	2	3	2	2	3	3	3	3	3	2	2	3	3	3	3	3	3	3	3	3	3	2	
MEDIA	59	2	3	3	3	1	3	3	3	3	3	2	2	3	3	3	3	3	3	3	3	2	2	
LKM	53	2	3	2	2	3	3	2	3	2	3	2	2	2	3	3	3	3	3	3	3	2	2	
PUSAHA	58	3	3	2	2	2	3	3	3	3	2	1	3	3	3	3	3	3	3	3	3	2	2	
IMAXI	1337	43	60	40	44	37	73	69	67	68	37	37	37	62	59	70	66	72	63	70	68	66	40	

Figure 8. The maximum direct (DMAXi) and indirect influence matrix (IMAXi) (MMDII).

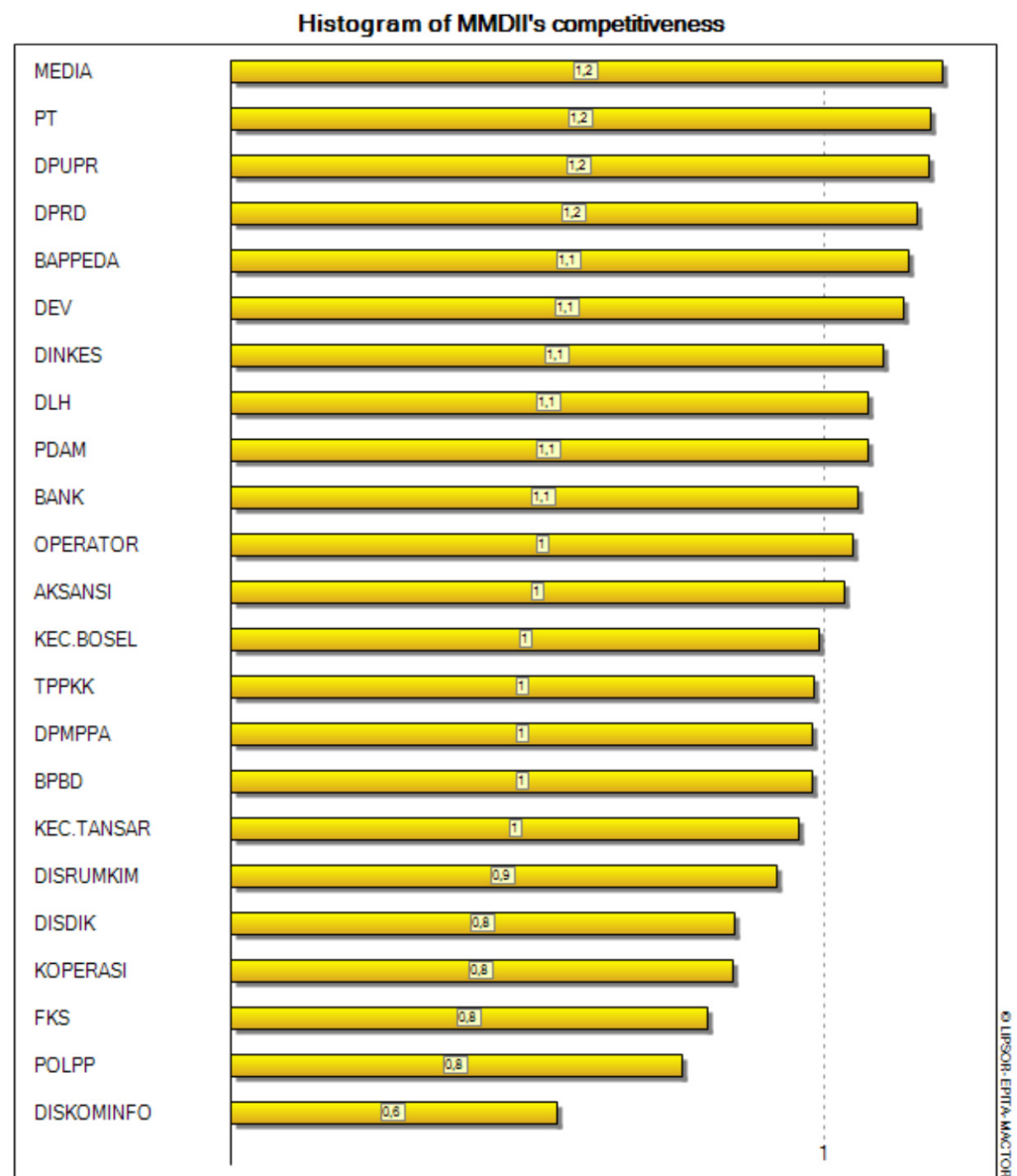


Figure 9. Competitiveness based on the MMDII matrix.

4.4. Actor Relations and Goals

The relationship between actors and the first-order goal is presented in Figure 11. DPRD was the most influential actor because it participates in determining the direction of development and budget approval as well as with low dependency, states that the objectives of ease of access to operation and maintenance financing are in the form of non-financial assistance (DOM). Increasing the adequacy of funds to manage domestic wastewater in informal self-help housing (BDANA) is challenging.

The difference between the number of stakeholders who agreed to be reduced and did not agree showed that more stakeholders disagreed with providing a spatial plan based on domestic wastewater management in informal self-supporting housing for the medium- and long-term (TRUANG), the existence of control/supervision of buildings and environmental management based on domestic wastewater in informal self-help settlements (TKENDALI), increased adequacy of funds to manage domestic wastewater in informal self-help housing (BDANA), and the existence of implementing regulations as derivatives of regional regulations regarding the provision of incentives, disincentives, awards, and sanctions (BATURAN). The relationship between actors and goals of the second-order is presented in Figure 12. The histogram shows the position of the actor's

relationship with the specified goals, for example, strenuous or easy, and whether or not there are activities that support the goals. This shows that the most challenging goals are TRUANG, TKENDALI, BDANA, and BATURAN.

The relationship between actors and third-order goals in the 3MAO matrix is presented in Figure 13a, where the actors that were the most active are in the rightmost column (DISRUMKIM, PT, and PUSAHA), while the bottom row describes the degree of goal mobilization that activates the actors, namely LKAPEM (increased capacity of the government (regional apparatus organizations) in managing domestic wastewater that can accommodate various aspects of management), SBUDAYA (creation of culture and habits of clean and healthy living (free open defecation)), TPELIHARA (increased maintenance of domestic wastewater treatment infrastructure), and TLONGSOR (preventing disasters in the form of landslides or subsidence due to the flow of domestic wastewater into the ground).

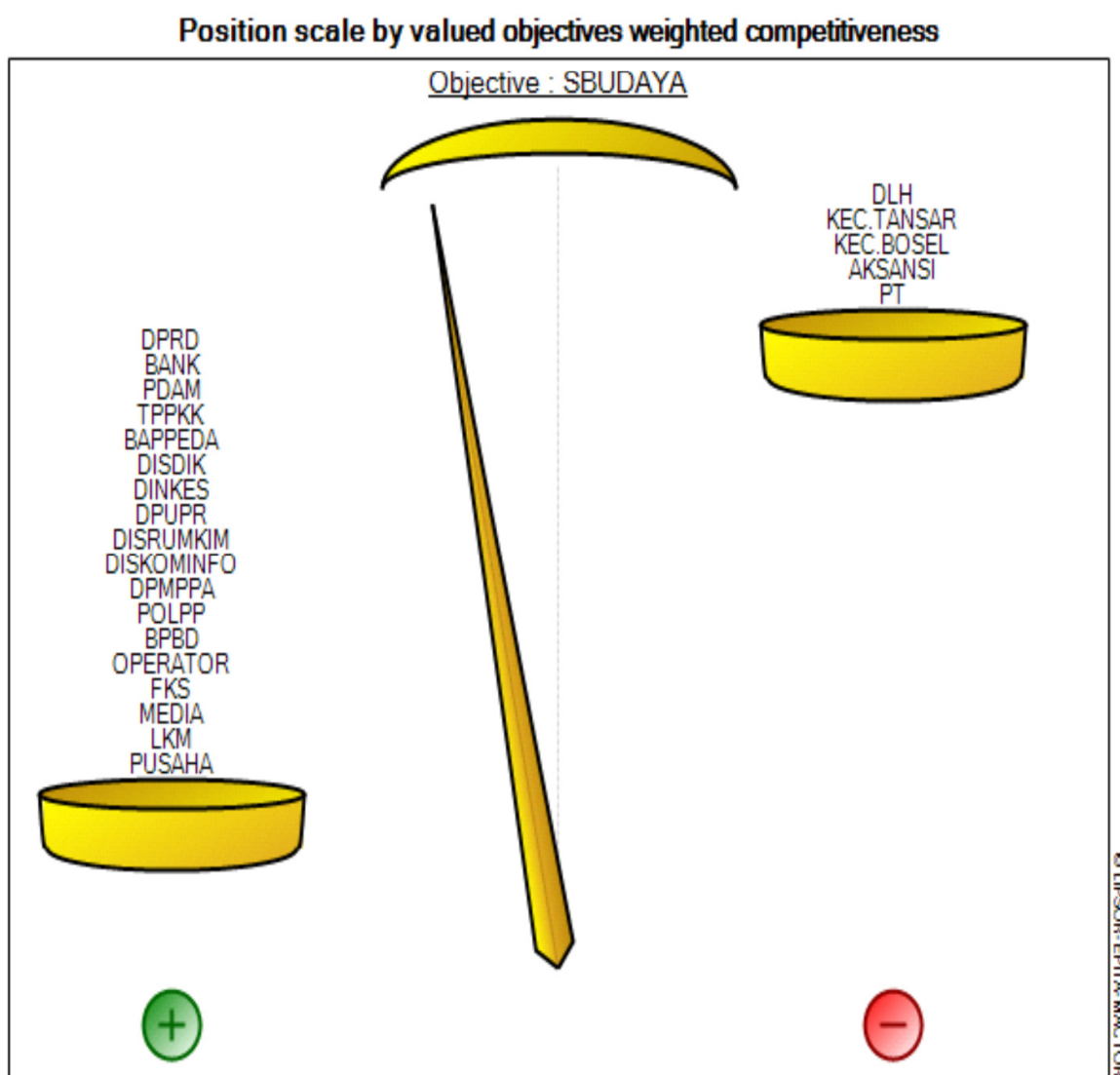


Figure 10. The scale of the actor's competitiveness position based on the achievement of the SBU-DAYA goal.

1MAO	SPAHAM	SBUDAYA	DBANGUN	DOM	TRUANG	TKENDALI	TBANGUN	TPELIHARA	TSEDOT	TMONNEV	TLONGSOR	LEMBAGA	LKAPEM	LDAMPEN	LMITRA	BIJAK	BASET	BDANA	BATURAN	Absolute sum
DPRD	1	1	1	-1	1	1	1	1	1	1	1	1	1	1	1	1	1	-1	1	19
BANK	1	1	1	1	-1	1	1	1	1	1	1	1	1	1	1	-1	1	1	-1	19
PDAM	1	1	1	1	-1	-1	1	1	1	1	1	1	1	1	1	1	1	1	1	19
TPPKK	1	1	1	1	-1	-1	1	1	1	1	1	1	1	1	1	1	-1	1	-1	19
BAPPEDA	1	1	1	1	-1	-1	1	1	1	1	1	1	1	1	1	1	1	1	-1	19
DISDIK	1	1	1	1	-1	-1	-1	-1	1	1	1	1	1	1	1	-1	1	-1	-1	19
DINKES	1	1	1	0	-1	-1	1	1	1	1	1	1	1	1	1	1	1	1	-1	18
DPUPR	1	1	-1	1	-1	-1	1	1	1	1	1	1	1	1	1	-1	-1	1	-1	19
DLH	-1	-1	1	1	-1	-1	1	1	1	1	-1	-1	1	1	1	1	-1	-1	1	19
DISRUMKIM	1	1	1	-1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-1	19
DISKOMINFO	1	1	-1	-1	-1	-1	-1	1	1	-1	1	1	1	-1	-1	1	-1	-1	-1	19
DPMPPA	1	1	-1	1	1	1	1	1	1	1	-1	1	1	1	1	1	1	1	-1	19
POLPP	-1	1	-1	1	-1	-1	-1	1	1	-1	1	1	1	1	1	1	1	1	-1	19
BPBD	1	1	-1	-1	1	1	-1	-1	1	1	1	1	1	-1	1	1	-1	-1	-1	19
KEC.TANSAR	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	1	1	-1	-1	-1	-1	-1	-1	-1	19
KEC.BOSEL	-1	-1	-1	-1	-1	1	1	1	-1	1	-1	1	1	1	1	-1	-1	-1	-1	19
OPERATOR	1	1	1	1	1	1	1	1	1	1	1	-1	1	1	1	1	1	1	-1	19
FKS	1	1	1	1	-1	-1	-1	1	1	1	1	1	1	1	1	-1	1	-1	-1	19
AKSANSI	-1	-1	1	1	1	-1	1	-1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	1	19
PT	1	-1	-1	1	-1	-1	-1	1	1	1	1	1	1	1	1	1	1	1	1	19
MEDIA	-1	1	-1	-1	-1	1	-1	1	1	1	1	-1	1	-1	-1	-1	-1	-1	-1	19
LKM	-1	1	-1	-1	-1	-1	1	1	1	1	1	1	1	1	1	-1	-1	-1	-1	19
PUSAHA	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19
Number of agreements	16	18	13	14	7	9	15	19	19	20	20	19	21	18	19	13	14	11	7	
Number of disagreements	-7	-5	-10	-8	-16	-14	-8	-4	-3	-3	-4	-2	-5	-4	-10	-9	-12	-16		
Number of positions	23	23	23	22	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	

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Figure 11. Actor relations matrix and first-order goals.

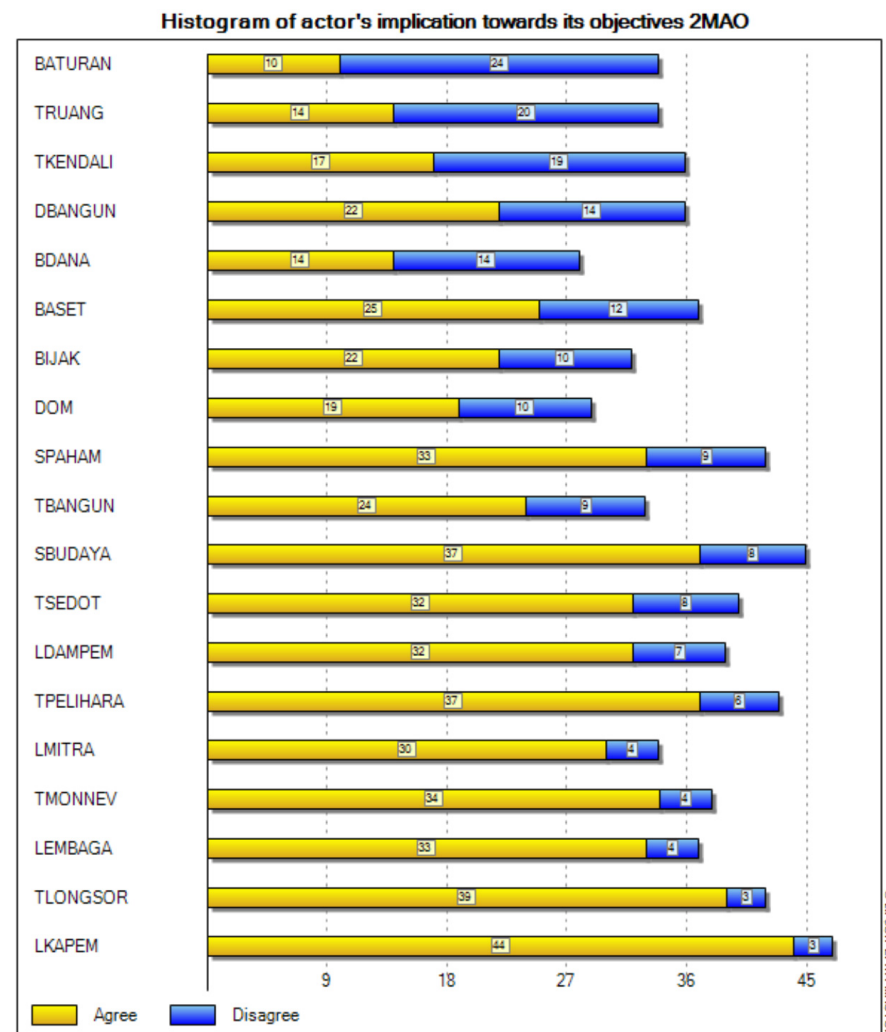
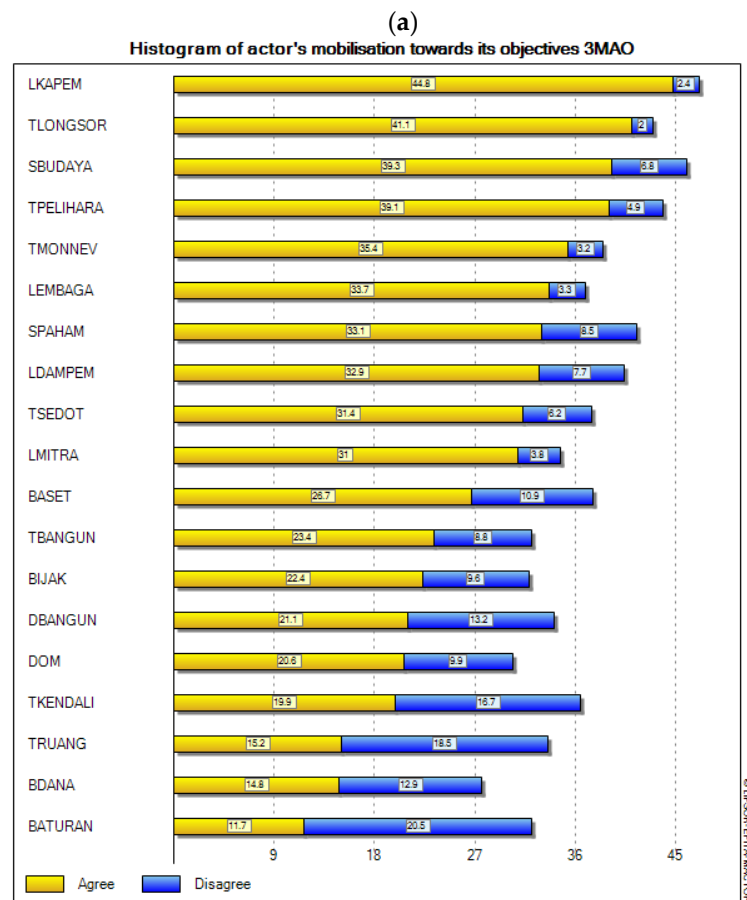


Figure 12. Actors' mobilization to achieve goals based on the 2MAO matrix.

3MAO	SPAHAM	SBUDAYA	DBANGUN	DOM	TRUANG	TKENDALI	TBANGUN	TPELIHARA	TSEDOT	TMONNEV	TLONGSOR	LEMBAGA	LKAPEM	LDAMPEN	LMITRA	BIJAK	BASET	BDANA	BATURAN	Mobilisation
DPDR	3.2	3.2	1.6	-1.6	1.6	1.6	1.6	1.6	1.6	3.2	3.2	1.6	1.6	1.6	1.6	3.2	1.6	-1.6	1.6	38.2
BANK	1.3	4.0	2.7	4.0	-1.3	4.0	2.7	4.0	2.7	4.0	5.4	4.0	1.3	1.3	1.3	-1.3	1.3	1.3	-1.3	49.7
PDAM	3.9	2.6	1.3	2.6	-1.3	-1.3	1.3	1.3	2.6	2.6	1.3	2.6	2.6	2.6	2.6	1.3	2.6	1.3	1.3	38.9
TPPKK	1.7	0.6	0.6	0.6	-0.6	-0.6	0.6	1.1	0.6	0.6	0.6	1.1	1.1	1.1	0.6	-0.6	0.6	-0.6	-0.6	13.8
BAPPEDA	2.0	2.0	2.0	1.0	-1.0	-1.0	2.0	2.9	2.0	2.9	2.9	2.0	2.0	1.0	1.0	1.0	2.0	1.0	-2.0	33.2
DISDIK	1.9	1.9	0.9	0.9	-0.9	-0.9	-0.9	-0.9	0.9	0.9	0.9	0.9	2.8	1.9	0.9	-0.9	0.9	-0.9	-0.9	22.4
DINKES	2.4	2.4	2.4	0.0	-0.8	-0.8	1.6	1.6	1.6	1.6	0.8	1.6	1.6	1.6	1.6	1.6	1.6	1.6	-0.8	28.5
DPUPR	0.9	0.9	-0.9	0.9	-1.7	-2.6	1.7	1.7	0.9	0.9	0.9	1.7	0.9	2.6	0.9	-0.9	-1.7	0.9	-3.5	27.1
DLH	-0.3	-0.3	0.3	0.3	-0.3	-0.3	0.3	0.3	0.3	0.3	-0.3	0.3	0.3	0.3	0.3	0.3	-0.3	-0.3	0.3	6.6
DISRUMKIM	2.5	2.5	2.5	-1.3	3.8	3.8	2.5	3.8	1.3	3.8	5.0	3.8	3.8	2.5	3.8	2.5	3.8	2.5	-1.3	56.5
DISKOMINFO	1.2	1.2	-0.6	-0.6	-0.6	-0.6	-0.6	1.2	2.4	-0.6	1.8	2.4	2.4	-0.6	-0.6	1.8	-0.6	-0.6	-0.6	21.1
DPMPA	1.8	1.8	-0.9	0.9	0.9	1.8	1.8	1.8	1.8	-0.9	0.9	2.6	1.8	1.8	1.8	0.9	0.9	0.9	-0.9	26.4
POLPP	-1.2	2.4	-1.2	2.4	-1.2	-1.2	2.4	1.2	-1.2	2.4	1.2	3.7	3.7	1.2	2.4	2.4	1.2	1.2	-1.2	35.5
BPBD	2.3	2.3	-0.8	-0.8	3.0	1.5	-0.8	-2.3	-3.0	1.5	3.0	1.5	0.8	-0.8	1.5	1.5	-0.8	-0.8	-0.8	29.5
KEC.TANSAR	-1.4	-1.4	-2.8	-2.1	-2.8	-2.1	-1.4	-0.7	-1.4	-1.4	0.7	0.7	-1.4	-0.7	-0.7	-0.7	-1.4	-1.4	-2.1	26.9
KEC.BOSEL	-0.8	-2.3	-1.6	-0.8	-0.8	0.8	0.8	0.8	-0.8	0.8	-0.8	0.8	1.6	0.8	0.8	-0.8	-0.8	-0.8	-0.8	18.0
OPERATOR	0.5	0.9	0.9	0.5	0.5	0.5	1.4	0.9	1.4	1.4	0.9	-0.5	1.4	0.9	1.4	0.9	1.4	0.9	-0.5	17.3
FKS	1.3	0.6	1.9	0.6	-0.6	-1.3	-0.6	1.3	1.3	0.6	1.3	0.6	0.6	1.3	0.6	-0.6	1.3	-0.6	-1.9	18.9
AKSANSI	-2.0	-1.0	1.0	1.0	1.0	-1.0	1.0	-1.0	-1.0	1.0	1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	4.0	23.0
PT	3.4	-1.7	-1.7	3.4	-1.7	-1.7	-1.7	3.4	1.7	1.7	1.7	3.4	3.4	5.2	3.4	3.4	3.4	1.7	1.7	49.8
MEDIA	-1.5	4.6	-1.5	-1.5	-1.5	1.5	-1.5	4.6	3.1	1.5	1.5	-1.5	4.6	-4.6	-1.5	-1.5	-3.1	-3.1	-1.5	46.0
LKM	-1.3	2.5	-1.3	-1.3	-1.3	-1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	-1.3	-1.3	-1.3	1.3	25.3
PUSAHA	3.0	3.0	3.0	1.5	4.4	4.4	3.0	3.0	3.0	3.0	4.4	1.5	4.4	1.5	4.4	1.5	3.0	1.5	1.5	54.7
Number of agreements	33.1	39.3	21.1	20.6	15.2	19.9	23.4	39.1	31.4	35.4	41.1	33.7	44.8	32.9	31.0	22.4	26.7	14.8	11.7	
Number of disagreements	-8.5	-6.8	-13.2	-9.9	-18.5	-16.7	-8.8	-4.9	-6.2	-3.2	-2.0	-3.3	-2.4	-7.7	-3.8	-9.6	-10.9	-12.9	-20.5	
Degree of mobilisation	41.6	46.1	34.3	30.5	33.7	36.5	32.2	44.0	37.6	38.6	43.1	37.0	47.2	40.5	34.8	32.0	37.7	27.7	32.2	

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(b)

Figure 13. (a) Actor relations matrix and third-order goals; (b) actor mobilization to achieve third-order goals.

Actor mobilization to achieve third-order goals is presented in Figure 13b, where the sequence of obstacles or lack of activities that support the achievement of goals according to the actors, successively from the largest value, was BATURAN (the existence of implementing regulations as derivatives of regional regulations regarding the provision of incentives, disincentives, rewards, and sanctions, meaning that there are still many regulations that need to be finalized, which can become the legal basis for implementing incentives, disincentives, rewards, and sanctions); TRUANG, namely the availability of spatial plans based on domestic wastewater management in informal self-help housing for the medium and long term; TKENDALI (control/supervision of buildings and environment based on domestic wastewater management in informal self-help settlements); DBANGUN (easy access to financing for the construction of domestic wastewater infrastructure); BDANA (increased adequacy of funds to manage domestic wastewater in informal self-help housing); BASET (increased security of land assets and domestic wastewater treatment infrastructure); DOM (easy access to operation and maintenance financing in the form of non-financial assistance); BIJAK (there are policies that support easy implementation of domestic wastewater management plans in informal self-help housing); TBANGUN (increased construction of domestic wastewater treatment infrastructure that meets technical requirements in informal self-help settlements); SPAHAM, namely the community is increasingly understanding how to properly manage domestic wastewater; LDAMPEN (increasing government assistance to the community in managing domestic wastewater in informal self-help housing); SBUDAYA (the realization of culture and habits of clean and healthy living (free of open defecation)); TSEDOT (increased accessibility of fecal sludge disposal); TPELIHARA (i.e., increased maintenance of domestic wastewater treatment infrastructure); LMITRA (increased partnerships between stakeholders in water management domestic waste); LEMBAGA (increasing the role of community institutions in managing domestic wastewater that can accommodate various aspects of management); TMONEV (reducing water and soil pollution due to domestic wastewater); TLONGSOR (preventing disasters in the form of landslides or subsidence due to the flow of domestic wastewater into the ground); LKAPEM (increasing government capacity (regional apparatus organizations) in managing domestic wastewater which can accommodate various aspects of management).

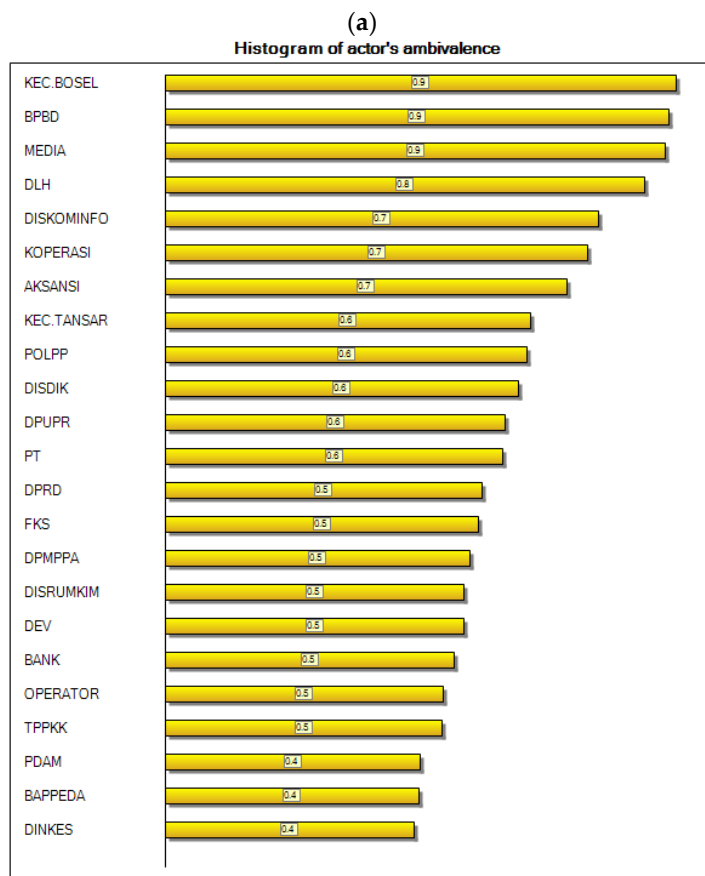
The divergence of goals between actors is presented in the form of the 2DAA matrix (Figure 14a). It appears that KEC. TANSAR had the highest score. A degree of divergence below 36.3% will result in greater potential obstacles in achieving these goals. The highest divergence value was 35, which occurred in KEC. TANSAR to PUSAHA. The recommendation on this matter is for PUSAHA to cooperate with KEC. TANSAR in the form of strengthening domestic wastewater management objectives in the region.

Based on the value of actor ambivalence, four actors had a high level of ambivalence, namely KEC BOSEL, BPBD, MEDIA, and DLH (Figure 14b). Recommendations for these actors are as follows:

- South Bogor Sub-District (KEC BOSEL): Increase the capacity of officials at the sub-district office both in theory and in practice to properly manage community-based domestic wastewater and provide a sufficient budget to carry out activities according to the scope of their duties and functions.
- Regional Disaster Management Agency (BPBD): Improving disaster studies caused by unmanaged domestic wastewater, especially ways in which to mitigate it.
- Media: Improving cooperation, campaigning, and massively disseminating the proper ways of managing domestic wastewater.

2DAA	POLPP	BPBD	KEC.TANSAR	KEC.BOSEL	OPERATOR	FKS	AKSANSI	PT	MEDIA	LKM	PUSAHA
DPRD	10.5	9.5	25.5	12.5	4.5	8.0	14.0	8.0	12.5	7.0	2.0
BANK	9.5	18.0	28.0	14.0	4.5	5.0	19.5	9.5	14.0	9.5	4.0
PDAM	6.5	17.5	27.5	15.5	4.5	5.0	17.0	3.5	17.5	8.0	4.0
TPPKK	7.5	16.0	20.5	10.5	6.5	1.0	16.0	6.5	12.5	6.0	7.0
BAPPEDA	6.5	17.5	26.0	15.0	3.5	3.5	19.5	6.0	15.5	9.0	5.5
DISDIK	7.5	12.5	18.0	12.5	9.5	1.5	15.5	7.5	12.5	7.5	10.0
DINKES	7.0	17.5	26.5	15.5	3.5	4.5	21.5	6.5	17.5	9.5	5.0
DPUPR	7.0	17.5	17.5	9.0	10.5	6.5	18.0	8.5	12.5	5.5	12.5
DLH	10.5	21.5	18.5	7.5	10.5	10.5	8.0	8.5	12.0	6.5	12.5
DISRUMKIM	12.0	13.5	33.5	16.5	3.0	10.0	24.5	11.0	19.0	13.0	2.0
DISKOMINFO	8.5	13.5	13.5	15.5	18.0	10.0	22.0	11.0	8.0	8.5	16.0
DPMPPA	8.5	14.0	29.0	10.5	4.0	10.0	21.5	7.5	15.0	10.0	4.5
POLPP	0.0	18.5	18.0	13.5	9.5	7.0	20.5	5.0	13.5	8.5	11.0
BPBD	18.5	0.0	18.0	15.5	17.0	17.5	17.0	18.0	15.0	15.0	14.0
KEC.TANSAR	18.0	18.0	0.0	11.0	35.0	20.0	14.5	21.5	13.5	13.0	35.0
KEC.BOSEL	13.5	15.5	11.0	0.0	17.0	14.0	13.5	12.0	10.5	6.5	17.0
OPERATOR	9.5	17.0	35.0	17.0	0.0	8.5	20.5	9.5	17.0	12.5	2.0
FKS	7.0	17.5	20.0	14.0	8.5	0.0	17.5	7.5	12.5	9.0	10.0
AKSANSI	20.5	17.0	14.5	13.5	20.5	17.5	0.0	18.0	15.0	10.5	18.0
PT	5.0	18.0	21.5	12.0	9.5	7.5	18.0	0.0	18.0	9.5	8.5
MEDIA	13.5	15.0	13.5	10.5	17.0	12.5	15.0	18.0	0.0	7.0	18.0
LKM	8.5	15.0	13.0	6.5	12.5	9.0	10.5	9.5	7.0	0.0	11.5
PUSAHA	11.0	14.0	35.0	17.0	2.0	10.0	18.0	8.5	18.0	11.5	0.0
Number of divergences	226.5	354.0	483.5	285.0	231.0	199.0	382.0	221.5	308.5	203.0	230.0
Degree of divergence (%)											

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(b)

Figure 14. (a) Goals divergence matrix between actors in the second-order; (b) actor ambivalence.

Department of the Environment (DLH): Increasing the budget for the inspection of water quality standards originating from domestic waste and increasing the budget for campaigns for proper domestic wastewater management and environmental law enforcement.

Based on the map of the net distances between goals, the goals that tended to diverge were BATURAN (there are implementing regulations as derivatives of regional regulations regarding the provision of incentives, disincentives, awards, and sanctions, meaning that there are still many regulations that need to be finalized, which can become a legal umbrella in the implementation of incentives, disincentives, awards, and sanctions), TRUANG (availability of spatial plans based on domestic wastewater management in informal self-supporting housing for the medium- and long-term), TKENDALI (control/supervision of buildings and environment based on domestic wastewater management in informal self-help settlements), DOM (easy access to operation and maintenance financing in the form of non-financial assistance), and BIJAK (the existence of policies that support the ease of implementation of domestic wastewater management plans in informal self-help housing), meaning that these goals will be achieved with more effort by all actors (Figure 15). The stronger the relationship between goals, the higher the convergence of the actors' opinions about these goals.

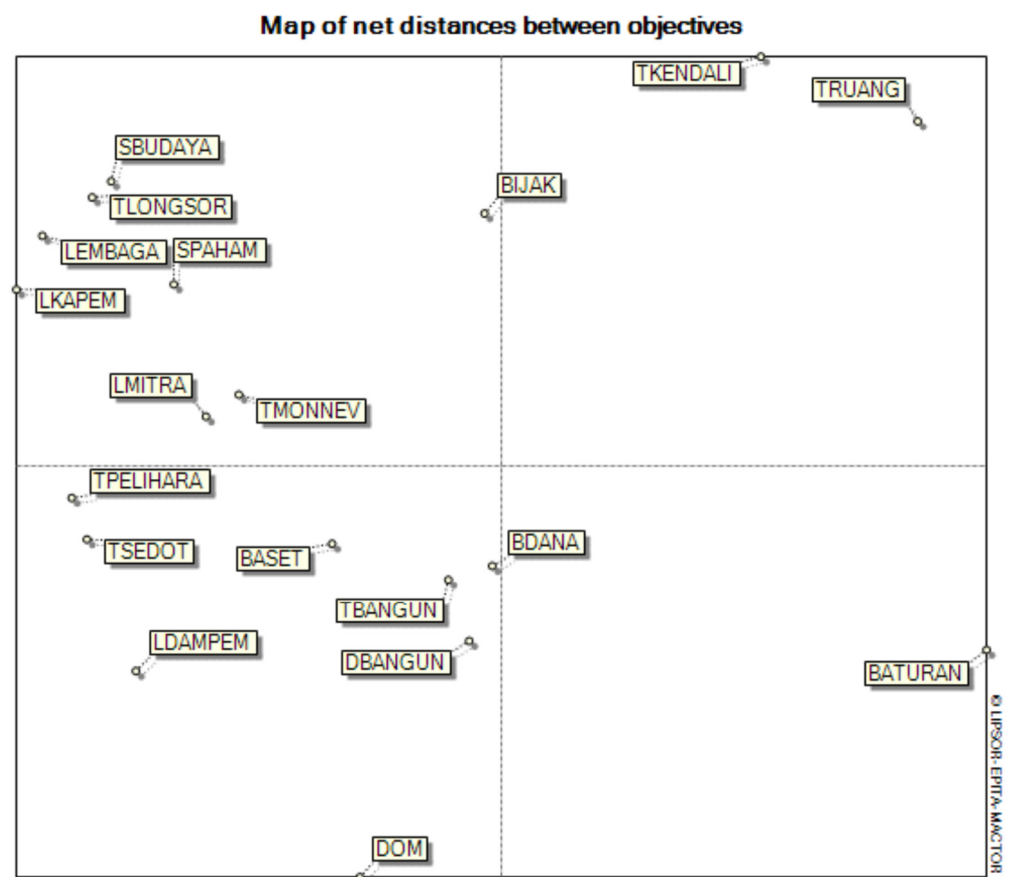


Figure 15. Map of the net distance between goals.

In general, managing domestic wastewater in informal self-help housing requires capacity building of actors who directly interact with the community. These actors include KEC TANSAR, KEC BOSEL, and AKSANSI. Based on MACTOR analysis, the three actors tended to have a high divergence of goals. Based on the 3MAO matrix, it can be seen that there are still constraints or the absence of activities to achieve these goals such as DBANGUN, TRUANG, DOM, BATURAN, SBUDAYA, and SPAHAM. Actors from Local Government Apparatus Organization (OPD) with high goal divergence are DLH and BPBD.

Therefore, it is necessary to increase the capacity of these actors to support these goals, especially TLONGSOR.

The role of DPRD as an actor is competitive and has high influence but low dependency among actors. Based on the 2MAO matrix, there are obstacles/difficulties in achieving goals according to DPRD on DOM and BDANA. The DPRD must make budget policies based on the community's needs; therefore, community suggestions are needed to achieve these goals. Therefore, the goals of SPAHAM and SBUDAYA must not be obstacles anymore. The awareness and culture of proper domestic wastewater management will increase the community ideas/suggestions for DPRD.

The role of MEDIA, as an actor with a high level of competitiveness, must be able to cooperate with DISKOMINFO, as an actor with a relatively low level of competitiveness and a high level of objective divergence, to jointly assist the government in organizing communication and informatics to achieve domestic wastewater management goals in informal self-help housing. Collaboration between BANK and LKM, where each of these actors has a relatively high competitive value, could provide affordable financing for the community.

The actors' opinions for achieving goals greatly influenced the results of the MACTOR analysis, and good results were influenced by the ease of achieving goals by the actors and vice versa. The MACTOR analysis shows which actors have difficulties/obstacles and the level of obstacles in achieving goals, so that the actors can be identified and which goals are having problems achieving them. A list of the actors and problems, obstacles, difficulties, and lack of activity for each goal, obtained from the 1MAO matrix and the results of interviews with actors, is presented in Table 1.

Table 1. List of the problems, obstacles, difficulties, and lack of activity toward achieving goals according to the actors.

Goals	Problems, obstacles, difficulties, and lack of activity towards achieving goals according to actors
Social aspects	
SPAHAM	Minimum information/does not understand about domestic wastewater management, one of the reasons is the absence of concrete examples of correct ways to manage domestic wastewater, whereas until now, many people still practice open defecation.
SBUDAYA	Open defecation has become a habit for several reasons including no sanctions for the community and no land for placing septic tanks; the government's budget is limited and not yet a priority.
Financial aspects	
DBANGUN	There are still limited funding institutions that can serve the construction of domestic wastewater infrastructure facilities; the construction of domestic wastewater infrastructure facilities has not yet become a development priority/lack of funding from the government; the community has also not prioritized its development, limited CSR from private companies.
DOM	There are no incentives/rewards, and no assistance with tools for the operation and maintenance of domestic wastewater infrastructure facilities.
Technical aspects	
TRUANG	There are no specific rules for organizing informal self-help housing, and it is impossible to plan for informal self-help housing.
TKENDALI	There is no supervision and control of space in informal self-supporting housing, it is impossible to control the construction of informal self-help housing, and there are no planning documents as a guide in controlling.
TBANGUN	The cost of constructing domestic wastewater infrastructure is not affordable by the community and due to limited land.
TPELIHARA	Topographical obstacles for draining fecal sludge (sharp slope, very narrow access), lots of community sanitation that is not maintained because KSM/KPP is inactive/non-existent.
TSEDOT	KSM/KPP has never/rarely desorbed desludging, KSM/KPP is not active, there are several locations where desludging cannot/is very difficult, and the cost is expensive.
TMONEV	There has never been/rarely been monitoring of the performance of domestic wastewater management by the government.
TLONGSOR	There are no mitigation activities for locations that have the potential for landslides due to the flow of domestic wastewater into the ground; as a result of managed domestic wastewater, there is no construction control (domestic wastewater infrastructure) in landslide-prone locations.

Table 1. Cont.

Institutional aspects	
LEMBAGA	Social capital is lacking in several informal self-help housing locations, existing institutions still lack knowledge about proper domestic wastewater management.
LKAPEM	The government budget is limited and not a priority, the existing government capacity is still lacking in knowledge about domestic wastewater management and not the duties and functions of local government apparatus organization (because it is not written in the Mayor of Bogor's Regulation regarding the main tasks and functions), so there are still many government officials who do not understand management methods for domestic wastewater.
LDAMPEM	There is no/rarely any assistance from the government, many government officials themselves do not understand aspects of domestic wastewater management, and not in the main duties and functions of local government apparatus organization
LMITRA	The existing partnerships are not continuous, there is a lack of determination from fellow partners to manage domestic wastewater better.
Policy aspects	
BIJAK	There are still policies that impede (indirectly) the management of domestic wastewater in informal self-help housing, and there is no planning for domestic wastewater management that is integrated between sectors.
BASET	The community is still not willing to relinquish their land, even though a communal WWTP has been built. The ownership of land that has been built by a WWTP is unclear because it is handed over to KSM/KPP, where KSM/KPP is not yet a legal entity, while the regional government only has its assets listed, but not owned.
BDANA	The government's budget is very lacking, community suggestions are very lacking, and are not a priority (budget policies have not prioritized domestic wastewater management).
BATURAN	There are no implementing regulations, so it cannot be implemented regarding the provision of incentives, disincentives, sanctions, and rewards. There is fear of social unrest because there are still many who practice open defecation.

4.5. Policy Recommendations and Strategies to Support the Achievement of Actor's Goals

Policy recommendations and strategies that support the achievement of actors are based on problems, obstacles, difficulties, and lack of activity toward achieving goals according to the actors. The recommendations and strategies are grouped into five aspects by minimizing conflict between conflicting actors as follows:

a. Social aspects

- Intensive triggering, with improved triggering materials, expanded triggering targets, expanded triggering media;
- Conduct awareness campaigns for the environment;
- Use of existing educational institutions (formal or informal) to promote proper management of domestic wastewater;
- Dissemination of Regional Regulation No. 4 of 2018 concerning domestic wastewater management, in which the regional regulation contains sanctions for people who do not treat domestic wastewater;
- Disseminate Law No. 32 of 2009 concerning environmental protection and management, wherein the law requires everyone who generates waste to process it;
- Increasing community participation in domestic wastewater management.

b. Financial aspects

- Making a community-based domestic wastewater management plan in each sub-district with government assistance including planning sources of financing (from the community itself, CSR, government, loans, etc.) so that the community knows/understands the importance of financing, providing input on ways to obtain financing, and facilitating the public to gain access to financing;
- Bringing microfinance institutions closer to communities that need loans for the procurement of domestic wastewater infrastructure;
- Dissemination of ways to implement the company's CSR.

c. Technical aspects

- Dissemination of methods for treating fecal sludge properly, especially how to operate and maintain domestic wastewater infrastructure including the disposal/absorption of fecal sludge;
- Making plans for the management of domestic wastewater in each sub-district based on the community with assistance from the government, so that the decision on the type of domestic wastewater treatment is carried out by the community itself by considering the advantages and disadvantages of each wastewater treatment system (looking for forms/ways of building that are agreed upon by the community) as well as agreement on ways to mobilize materials, tools, and labor;
- Government assistance in construction, operation, and maintenance;
- Dissemination of the need for building and environmental management in support of sustainable domestic wastewater management;
- Socialization of the need for the supervision of buildings that will be and are being built to support the arrangement of buildings and the environment based on domestic wastewater management;
- Conducting training on the construction of proper pre-sanitation facilities for local residents;
- Adding BPBD tasks and functions to create mitigation strategies for domestic wastewater infrastructure facilities that have the potential to cause landslides;
- Creating appropriate technology in locations with limited land.

d. Institutional aspects

- Disseminating/explaining to the public that managing domestic wastewater involves various aspects (social, technical, financial, institutional, policy) and various activities ((socialization, triggering, planning, development, operation, and maintenance), thus a combination of existing institutions is needed, and therefore the need to increase the role of existing institutions in the community to be able to manage domestic wastewater, and strengthen the institutional capacity of managers and users;
- Strengthening community institutional cooperation internally in the sub-district with government facilitation as a basis for cooperation with other institutions;
- Increase the capacity of government officials both in the region as well as in other regional apparatus organizations regarding the management of domestic wastewater, and as parties who assist the community;
- The recommendation to overcome this difficulty is to provide an understanding that domestic wastewater management includes various aspects.

e. Policy aspects

- Provide sufficient funding for the sub-district office;
- Positioning sanitation management as a development priority;
- Increase the portion of the government's budget for domestic wastewater management;
- Make clear rules on how sanctions can be implemented through a Mayor's Regulation as a derivative of No. 4 of 2018 concerning domestic wastewater management;
- Planning for the construction of domestic wastewater infrastructure (especially communal WWTP) must include proper land administration planning and an explanation of the consequences of the function of the land used by the communal WWTP;
- Give awards to people who have managed domestic wastewater properly, for example, holding a competition for managing communal WWTP, etc.;

- Making rules in the form of guardianship and instructions for implementing the control/supervision of buildings and the environment based on domestic wastewater management in community-based informal self-help housing;
- Providing incentives to communal WWTP land owners, making clear rules on communal WWTP land ownership;
- Recommendations for overcoming this difficulty are to establish guardianships with an explanation of the conditions under which sanctions can be applied, and by creating implementing regulations as derivatives of regional regulations regarding granting incentives, disincentives, awards, and sanctions.

5. Conclusions

The results of this research show that (1) the most influential actors in wastewater management are the Housing and Settlements Agency (DISRUMKIM), regional drinking water companies (PDAM), PUSAHA, MEDIA, the Regional People's Representative Council (DPRD), BAPPEDA, DPUPR, and the Health Service (DINKES); (2) the most difficult goals of wastewater management to achieve are the availability of a spatial plan based on domestic wastewater management in medium- and long-term informal self-help housing (TRUANG), the control/supervision of buildings and the environment based on domestic wastewater management in informal self-help settlements (TKENDALI), increasing the adequacy of funds to manage domestic wastewater in informal self-help housing (BDANA), and the existence of implementing rules as a derivative of regional regulations regarding the provision of incentives, disincentives, awards, and sanctions (BATURAN); (3) the highest divergence value was 35, which occurred in KEC. TANSAR to entrepreneurs (PUSAHA); (4) the recommendation is for PUSAHA to cooperate with KEC. TANSAR in the form of strengthening the goals of domestic wastewater management in the region; (5) there were four actors with a high level of ambivalence, namely KEC BOSEL, BPBD, MEDIA, and DLH; (6) most stakeholders converged in supporting the strategic goals to be achieved. These findings form the basis for developing a pattern of collaboration between all stakeholders necessary for the development of sustainable wastewater management in Bogor, Indonesia. In addition, this finding allows it to be used as relevant information, and it can be implemented in other cities with the same characteristics as Bogor Town is facing similar challenges in wastewater management.

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