Revisiting Land Subsidence Case in Semarang using the Adaptive Monitoring Framework

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Abstract

In the past, and even presently, there are many investigations on the topic of monitoring and land subsidence in Semarang. However, these researches often focus on monitoring of physical aspect with less focus on monitoring the system in its entirety, including the measures which have been taken to reduce the impact. To conduct this analysis, we make use of The Adaptive Monitoring Framework (AMF), which is a framework that aims to also include aspects such as societal acceptation, support and institutional feasibility. The objective of this research is to provide insights into the monitoring of land subsidence for governance aspects, while using a case study in Semarang, Indonesia. While technical aspects are also included, the specific focus is set out aspects such as the effectivity of current policy and measures, and their impact on socio-economic aspects. The basis for this study is an extensive literature review, complemented by interviews with several key and non-key stakeholders. In 2019, a roadmap had been produced to tackle the land subsidence problem at national level, which includes a list of strategies to deal with land subsidence. As the first follow up, a Task Force for land subsidence has been formed in 2020. The results show that the current monitoring of the subsidence rate is still done by many actors. Moreover, there are no specific regulations governing land subsidence and the current policy to restrict groundwater extraction is still not very effective to reduce the land subsidence rate. It was shown that there are severe delays in implementing the proposed measures, by specifically the task force. Awareness of the long-term impact of land subsidence is seen as a key first step to try to revitalize this initiative.

Keywords: land subsidence, Semarang, adaptive monitoring framework

Introduction of the adaptive monitoring framework

Investigations on land subsidence often focus on monitoring the physical aspects and less focus on monitoring the system or measures that will be implemented to reduce the impact. The Adaptive Monitoring Framework (AMF) is a framework introduced by Schouten (Schouten, 2020), focusing on technology and systemic effects, economic costs and benefits, societal acceptation and support and institutional feasibility. As can be seen in Figure 1, the AMF framework has cycles and started with the Measuring, Mechanism Understanding, Modelling, Making CBA Analysis, Measure Implementing, and Monitoring & Evaluation (6M approach) to investigate each case. In this AMF framework, there are several added questions to ensure that the data collection of physical monitoring has been done correctly, if the proposed solutions have been correctly implemented, and if the taken measures are still desired by all stakeholders.

Methods

In this paper, the case of land subsidence in Semarang is explained by following steps described in the AMF. It was started by answering the questions from the 6M-method cycle, the policy cycle, the monitoring and consideration cycle, and lastly the adaptive monitoring cycle. The basis for this study is an extensive literature review of papers, reports, and reviewing the current policies. It is also supported by the secondary data survey and interviews with several key and non-key stakeholders, such as the task force for land subsidence.

Investigation of land subsidence in Semarang is done by following several steps which are introduced by the adaptive monitoring framework as follow:

1. Identifying potential problems by a system and stakeholder analysis
2. Drawing up a monitoring plan and associated indicators
3. Collecting data from practice
4. Analyzing and interpreting the data
5. Evaluating the data
6. Integrating results into the approach

Results for Semarang Case – the cause and effect of the land subsidence

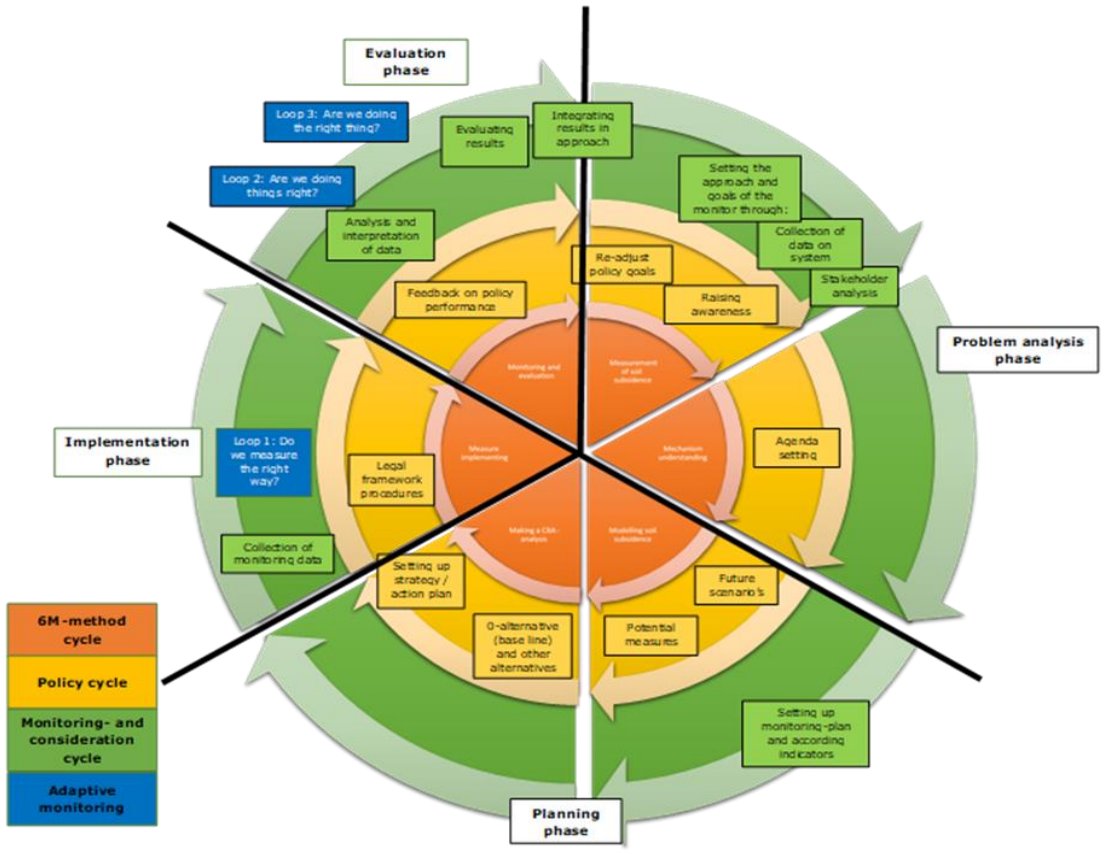

Figure 1 Adaptive Monitoring Cycle

Measurement and monitoring is the first step in identifying the land subsidence event. In Semarang case, monitoring of the current land subsidence rate has been done by many actors with various methods. Different monitoring methods may give different values for the same area and sometimes leads to (unnecessary) confusion during discussion on the monitoring progress of the rate. In the

Semarang case, monitoring of the land subsidence is mainly focused on the physical aspect and less on law enforcement. Based on many sources, the rate of the subsidence in Semarang varies, with the highest rate up to 15 cm/year (Ismanto et al., 2009) (Koch et al., 2019).

It is mentioned that the expected impacts of land subsidence in the region will result in an economic loss of IDR 75 trillion for Semarang (Water Dialogue Consortium, 2021). The main cause of the subsidence is still an on-going debate, whether it is due to a natural consolidation of the soil or due to anthropogenic causes such as the excessive groundwater withdrawal, or other (seismic, human) causes (Lo et al., 2021). However, from previous cases in other area, natural compaction of a subsoil will not be exceeding from 1 cm/year. Research from Sarah et al. (2020) on Semarang and Demak also approved that the natural compaction on Semarang is less than 0.8 mm/year, and Demak is more than 0.8 mm/year.

There are a lot of research to confirm that the cause of the land subsidence in Semarang is mainly due to the excessive groundwater withdrawal (Lo et al., 2021). Based on the result from a groundwater modelling for Semarang, it was shown that the land subsidence can be reduced if groundwater extraction can be stopped (Popang et al., 2020). This was used as a basis in a follow-up study where costs and benefits of piped water supply as an alternative was discussed, and which concluded that this can be a viable alternative (Pratiwi, 2021).

Based on 2021 data in Semarang, fresh water from piped water supply, which is served by a city-owned company, only covers 60% of the demand. This is indirectly linked to the problem with the waste-water management system in the city. Reports on bad service due the water quality and the other technical problem are also found. It is concluded that there are many people in Semarang that prefer to use the groundwater or use both piped water and groundwater to meet their daily need of fresh water (Hamdani et al., 2021).

In Semarang, land subsidence is highly correlated with flood, locally known as 'rob' which actually mean coastal flood. The area of where land subsidence is occurred is also the area with high risk of flood and with high density population. Both the government and the local society are aware of the short-term consequences of the current land subsidence in Semarang. However, from the perspective of the local population, other hazards, such as floods are perceived as much more problematic compared to land subsidence. Based on a qualitative research to 7 villages in Semarang, 57% of surveyed respondents stated that their building is subsiding due to natural hazard (Bott et al., 2021). Despite the fact that evidence for both of short term and long term impact of land subsidence has been showed, floods are perceived as much more problematic compared to land subsidence. The government also treat the land subsidence as a threat when it comes together with flood, instead of as a cause of the water availability. Therefore, measures are focus to reduce the flood damage with structural measures such as raising the road or raising the building floor, instead of mitigation action.

This can be as a result of there not being any specific regulations on land subsidence, whereas for dealing with the effects of flooding there are rules and regulations. There is no specific regulation about land subsidence in Indonesia. Land subsidence is only mentioned in ESDM regulation no.31/2018 as an impact of the damaged groundwater environment. Although the impact of the land subsidence is massive, it is hard to plan any measure if there is no specific regulation mention about this as a disaster.

The Coordinator Ministry of Investment and Maritime Affairs (Kemenkomar) with several experts from private and universities produced a Roadmap for National Land Subsidence in 2019 as an action to plan for the mitigation and adaptation of the current land subsidence (Wetlands International

Indonesia, 2019). The roadmap has 7 strategies to cope with the current land subsidence. The stakeholder map is already included in the roadmap, although the role of each stakeholders are not clearly specified in the document.

The first aim of the implementation of this roadmap is to form an official agency. In 2020, the Coordinator Ministry of Investment and Maritime Affairs has formed a task force for land subsidence with the team members of the stakeholders from the government and research agency which are related to water usage, disasters and spatial planning. This new task force for land subsidence is already a positive move to coordinate the layers of stakeholders. However, this is not enough: even with the initiation of the task force, it is necessary that , the existing institutions (on national and provincial level) carry out the programs based on the main functions and tasks of each stakeholder. With layers of stakeholders and lack of law enforcement, implementing measures for land subsidence, including solving the water supply, are complex and time consuming. Monitoring and evaluating of the progress of implementation of these measures are complex and difficult to conduct, since the detailed action plans on mitigation and adaptation are missing. Awareness of the long-term impact of land subsidence is seen as a key first step to try to revitalize this initiative.

Conclusion

The AMF framework is very helpful to understand the problem of the land subsidence, as seen from the case study in Semarang. The questions do not cover only the physical conditions but also the underlying problems within the legal and institutional setting. Current land subsidence monitoring in Semarang is only focus on physical aspect and less on the soft measure. Based on the roadmap, government will focus to create SOPs to manage ground water, surface water, to separate the waste-water system from the drainage, and to include the land subsidence issue in the spatial planning as the long-term strategy. Following the adaptive monitoring framework, it is recommended that the relevant authorities/stakeholders first create the monitoring and evaluation system of planned measures. Reviewing the current policy performance should be done to make sure that there is no conflict of interest in the current setting. When the proposed strategy has been implemented successfully, further integration plan can be adjusted.

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