



Stakeholder engagement in urban water management: A SWOT analysis of the Banger polder system in Semarang

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ABSTRACT

Semarang is a coastal city of more than 1.6 million people and is considered a global hotspot for land subsidence due to groundwater extraction. Large parts of the city are below sea level already. The Banger polder Project, Launched in 2016, aimed to reduce flood risk in the area by developing a technically well-functioning polder system, creating a sustainable water management organization and improving stakeholder participation. Stakeholder engagement is critical for the financial and operational support of the polder system. However, the results show that Semarang's stakeholder engagement scores the lowest on the OECD ladder of stakeholder engagement. This paper assesses the engagement of various stakeholder representatives in the water management organization and identifies key strengths, weaknesses, opportunities, and threats to the polder system through a SWOT analysis. The main threats are the lack of awareness among residents, that leads to solid waste being disposed of in waterways, the lack of adequate management and funding, and uncertainty about the future maintenance system.

Introduction

Land subsidence and flooding are two major challenges facing coastal cities in deltaic areas around the world. Coastal cities are increasingly threatened by flooding and land subsidence (Van Coppenolle and Temmerman, 2019). According to a recent study by Wu et al. (2022), 99 coastal cities experienced significant land subsidence rates between 2015 and 2020 due to groundwater extraction. Without adaptation measures, these cities face a 3–160-fold increased risk of flooding with projected sea level rise by 2100 (Yin et al., 2020).

A polder system is an artificial hydrological unit consisting of various infrastructures, including regional drainage systems, detention basins, dikes, pumps, and/or gates to control water levels (Kartiwa et al., 2021) and prevent flooding. In 2015, five years after the polder project was launched in Semarang, up to 70 % of communities living in some of the most flood-prone areas in the Banger polder area were unfamiliar with the polder project and in some neighborhoods, up to 80 % of the population was unaware of the BPP SIMA waterboard that represents them. Unfamiliarity and lack of stakeholder engagement could lead to lower

support for paying water levies for operation and maintenance of the polder system (Ham et al., 2015). Understanding of the polder system, support, and a sense of ownership by residents are especially important because they must pay the local water levies to maintain the polder system. In Semarang, the Badan Pengelola Polder Banger Water Association SIMA (BPP SIMA) was established in 2010 to promote collaboration and engagement with stakeholders. In Indonesia large infrastructure projects are developed often without clear financial arrangements for the operating costs of these projects (Setiono et al., 2021).

Water governance

The implementation of the polder has technically proven to be a success as a significant decrease in flooding has been observed in the Banger polder project area (Kartiwa et al., 2021), but the level of stakeholder engagement is not known. Stakeholder participation, involvement and active participation of citizens in urban water management is also important to sustain and finance the operation and

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maintenance costs of the water management system. The traditional role of “governments” as the sole decision-making authority has in many cases been replaced by polycentric governance at multiple levels (Akhmouch and Clavreul, 2016). Stakeholder engagement is critical to promoting public participation and improving comprehensive water resources management (Akhmouch and Clavreul, 2017). Since the UN Water Conference in Mar del Plata in 1977, there have been international debates about how water governance could and should respond to the challenges of sustainable development (Woodhouse and Muller, 2017). A well-known and influential model for citizen participation in planning was developed by Arnstein in 1967 (Arnstein, 1969). The typology is arranged in a ladder pattern, with each rung corresponding to the extent of citizen power in determining the plan and/or program. Arnstein’s ladder is still widely used today and promotes the evaluation of the community’s role (Contreras, 2019). A consistent theme in the UN World Water Assessment Program’s World Water Development Reports is that the “global water crisis” is a crisis of governance (Paquin and Cosgrove, 2016). Groundwater management is action-oriented: it focuses on practical implementation activities and day-to-day operations (Linton and Brooks, 2011). Water connects sectors, places, and people, as well as geographic and temporal scales (Pahl-Wostl et al., 2012). In most cases, hydrological boundaries and administrative boundaries do not coincide, complicating water governance. In 2015, principles for water governance were established by the OECD (OECD, 2015). Water governance is considered a critical factor for adequate and sustained progress toward Sustainable Development Goal (SDG) 6: Ensure availability and sustainable management of water and sanitation for all (Guppy et al., 2019). The OECD Principles of Water Governance are based on the principles of good governance (Di Vaio, Trujillo, D’Amore, and Palladino, 2021). Principle ten of the OECD Principles for Good Governance urges for stakeholder engagement taking into account local conditions, needs, and capacities (OECD, 2021).

Stakeholder engagement

Water resource governance involves political, institutional, and administrative rules, practices, and processes through which decision makers make and implement decisions. Stakeholders articulate their interests and their concerns are addressed, and decision makers are held accountable in the management of water resources and the provision of water services (OECD, 2015b). The OECD model distinguishes six levels of stakeholder engagement, with each level consisting of a process with a specific intent. The first level is communication, which primarily aims to share information and raise awareness. However, communication means that engagement is mostly passive, meaning that stakeholders receive information about a water policy or project but do not necessarily have the opportunity to influence final decisions. The typology incrementally progresses up to the level of co-production and co-decision. Each level implies different forms and intensity of stakeholder engagement (Fig. 1).

This paper aims to answer the following research question: How does stakeholder engagement affect the sustainability and functionality of the polder system in Semarang? To answer this question, we conducted a SWOT analysis to assess the strengths, weaknesses, opportunities, and threats of the polder system from the perspective of different stakeholder groups, such as residents, experts, government representatives, and businesses. We collected data from interviews using the SWOT framework.

Materials and methods

Study area

One of the most affected cities is Semarang, Indonesia, with a population of more than 1.6 million, which is located in a floodplain where land subsidence is occurring due to excessive groundwater extraction

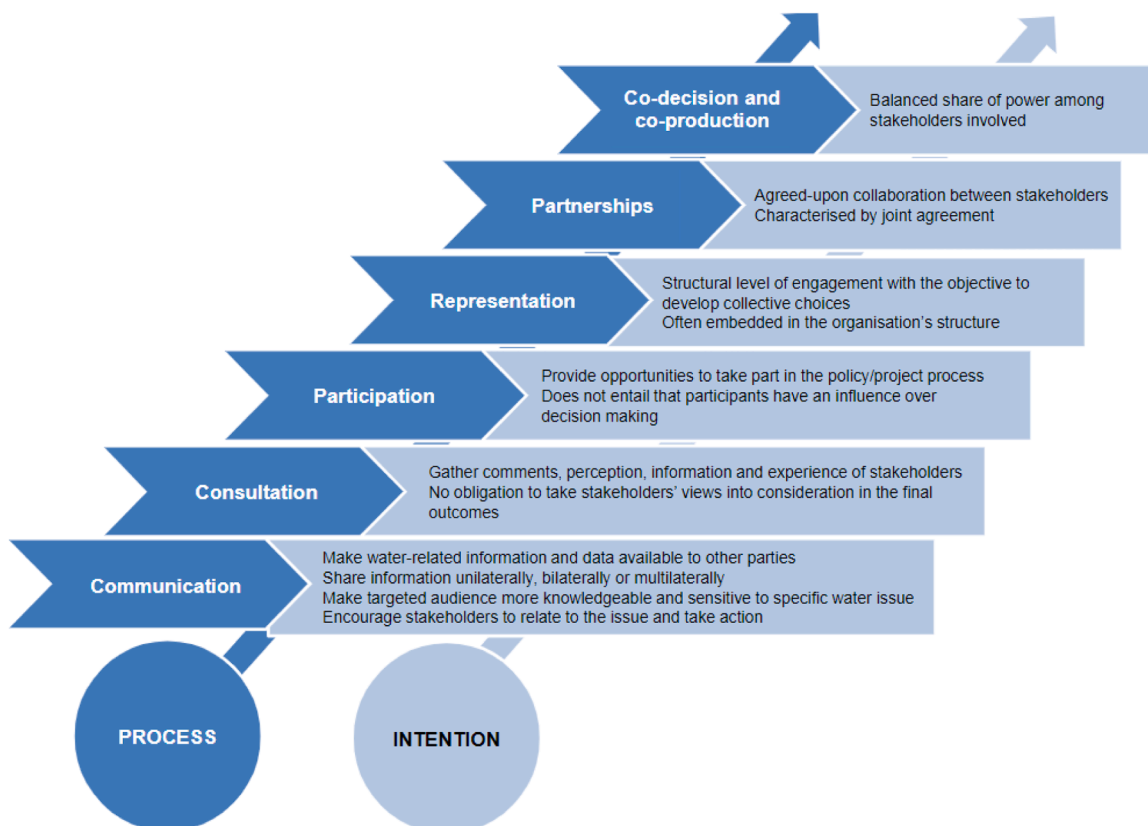


Fig. 1. Levels of stakeholder engagement (OECD, 2015b).

(Water, 2022). On the north coast of Central Java Province, flooding occurs in urban areas due to rapid urbanization, intensification of land use change (Mardiansjah et al., 2021), and lack of governance in flood management (Handayani et al., 2020). As a result, the flooded area is already about 2400 hectares with a flood depth of 1 to 66 cm (Sugeng et al., 2020). Poor communities in the coastal areas of Semarang experience floods up to 30 cm high 1–7 times per month with a flood duration of up to 6 h (Muktiali et al., 2023). The Banger polder system covers an area of about 670 hectares with a population of about 90,000 (Wahyudi et al., 2017) (Fig. 2).

Semarang is affected by rapid land subsidence in the urban area averaging 6 cm/year, while data from GPS between 2008 and 2009 showed maximum subsidence rates of 13.5 cm/year along the coast (Chaussard et al., 2013). Therefore, urgent measures need to be taken to save the low-lying areas of Semarang city. In 2001, collaboration between Indonesian and Dutch water experts began. In November 2006, the United Assembly of the Water Board Hoogheemraadschap Schieland and Krimpenerwaard (HHSK), based in Rotterdam, the Netherlands, agreed to contribute to the institutional development of the reclamation of the Banger area. With the signing of the 'Schokland Agreement' in 2007, several Dutch water boards agreed to contribute to the achievement of the United Nations Millennium Development Goals (Novum, 2007). This has further enhanced cooperation between Dutch and Indonesian partners in combating daily flooding in the Banger area.

The district most affected by flooding and land subsidence in the Banger polder area is the Kemijen district (yellow in Fig. 2). This low-

income community was already severely affected by daily flooding before the polder project began (Dewi, 2007). Flooding occurred daily and the situation worsened due to sedimentation in the drainage system caused by the accumulation of garbage and improper garbage disposal (Marfai et al., 2008). Some low-income residents had no choice but to leave their homes and move to another location (Fig. 5). Although the situation became unbearable, other residents did not want to leave. One of the physical measures taken by the local government was to raise the roads, but this did not address the cause of the flooding (Jayanimita et al., 2018) or solve the flooding problems. In some cases, the situation worsened for residents because water now flows from an elevated road directly into their homes (Fig. 4). Higher-income residents renovated their homes and filled the first floor with soil and moved to the second floor (Figs. 3 and 6).

A sustainable solution to prevent flooding of the area due to continued land subsidence is a polder system. A polder is a low-lying piece of land that is diked and has its water level regulated by a pumping system. The Banger polder project consists of several elements: a dam in the drainage channel, construction of a water retention area (Fig. 7), and construction of a pump station (Figs. 8 and 9). The pumping station pumps water from the water retention area with a lower water level into the Banger river with a higher water level. The Banger river discharges directly into the sea.

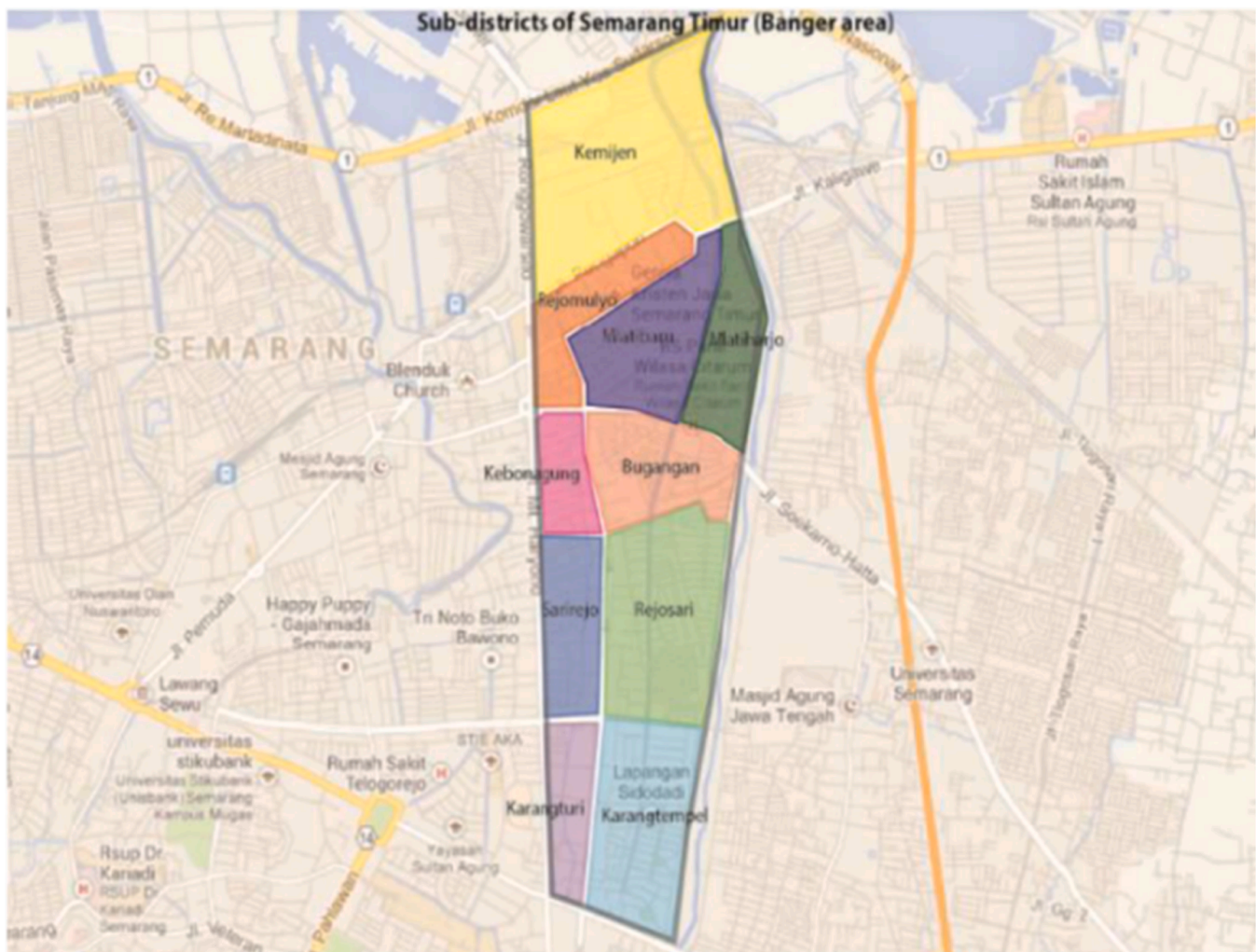


Fig. 2. Banger polder area with in the Kemijen neighborhood in yellow.



Fig. 3. Ground floor is being given up and filled with stones to compensate for land subsidence and tidal floods in Kemijen neighborhood (2013).



Fig. 5. Permanently abandoned homes in the Kemijen area (2013).



Fig. 6. Ground floor is given up, residents demolished and rebuilt their house to be able to cope with tidal floods (2013).



Fig. 4. Road heightening project with negative impact on houses in Kemijen area (2013).

Governance structure of the polder

An independent water management organisation, Badan Pengelola Polder Banger SIMA (BPP SIMA), was established in 2010 in advance of the official commissioning of the Banger polder and pumping station. The tasks assigned to BPP-SIMA are listed in [Table 1](#).

The board members of the SIMA water board are composed of different representatives from the Banger polder area. The composition of SIMA water board is presented in [Table 2](#).



Fig. 7. water retention and pumping station (2022).

Study setting and design

A cross-sectional study was conducted among 13 different stakeholder representatives in the Banger polder project area in Semarang, Indonesia, over a 5-month period (February–June 2022).



Fig. 8. Pumping station (2022).



Fig. 9. Banger river and river embankment with pumping station on the left (2022).

Table 1
BBP-SIMA responsibilities (Rijksoverheid, 2020).

1	Operating and managing all engineering infrastructure
2	Maintaining the water management system
3	Waste management in primary and secondary canals in collaboration with the community
4	Contributing to the socio-economic and cultural development of the Banger polder
5	Informing and engaging community members and stakeholders
6	Monitoring, managing and development of the Banger polder area
7	Collecting financial contributions for polder management

Table 2
BBP-SIMA members.

SIMA members	number
Experts; representatives from the Federal, Catholic and Islamic University in Semarang.	3
Inhabitants; 2 representatives of the inhabitants in the area and one representative from the adjacent area.	3
Business sector; representatives of the companies in the area.	2
Municipality; representatives of the municipality of Semarang.	3
Operator; representatives of the support staff	2

SWOT analysis

A SWOT analysis is a widely used tool to evaluate the strategic position of an organization (Palo et al., 2020), (Teoli et al., 2022). SWOT Analysis is a method of analysis to evaluate the "strengths", "weaknesses", "opportunities" and "threats" of an organization, plan, project, person or business activity (Gürel, 2017). Since the study aimed to assess the level of stakeholder engagement, the SWOT analysis method was considered the most appropriate method compared to other decision support tools and paradigm models (Cambridge, 2016) to define BBP-SIMA's strengths, weaknesses, opportunities, and threats related to stakeholder engagement. SWOT analysis is a relatively easy-to-perform method that has been used continuously since the 1960s. It helps organisations gain better insight into their internal and external environments when making strategic plans and decisions by analysing and positioning an organisation's resources and environment in four areas: strengths, weaknesses, opportunities, and threats (Phadermrod et al., 2019). The SWOT analysis method is used by both leading companies and academic communities. The area in which SWOT analysis is used is broad. An analysis of 557 papers showed that SWOT is mainly used in case studies in agriculture, health and care, tourism, general business management, marketing & marketing planning, and environment and other sectors (Ghazinoory et al., 2011). SWOT analysis is the most widely applied strategic tool by organizations in the UK (Gunn and Williams, 2007). However SWOT analysis has been criticized that it is likely to hold subjective views of the individuals who participate in a brainstorming session and that SWOT factors are not prioritized by their significance thus it may result in an improper strategic action (Phadermrod et al., 2019) and sometimes may lead to a wrong business decision (Coman and Ronen, 2009; Wilson and Gilligan, 2005). This is because the traditional approach of SWOT analysis is based on qualitative analysis in which SWOT factors are likely to hold subjective views of managers or planner judgements. Besides, SWOT factors in each region are either not measurable or ranked by the significance towards an organisation's performance. In addition, the SWOT analysis should be evaluated by considering the stakeholder's perspective rather than being evaluated solely on the organisation's point of view to ensure that the capabilities perceived by the organisation are recognized and valued by the stakeholders (Piercy and Giles, 1989; Wilson and Gilligan, 2005).

Internally related considerations are "strengths" and "weaknesses." Externally related, "opportunities" are realities in the larger environment that can be leveraged to benefit the company. On the other hand, "threats" are realities in the broader environment that could lead to problems for the company (Teoli et al., 2022). By conducting an external analysis, the Banger polder Project can identify the critical threats and opportunities for the Banger polder Project to move forward. While the external analysis focuses on the environmental threats and opportunities facing the project's organization, the internal analysis helps an organization identify its organizational strengths and weaknesses. Based on the SWOT analysis, organizations can choose the appropriate strategy (Gürel, 2017).

Data collection and analysis

To collect data on the level of stakeholder engagement, a qualitative method using the SWOT -framework form was used. The SWOT -framework form was prepared (Fig. 10) and translated into local language (Bahasa Indonesia) and distributed to representatives of different stakeholders in the Banger polder area. A total of 13 SWOT -framework forms were completed by 6 different stakeholder representatives. Stakeholders play an active role in polder management in one of the following roles: local government decision maker, SIMA water board member, professor and expert from a local university, local resident, a local business, or operator. The SWOT -framework forms were completed by the participants in the presence of the researcher, who was able to explain and answer the participants' questions in the local

The purpose of these questions is to gain insight into the visions of the various stakeholders of the Banger folder project.

Name:

I am part of :

Municipality Professor

SIMA Operator

Residents Business

Specifically (department/role):

.....

.....

.....

<p>What are the strengths of the current water management regarding stakeholder engagement?</p> <p>For example: Technical aspects working well</p> <p>—</p>	<p>What are the weaknesses of the current water management regarding stakeholder engagement?</p> <p>For example: Does not listen to ideas from residents</p> <p>—</p>
<p>What are the opportunities for the current water management regarding stakeholder engagement?</p> <p>For example: Increasing interest in water management</p> <p>—</p>	<p>What are the threats for the current water management regarding stakeholder engagement?</p> <p>For example: Dissatisfied residents</p> <p>—</p>

Fig. 10. SWOT framework.

language. The participant’s name and stakeholder category were recorded on the SWOT-framework form. For each SWOT component, a sample response was provided in the four-quadrant framework to encourage participants to be precise in their response. The SWOT-framework forms were then translated into English. Strategies were formulated based on the analysis of the SWOT components.

Results

Strengths

All stakeholder representatives reported that the water management system was technically working very well. Illegal buildings have been removed from the riverbanks and the number of floods has decreased significantly. The number of residents criticizing the polder project itself is minimal, indicating that there are virtually no incidents and residents are cooperating with the local government. The strengths cited by each stakeholder representative are shown in Fig. 11.

One resident said, “I think water management has improved in recent years. In the beginning, we had a lot of severe flooding, and now that has decreased.”

A resident said, “People used to be exposed to tidal waters almost every day, but now there are no tidal waters. Especially in residential areas, things have improved.”

Weaknesses

The weaknesses cited by representatives of stakeholder groups

varied widely. Municipality representatives reported that residents need to be constantly reminded not to litter the Banger river, as solid waste could reduce pumping capacity and solid waste could also be the cause of foul odors in the area during the dry season. Another important weakness mentioned by the local government representative is the lack of funds for polder management. A weakness mentioned by both the waterboard representatives as well as the experts, residents, and businesses is the lack of effort by the local government to involve residents in the maintenance of the Banger polder. According to the experts, the rapidly changing natural environment, such as land subsidence and sea level rise, is not sufficiently taken into account. The weaknesses of each stakeholder representative are shown in Fig. 12.

The business representative said, “There is little or no connection between the community and the municipality. The decisions are all made from the top down by the higher levels of government. Everyone just has to accept them.”

Opportunities

Two stakeholder representatives mentioned as opportunity the development of local tourism, water attractions and fishing to finance the water management and stimulate the local economy. Two water board representatives suggested to re-establish an active waterboard with a specific role for the community representatives to create awareness about a clean river and solid waste collection among residents. Residents are more than willing to collaborate with the local government regarding the water management. An opportunity according to the local experts is the large number of companies in the Banger polder area, which could increase their financial contribution to improve the water

Strengths	
Municipality representatives	<ol style="list-style-type: none"> 1. The local government removed illegal buildings on the banks of the Banger river to create more space for the river and reducing the risk of flooding 2. Since the pump system was operational in 2016, there were significant fewer flooding incidents.
SIMA waterboard members	<ol style="list-style-type: none"> 1. Since the polder system is operational, riverine floods decreased. 2. The number of critical residents towards the polder system is small
Residents representatives	<ol style="list-style-type: none"> 1. There are almost no tidal floods anymore, especially in the residential areas, as a result of improved water management. 2. The pumping system works well. 3. Residents are cooperating with the local government and make suggestions and share ideas for improved water management.
Local experts & university representatives	<ol style="list-style-type: none"> 1. The water management infrastructure became adequate in the last few years, which enabled the local government to reduce the number of floods. 2. Residents are cooperating with the local government and make suggestions and share ideas for improved water management.
	<ol style="list-style-type: none"> 3. The academe have the knowledge about water management and are willing to help with the water management in the Banger polder.
UPTD pump operators	<ol style="list-style-type: none"> 1. Residents do not file complaints about the water management, which indicates that the UPTD Flood Pump Management Region 1 has worked well. 2. When a machine failure occurs, it will be fixed immediately by UPTD 3. UPTD makes an annual management plan for the pump station
Businesses	<ol style="list-style-type: none"> 1. The new projects that were implemented in the Banger polder area, related to the management of the water system, function well on the technical level.

Fig. 11. Strengths.

Weaknesses	
Municipality representatives	<ol style="list-style-type: none"> 1. Residents must be constantly reminded to maintain cleanliness and not litter the Banger river 2. There is not enough funding to keep the system operational 3. There is a bad smell in the Banger river during the dry season because of the low water level.
SIMA waterboard members	<ol style="list-style-type: none"> 1. The municipality does not encourage residents to participate in the maintenance of the Banger polder. 2. The government claims sole control over water management
Residents representatives	<ol style="list-style-type: none"> 1. After the pumping system became operational in 2016, the local government has not continued to improve the water system in the remaining parts of the polder system. 2. The local government does not communicate adequately with residents 3. Pump operators are late or turn on the pump station too late, resulting water not able to drain into the Banger river.
Local experts & university representatives	<ol style="list-style-type: none"> 1. The rapidly changing natural environment in the coastal region of Semarang is not taken into account; sea level rise, land subsidence etc. 2. The government does not want to consider the interests of local residents and fishermen in managing the polder system and water management. 3. Stakeholders are not yet fully involved in water management. 4. There is mutual distrust between residents and the local government regarding water management.
UPTD pump operators	<ol style="list-style-type: none"> 1. Residents report blockage of waterways 2. When residents suggest changes for polder management, UPTD cannot always respond to those suggestions. Instead UPTD coordinates with stakeholders and policymakers.
Businesses	<ol style="list-style-type: none"> 1. There is little or no connection between the municipality and the community. Decisions are mostly made from the top-down at the highest levels of government, and imposed on the community and businesses.

Fig. 12. Weaknesses.

management or can contribute by taking measures on their industrial estate (e.g. water storage). The opportunities per stakeholder representative is given in Fig. 13.

The municipality representative said- *“Use the Banger river as a for local tourism destination and raise extra income’.*

The local expert said- *“We must Increase the public awareness and protect the environment. The government’s task to keep the water system clean will be easier when the water system is free from pollution and solid waste.”*

Threats

The municipality representative said that the biggest threat is the lack of waste collection and malfunctioning of the waste management system that could result in clogging of the Banger river and eventually damaging the polder pump system. The sedimentation of the Banger river and a lack of proper maintenance of the water system could result in the failure of the waters system in the Banger polder area. The water board representatives mentioned a related concern; namely the lack of

Opportunities	
Municipality representatives	<ol style="list-style-type: none"> 1. Use the Banger river for (local) tourism, touristic (water) attractions which can generate income. This income generating activities could be used to maintain the water system or to stimulate the local economy. 2. When a proper maintenance system is operational, including the latest technologies, the water management system will function properly.
SIMA waterboard members	<ol style="list-style-type: none"> 1. SIMA can play an active role in creating awareness among residents for the need to clean the polder system and address the current unrest among the residents about the solid waste pollution.
Residents representatives	<ol style="list-style-type: none"> 1. Residents are willing to participate in maintaining the polder area upon invitation from the local government. Currently this happens on a smaller scale, but this could be expanded. 2. Make the Banger river contribute to the local economy by implementing opportunities around fishing for example.
Local experts & university representatives	<ol style="list-style-type: none"> 1. The increase of public awareness about the importance of a clean environment and the increasing willingness to help achieve this. 2. The large number of big companies that are present in the Banger polder area and that could financially support the water management system or provide space for infrastructure on their industrial estate.
UPTD pump operators	<ol style="list-style-type: none"> 1. If the UPTD would regularly inspect the areas that are prone to flooding and regularly assess the state of the primary, secondary and tertiary canals, these inspections could result in the prioritization of the actions needed, which could be the basis for the daily work of UPTD employees. 2. Frequent consultations with residents about the importance not littering the drains and gutters of the water system, could result in limiting the occurrence of flooding.
Businesses	<ol style="list-style-type: none"> 1. It would be good to re-establish a democratic water board, similar to the former SIMA-waterboard, with an even spread of stakeholder representatives, to ensure a fair and inclusive decision-making process.

Fig. 13. Opportunities.

discipline of the residents to obey the regulations with regards to littering and dumping of solid waste in the Banger river. In confirmation of the above, the resident representatives mentioned that there is a lack of awareness among residents to not litter. People from the Banger area, and upstream along the Banger river, dump their solid waste in and around the river and they are unaware of the importance of the maintenance of the polder system. The lack of awareness could cause failures and problems in the future. The experts said that the lack of financial means allocated by the government for managing the water management system in the Banger polder area was the biggest threat in combination with frequently changing visions, policies and regulation with regards to the management of the polder system. The pump operators said that the heavy workload for managing the pumping station is not in line with the vision and mission, while the business representative said that the maintenance of the polder is lagging behind and is not future proof. The weaknesses per stakeholder representative is given in Fig. 14.

Discussion

All stakeholders are satisfied with the decrease in flooding in the Banger polder area from 2016 to date. It can be said that the novel Banger polder project in Semarang is successful and the lives of residents have improved. The SWOT analysis conducted in Semarang likely contains subjective views of the people who participated in the interviews, and it may be that the SWOT factors are not prioritized according to their importance, as Phadermod indicated (Phadermod et al., 2019).

The results of the SWOT analysis show that the floods are well managed in the current situation. The main strength cited by stakeholders is that tidal flooding has completely stopped and pluvial (rainfall) and fluvial (riverine) flooding has greatly reduced. Technically, the Banger polder pilot project is working well. As the OECD notes (OECD, 2015b), citizens want to be involved in decision-making processes, and this is evident in the Banger polder Pilot Project. Stakeholder involvement in the Banger polder Pilot Project was institutionalized from the beginning with the BBP-SIMA organization, which is responsible for water management in the Banger polder and represents multiple stakeholders. The management of the polder system and the water management itself are not in the hands of a single government decision-making body. This is consistent with trends identified by Akhmouch and Clavreul in a study of 69 case studies of specific stakeholder engagement initiatives in water management (Akhmouch and Clavreul, 2016).

To make Semarang a survivant city for the coming decades, able to cope with the challenges of land subsidence and recurring floods, stakeholder engagement is of utmost importance. Currently it is not known to what degree stakeholders are satisfied and engaged in the novelty Banger polder pilot project. Engagement of stakeholders is the key to Semarang's survival. The management body of the Banger pilot polder is BBP-SIMA which represents experts, inhabitants, businesses, the municipality and pump operators that are jointly tasked to operate and maintain the engineering infrastructure, the maintenance of the water management system, solid waste pollution prevention, community engagement, the development of the polder area and the collection of the financial contributions for the polder management. Like Roth et al. described (Roth et al., 2017) some participatory processes in flood risk management tend to be colored by power differences, hidden agendas, and perceived injustices that influence trust in the process. The results of the SWOT analysis of the stakeholder engagement among different stakeholders in the Banger polder pilot project, indicates that the ambition to set up an inclusive governance system led to a range of different stakes and related vagueness of the decision-making process and lack of trust between stakeholders. Which hinders future engagement.

Although the lack of trust was not literally mentioned by the participants there are hints that there is mistrust between the government and residents such as the continuous need to remind the population not

to pollute the rivers, which was indicated as weaknesses of stakeholder engagement by the municipality representative. This could indicate that the local government and the residents are not on the same page, or it could indicate that the local government is indirectly blaming the residents for the not-functioning of the water system, while waste collection is primarily a government task. However the said pollution of the rivers and canals by residents could also be a direct reaction from the population to the municipality regarding the lack of further improvement of the water system. The lack of further improvement of the water system from 2016 to present was mentioned as the most important weakness by the residents.

The SIMA Waterboard members said that the lack of encouragement from the local government to involve citizens in the maintenance of the Banger polder is a weakness and that the local government claimed sole control over water management. The lack of connection between the municipality and the community was mentioned by several stakeholders. According to the business representative, decisions are mostly made from the top down, i.e., at the highest level of government, imposed on the community and businesses. Top-down decisions and the lack of connection between the municipality and the community mean that the third lowest level of stakeholder engagement – participation, i.e., providing opportunities to participate but not influence decision-making - has not been fully achieved (Fig. 1).

Another weakness mentioned by the government representative was the lack of financial resources to keep the water management system operational. Financial contributions from residents and businesses are essential to the operation and maintenance of the water management system in the Banger polder. Without a dedicated budget for operations and maintenance, the survival of the water management system, and thus flood management in the Banger Polder Project, is at risk. Lack of funding was also cited as a threat by experts, while lack of maintenance was cited as a threat by business representatives. Lack of maintenance is often an indicator of lack of funding, but could also be due to a lack of political will or capacity to properly perform maintenance. The lack of funding to keep the water system functioning and the lack of maintenance could be an indication that residents, businesses, and experts are not being adequately consulted, as a functioning water system is the most important concern for residents of the Banger polder area and businesses. These stakeholders would most likely prioritize a functioning water system over other priorities. This suggests that the second lowest level of OECD stakeholder engagement in water management – consultation aimed at gathering stakeholder comments, perceptions, and experiences - has not been fully achieved (Fig. 1).

An important threat to the functioning of the Banger polder project is the (lack of) waste management and littering. If solid waste ends up in the water system, it could hamper the flow in the river and channels and it could obstruct the pumps. The need to constantly remind the residents not to litter and not to pollute the water system, was articulated as a weakness by the municipality representatives of the current water management. The not-functioning of a proper waste management system was mentioned as a future threat by as well as the municipality representative, the SIMA waterboard members and the residents representatives. In addition to this, the UPTD pump operators mentioned the blockages of the waterways as a weakness as well. Since (the lack of) waste management is vital for the functioning of the water system it is good that this problem is expressed by most stakeholder representatives as a weakness or threat. On the other hand it is alarming that proper waste management, a crucial element of a functional polder system, is mentioned as a threat, but apparently not addressed properly by the city of Semarang. It can be concluded that the stakeholders can put the topic on the agenda, but that it is insufficiently followed up. This is an indication that the stakeholders are not fully engaged and do not have an influence over the decision making. This indicates that the second lowest level of OECD stakeholder engagement in water governance – consultation, with the aim of gathering comments, perception and experience from stakeholders - was not achieved (Fig. 1).

Threats	
Municipality representatives	<ol style="list-style-type: none"> 1. Sedimentation in the Banger river, not well taken care of, could cause malfunctioning and failure of the water system. 2. Ignoring to improve the maintenance system could result in malfunctioning of the the water system. 3. Malfunctioning of the waste collection and waste management system, resulting in solid waste in the Banger river, could result in the clogging of the Banger river. This could lead to the malfunctioning of the polder pumping system. 4. Nothing, because of the support of the government
SIMA waterboard members	<ol style="list-style-type: none"> 1. People do not have enough discipline to obey the regulations with regards to littering and dumping of solid waste in the Banger river. 2. When more parties get involved in the decision making process, it may take much longer to reach to a decision.
Residents representatives	<ol style="list-style-type: none"> 1. The lack of awareness among residents to not litter. People from the Banger area, and upstream along the Banger river dump their solid waste in and around the river. 2. There is a lack of awareness about the importance of the maintenance of the polder system. The lack of awareness could cause failures and problems in the future.
Local experts & university representatives	<ol style="list-style-type: none"> 1. There is not enough budget allocated by the local government to finance the water management system. 2. The water management regulations issued by the local government change frequently. 3. There is a lack of public involvement for the functioning of the water management system. The management changes frequently, which lead to changing visions and policies.
UPTD pump operators	<ol style="list-style-type: none"> 1. The heavy workload given to the UPTD staff for managing the pumping station is not in line with the vision and mission.
Businesses	<ol style="list-style-type: none"> 1. Maintenance is really lacking behind which will have bad consequences the coming years. The system is not future proof.

Fig. 14. Threats.

Conclusions

The pilot polder project is an important project because the main objective is to protect the city center of Semarang, which is part of the Banger polder area, from flooding. All stakeholders said the biggest strength of the polder system is the significant decrease in flooding since the polder project has been in operation. Technically, the main goal of the Banger polder project has been achieved. If the polder system works in the city of Semarang, it could be replicated in other cities in other parts of the world.

Stakeholder involvement has been formalized through the establishment of BBP SIMA water board. Ostensibly, the establishment of a water board corresponds to the highest level of stakeholder participation on the OECD ladder of stakeholder engagement for inclusive water governance – co-decision and co-production, with the intention of balancing power among the stakeholders involved. However, looking at the perceived functioning of the water board and stakeholder engagement, as well as the strengths, weaknesses, opportunities, and threats of stakeholder engagement, it can be concluded that engagement is too low to sustain the polder system. Stakeholders identified serious internal weaknesses and external threats that could affect the proper functioning and sustainability of the polder project in the future. The main functions of the polder system are to prevent flooding, maintain the water system, and prevent pollution of the water system. The three main conclusions and policy recommendations related to stakeholder engagement are discussed below.

The main internal weakness and threat to maintaining the viability of the polder system identified by municipality representatives and experts is the lack of financial resources. This could threaten the continuation of the polder system. Without the provision of financial resources, the functioning of the polder system and the safety of all residents and businesses in the polder area is at risk.

Second, solid waste contamination of the water system by residents was cited by several stakeholders as a major weakness. This is an indication of the non-functioning of the solid waste collection system. Indirectly, it is also indicative of the lack of enforcement of regulations and the lack of discipline among residents. The constant pollution of the water system threatens the functioning of the polder system and is especially a threat to the pumping stations. The waste collection system in the Banger polder area should be improved.

Recommendations

In order to make the water management of the Banger polder sustainable and future-proof and to strengthen the commitment of the stakeholders, the following measures are recommended.

The results show that the actual and perceived roles assigned to various stakeholders when BBP SIMA was established in 2010 are different today than they were when BBP-SIMA was first introduced. The gap between the roles assigned to stakeholders in 2010 and the actual - or perceived - engagement, roles and responsibilities in 2023 needs to be reduced. It is recommended that the formal engagement, roles and responsibilities of BBP SIMA water board members be reviewed.

It is recommended that the actual stakeholder engagement in the de Banger polder be restored to the level of co-decision and co-production. Sharing power among the stakeholders involved should be restored- as was the original plan when BBP SIMA was created.

It is recommended that the allocation of funding for the management and maintenance of the polder system be reviewed and that sufficient funding be reserved and protected from political influence and competing interests.

It is recommended that the currently inadequate solid waste collection system in the Banger polder be improved. Solid waste pollutes the water system and increases the risk that it will clog and stall pumps, preventing pumps from operating during periods of heavy rainfall.

Residents pollute the water system with solid waste. It is

recommended that residents be continuously informed to not pollute the water system and that awareness be created of the causal relationship between solid waste pollution of the water system and the increased risk of pump malfunction.

Residents and stakeholders perceive a lack of information, communication, and engagement from the local government. It is recommended that residents and stakeholders be more involved in decision-making processes to ensure the sustainability of the polder project and to ensure that the level of stakeholder involvement rises to a higher level on the OECD's ladder of stakeholder engagement.

Residents feel that the improvement of the water system is no longer being pursued. It is recommended to clean up the water system and continue the improvement of the entire water system in the polder area.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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