



Conceptualizing community in disaster risk management

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ABSTRACT

Community resilience is often assessed in disaster risk management (DRM) research and it has been argued that it should be strengthened for more robust DRM. However, the term community is seldom precisely defined and it can be understood in many ways. We argue that it is crucial to explore the concept of community within the context of DRM in more detail. We identify three dominating views of conceptualizing community (place-based community, interaction-based community, community of practice and interest), and discuss the relevance of these conceptualizations. We base this discussion on quantitative and qualitative empirical and policy document data regarding flood and storm risk management in Finland, wildfire risk management in Norway and volcanic risk management in Iceland. According to our results, all three conceptualizations of community are visible but in differing situations. Our results emphasize the strong role of public sector in DRM in the studied countries. In disaster preparedness and response, a professionalized community of practice and interest appear to be the most prominent within all three countries. The interaction-based community of informal social networks is of less relevance, although its role is more visible in disaster response and recovery. The place-based (local) community is visible in some of the policy documents, but otherwise its role is rather limited. Finally, we argue that the measured resilience of a community depends on how the community is conceptualized and operationalized, and that the measures to strengthen resilience of a particular community should be different depending on what the focal community is.

1. Introduction

‘Community’ and ‘community resilience’ are widely used concepts in literature addressing policies and strategies to prevent and reduce disaster risks and manage residual risks with preparedness, response and recovery activities [1]. In this literature, resilience has been defined in multiple different ways, but it typically denotes how certain actors prepare for, act during, recover from, and mitigate hazards [2,3]; thus it is a dynamic process that should lead to a desired outcome [2,4,5]. The term community is often simply reduced to denoting a specific geographical location at a local scale [2,3,5–9]. Even though the complexity of community has been discussed in the social sciences for decades [10–19], such discussions are hardly visible in the disaster risk management (DRM) literature [20–22].

The notion of community is understood in many ways [17,23]: community as a local scale of analysis [2,5,6]; a network of actors and interactions between people [13,24–27]; a totality of social structures

within a specific place [17,28,29]; unstructured interrelations between people [15,30]; an arena for shared identity and belonging together [12]; networks of specific types of actors such as professional groups [31,32]; or groups of people sharing attachment to a place [33]. These examples show that community is commonly linked either to a specific place or actor interactions, or to both. Some interpretations also include multiple layers or dimensions of the concept of community, thus further highlighting the complexity of defining it [17,23,34]. For instance, Hunter [34] identifies three dimensions: ecological (space and time), social structural (networks and interactions), and symbolic cultural (identities, norms and values).

Scholars have further emphasized that homogenous (local) communities hardly ever exist, as there always are power asymmetries within communities [11,20,35]. Communities also change over spatial and temporal scales [11,16,22,36], including being arenas for different actors, interests and processes specific to one location, yet extending beyond the particular location [11,12,16,20]. Finally, communities can

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be seen as undergoing continuous processes of formation and reformation in which external and internal pressures challenge the existence and functionality of communities [12].

There have been numerous endeavors to measure and assess community resilience against natural hazards and disasters [3,8,37,38]. These measurements are usually based on composite indices, which try to capture the essential elements of a community and its ability to deal with disasters. If the aim is to develop valid and reliable measures of community resilience, we argue that community must be defined and operationalized so that it is meaningful in light of DRM. In turn, applied DRM aims to strengthen the resilience of a community and then the very definition of a community is obviously of importance. Some have argued that community-based DRM and climate change adaptation have partly failed due to simplistic understandings of community [20,21]. If a community is considered a homogeneous group of people in a specific location, power dynamics, changing cultural contexts and root causes of vulnerability may be ignored [20,21]. Furthermore, any DRM and community conceptualization should take local policy and governance context into account [12,39]. For instance, in the Nordic welfare states, there are (almost) universal social safety nets, a strong public sector, and a fairly institutionalized system for DRM [40,41]. DRM is led by the public sector whereas public-private partnerships are less common [41]. In terms of social capital, generalized trust and civic engagement are high [42–45], while family ties and social networks appear to be of less importance in relative terms [42,45], yet they are stronger in rural than urban areas [46,47].

The discussions above lead us to raise the following question: what types of conceptualizations of community are visible and relevant in DRM in Finland, Norway and Iceland? We address the question by analyzing policy documents as well as qualitative and quantitative empirical data from the case study countries. We analyze what roles are assigned to communities in DRM, and discuss how the roles of these communities and perceived resilience vary concerning how the term is conceptualized.

2. Three conceptualizations of community

In light of the above, we approach the concept of community in three different ways (Table 1). We acknowledge that there are numerous ways to conceptualize the term community and its different aspects [34]; however, the three approaches chosen draw on general social science literature and are at the same time relevant in a DRM and resilience context.

The first conceptualization of community refers to community as a (small) spatially defined entity, hereafter termed *place-based community*. In this approach, community is the totality of individuals and social structures within a specific geographical location. The focus is a specific place, typically a village or a residential area, and the community includes all the inhabitants of the location. In addition, the community embrace organizations, institutions and authorities within the place.

Table 1
Description of the three types of community.

Type of community	Place-based community	Interaction-based community	Community of practice and interest
Description	Totality of individuals and social structures within a geographical location, e.g. a village; includes inhabitants, organizations, institutions and authorities therein	Network of interactions between people; foci on informal co-operation and everyday life; civil society organizations can be an important forum for interactions	Network of specialized and/or professional actors that engage in common actions, imagine a shared identity and align activities towards a shared goal

This understanding is widely used in DRM literature and index-based assessments, often using administrative units as a proxy for communities [2,3,5–9]. Quite often, community resilience is measured through multiple dimensions, which focus on economic, social, institutional, environmental, infrastructural, communicative, informative and learning characteristics of the community [2,3,5]. To enhance resilience, the various dimensions should be strengthened. The place-based understanding can be linked to the concept of local society, which consists of the organization of daily life and decision-making within a specific geographical location as well as to interactions between the community members [17,28,29]. Although spatially delimited, also institutional arrangements and social networks outside the location interact with the community [6,48].

The second conceptualization of community – the *interaction-based community* – refers to interactions between people which can be conceptualized as social networks [13,24–26]. The interaction-based community is tightly connected to the concept of social capital, which can be divided into strong social networks (bonding capital), weaker social networks (bridging capital), and linkages between those of power and citizens (linking capital) [42,45,49]. The foci in this understanding are informal co-operation and everyday life of the inhabitants of the specific community. Interaction-based understanding of community is linked to the concepts of ‘community field’ and ‘communitas’, despite these terms having partly different meanings. *Communitas* can be described as the flip-side of social structure as it refers to types of unstructured communities which form around shared experiences, identity and interests [15,30]. In contrast, community field is a location oriented social unit bound around the interests of the community as a whole, including different actors, associations and actions within the community [17,27–29]. Civil society organizations and other associations can be an important forum for the interactions [25,50]. To some extent, interaction-based community can be considered as a sub-unit of the place-based community as it focuses on one specific dimension of place, i.e. the social. However, social interactions extend beyond a specific geographical location [26,36]; thus, in this understanding of community, social capital should not be bound to a specific place. When resilience is measured, the strength and extent of social networks should be assessed [25,36], and other factors relevant to social capital such as reciprocity and trust could be included [42,45,51].

The third conceptualization of community – *community of practice and interest* – refers to specialized networks of actors who share a practice they perform together [31,32]. These actors engage in common actions and share an (imagined) identity [52], and align activities towards a shared goal [31]. As the term suggests, in communities of interest, actors have a shared interest, which promotes collaborative behavior in the group [53,54]. These communities are by definition informal, meaning that they organize themselves [31], and actors within them can include authorities, civil society organizations and local residents. However, communities of practice and interest differ from the interaction-based communities, as the specific trait of communities of practice and interest is a purpose for the interaction; and in DRM, actor networks conducting DRM together can be understood as communities of practice [55–57]. In this case, the resilience can be linked to how well the communities of practice are prepared for, act during and learn from disasters [57]. In community of practice literature, the focus is often on learning within the community; the community is an arena for knowledge dissemination and actors collectively learn how its tasks should be carried out [31,32].

3. Materials, methods and case study areas

We analyzed case study areas located in Finland, Norway and Iceland. As the research methods and data are not identical across countries and cases, we do not conduct cross-comparisons but rather show different examples of DRM practice and perceptions in the studied countries. We examine DRM related to different focal hazards (floods,

storms, wildfires and volcanic eruptions) and the different stages of the risk cycle (i.e. preparedness, response, recovery).

In all countries, we used a mixed methods approach [58], including qualitative interviews, quantitative surveys, and policy document analysis. With mixed methods, we corroborated findings from multiple sources to obtain a versatile in-depth view of community in DRM. Interviews targeted at authorities, civil society actors, and local residents were conducted in order to gain insights into how the different actors perceived the role of community. Surveys were used to gather a larger sample of lay perceptions of community and DRM. Policy documents were analyzed to obtain an official view on DRM policies and how the role of community is presented in the policies.

3.1. Finland

For Finland, we analyzed the ways different conceptualizations of community are visible in flood risk management (FRM) and storm risk management (SRM). We examined FRM in the village Kittilä, and the residential area of Saarenkylä in the city of Rovaniemi. Both study areas are located in the River Kemijoki basin in Finnish Lapland and are among the significant flood risk areas in Finland. In 2017, the lead author conducted semi-structured interviews of FRM actors including local and regional authorities, civil society actors and flood-risk area residents, and a quantitative household survey targeted to flood risk area residents. The interviews focused on flood experience, actors and actions within FRM, and relationships between different actors within the study areas. The survey included questions about flood risk perception, main FRM actors, flood preparedness, preferred FRM solutions, and social networks. Moreover, we reviewed key policy documents and official institutional material relating to FRM. The most important document was the FRM plan for the Kemijoki basin area for the period 2016–2021 [59], its appendices, written feedback by different authorities, civil society organizations, and individuals, including responses to the feedback, as well as a guide to flood self-preparedness targeted at local inhabitants [60]. The cases and methods are described in more detail in Ref. [61].

To get a broader overview of how community is visible in Finnish DRM policies, we also analyzed policy documents related to SRM and safety. These included reports about storms and guidelines for how to prepare for storms [62–66], as well as documents and reports related to village safety [67–69] and societal safety [70]. These documents had both a regional (Lapland) and national focus.

3.2. Norway

For Norway, we examined qualitative studies focusing on authorities', civil society actors', and residents' engagement in wildfire risk management (WRM) during two hazardous wildfires in Norway in January–February 2014 [71,72]. The studies of WRM examined the role of local knowledge for decision-making during the early hours of the crises, against which insights into the role of community and how community is narrated through hands-on efforts is demonstrated.

We also investigated lay notions of community through a large-scale nationally representative survey (1812 respondents) of community resilience [73]. The survey captured various aspects related to people's perceptions of their communities' resilience as well as a specific question where the respondents were asked to define their understanding of the community concept. Of the total sample, 1378 codable responses to this question were provided, on which the results presented below are based.

Finally, we draw on national policy documents in order to get insights into conceptualizations of (local) community, or lack thereof, within the context of building community resilience both locally and nationally in Norway [74,75].

3.3. Iceland

For Iceland, we analyzed how different conceptualizations of community are visible in DRM and more specifically to volcanic risk management (VRM). Policy documents, accessed through *Almannavarnir* – the Department of Civil Protection and Emergency Management (DCPEM) included national emergency management structures and response strategies [76], the national safety policy [77] and general household guidelines on how to prepare and respond to avalanches, earthquakes, volcanic eruptions, and other natural hazard events [78].

Interview and survey data are sourced from a longitudinal study, which examined knowledge, perceptions, experiences and behavior in relation to preparedness for and response to eruptions in the Katla and Eyjafjallajökull volcanoes in south Iceland. The research presented in this paper draws from semi-structured interviews and questionnaires administered in 2008, 2010 and 2016 [44,79–81]. Details of the methods applied throughout the longitudinal study are given in the associated published literature.

To compliment the Katla and Eyjafjallajökull focus, we also examined specialized VRM policy documents produced by the South Iceland Police District, which is one of nine police districts across the nation [82, 83].

4. Results

4.1. Finland

Finland has no specific national level organization for DRM or natural hazard management, and the management regime can be described as a complex network reliant on co-operation and trust between different authorities [41]. Each authority, organization and individual are responsible for their own actions, reflected through relatively strong municipal autonomy. There is also sectoral state-level steering; for instance, Ministry of Interior steers disaster response and emergency management [41]. As another example, the major regional actors in FRM include the regional environmental administration responsible for the authorities' interplay in flood preparedness, and fire and rescue services leading the actions during flood response. The objectives and measures for FRM are listed in six-year FRM plans, which are coordinated at the national level by the Ministry of Agriculture and Forestry and at the regional level by the Regional Councils and the regional environmental administration [61].

In the national level societal safety policy document, the term community is used quite loosely denoting different groups of people and organizations. Different types of communities are delineated, such as immediate social communities (referring to closest friends and family-members), contract-based communities (e.g. contract fire brigades), residential communities, and religious communities. Although these are not explicitly defined, the term community seems to refer mostly to the interaction-based community, including civil society organizations. The self-preparedness of these communities as well as individuals is emphasized in the document, but at the same time, communities and individuals are seen as part of a larger network of actors, including authorities and companies, which together are responsible for overall societal safety.

According to policy documents and interview data, Finnish FRM is strongly institutionalized, and authorities at the local and regional level play the most prominent role. In the FRM plans, little role is given to informal actors or civil society organizations. It was only mentioned that self-preparedness is important, while the plans mostly concentrated on e.g. the role of authorities and other FRM measures. However, authorities interviewed highlighted the importance of self-preparedness, while local residents interviewed and survey respondents living in flood risk areas had a somewhat opposite stance as they regarded formal authorities to be mainly responsible for flood preparedness. Regarding networks and co-operation, professional networks of authorities (i.e.

community of practice and interest) played the central role in FRM activities. Interviewees emphasized that co-operation between authorities is crucial in annual flood preparedness and that links between different actors work well. The social networks and social interaction of local inhabitants were discussed in the interviews, but interviewees stated that informal social networks are not considered so relevant in flood preparedness. However, the value of social networks (i.e. interaction-based community) was visible during a major flood in Kittilä in 2005. Several interviewees discussed how the village came together during the event. Place-based community was also partly visible in FRM; for instance in Rovaniemi, some actors stated that the preparedness in Rovaniemi would have been better than in Kittilä, when a major flood hit Kittilä in 2005. They highlighted that in Rovaniemi FRM was well integrated in municipal policies due to several smaller floods in the past. Additionally, several interviewees highlighted how local policies (e.g. land use planning) as well as local politics and diverging interests affect FRM, especially what kind of flood defense measures are being built.

SRM is less institutionalized than FRM. There are no formal SRM plans for different administrative areas, but different actors, such as municipalities and electricity companies have their own preparedness plans, and there are also some plans for co-operation between authorities. Several authorities have published short guides targeted to individuals about what to do when a storm hits. These instructions deal with self-preparedness, and co-operation within specific localities or social networks is little discussed. However, residential co-operation, social networks and the role of civil society organizations are emphasized more in the guides and policy documents related to village safety. Although these documents discuss mostly safety issues in general terms, storms, extreme weather conditions and related electricity outages are one of the included safety problems, but again, they are mostly discussed in terms of self-preparedness. Otherwise, the village safety documents take a holistic place-based understanding of 'the community' and emphasize all actors and institutions therein.

4.2. Norway

At the national level, the Ministry of Justice and Public Security, supported by the Norwegian Directorate for Civil Protection, has the overall responsibility for DRM. Yet, responsibilities for assessing risks and preparedness plans rest strongly with regional and local authorities [41]. By law (Sivilbeskyttelsesloven¹) the municipality is bound to carry out comprehensive and context specific risk and vulnerability analyses (ROS-analyser). These analyses are expected to cover all potential hazards and risks assumed to be relevant for the particular municipality. Based on the analyses, the municipalities are by the same law obliged to prepare a general emergency plan that should include plans for crisis management staffing, overview of available resources, evacuation plans and a communication plan. The municipality is thus, regardless of geographical area (varies between 45 and 9707 km²) and population (varies between 200 and 680,000 inhabitants), by law a key local level actor in DRM. In addition, the Norwegian Water Resources and Energy Directorate (NVE) has special responsibilities for national flood contingency planning and for reducing the risk of loss due to flooding and of landslides. When there is a threat for loss of life or injuries, the responsibility for handling the crisis lies with one of two national Joint Rescue Coordination Centres, who can delegate responsibility to local Rescue Coordination Centres led by the local chief of police.

In addition to the public agencies, there is a considerable civil society organization involvement in crisis management including DRM [74,75]. Organizations like Red Cross and Norwegian People's Aid as well as many small, specialized rescue organizations are important and integrated elements of Norwegian crisis management. These organizations

have about 10,000 members, organized in local groups scattered across the country and are commonly used in search and rescue operations as well as in crisis management, normally upon a request from the rescue coordination centres or the local police [84].

DRM documents published by national authorities refer to 'local communities' (*lokalsamfunn*) as both a means and end in order to meet and respond to hazards and risks [74,75]. A hallmark of the documents is that there is no straightforward definition of what (local) community is. In most cases, the municipality is seen as the local community, i.e. an administratively defined, place-based interpretation of community. However, in some documents, local community is also described as an unspecified sub-unit within the municipality. It is worth noting that notions of community in documents often is accompanied by terms such as 'robust', 'strong' and 'resistant'. The meaning ascribed to these terms appears to overlap with 'resilient communities' and 'community resilience'.

In the large-scale nationally representative survey, 93% (1285) of 1378 respondents, made reference to 'lokalsamfunn' as spatial entity, i.e. people ground their community in a location, territory or a generic 'there'. The lay interpretation of 'local community' thus appears primarily to be an emplaced entity referring to an ill-defined place-based community. However, for about 700 of the respondents local community was, in various ways, more than a spatially identifiable form in the sense that they added (again rather generic) references to the people (known and unknown) or references to relations between people or people and place (place attachment). Few actually referred to the local community as an arena where community members involve themselves in common activities. Lay perceptions of 'communities' appears thus to be less focused on the social and emotional aspects often highlighted when the meaning of communities is discussed in more academic literature. This apparently challenges reports where Norway is described as a society "in which the *dugnadsånd* [communal work] is strong, and [where] in many communities inhabitants know each other well and are used to helping out if something happens" [75].

The fact that communities as social units can play a crucial role in DRM is well demonstrated in studies of two wildfire events that hit two rural communities in January–February 2014 [71,72]. In both studies, local community efforts played a major role in the early phase of the wildfires and the relative success in limiting the fires is commonly ascribed to this. Local actors described how the informal social networks, local knowledge and local skills and resources were crucial to handle the fires; in particular, they were extensively mobilized in the early phases of the fire. Yet, as argued by, a community is never only local and during the wildfire in Flatanger local firefighters' networks and professional relation relations beyond the local community proved crucial for WRM following the first hours of the crisis. Furthermore, the wildfire responses could also be seen in the light of community of practice and interest, as the actor networks were formed around contract fire brigades and other actors such as the police who had the common interest to prevent losses. These communities of practice and interest were already loosely formed before the wildfires but were more tightly organized during the events.

4.3. Iceland

As with FRM in Finland, DRM in Iceland is highly institutionalized with the greatest responsibility resting with local and national authorities. At the national level, the Minister for Justice is head of civil protection and emergency management while the National Commissioner of Police (NCIP) is responsible for all national issues. Within NCIP sits the DCEPM. At the local level, each of the nine Chiefs of Police lead, alongside their representative Civil Protection Committees, all related operations within their jurisdictions. This includes assigning hazard alert levels in collaboration with NCIP, as outlined in the Civil Protection Act No. 82, 2008 [85]. Representatives from all these levels form the Civil Protection and Security Council, which is tasked with establishing

¹ Lov om kommunal beredskapsplikt, sivile beskyttelsestiltak og Sivilforsvaret LOV-2010-06-25-45.

overarching DRM strategies for the nation every 3-years [86].

At the local level, DCPEM works with Chiefs of Police and Civil Protection Committees to develop DRM plans to prevent and/or limit fatalities, physical injury and impacts to public health and wellbeing as well as damage to the environment and personal property [86]. These plans, which are specific for a geographical location, largely focus on the role of authorities and the required co-operation between professional networks of authorities with respect to monitoring, assignment of alert levels, dissemination of warnings and emergency response, including crisis coordination. While these plans signify a place-based conceptualization of community, they epitomize a top-down approach to DRM. However, informal actors and civil society organizations also play a role. The roles of the Red Cross and local rescue teams are clearly outlined in overarching DRM and place-based VRM plans. Interviews with local residents confirmed the importance of the rescue teams in relation to VRM, with residents stating that even the Chief of Police recognizes that *'the rescue team are more qualified to deal with a Katla eruption here [in the rural community of Álftaver] than the police'*. Nevertheless, the overarching responsibility still rests with the Chief of Police.

In regard to informal actors, interviewed authorities highlighted the role and responsibility of the sweeper system during an evacuation. The sweeper system consists of local residents that have volunteered to 'sweep' their neighborhood from house to house to ensure everyone has received the warnings and have, or are in the process of evacuating to their designated centre [87]. Alongside the sweeper system, the general public are encouraged to check on neighbors, particularly those without access to personal motor vehicles, if an evacuation has been ordered. In addition to checking on neighbors, local residents are encouraged to take responsibility for generalized DRM by:

- Knowing the risk by educating themselves about potential hazards in their region and what options they have to prepare themselves to respond.
- Making a plan for their household and practicing their plans with all members of their household. The plan should include ensuring they have enough fuel at all times to evacuate in personal vehicles if instructed to do so and, making special arrangements to safeguard pets and livestock.
- Preparing an emergency kit, either for evacuation or for sheltering in place, keeping in mind that while civil protection authorities are mandated to respond to public need during an emergency, they may not have the capability to reach everyone [78].

It was revealed during interviews and surveys undertaken prior to the 2010 Eyjafjallajökull eruption that social networks play an important role in preparedness and response to volcanic risk. However, it became undoubtedly apparent during the 2010 eruption. While interviewees recognized the critical role of authorities, many discussed the significant impact social networks and social interactions had on their decision-making during their response to evacuation orders and during their recovery. However, as with FRM in Finland, the linkage between social networks and VRM are not evident in national or local plans where a more top-down view is embraced.

5. Discussion and conclusions

We have conceptualized community in three ways (see Table 1), and demonstrated how these conceptualizations are both visible and, importantly, overlapping in DRM in Finland, Norway and Iceland. According to our results, the three 'versions' of community are of relevance when discussing the role of 'communities' in DRM yet to a different extent and in different types of situations (Table 2).

In disaster preparedness and response, the community of practice and interest appears to be the most prominent within all three countries. The interaction-based community appears to be of less relevance, although its role is more visible in disaster response and recovery. This

Table 2
Different interpretations of community and how they are visible in disaster risk management in the study areas.

	Place-based community	Interaction-based community	Community of practice and interest
Finland	<ul style="list-style-type: none"> - Small role in flood risk management, but it is acknowledged that municipal policies and politics have a role. - Dominant in the documents about village safety, that are about overall safety in the countryside and partly focused on storm-related hazards. 	<ul style="list-style-type: none"> - In flood risk management, residential networks are visible during flood response, but no attention is paid into these in official policies. - Residential networks emphasized in storm risk management a little. - The role of interaction-based communities emphasized in national-level societal safety policy documents but the term community is used loosely. 	<ul style="list-style-type: none"> - Dominant in flood risk management which is dependent on professional co-operation between authorities. - Strong in storm risk management, but organization is less structured than in flood risk management.
Norway	<ul style="list-style-type: none"> - Dominant in national level policy documents with the term 'local community' in use, but the term is not defined - The most common way of understanding local community in the nationally representative survey, but quite often referring mostly to people living within the place 	<ul style="list-style-type: none"> - Relational aspects (i.e. people interacting with each other) recognized to a lesser extent as a key characteristic of a local community in the survey - Interactions between people important for constructing functioning forms of actions in wildfire response 	<ul style="list-style-type: none"> - Communities of practice forming around contract fire brigades evident during early response phase of wildfire risk management; however, these communities are strongly embedded within geographical locations as there is a high degree of place attachment, local social networks and local knowledge - In general disaster risk management, communities of practice form around authorities and civil society actors
Iceland	<ul style="list-style-type: none"> - Local-level plans steer disaster risk management, are municipality-focused, and take the local context into account; however, authority-led policies are emphasized in the plans. 	<ul style="list-style-type: none"> - Social networks between residents important especially during response and recovery phases of volcanic risk management, but these networks are not detailed in official policies. 	<ul style="list-style-type: none"> - Dominant in volcanic risk management, which is based on authority-led networks; however, also civil society actors and volunteered residents (such as local rescue teams and sweepers) are key players in these networks at the local level.

finding is supported by previous research, e.g. in SRM in Finland, where preparedness was part of everyday life for people living in the countryside, residents also helped each other and did not expect authorities to help them when storm hits [88]. Finally, a place-based community is visible in some of the policy documents, but overall, its role seems to be

rather limited. However, this does not mean that place and location do not play a role; importantly, many local institutions and municipal policies play a role in DRM. This is certainly the case in Iceland where VRM plans focus on a place-based approach and clearly articulate the municipality's responsibility. Furthermore, networked communities, both interaction-based and communities of practice and interest, are embedded in place, as exemplified in the Norwegian WRM.

When looking at DRM policy documents, it appears that, in Norway, the most evident conceptualization of community is as a place-based notion, whereas in Finland, the dominant conceptualization of community is as interaction-based. However, the difference may be related to differences in language, which makes the analysis complex. In Norwegian, there is no single word for community, yet community is commonly translated to local community. In Finnish, a community may have multiple meanings, and in order to understand the meaning of community, it usually needs to be specified with the help of a prefix.

Our analysis was structured according to three possible conceptualizations of community (Tables 1 and 2); thus, alternative conceptualizations were not analyzed. This does not entail that alternative forms of community structures and formation processes are not relevant in the studied countries and cases. Instead, also other types of communities can be found, and alternative framings, such as the three community dimensions (i.e. ecological, social structural and symbolic cultural) by Hunter [34], could perhaps have given a different interpretation to our empirical data.

Our datasets from different countries diverged from each other providing challenges to validity and reliability of our results. However, the mixed methods approach and usage of multiple information sources alleviated these concerns. In all studied countries, policy documents can be considered being reliable in providing an official view on the DRM practices, yet the information given in the documents is typically simplified and abstract and local practices are rarely described in detail. With interviews, we could exemplify the DRM practices on three focal hazards and with surveys have a larger sample on local residents' perceptions. We judge that our case-specific results are valid and reliable; however, generalization of the results to the other DRM practices (e.g. other hazards, other locations) and thorough comparison between the three countries and beyond would require further research. Regarding the surveys, the lay perceptions gathered from the Norwegian large-scale survey are the most reliable and can be generalized to the Norwegian population while the lay perceptions reported in Finland and Iceland are more context-specific.

All three studied countries are Nordic welfare states and the strong role of the public sector is visible in the strongly institutionalized DRM practices [40,41]. When investigating DRM, the communities of practice and interest are strong and perhaps the most visible type of community in all three countries. However, these communities of practice are different, mostly dependent on the focal hazard. In the Norwegian case of WRM, the key actor in community of practice were, at least in an initial phase, local contract fire brigades, whereas Finnish FRM and Icelandic VRM appear to be more centralized and authority-led. This does not necessarily mean that authorities are of lesser importance in Norway, nor that there are no contract fire brigades in Finland and Iceland; vice versa, WRM organization is relatively similar in all three countries and is largely dependent on contract fire brigades, especially in the countryside. Furthermore, the strong institutionalization in Finnish FRM is linked to EU policies and the Floods directive which requires that each EU member should develop FRM plans for their potentially significant flood risk areas [89–91]. In all three countries, the identified communities of practice and interest are partly formal: there is state-level steering of actor networks and policies in DRM; however, such communities are also informal, as the local context and social relationships between actors affect the nature of networks and how they are organized.

Although we did not attempt to measure or assess community resilience, the level of resilience can be subject to discussion. As shown

through our research and also previous research, community is a multifaceted concept [20–22], and communities are dynamic across time and space [11,16,22,36]. In particular, when looking at community resilience within the case study countries, resilience looks notably different when linked to different conceptualizations of community. On the one hand, our results suggest that understanding and conceptualization of community affect the assessment of resilience; the measured resilience of a community depends on how a community is conceptualized and operationalized. On the other hand, in order to advance DRM practices, it has been argued that community resilience should be strengthened [2,5]. Our study suggests that the measures to strengthen resilience of a particular community should be different depending on the community in question.

If one looks at communities of practice and interest, the resilience seems to be high: in Finnish FRM, Icelandic VRM and Norwegian WRM semi-professional and professional networks appear to function well and are capable of preparing for and responding to hazards. This argumentation is backed by the relatively strong institutionalization of DRM in the three countries [40,41], as well as our results illustrating the institutionalized public sector-led nature of DRM. Further strengthening of communities of practice and interest in DRM would perhaps require acknowledgement of different types of actor networks and supporting local initiatives for managing disasters, so that informal actor networks, best practices and social learning would be supported [31]. In essence, DRM practices could be a mixture of top-down and bottom-up approaches.

When looking at interaction-based community and related social capital, the resilience against disasters in the studied countries appears to be lower. Relatively marginal roles are assigned to informal social interactions and social capital, although the emphasis on self-preparedness has grown. Therefore, it seems that few policies are implemented to support the role of such communities in DRM. Nevertheless, our analysis hints at the importance of informal social networks in response and recovery stages of DRM, and shows that such networks exist in the studied countries. According to existing literature, community resilience in this view differs along the rural-urban continuum; it might be higher in rural areas in which social networks and capital are stronger than in urban areas [46,47]. As it has been shown that social capital help especially disaster recovery [49,92–94], a possible way to develop DRM practices could thus involve a stronger acknowledgement of informal actor networks and reciprocal help in official policies. Such a shift could also help in reducing the mismatch between authorities' and local residents' perceptions of which actors should be responsible for DRM. This was shown in the Finnish case where local residents did not consider themselves responsible while authorities emphasized self-preparedness. Furthermore, future research could further examine what kind of interaction-based communities should be supported in DRM policies within different governance contexts.

When analyzing the resilience of place-based communities, no straightforward conclusion can be derived. In Norway, the importance of robust and strong 'local communities' are highlighted in key policy documents, but it is not clear what that means. In other countries, place-based communities seem to be less visible in policies and practice, suggesting that place-based understanding of community may not always be the most relevant way to understand community. The perceived resilience in this case could be measured with quantitative index-based studies which use place-based or administrative unit-based metrics [3,8,95]. However, it has been discussed in detail that index construction processes affect how the final index values look like [96–98]. This exemplifies the inherent epistemological uncertainties in index-based studies. If place-based understanding of community is prominent, enhancing disaster resilience would require efforts for strengthening the different community dimensions, yet the practical question is if the different dimensions are relevant in the light of DRM. Thus, it should be considered if place-based metrics are relevant for measuring community resilience and what kind of alternative metrics could be used instead.

Based on our research, potential community resilience indicators should include aspects of public sector policies and DRM actor networks as well as informal social networks and social capital. The different indicators should be constructed and weighted based on case-specific knowledge. Both in DRM actor networks and in informal social networks, the metrics should acknowledge that networks extend beyond a specific place. We hold that the strength of such networks may be difficult to assess; therefore, construction of indices with which community resilience can be compared between locations is a true challenge that should be targeted in future research.

Declaration of competing interest

The authors declare no conflict of interest.

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