

Manifestations of societal resilience in local management of extreme events.

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Climate change causes weather events that could severely damage infrastructure and threaten lives and basic needs in local communities. In these situations, using all available resources and ensuring emergency preparedness at every level of society is crucial. Within Norway's emergency preparedness system, guided by the principles of responsibility, similarity, proximity, and cooperation, municipalities play a central role in crisis management. However, significant variation in municipal size, geography, and resources raises the question of how resilience manifests at the municipal level when responding to extreme weather events. This paper addresses the research question: How is resilience manifested at the municipal level in response to an extreme weather event? Drawing on community and societal resilience theory, including concepts such as adaptive capacity and graceful extensibility, the case study examines a small Norwegian municipality affected by Storm Amy in October 2025. The analysis draws on interviews, municipal documents, local media, and a citizen survey. Findings demonstrate that the most prominent manifestations of resilience arise from the interaction between formal municipal structures and informal community capacities. Municipal planning, technical systems, and predefined responsibilities, such as those embedded in the Emergency Preparedness Council, provide robustness. Yet the strongest resilience emerges through informal, citizen-driven adaptive capacities, including local knowledge, dense social networks, volunteerism, hamlet contact persons, hunting radio networks, and the role of local merchants. These relational mechanisms enable rapid improvisation and flexible responses, allowing the system to stretch beyond its designed limits when formal resources are insufficient. Overall, the study shows that small municipalities possess unique resilience advantages and that adaptive, informal, and relational capacities are the most impactful manifestations of municipal resilience during extreme weather events.

Keywords: Community resilience; Societal resilience; Emergency preparedness; Critical Infrastructures; Natural Hazard Events.

1. Introduction

Climate change is a creeping crisis that drives extreme weather events that can severely damage infrastructure, have cascading effects, and threaten the lives and basic needs of local communities. In such situations, it is essential to mobilize all available resources and ensure emergency preparedness at all levels of society.

This includes citizens, municipalities, and society at large.

In Norway, four principles form the basis of the society's emergency preparedness (The Norwegian Ministry of Justice and Public Security, 2022). 1.) The *Principle of Responsibility* states that the organization/entity that has responsibility for a sector or function under normal conditions retains that

responsibility during emergencies and crises. 2.) The *Principle of Similarity* emphasizes that crisis management should be organized as similar as possible to ordinary operations 3.) The *Principle of Proximity* states that crises should be managed at the lowest effective level, as close as possible to the event. 4.) Last, the *Principle of Cooperation* states that all stakeholders involved in crisis management have a duty to cooperate before, during, and after crises.

The principles, particularly the first three, illustrate the importance of the municipal level during crises, e.g., those caused by extreme weather events. Still, in a Norwegian context, there are significant variations in municipalities' populations, areas, and resources, and possibly also in their capacities to handle such events. This makes handling of crises at the municipal level especially interesting to study.

To better understand the crucial role of municipalities in crises, this paper addresses the following research question: How is resilience manifested at the municipal level when responding to an extreme weather event? The work is based on a case study of a small Norwegian municipality that was critically affected by storm 'Amy' in October 2025. The empirical material stems from interviews and various publicly available documents, including a citizen survey among the municipality's inhabitants and articles from the local newspaper.

The paper is structured as follows. Section 2 presents a theoretical framework focusing on societal resilience. Section 3 describes the method, and Section 4 presents the results. Section 5 offers a discussion, and Section 6 summarizes the work and provides concluding remarks.

2. Theoretical framework

This paper focuses on the role of municipalities in strengthening community resilience across all crisis phases and on manifestations of adaptive capacities among various actors. Whittaker et al. (2015) describe 'community resilience' as the capacity of all community members, both formal and informal, organized and unorganized, to respond effectively to unexpected and challenging situations and to social contexts that influence this capacity.

Moreau and Dryhurst (2025) emphasize that a community's ability to respond to and adapt

to hazards is a key capability in emergency management. They regard community resilience as an ongoing process that improves strategy, emergency responses, and community involvement through lessons learned from the bottom up, engaging multiple stakeholders, and establishing clear accountability, with responsibilities shared between government bodies and the public. Thornley et al. (2015, p. 23) define community resilience as '*the process of communities adapting positively to adversity or risk*'. In this setting, resilience is understood as the capacity of people, communities, and societies to prevent, respond to, and recover from the consequences of a crisis. They emphasize that factors of strength and vulnerability at the individual, community, and societal levels interact to influence outcomes. Their study following the Canterbury earthquakes in New Zealand found that community connectedness, infrastructure, opportunities for participation and engagement, and external support are factors that influence community resilience.

To broaden our understanding of how various manifestations of community resilience can be explored, we draw on societal resilience literature in the following section.

2.1 Societal resilience

Societal resilience is a broad, scalable term that encompasses contexts, ranging from local communities and regions to nation-states and beyond (Haavik, 2020). As it is used in the field of safety science, the term incorporates concepts and insights from resilience research over the last 20 years, typically in contexts involving organizations, sociotechnical systems, and critical infrastructures scaling up to societal resilience (Herrera et al., 2025). The turn to societal resilience covering governance and crisis management, particularly in relation to climate-related risks, reflects two conditions worth noting.

First, risk is being increasingly democratised and localised. This reflects not only that risk is increasingly a dimension that organises citizens' life, cf Beck's (1992) risk society, but also that – as stated in the prevailing principles of societal safety – any crisis should preferably be handled at the lowest possible organisational level. While the literature is rich on examples of citizens playing an important role in community resilience (e.g. Andresen, 2017) this actualizes a

debate on how much responsibility can be put on citizens' shoulders before resilience policy turns into a neoliberal scheme (Bergström, 2018). There is a rich body of knowledge about individuals, communities, and systems' ability to adapt and thrive in the face of adversity. However, a well-documented challenge is the need to translate this knowledge into actionable practice by stakeholders such as policymakers, civil society organizations, and other practitioners (Casajus et al., 2021), and in our case municipalities.

Second, resilience theory faces the challenge of scaling to translate resilience concepts across settings. It also implies actively relating to norms and ethics that may reflect different expectations across different scales. Thus, as the subject of resilience spans scales from organisations to local communities and beyond, the question of politics becomes more acute (Haavik, 2021). Prioritization is central to preparedness and crisis management, and this may look different from a municipal perspective than from a more distant national perspective.

The theory of graceful extensibility (Woods, 2018) lays the foundations for architecting the expansion of the adaptive capacity to continue operations. It recognises that systems, organisations, societies, and entities such as municipalities operate with finite resources (time, people, materials) while navigating environments that are inherently dynamic, continuously changing, and evolving.

Currently, the challenge of enhancing resilience lies in organisations' and societies' ability to perform in ways that sustain strategic work, core purpose, and operational objectives while navigating the inevitable need for flexible adaptation to change, highly unpredictable conditions, conflicting goals, and limited resources to meet crisis demands. One core purpose of a municipality is to serve and protect its citizens, especially in emergencies.

4. Method

The paper is part of the Resilient Citizenship (RECITE) research project, which aims to foster citizen-empowered crisis management governance and support adaptive capacities that enable authorities, civil society organizations, and citizens to better handle unexpected events.

The work is based on a case study (Yin, 2018) of a small local community that was severely affected by the storm 'Amy' in October 2025. The community has approximately 2,000 inhabitants and 900 households spread across more than 1,000 km². Farming is the most common occupation. The municipality offers valuable insight into various manifestations of community resilience.

The mayor and deputy councillor of the municipality were interviewed together by the two first authors. The semi-structured interview lasted approximately one hour and covered topics such as their experiences during the storm, their preparedness, and the lessons learned and measures taken after the storm.

The empirical material also stems from publicly available information and documents. This includes the results from a survey sent to all households in the municipality (response rate approximately 43%) in October 2025. The survey included seven open questions related to handling of the storm, worries during the event, alternative energy sources, possible measures, etc. (Municipality Survey, 2025). We also received reports from evaluation meetings held by the municipality after the storm. The data also includes articles from the local newspaper that reported on events during and after the storm, and provides insight into the characteristics of this local community

5. Results

Based on the empirical material, the municipality's initial handling of the storm is described, revealing community strengths and weaknesses, and a section on measures implemented after the event concludes this section.

5.1 Initial handling of the storm

The storm 'Amy' hit the municipality on October 3, 2025. The increasing winds eventually led to extensive tree falls, and the electricity supply was lost the following day. Within hours, the mobile phone network, the internet, and the emergency network were lost when the systems' battery backups were exhausted.

The situation came as a surprise to the municipality administration. The storm became more severe than forecasted, and the unusual

southeasterly wind direction contributed to the severe consequences. The municipality was not fully prepared for the storm, and one of them stated; *'It is a fact that we reacted a bit too late. Perhaps we should have established the emergency management team earlier. We should have informed the public. We did inform them that there could be a storm, but we did not think it would become this severe.'*

The consequences of communication with the inhabitants were also surprising. They could not convey information about where to get assistance. The fact that the emergency net was down was concerning to emergency services, and the local ambulances were also short on diesel and could not refuel because the gas station's pumps relied on electricity.

The municipality's emergency management team was established the day after the storm hit, and they initially began gathering information on the status of vulnerable groups and how home nursing services could assist those in special need. The team also started an emergency generator at the municipal building and was in close contact with the state administrator.

On October 5th, the electricity gradually returned, and it became clear that there were no serious consequences for the inhabitants' health or safety. Although the municipal administration felt unprepared, they noted that both staff and residents had improvised effective solutions throughout the event. The outside temperature was also mild, and because the storm struck during the weekend, many people were at home and not directly exposed to the weather.

A story in the local newspaper about a caravan merchant illustrates how people helped each other during the storm. The store had a small supply of food and made it available to those in need, asking them to pay later. The store even provided some diesel to a woman on her way to the airport, who was in a hurry to make her flight home. The merchant said that all those he had helped had paid what they owed for his services as soon as the bank services were back.

5.2 Revealed community strengths and weaknesses

The handling of 'Amy' was evaluated by the emergency management team, the municipality administration, and through the inhabitant survey. In the interview, the informants considered that

being a small municipality was an advantage in handling the storm. One of them said, *'I think we are very privileged because we are so small. Everyone knows everyone.'*

Results from the inhabitant survey (Municipality Survey, 2025) also illustrated that social support and a sense of community were important strengths during the event. The survey highlighted that the communication failures, including the failure of the emergency net, were especially worrying for the inhabitants. The vulnerabilities described by the survey respondents are summarized in Table 1.

The survey illustrated that almost all households (97,9%) had access to wood stoves as an alternative heating source. Also, 39,7% stated that they had access to fueled generators, making them, to some extent, independent of the electricity grid in an emergency. The availability of generators could be attributed to the fact that many of the inhabitants are farmers.

Table 1: Revealed vulnerabilities after the storm

Vulnerability	Description
Community communication	Total communication infrastructure failure: Internet, mobile phone network, emergency net, DAB/FM radio
Emergency preparedness	Inhabitants could not call emergency services, security alarms for the elderly were not functioning
Information	Delayed warnings from the municipality (received after the electricity/mobile phone network came back)
Infrastructure	The diesel supply failed as the pumps at gas stations didn't function Deep freezers and refrigerators were not functioning and led to food loss in grocery stores

5.3 Measures

There are several planned and ongoing measures from the municipality intended to reduce vulnerabilities and make the community better prepared for similar situations. These measures are related to strengthening the organization of emergency preparedness and improving technological robustness.

The municipality has established an *Emergency Preparedness Council*, which includes the Red Cross, the Farmers' Union, the Norwegian Women's Public Health Association, the Church,

the Fire and Rescue Services, and the municipality administration. In the interview, non-governmental organizations (NGOs) were considered a crucial asset in emergencies. The Emergency Preparedness Council is intended to help prepare and coordinate efforts across organizations and provide valuable input into emergency plans.

The municipality has scattered settlements, and the storm illustrated how difficult it can be to reach everyone. *Hamlet contacts* are planned to be established to serve as liaisons between the municipal administration and the local community

Related to these contacts, the municipality has acquired *security radios* that enable contact with hunting radios, which are readily accessible and widely available in many households in the municipality. This provides additional communication redundancy if other communication methods fail.

Another lesson after ‘Amy’ was the very limited *battery backup for the mobile telephone net transmitters*. More battery backup for a centrally placed transmitter is on the way, and the municipality is in contact with the tele company to improve backup.

The storm also illustrated the need for a more *robust and resilient electricity grid*, as supported by recent directives on critical infrastructure that balance robustness with resilience. The municipality will address the grid owner and the state administrator (at the county level) and advocate for greater grid redundancy.

The emergency services had no local access to fuel when the electricity was cut. Thus, *better access to fuel in emergencies* is a priority, and it is now explored how this issue can be resolved.

It should be noted that all Norwegian municipalities are required to conduct risk and vulnerability analysis (ROS) to identify potential threats and hazards (e.g., floods, power outages, extreme weather) and assess their potential impact on the local community. This forms the basis for emergency preparedness and implementation. Municipalities must regularly update and exercise these plans.

6. Discussion

Our case illustrates how formal crisis management responsibilities, risk assessment, preparedness planning, resource allocation, and inter-

organizational coordination, constitute the backbone of a municipality’s capacity to maintain function during foreseeable crises. These tasks reflect Moreau and Dryhurst’s (2025) institutionalized dimension of community resilience, in which responsibilities are shared but clearly mandated, and municipalities serve as central actors in coordinating preparedness and ensuring accountability. At the same time, the empirical material shows that citizens hold significant control over informal capacities such as local relationships, community trust, tacit knowledge of the terrain, and volunteer mobilization. These align with Whittaker et al.’s (2015) understanding of community resilience as involving all actors, formal and informal, whose actions collectively shape adaptive capacity during unexpected events.

These informal capabilities are not under municipal command, but they play a critical role when conditions deviate from established plans. Thornley et al. (2015) similarly argue that community connectedness, opportunities for participation, and local support networks are key elements influencing resilience outcomes. In our case, local hunting radio networks, designated contact persons, and rapid volunteer mobilization exemplify how adaptive capacity emerges bottom up through social networks, tacit local knowledge, and community norms

The empirical material also indicates that regional collaboration is important when handling extreme weather events. Some tasks are simply beyond the boundary of any single municipality and require cooperation across municipalities. It illustrates how resilience spans multiple scales. The need for cross-municipal cooperation, mutual aid agreements, shared logistics, interoperable communication, and surge capacity reflects a challenge emphasized in the societal resilience literature: resilience must be scaled across governance levels (Haavik, 2020; Haavik, 2021). Many crisis tasks exceed what a single small municipality can manage alone, making networked resilience a necessary complement to both formal municipal structures and informal community actions. It indicates that resilience emerges from the interplay of municipal (formal), citizen (informal), and inter-municipal (networked) capabilities.

Different interventions shape resilience in different ways. Following Woods (2018),

resilience does not only mean resisting shocks; it includes graceful extensibility, the ability of a system to stretch its adaptive capacity when operating near or beyond designed limits. In our case, this distinction helps clarify the role of interventions. The Emergency Preparedness Council is a flexible governance arrangement that can be used for multiple purposes, such as relationship-building, trusted contact networks across hamlets, and social sensemaking; hence, it contributes to adaptive capacity. These features resonate with Moreau and Dryhurst's (2025) view of resilience as an ongoing, participatory process where multi-stakeholder engagement strengthens learning and adaptation. By contrast, technical solutions (e.g., standardized radios, backup power, redundant communication links) typically strengthen robustness: they are targeted, reliable, but often unidirectional and limited to predefined failure modes.

The case also highlights forms of what may be termed "resilient by accident." This reflects the societal resilience challenge identified by Casajus et al. (2021): while knowledge about resilience is rich, translating it into systematic practice is difficult. Much successful adaptive performance emerges from distributed problem-solving, improvisation, and ad hoc collaborations that are not centrally planned. These emergent forms of resilience mirror Haavik's (2021) argument that resilience is political; prioritization, resource constraints, and local norms shape which adaptations become possible and for whom. The challenge is to systematically integrate citizen experience, local knowledge, and informal collaborations without making resilience person-dependent or brittle (Woods, 2018).

The interaction between formal and informal systems is crucial. Formal structures provide legitimacy, accountability, and coordination; informal community capacities provide agility, local knowledge, and rapid mobilization. Overreliance on either dimension is risky. Leaning too heavily on formal plans may produce rigidity in situations that differ from anticipated scenarios (Haavik, 2021). Conversely, relying solely on informal responses risks fragmentation, inequality, or person-dependency (Bergström, 2018). Our material clearly illustrates this tension: small municipalities benefit from dense social networks, shorter decision-making lines, and strong norms of mutual assistance, yet

the system becomes vulnerable when key individuals are unavailable or when specialist expertise is required.

Notably, plans produce coordinating effects even when they are not followed. They establish shared expectations, roles, and reference frames that enable actors to coordinate deviations, reflecting Woods' (2018) insight that systems require both structure and flexibility to manage surprise. In our case, volunteerism is amplified by intermediaries such as local merchants who serve as extenders of municipal capacity, bridging logistical gaps and thereby increasing the system's graceful extensibility.

Small municipalities exhibit strengths in community resilience: strong relationships, practical local knowledge, and traditions of volunteerism support rapid mobilization and trust-based collaboration. These characteristics align closely with Thornley et al.'s (2015) findings that social connectedness and opportunities for participation enable communities to adapt positively to adversity. However, these same features also create vulnerabilities, including limited redundancy, lower specialist capacity, and dependence on key individuals. Thus, resilience on this scale can be both exceptionally strong and inherently fragile.

7. Conclusion

The discussion shows that the most prominent manifestations of community resilience during extreme weather events arise from the interaction between formal municipal structures and informal community capacities. While municipalities provide robustness through formal planning, technical systems, and predefined responsibilities, such as the Emergency Preparedness Council, the strongest manifestations of resilience emerge from informal, citizen-driven adaptive capacities. These include local knowledge, social networks, volunteerism, hamlet contacts, hunting radio networks, and involvement of local merchants. This enables rapid improvisation and flexible response, which are hallmarks of societal resilience.

The discussion also highlights graceful extensibility, showing that relational and community-based mechanisms allow the system to stretch beyond its designed limits when formal resources are insufficient. Small municipalities exhibit unique resilience advantages, such as dense

social ties and rapid mobilization. Overall, the discussion demonstrates that adaptive, informal, and relational capacities, rather than purely technical or formal measures, represent the most prominent and impactful manifestations of community resilience.

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