Pompoes, R. F., W. D. Pot, and A. R. P. J. Dewulf. 2025. Governing sinking worlds: sensemakings of subsidence in Rotterdam, The Netherlands. Ecology and Society 30(1):39. https://doi.org/10.5751/ES-16041-300139

Research, part of a Special Feature on The Next Wave in Water Governance

Governing sinking worlds: sensemakings of subsidence in Rotterdam, The Netherlands

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ABSTRACT. The neighborhood of Bloemhof in Rotterdam-South is often presented to be sinking because of soil subsidence. The City of Rotterdam makes use of participatory methods to involve a wide range of stakeholders in Bloemhof and to build consensus on how to deal with the subsiding neighborhood. However, what remains unknown is how civil society, civil servants, and subsidence policy programs actually make sense of subsidence. Therefore, we address the question: How do residents, civil servants, and policy programs make sense of subsidence in Bloemhof, Rotterdam-South? We followed an ethnographic approach, focusing on conversational interviews, events, and policy documents, to uncover the often taken-for-granted ways, unexamined assumptions, and consequences of how subsidence is performed differently across actors and domains. We present four main themes characterizing subsidence sensemaking of residents, civil servants, and policy programs in Bloemhof, showing how (1) most only notice discursive cues of subsidence, while relying on remote sensing tools to make subsidence materially visible (cues of subsidence); (2) how the municipal subsidence efforts in Bloemhof are publicly communicated as open-ended, while internally enacted as resistant to political debate (uncertainty and open-endedness); (3) how subsidence is made sense of as temporally distant, yet enacted as requiring immediate responses (subsidence temporalities); and (4) how municipal subsidence efforts are tinkered with to address other matters of concern (institutional tinkering). With this analysis we contribute to sensemaking theory, and hope to attune practitioners' sensibilities to reflexivity, by showing how particular science-based sensemaking enacts specific realities of subsidence that constrain the enactive capacity of other meanings (i.e., of residents). Broadening the policy space for multiple meanings may help us better connect with diverse (i.e., social, economic, public) domains, human/non-human actors, and material concerns when governing environmental change, in Bloemhof and beyond.

Key Words: *ethnography; governance; Rotterdam-South; sensemaking; subsidence*

INTRODUCTION

In October 2023, I (first author) met Julian (pseudonym) at his residential street in the South of Bloemhof, Rotterdam-South, where he told me he has not witnessed any subsidence related issues in his home, like cracks in the walls or moisture building up. These are subsidence indicators repeatedly listed in communications sent from the municipality of Rotterdam to the residents of so-called "sinking Bloemhof," part of a wider strategy of the municipality to involve citizens and other actors in co-creating responses to subsidence in Bloemhof. Julian told me about water filling his basement every year and motioned with both hands that the water level once came up to about two hand widths. A woman next to us nodded, as if confirming this measurement. No one is helping Julian with his recurring water problem, he said, not his social housing association or the municipality. Still, subsidence was not a problem according to Julian.

At a later date, I spoke to Omar, a municipal civil servant and policy advisor at his office in the city center of Rotterdam, where we looked at subsidence maps of Rotterdam, zoomed in on the area where I met Julian and his neighbors. Omar told me about the severity of subsidence in that exact part of Bloemhof, pointing toward the darkest red on the map and its legend. We spoke about what can be done to keep houses from sinking, cracks forming, moisture building up, and residents losing their homes and quality of life. We urgently need an integrated program to deal with subsidence, he said, to work with housing associations, residents, the municipality, and financial sector, more integrated and localized than the main policy programs of the region.

These two responses to subsidence, part of the municipal subsidence efforts in Bloemhof, Rotterdam-South, are important examples hinting at the complexity of human-subsidence relations, where managing subsidence commonly means navigating ambiguities (i.e., different understandings of subsidence; Siriwardane-de Zoysa et al. 2021). Ambiguities around subsidence may be linked to its hybridity and dynamic, where subsiding subterranean soils and waters shift over long time periods because of above- and belowground processes and practices, such as particular land uses and compaction of soils due to drainage and drought (Erkens et al. 2016, Wang 2021). Finding ways to respond to subsidence is important as urbanizing deltas globally have been sites of emerging loss and damage realities as a result of subsidence coupled with sea level rise and more extreme weather events (Saputra et al. 2019, Takagi et al. 2021, Batubara et al. 2023).

Despite some notable examples of case studies outside of the Netherlands, in scholarly literature on the Dutch context, subsidence is known in technical terms and singularizing ways. Knowledge about subsidence in technical terms hinges on remote sensing data to quantify changes in ground height over time (see van Thienen-Visser and Fokker 2017, Erkens and Stouthamer 2020, Yan et al. 2020). Yet, also the more social scientific literature on subsidence in the Netherlands is singularizing, as challenges around managing subsidence are viewed as originating from imperfect understandings of the issue (i.e., van den Ende et al. 2023). In this way, national research initiatives such as NWA-LOSS, DeepNL, NOBV, and Regio Deal Bodemdaling Groene Hart focus on understanding (and modeling) subsidence-induced ground deformations, increasing societal awareness of subsidence, and proposing management pathways (DeepNL 2024, NOBV [date unknown], NWA-LOSS [date unknown], Regiodeal Groene Hart [date unknown]; see also Kılıç et al. 2024).

Subsidence research in the Netherlands largely assumes the existence of a set of basic truths about subsidence as points of reference, inferred from monitoring data and calling for consensus

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building. At the same time, there has been a growing interest globally in writing about how people experience differently the phenomena that (in part) occur underground (Squire and Dodds 2020, Wang 2021), particularly groundwater and aquifers (see Ballestero 2019, Agrawal et al. 2024, Wingfield 2024). Therefore, although subsidence is a phenomenon that can be known by scientists using subsidence maps fed with data from satellites, it is also known by residents observing puddles forming in their basements, cracks in the walls, or moisture building up on windows (Wang 2021).

In addition to having to navigate between ambiguities, governing subsidence requires dealing with uncertainties about the rates of subsidence, variability, causes, and complexities around responsibilities (Schouten and de Waal 2020). Public responsibilities in Rotterdam revolve only around infrastructure and public spaces, while homeowners, and social housing associations are responsible for their private property and potential foundation damage (KBF 2022). High foundation repair or replacement costs may burden homeowners and displace tenants if no mutually beneficial agreement is reached between residents (homeowner residents, social housing, private renters), landlords, social housing associations, and the municipality. Here actors will make decisions on how to deal with subsidence based on what they deem as meaningful (Dewulf et al. 2020, Hofmann et al. 2023). Indeed, facts and meanings are always inextricably entangled (Turnhout 2024). How we know environmental problems is linked to how we respond to them (Jasanoff and Martello 2004). Therefore, we perform a sensemaking analysis, studying the meanings actors attribute to subsidence, to learnings from civil society, municipal civil servants working on subsidence, and the policy programs addressing subsidence in Bloemhof.

The focus on Bloemhof is motivated by a concern with how a part of the residential neighborhood is sinking (~2–8mm/year of subsidence in Rotterdam [Rotterdams Weerwoord 2023]), while its residents, many of whom are low-income social housing renters with migration backgrounds, are often already subjected to intersecting socioeconomic precarities (Gemeente Rotterdam 2018). Therefore, to answer the research question "How do residents, civil servants and policy programs make sense of subsidence in Bloemhof, Rotterdam-South?;" we analyze conversational interviews with residents of Bloemhof and civil servants, policy documents, as well as observing participants in public events, all of which provide ethnographic sensemaking material. Making sense of what subsidence is, in other words, its ontology, is understood as an interpretive practice in which sense-makers negotiate meaning and make plausible their experiences, expectations, emotions, and thoughts (Weick et al. 2005, Brown et al. 2015).

THEORETICAL FRAMEWORK

Sensemaking is the negotiation of meaning (Weick et al. 2005). Sensemaking here is understood in its broadest sense, where it can include the meanings attributed to the materiality of subsidence, proposed solutions, and other discursive and material signs of subsidence manifesting in the neighborhood and beyond. Sense is made through embodied interpretations, including the emotional, sensed, bodily, and phenomenological experience embedded in words, touch, facial expressions, and through sensing our surroundings (Cunliffe and Coupland 2012).

Relational sensemaking

Weick (2010) initially viewed sensemaking as relational between humans, only to later express that his early work on sensemaking was "basically cool and cognitive" (p. 545), where a bigger emphasis on the affective dimension of sensemaking would have enabled him to theorize more widely on the weight of prevailing moods in sensemaking situations. Building on this, we hold that there is an affective dimension to subsidence and responses to it, as all entities (i.e., collectives of residents, basements in a groundwater nuisance prone area, meanings, emotions, policy programs) have a capacity to affect and be affected (Pihkala 2022). Relationality to us, therefore, means that actors, meanings, and rules and regulations, and other discursive and material entities, are enmeshed in dynamic and ontologically diverse assemblages or networks (Slaby et al. 2019). There is not one "sensemaker," as sense is always "made" relationally, decentered and sense is always already simultaneously given and received (Introna 2019). An actor involved in sensemaking is always simultaneously both a subject and object of sensemaking, a sensemaking subject-object (Sandberg and Tsoukas 2020). With this in mind, we center our analysis on the subsidence sensemaking of particular entities: residents, civil servants, policy programs. For ease of reading, we refer to them as sensemaking subjects.

Meanings are negotiated dialogically and emerge in affective interactions between material and discursive entities. Affective or sensory cues can include visual, olfactory, auditory or tactile signals or things that manifest materially as signs in the landscape (i.e., via footprints, puddles forming in basements) or discursively (i.e., in thoughts, policy; Boonman-Berson and van Bommel 2023, Leonardelli et al. 2023). It is not only humans engaging in meaning-ordering but a range of actors in the relational whole (Hultin and Mähring 2017, Introna 2019). This also means that policy programs may engage in sensemaking. Here we understand agency as the capability to be the originator of acts and thus to make sense and as constantly flowing between actors, as a relationship, continuously emergent between subjects (Barad 2003, Yanow 2014, Hultin and Mähring 2017, Verlie 2017). Similarly, in processes of sensemaking within networks of actors, actors hold different pieces of information and together negotiate meanings (Weick et al. 2005, Graff and Vabo 2023). Viewing agency as constantly flowing between actors, helps shift our attention to the unusual suspects of sensemaking (i.e., concrete, soil; Introna 2019), or urban planning (i.e., residents; Kaika 2017).

Enactive sensemaking

Viewing meaning as negotiated dialogically between diverse actors also means acknowledging that sensemaking is enactive, where actors co-constitute the environment they make sense of. In other words, there is no one pregiven world, only a multiplicity of brought forth or enacted worlds (De Jesus 2018). Sensemaking as a practice shaping human politics and knowledge is well established (Choukrani et al. 2023), where actors are seen as enacting the environment they impose on themselves (Dewulf 2006). The environments actors may enact hinge on their situated embodiments, on their experience that is shaped by their having a body with various sensorial capacities and concerns (De Jesus 2018). A crack in a building wall is uniquely brought forth between construction companies that may rely on fixing houses in disrepair, or a bird nesting in such gapes. This, too, means that we cannot privilege one particular world, or reality of subsidence,

as true or truer than others. Although we might acknowledge the material, physical attributes of subsidence as "there" and present, they hinge on sensemaking subjects to acknowledge their presence and to bring them forth and make the physical world emerge (De Jesus 2018). When particular discursive realities of subsidence are brought into being, other ways of making sense can be crowded out by these discursive realities when they become institutionalized and given particular power inequities (Howarth 2010; see also Meesters et al. 2023).

METHODOLOGY

To research the subsidence sensemakings in Bloemhof in Rotterdam-South, we made use of qualitative research methods, producing and interpreting ethnographic sensemaking material.

Study area: Bloemhof in Rotterdam-South

Subsidence in Bloemhof may already cause damage to above and below-ground infrastructure, including houses, roads, bridges, sewers, cables, and pipes (Gemeente Rotterdam [date unknown]). In the Netherlands houses are usually built on pile foundations, which are deep rods that help carry the weight of a building. However, about 2700 houses in Bloemhof have wooden piled foundations or lack piled foundations and may sink along with the subsiding soil. If wooden piles become exposed to oxygen due to subsiding soils and changing groundwater levels, they run the risk of pile rot. According to subsidence experts at the Municipality of Rotterdam, rates of subsidence are highest in Bloemhof-South, Bloemhof-Midden, and in the Seringenbuurt administrative sub-divisions of Bloemhof (Gemeente Rotterdam [date unknown]). Yet, subsidence policy action also centers on its effects on other areas of Bloemhof, such as streets, gardens, playgrounds, and squares, as well as underground sewage and cable systems (Gemeente Rotterdam [date unknown]).

Responsibilities around subsidence are complex in Bloemhof, as a majority of Bloemhof residents live in subsidized social housing for lower income households. About 60% of the houses in Bloemhof are owned by social housing associations, which are responsible for renovation and maintenance of their properties (Gemeente Rotterdam 2018). About 40% of Bloemhof residents are homeowners or live in privately rented housing, some of which are members in owners' associations. These associations are the venues in which individual house owners together make decisions about, and share responsibilities for, renovation and repair of matters such as insulation, heating, and foundation. The associations can consist of smaller landlords, as well as individual house owners.

Key actors in the Bloemhof subsidence issue are thus different types of residents, civil servants at the municipality of Rotterdam (who are modeling rates of subsidence, facilitating citizen participation, and formulating policy advice), and policy program documents (which are enacting policy decisions to respond to the issue). We juxtapose these different sensemaking subjects to show interrelations and tensions between them.

Positionality

Data was collected by the first author. My (first author) experiences and access to the field were mediated through my self-identifications and privileges and participants' race, gender, class, along with other intersecting social differences and power relations. As an outsider to Bloemhof, with Dutch not being my native language and speaking from the positionality of a researcher at a renowned Dutch research university, distant from Rotterdam-South in multiple ways, my embeddedness in Bloemhof was constrained in some ways (i.e., holding long, meaningful conversations with residents), but also enabled in others (i.e., bonding over shared experiences as foreigners, holding technical conversations with civil servants). At times this also meant tinkering with different forms of expression in conversation, speaking with participants in other languages, or via facial, bodily expressions and drawings.

Data collection

Our fieldwork in the neighborhood of Bloemhof took place over the course of about 6 months, including conversational interviews, participant observation, and document analysis. Conversational interviewing is a method of data collection in which the researcher and interviewee engage in more or less topical conversation. An overview of the 30 planned interviews with civil servants and residents can be found in Appendix 1. During conversations, participants were asked about their understanding of subsidence, responses to it, and to help identify other relevant participants. Interviews were documented via recordings, notes, journaling, and/or voice memos, depending on the interviewee's preference and context of the conversation, and always pseudonymized in the final analysis. Following an ethics protocol approved by our institution meant that in the beginning of conversations, interviewees were informed of the context of the study and asked if they agree to a recording or preferred not to. If informed consent was given by the interviewee, this was also restated and recorded in the beginning of audio recordings.

Observing participants during events meant that I was present during and paid serious critical attention to different, potentially taken-for-granted cues of subsidence (see Roy 2012). The attended events are tallied in Appendix 2, but the observations I made also occurred during city walks, friendly banter with bakery staff, church meetings, or unplanned encounters in hallways, which cannot be tallied or made explicit. I documented my observations via recordings, notes, journaling, and/or voice memos.

Relevant policy programs and specific policy documents also emerged in conversations with civil servants and residents, and can be seen as projects of (civil servant, resident) sensemaking. One of the policy program documents we identified and analyzed is the 2023-2027 implementation plan of the multi-sectoral National Programme for Rotterdam-South (NPRZ), which sets out to develop housing, youth, health, among other areas in Rotterdam-South (NPRZ 2023). The second program we assessed, Rotterdams Weerwoord, is a multi-sectoral program focused on climate adaptation in Rotterdam, where subsidence is one of the focus areas (Rotterdams Weerwoord [date unknown]). Here we assessed the program's framework until 2030. Third, we identified the Raad voor de leefomgeving en infrastructuur (Rli; Council for the Environment and Infrastructure), a strategic advisory board for the Dutch government (Rli [date unknown]). Here we assessed their advisory report, published in February 2024, on how to tackle foundation problems in the Netherlands. In addition, we analyzed program descriptions of the subsidence efforts by the "project team Bloemhof" on their website. This project team is leading the participatory efforts in Bloemhof.

Data analysis
Data analysis followed a constant comparative method, coding emergent data using Atlas.ti software and then fleshing out organizing codes using a thematic analysis, grouping them with similar stories, while continuously revisiting previously collected data (see Appendix 3 for overview of codes; Booth et al. 2016). Organizing data meant identifying four main themes characteristic of how sensemaking subjects make sense of subsidence. The different ways of collecting primary data (notes, journal, drawings, voice memos, meeting recordings, photos) often complemented each other and enabled a richer, more contextualized analysis.

RESULTS

From our analysis of conversational interviews, events, and documents, four main themes emerged, describing how policy programs, civil servants, and residents of Bloemhof, make sense of subsidence (see Table 1 for overview). The first theme (cues of subsidence) revolved around how the sensemaking subject(-object) was informed by material and discursive cues of subsidence and the subject's interrelations with other entities. The second theme (uncertainty and open-endedness) depicted how certain the subjects were about subsidence and the extent to which responses to subsidence were still open-ended. The third theme (subsidence temporalities) revolved around the different time-scapes in subsidence sensemaking. The fourth theme (institutional tinkering) was about how the sensemaking subjects adapted the subsidence issue and efforts to other concerns they have.

Policy programs
Subsidence sensemakings in policy programs were diverse, ranging from making sense of subsidence, and potential responses to it, as hinging on its interrelations with different actors, or drought and groundwater flooding. Similar to how civil servants made sense of subsidence behind closed doors, policy programs publicly enacted the neighborhood as a space ready for (re-) development and the issue as simultaneously resistant to political debate, and as open-ended.

Policy programs' cues of subsidence
Although some policy programs, particularly the subsidence program of the Bloemhof project team, emphasized that responses to subsidence hinged on its interrelations with different actors, the Rotterdams Weerwoord program emphasized that subsidence is interrelated with climate risks, particularly drought and groundwater nuisance. In a report summarizing the program's framework until 2030, land subsidence, drought, and groundwater "are treated integrally ... because they are very closely related." (Rotterdams Weerwoord 2023:49). Subsidence was made sense of as exacerbating vulnerabilities to, and effects of, climate risks such as tidal flooding and as affecting uneven settlement of buildings in urban environments. "Solution directions" to subsidence included spatial planning taking soil and groundwater as guiding systems, where "buildings and public space will be adapted to the local groundwater level" (Rotterdams Weerwoord 2023:55). The solution direction of adapting buildings and the public space to local groundwater levels remains rather vague:

> *Further investigation* [on building-level] *is always needed to determine whether measures* [against groundwater flooding due to subsided areas with buildings not built on piles] *are required by the property owner and/or the municipality.* (Rotterdams Weerwoord 2023:98)

At the same time, all policy programs made sense of responsibilities around subsidence as defined by the legal boundaries of public and private property. This focus of policy programs and legal rules on managing subsidence related damages to buildings and infrastructure suggested that subsidence efforts in Bloemhof are about damage control and not about mitigating subsidence.

Policy programs' subsidence temporalities
The Rotterdams Weerwoord, NPRZ, and Bloemhof subsidence program of the Bloemhof project team made sense of subsidence as a long-term process that will lead to, if it has not already, damage to foundations and infrastructure. Although these programs focus on subsidence resulting in foundation damage, the Rli report on the foundation problems in the Netherlands did not make subsidence out to be the central issue. Subsidence is contributing to the foundation problems, but it is made sense of as a part of the "damaging processes ... for buildings" (Rli 2024:26). An amalgamate of processes (groundwater fluctuations, construction, vibrations, mining/mineral extraction, soil oxidation, shrinking/swelling of soils, among others) ultimately led to consequences for buildings and foundations (skewing of buildings and crack formation, moisture problems and in the worst cases unsafe buildings). The report made sense of subsidence as one process, part of broader, dynamic changes that lead to adverse consequences for buildings. In this way, the Rli decentered much of the problem framing from an exclusive focus on the subsidence that is linear, long-term, yet immediately problematic for buildings to more explicitly include also other immediate and long-term policy challenges as affecting foundations. For the longer term, the Rli also advocates for an approach looking beyond legal responsibilities, in which "the [different levels of] government stand alongside owners and tenants and work with them on an effective approach to repair foundation damage" (Rli 2024:14).

Policy programs' uncertainty and open-endedness
Policy programs for Bloemhof and Rotterdam South, including Rli, Rotterdam Weerwoord reports, and the efforts of the Bloemhof project team, presented subsidence as an open-ended problem. To illustrate, the Bloemhof project team reported:

> *We want to make a plan for the neighborhood together with residents, entrepreneurs and other organizations. A plan for Bloemhof*. (Like Je Wijk Bloemhof [date unknown])

At the same time, other policy programs seemed to know what to do with Bloemhof and Rotterdam-South, such as the 2023–2027 implementation plan of the NPRZ:

> *Even with very high investments, these houses* [the Rotterdam housing stock] *fail to become truly sustainable or future-proof. Demolition/new construction is then a good alternative.* (NPRZ 2023:89)

Table 1. Summary of main sub-themes emerging from the analysis.

Sensemaking subjects	Cues of subsidence	Uncertainty and open-endedness	Subsidence temporalities	Institutional tinkering
Policy programs	Subsidence as interrelated with climate risks and social realities.	Subsidence as either an open-ended problem, or with demolition as idealized response.	Subsidence as long-term, yet urgent, responsible for foundation damages.	Subsidence enacted as only one of multiple issues.
Civil servants	Subsidence meanings are reliant on remote sensing, where data travels between actors.	Subsidence as a technically lost case and social problem, where differing values complicate resolution.	Subsidence as a long-term process, requiring urgent efforts.	Subsidence efforts enacted to address multiple issues.
Residents	Subsidence materially invisible, relying on municipal discursive cues.	Subsidence efforts inducing uncertainty, anxiety, and despair.	Subsidence subsumed to other, immediate concerns.	Subsidence efforts enacted to address other issues.

According to this implementation plan, the issue of subsidence, the "foundation problem," and implicitly also all of Bloemhof, are certainly amendable by means of demolition and new construction. The tension between certainty and open-endedness suggests that the government does not yet unequivocally know how to respond to subsidence. It could also mean that policy intentions are not always communicated transparently to other actors.

Policy programs' institutional tinkering

The Rli, Rotterdams Weerwoord, NPRZ, and the efforts of the subsidence program in Bloemhof make sense of subsidence, and explicitly so, as part of wider issues in the neighborhood and Rotterdam-South more broadly. Although most focus on climate risks, social goals and renewing subsurface infrastructure, in the NPRZ implementation plan, new development efforts were also all made to support social restructuring of Rotterdam-South, or social mixing, which means diversifying neighborhoods and attracting new residents. The NPRZ also highlighted the need to address sewer replacements, climate adaptation, and making neighborhoods natural gas free. Therefore, although the future of Bloemhof, or how to deal with subsidence in particular, was not made explicit, it means that the NPRZ had a clear vision for the future of the housing stock in Rotterdam-South: demolish and redevelop, to address multiple issues at once. But how a redeveloped Bloemhof may actually look then, with what material implications for whom, cannot be discerned from the policy programs. In this way, the programs enact the redevelopment of Bloemhof as the means to a still unknown end.

Linking the problem framing (that even with high investments, houses cannot become truly sustainable or future proof) with the solution (demolition of the entire neighborhood and constructing new houses) enacts the neighborhood as a linear, tightly-planned project. This linear reasoning enacts the issue of subsidence as resistant to political debate and Bloemhof as a space ready for (re-)development. In this way, much of the political process and participatory efforts already put in motion by the municipality in Bloemhof are pulled into question.

Civil servants

Civil servants rely on their tools to make subsidence visible. Their sensemaking includes understanding it as a long-term, autonomous process that threatens the health of sewage systems and other infrastructure, and as a simultaneously technical, social, and economic problem. Like public policy programs, albeit behind closed doors, civil servants mobilize the issue of subsidence to address other concerns they have in Bloemhof. This may be problematic when these are obscured by a public focus on subsidence. Similarly, residents, too, tinker with the subsidence platform and adapt it to other concerns.

Civil servants' cues of subsidence

To make sense of subsidence, technical civil servants, including geo-hydrologists, geotechnicians, and other engineers, all part of an in-house engineering consultancy of the municipality of Rotterdam, rely on data derived from space-based inSAR remote sensing data showing changing elevations over time. I (first author) was told, they would not be able to accurately know subsidence only via subsurface sensing methods, such as by looking at changing groundwater levels, increasing sedimentation in sewage pipes or from monitoring points in the sewer system in Bloemhof that indicate its end of life (expected around 2027 in Bloemhof, but this estimate can vary by as much as 10 years, I was told by a municipal sewage expert). To these civil servants, subsidence in Bloemhof and Rotterdam is very real. Yet, a team leader told me that although subsidence has increasingly become an everyday part of their practices over the last years, it is only ever a variable or factor affecting their efforts, never the central concern.

Although subsidence sensemakings of civil servants hinge on material, remote sensory cues, many are also seriously concerned with social realities of residents in Bloemhof and pick up on related cues. However, what many civil servants shared are the meanings they attribute to the residents of Bloemhof, that residents require engagement to build consensus on what subsidence really is, rather than acknowledging them as subsidence knowledge bearers and allotting them agency to define it for themselves:

> *So, we go house by house to ask them, what do they need … and if they agree on the problem because some people say even if their house is cracking down "No we don't see the issue. We don't see the problem." They are in denial and yes, some people are in denial.* (Interview NG)

By making sense of residents as in denial about the municipality's truth and as defined by the precarities they are subjected to, the municipality enacts Bloemhof as a problem zone requiring policy action and reduces the policy space for the meanings others might attribute to subsidence.

Civil servants' subsidence temporalities
The more technical civil servants make sense of subsidence as a long-term process, caused by compaction of soils and oxidation of peat. They, too, spoke of differing water pressures:

> *I think bodemdaling* [subsidence] *is the long-term process, that the whole western part of the Netherlands is going down because of long-term processes like the tilt of the* [tectonic] *plate I think, and also especially because the water pressure in the clay layers is somewhat lower than how it was a very long time before .... So, that's subsidence.* (Interview EE)

Making sense of subsidence as a long-term process in this way does not necessarily depoliticize the present day sinking of soil in Bloemhof. Groundwater lowering in reclaimed polder areas such as Rotterdam is, also, anthropogenic. And even the more technical civil servants spoke about the human dimensions of settling or sinking soil, and their efforts to mitigate it, such as reducing the load on the topsoil by using different building materials or via active groundwater level management. Instead, these varying definitions of subsidence show how important noticing and acknowledging this diversity and corresponding tensions are, because subsidence seems inevitable, as an engineer's definition of subsidence suggests, where subsidence is the "settling of soil until it reaches entropy. ... Then, unless disturbed by humans, it [the soil] will never move" (Interview NE2). Subsidence is here made sense of as a process leading soils from disorder and imbalance to order and stability, rendering any intervention difficult and technical.

Civil servants' uncertainty and open-endedness
The remote sensing inSAR data enables the more technical civil servants to know subsidence "without any uncertainty" (Interview RE), around its rates, temporal and spatial variabilities, I was told by an engineer. Subsidence is entirely knowable. In this way, it is made resistant to ambiguity and political debate. And indeed, it seems that some civil servants already know how to respond to the subsiding neighborhood:

> *So, I say Bloemhof is a lost case. I'm sorry that I say that on the technical side, on the sustainable side, I say don't try to keep it. Even if you think it's really nice, build it back like you want it to look like, good for me, doesn't matter, but ... we cannot save anything.* (Interview TG)

Various civil servants made sense of the entirety of Bloemhof as a "technically" lost case. This can be problematic when this view guides municipal policy programs, which might be equally maximalist (i.e., redeveloping the entire neighborhood). Yet, the social cues some civil servants pick up from residents also likely affects their appreciation of the complexity of the situation and how certain they are about which way to proceed. They acknowledged that subsidence is "so tricky to solve ... because we all have different sorts of underlying ideas or values about how something should be" (Interview SM). Another civil servant also argued, "In Bloemhof it is not only a technical solution needed, but a social, economical solution" (Interview TG).

This social sensitivity, I was told, also comes from experience with the recent case of the Tweebosbuurt, a neighborhood adjacent to Bloemhof, where the majority of the existing social housing units were demolished and transformed to private housing. I was told the Tweebosbuurt case "was very bad for the trust people had in our organization [the municipality]" (Interview NG). Therefore, although technically the future of Bloemhof might not be as open-ended to civil servants, many acknowledge how particular social realities and values (including their own) complicate governing it.

Civil servants' institutional tinkering
Similar to how policy programs (and residents) speak about concerns beyond subsidence, municipal civil servants also mobilized the subsidence issue in Bloemhof as an opportunity for broader transformational action: "[Subsidence], you see, is an opportunity maybe uh for a longer-term development, also on social goals" (Interview JG).

In this way, subsidence was enacted as an opportunity to address several problems: the need to renew sewers and pipes, replace the subsurface cables, repair or replace the houses in disrepair, greening the neighborhood to address heat stress, meet the housing demand in the Netherlands, and make the South of Rotterdam more attractive to newcomers, to name a few.

> *So, those things, the house problems, and the things in the surroundings of the houses, they are going to clash. So that's why we need people to collaborate with us. And so we knew we were creating an issue at the moment we started to communicate the problem* [of subsidence]. (Interview NG)

Civil servants and the municipality making sense of subsidence as an opportunity for wider policy action can be problematic when the multiple reasons for change are singularized in communications. And because the municipality emphasized that they are not the so-called "issue owners" of subsidence, complex public/private responsibilities may further obfuscate the situation for residents:

> *Legally we are not obliged to help them because it's the problem of the owner of the houses, but we have a moral, there's a moral appeal and we also need to renew the sewers and we have ... a lot of cables in the in the underground, which is totally full already.* (Interview NG)

Although the residents' institutional tinkering became visible to us during information evenings, in the comment sections of the neighborhood's and municipality's social media pages, the agenda of the civil servants remained more obscure. To the civil servants it is certainly a delicate matter, and a fine line to navigate between communicating the municipality's truth and inducing anxiety among residents about their future. However, as a civil servant commented on this tension, "I think they [residents] can handle it, they can handle more of the truth" (Interview RE).

Residents
Residents attributed different meanings to subsidence but relied on the targeted discursive cues of the municipality and social housing associations to make subsidence visible. Sensemaking by residents ranged from understanding it as a problem, fostering emotions of anger and anxiety induced by uncertainty, to an opportunity to enact change in their neighborhood. Yet, like other sensemaking subjects, residents repurposed subsidence efforts to voice matters of concern other than subsidence.

Residents' cues of subsidence

To residents in Bloemhof, subsidence was more visible discursively than materially. Residents did not speak about noticing the ground shifting, and rarely about cracks in the walls or moisture building up. Those that did observe so-called subsidence indicators spoke of them as consequences of their homes being old and not well maintained. Homes in disrepair are a common sight in Bloemhof. Instead, residents made sense of subsidence mostly through discursive signs of subsidence in the neighborhood. These discursive signs could consist of letters and events orchestrated by the municipality and social housing association Woonstad Rotterdam. They also set up the *wijkhub* [district hub] and *buurtpunt* [neighborhood hub], where residents can walk in to speak about subsidence or other concerns. Without these efforts, subsidence would likely remain invisible for many. To illustrate, when speaking to a resident at a coffee car, an outreach activity organized by the municipality to inform residents of subsidence over a cup of free coffee, a resident told me: "I don't know why we are here, we came for the coffee" (Resident AK).

Despite such outreach activities, in engagements with residents, I often felt distrust in, and dissatisfaction with, government efforts around subsidence, and the government more broadly. One resident also saw this tension and commented:

> *So there is a little bit, or there's a big distrust about the agenda, so behind what is going on? So, I think they* [other residents] *say, OK, climate change, hmm yeah, but how, what is the solution? Who is winning by it?* (Interview RD)

Therefore, some residents made sense of municipal subsidence efforts as a climate change related problem, as something imposed on them, as a problem that they do not get to define responses to. Residents related the meanings they attribute to subsidence to other concerns they had about the neighborhood, many of which they felt were insufficiently addressed by the government and social housing associations. Residents spoke about higher crime rates, littering, and their homes needing renovation and maintenance.

Residents' uncertainty and open-endedness

Uncertainty about the materiality of subsidence and its implications was also a common response to subsidence efforts of the municipality. Uncertainty was negatively evaluated, so rather embodied as anxiety than hope. In an online information session in October 2023, participants were invited to speak to civil servants about subsidence. Different participants asked the following:

> *Why is the municipality concerned with subsidence? Why aren't you guys saying what is going to happen yet? Why is the municipality now going to do something about this problem in Bloemhof?* (Event TH1)

A participant also posed a question about the likelihood that homes will be demolished, to which a panelist responded: "Demolition is one of the technical options. This is a drastic option. We want to have a good discussion with everyone first." The uncertainty and perceived open-endedness of residents' futures likely fed into the emotions they associate with subsidence. Residents, social housing, private renters, homeowners alike, often spoke of feeling anger, frustration, and anxiety when I asked them about their emotions in connection to subsidence and the changes it might bring in Bloemhof. I, too, noticed these emotions in body language and gestures:

> *So, for me it's more that I get a feeling of despair, but when I'm very positive, then* [gesticulates stabbing] *they* [points to other residents] *say "You're not using your brains. Do you not see what is happening here in the streets and also everything which is illegal, the criminal deeds?"* (Interview RD)

Residents' institutional tinkering

Residents also co-produced discursive cues of subsidence in the neighborhood that helped them and others too, to make sense of subsidence. Through social media outlets, such as Facebook pages "Like je Wijk Bloemhof" and "Wijkraad Bloemhof," information about the municipal subsidence efforts was shared on a regular basis. In this way and in tandem with the certainly numerous conversations between residents about subsidence, subsidence was enacted as a reality of residents, instead of only something municipal and abstract.

Prompted by the discursive cues of the municipality, social housing associations, and then their own, residents also enacted subsidence as an opportunity to voice other concerns they have. They enacted the issue of subsidence as a platform for transformational interaction, instead of only an occasion for residents to receive information. Residents tinkered with the platform, adapting it to other concerns they have. At information evenings, instead of speaking about subsidence, residents voiced concerns about nuisance induced by other residents living in their streets, littering, feeling unsafe, people stealing belongings from their gardens, teenagers smoking weed. One resident exclaimed that, "Togetherness no longer exists. It is everyone for themselves now" (Event WH1).

It seems the tinkering was also not a hopeful attempt. Yet, residents were pragmatic in finding their own ways of managing life in the neighborhood. Among many other activities, there were networks of *buurtvaders*, *buurtmoeders* [neighborhood fathers, mothers], where residents together discuss their matters of concern in the neighborhood and take action to address these. The buurtvaders, for example, meet weekly in the evening to patrol Bloemhof, to write citations about improper waste disposal, parking, or to nudge loud teenagers to move elsewhere.

Residents' subsidence temporalities

I spoke to another resident about whether they have observed cracks in the walls of buildings or climate related changes in their neighborhood, when they told me "Oh dear, we are not thinking of the climate. People are worried with the living climate only" (Resident AH). Residents often spoke of the climate in terms of living climate when I asked them about climate change and risks in the neighborhood. They spoke of interpersonal conflicts, depression, feeling lonely, increasing nuisance in the neighborhood induced by other residents, or other precarities they face, socioeconomic or otherwise. These concerns were made sense of as immediate and ongoing, referring to arguments with neighbors having happened yesterday, last week, or about uncertainties tomorrow and expected nuisances next week. Residents did not allot subsidence this immediacy in our conversations.

DISCUSSION

The findings of this paper show that subsidence sensemaking in Bloemhof can be characterized by how (1) differing concerns, with their intersections and tensions, shape the cues sensemaking subjects mobilize to make sense of subsidence (cues of subsidence); by how (2) most subjects either know or fear the most likely response to subsidence (demolition), where power inequities and intransparencies mediate the difference between definitively knowing and fearing (uncertainty and open-endedness); by how (3) human sensemaking time-scapes are difficult to reconcile with the multiple subsidence time-scapes of shifting soils, deteriorating subsurface infrastructures and houses (subsidence temporalities); and by how (4) the invisibility and complexities associated to subsidence may feed into actors tinkering with subsidence efforts (institutional tinkering). In this way, we show how "the object" of sensemaking, subsidence, is never passive and inert, waiting to be brought to the surface. Instead, subsidence is always situated and being done (Bueger and Gadinger 2018).

Subsidence ontologies

The diversity of ways of making sense ground ontological claims about subsidence and the neighborhood. Despite the diversity, subsidence, in its entanglements with soils, waters, humans, and all other entities, before being made visible by civil servants, was not really part of human sensemaking in Bloemhof. Beyond remote sensory ways of knowing, subsidence is epistemologically distant (Belland et al. 2023).

The government, through remote sensing and with more or less involvement of other actors, renders subsidence governable. Public space, sewage systems, drainage systems, and cable infrastructure are enacted as public responsibilities. However, at some point state power diminishes and subsidence exceeds the state power to control. Redevelopment will require huge investments (likely from the private sector) and is difficult to implement (both technically and because of threats of displacement and gentrification; Willemsen et al. 2020; see also Thompson et al. 2023). And despite legal responsibilities for homeowners for their foundations, subsidence is multiple and often made sense of as a lesser urgent issue.

It is not that residents make sense of subsidence as a lesser urgent issue because they do not care; it is the opposite: they are affectively enrolled in issues in their neighborhood and take actions to address these. So, why is it difficult to place subsidence on the agenda of residents? Pondering about the politics of responsibility through Haraway's (2012) notion of "response-ability" may be helpful: the concept reminds us (humans) that we are in debt to others we are in relation with (i.e., soils, waters, foundations, meanings, birds). Our debt is to actively care for how we are implicated in these relations. This means that ethics, being (ontology), and knowing (epistemology) are inseparable (Cozza and Gherardi 2023). The politics of response-ability thus suggest that residents are constrained in their ability to be responsible (and held accountable). This is because subsidence policy ethics (i.e., doing what is seen as morally right), ontology (i.e., what subsidence is), and epistemology of action (i.e., how to know what to do) do not align. Civil servants have good intentions and are concerned about residents, yet already definitively know what the nature of the problem is. Only through correctly aligning their ethics, with their particular onto-epistemological preferences, can actors in Bloemhof (residents and government in their relationship) have the response-ability to act on subsidence. Then having the financial means to be able to respond is a remaining issue. Still, opening up to other meanings is a necessary first step, which may remain a challenge when governmental sensemaking constrains other ways of making sense (i.e., when residents are seen as "in denial"). The way the facts are currently settled has implications for ethical considerations; instead, values and facts are inseparable, and need to emerge together (Juelskjær and Schwennesen 2012).

Pluralizing subsidence

Belland et al. (2023) identify a prominent claim in subsidence literature that geological and engineering sciences should be the basis of policy making, similar to how Scott (1998) describes the (high-)modernist beliefs and paradigms as often characteristic of environmental planning and policy making. Akin to this, sensemaking of underground water resources are also dominantly framed through technoscientific lenses (Wingfield 2024). Here science is considered as the most valid form of knowledge, helping to "rationally design social order" (Scott 1998:90). Therefore, if residents, civil servants, or policy programs as sensemaking subjects rely on remote sensing-derived policy action to see subsidence in Bloemhof, such a gaze may, too, shape what they see and how to organize their sensemaking: "Vision is always a question of the power to see - and perhaps of the violence implicit in our visualizing practices. With whose blood were my eyes crafted?" (Haraway 1988:585).

The reliance of policy actors on remote sensing data for subsidence policy making is certainly linked to the complexity of the process itself. Yet, knowledge use in policy making is also deeply political (see Cairney 2017). As our analysis shows, some civil servants see the issue in Bloemhof as a simultaneously technical and social problem. They might seek inSAR data to combine these "facts" with emotional appeals, to prompt other policy makers to shift their attention from one way of making sense to another (Baumgartner et al. 2018). Civil servants might also base their knowledge on inSAR data over less exact forms of science to tell straightforward, easily understandable stories, to manipulate the preferences and concerns of other powerful stakeholders (Jones et al. 2014); or to generate policy solutions that seem feasible and seeking moments in the policy-making process to adopt these (Kingdon 1984). In any case, subsidence in Bloemhof emerges with different issues for different actors; it is attached to other matters of concern. As we show with our analysis, it can only be successfully placed, and stay, on the agenda of different actors when these interrelations are made explicit and taken seriously. This requires (re-)politicizing the question of what subsidence is, critically interrogating which meanings are mobilized in subsidence governance, and what other forms of sensemaking are excluded and to what effects (Turnhout and Lynch 2024). If science and policy continues to heavily rely on particular ways of knowing and singularize subsidence, at the detriment of pluralizing, this means that phenomena will be forced to match epistemology rather than the other way around (Turnhout and Lynch 2024). Pluralizing means going beyond the usual suspects of sensemaking (such as discursive cues) and planning (such as planners and policy makers), and necessarily engaging with multiple meaning-making subjects, acknowledging each as interconnected, different, yet the same in ontological status. With this paper, we bring forward one attempt of doing things differently in this way.

CONCLUSION

We co-authors began this paper with one straightforward question: How do residents, civil servants, and policy programs make sense of subsidence in Bloemhof, Rotterdam-South? To find possible answers, we traced the meanings attributed to subsidence around municipal management efforts in Bloemhof, looking for the cues that knowing subsidence rests upon. Through planned and unplanned conversations with residents of Bloemhof and civil servants, observing participants in events and reading policy programs, we show how civil servants and policy programs make subsidence visible for others.

We show that among residents, as well as civil servants, and even in policy programs, subsidence is made sense of in variously different ways. Therefore, we hope that our different sensemaking accounts complement the municipal appreciation of how its citizens understand subsidence. However, for different actors to actually be more response-able, this necessarily requires a more reflective practice of civil servants (and residents in their relationship). The notion of "passionate humility" may be one criterion for such a practice: it means turning actions around the Bloemhof subsidence platform from an attitude of certainty to an attitude of reflective and doubtful inquiry (Yanow 2009). If the municipality wants to enroll more residents, this can mean furthering the dialogue by finding different ways of speaking and listening. This could also mean, to create support, connecting subsidence efforts more to residents' other matters of concern or seriously thinking about how effects of demolition and re-development may play out differently along intersecting social differences.

The best time to act on subsidence is now, to minimize loss and damages for homeowners, renters, and other actors alike. The municipality certainly has a key role to play in mediating this action. We therefore hope that making and holding space for multiple meanings, particularly for the unusual suspects of planning and sensemaking, and acknowledging the world-making capacity of sensemaking can inspire more reciprocity in the subsidence issue and lead to better, fairer outcomes.

Acknowledgments:

This research was supported by a grant from the Dutch Research Council (NWA.1389.20.224). We thank the participants of this study for dedicating their time to speak with us and the Red&Blue research program for the logistical support that made fieldwork in Bloemhof possible.

Data Availability:

The data and code that support the findings of this study are available on request from the corresponding author, R. Pompoes. None of the data and code are publicly available as they contain information that could compromise the privacy of research participants. Ethical approval for this research study was granted by the Wageningen University and Research - Research and Assessment Committee (WUR-RAC).

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APPENDIX 1

Table 1. Overview of planned conversational interviews held

	Affiliation	Role	In-text acronym
1	City of Rotterdam	Civil servant	
2	City of Rotterdam	Civil servant	
3	GGD Rotterdam-Rijnmond	Civil servant	
4	City of Rotterdam	Civil servant	
5	City of Rotterdam	Civil servant	
6	City of Rotterdam	Civil servant	
7	City of Rotterdam	Civil servant	
8	City of Rotterdam	Civil servant	
9	Woonstad Rotterdam	Social housing	
10	Resident	Civil society	RD
11	City of Rotterdam	Civil servant	TG
12	GGD Rotterdam-Rijnmond	Civil servant	
13	GGD Rotterdam-Rijnmond	Civil servant	
14	Gemeente Rotterdam	Civil servant	JG
15	Resident	Resident	AK
16	City of Rotterdam	Civil servant	
17	Resident	Resident	
18	Resident	Resident	JH
19	Resident	Resident	
20	Resident	Resident	AH
21	Ministry of Water and Infrastructure	Civil servant	SM
22	City of Rotterdam	Civil servant	NG
23	Resident	Resident	
24	City of Rotterdam	Civil servant	RE
25	City of Rotterdam	Civil servant	EE
26	City of Rotterdam	Civil servant	
27	City of Rotterdam	Civil servant	
28	City of Rotterdam	Civil servant	NE2
29	Resident	Resident	
30	Resident	Resident	TR

APPENDIX 2

Table 2. Overview of planned events attended

	Participants	Number of participants	In-text pseudonym
1	Staff of Municipality of Rotterdam, Woonstad Rotterdam, GGD Rotterdam-Rijnmond, homeowners, renters	~20 staff, and ~20 residents	
2	Staff of Municipality of Rotterdam, Woonstad Rotterdam, GGD Rotterdam-Rijnmond, homeowners, renters	unknown (online)	TH1
3	Residents of social housing corporation in Bloemhof-Zuid	15 residents	
4	Residents of Bloemhof	15 residents	
5	Gemeente Rotterdam, Red&Blue researchers	5 civil servants, 3 Red&Blue researchers	
6	GGD Rotterdam	18 civil servants, 1 MSc student	
7	Social housing residents of Bloemhof	~15 residents	WH1
8	Rotterdam Weerwoord team meeting	2 civil servants	
9	GGD Rotterdam	40 civil servants	
10	Hogeschool Rotterdam, Gemeente Rotterdam	28 civil servants, 3 staff of Hogeschool Rotterdam	
11	Residents of Bloemhof-Hillesluis	~35 residents	
12	Residents of Bloemhof-Hillesluis	~15 residents	
13	Residents of Bloemhof-Hillesluis	~20 residents	

APPENDIX 3

Table 3. Overview of coding scheme

Organising code	Theme
Notice material aboveground cues of subsidence	Cues of subsidence
Notice material belowground cues of subsidence	
Notice only discursive cues of subsidence	
Notice discursive and material cues of subsidence	
Concerned about subsidence (responses)	Uncertainty and open-endedness
Anxious about subsidence (responses)	
Indifferent about subsidence (responses)	
Optimistic about subsidence responses	
Curious about subsidence responses	
Indifferent about subsidence responses	
Angry about subsidence responses	
Certain about subsidence responses	
Uncertain about subsidence responses	
Open to political debate	
Closed to political debate	
Subsidence as temporally abstract and distant	Subsidence temporalities
Subsidence as imminent	
Subsidence as a long-term process	
Subsidence as opportunity to voice other concerns	Institutional tinkering
Subsidence as opportunity to take action about other concerns	
Subsidence efforts as public reason for wider action	
Other problems as public reason for addressing subsidence	
Subsidence publicly part of other actions	
Subsidence not publicly part of other actions	