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# Climate Change and Natural Hazards:
# The Geography of Community Resilience in Norway

Sabrina Scherzer, Gunhild Setten, Haakon Lein, Päivi Lujala, Jan Ketil Rød



Flatanger, January 2014
Photo: Silje Kolaas, NRK Trøndelag

FINAL REPORT

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# Contents

# Sammendrag

*Community resilience* beskriver et lokalsamfunn sin evne til å forberede seg på, håndtere og komme seg etter en krise. Gjennom bruk av kvalitative og kvantitative metoder, og geografisk visualisering, har prosjektet *Climate change and natural hazards: the geography of community resilience in Norway* undersøkt ulike aspekter ved norske lokalsamfunn sin resiliens.

I prosjektet har vi blant annet:
- undersøkt hvordan lokalsamfunn har vært involvert i håndtering av kriser, og hvilken betydning lokalkunnskap har spilt i krisehåndteringen.
- undersøkt i hvilken grad egne erfaringer med klimarelaterte naturskader påvirker folks syn på klimaendringer.
- sett nærmere på folks oppfatninger av hvordan et lokalsamfunn best kan defineres og avgrenses.
- beskrevet og anvendt en metode for å måle norske kommuners resiliens.
- utviklet et interaktivt web-basert verktøy for visualisering av naturskader og resiliens.

Basert på forskningen anbefaler vi at:
- lokalsamfunn og lokale ressurser og kompetanse trekkes inn i risiko- og sårbarhetsanalyser, og planlegging av krisehåndtering;
- det etableres rutiner og mekanismer som sørger for at lokalbefolkningen sin kunnskap og sine ressurser, og det offentlige beredskapsapparatet, finner hverandre under kriser;
- forskere og praktikere samarbeider om å utvikle et sett med sårbarhets- og resiliens-indikatorer som kan være anvendbare både på lokalt, regionalt og nasjonalt nivå;
- det utvikles geovisualiseringsverktøy som kan sørge for enkel og brukervennlig tilgang til oppdatert informasjon om naturfarer, såvel som lokalsamfunn sin sårbarhet og resiliens.

# Summary

Community resilience describes a community's ability to overcome adversity through, at least to some extent, the use of local-level resources and capabilities. Using qualitative and quantitative methods and geographic visualization, the research project *Climate change and natural hazards: the geography of community resilience in Norway* has examined various aspects of community resilience.

In the project we have:
- explored the importance of local knowledge and community involvement in disaster response.
- investigated people's perceptions of climate change, natural hazards and their consequences, including possible factors that influence these perceptions.
- taken a closer look at the notion of community, an integral part of community resilience that is often overlooked.
- operationalized community resilience through the development of an index.
- depicted natural hazard damages through the development of a visualization tool.

Based on our research, we recommend:
- engaging local people in disaster planning and response efforts;
- planning for and building bridging institutional arrangements that connect local people with emergency managers and official responders;
- including local resilience resources, such as people with certain skills or access to certain machinery, in existing risk and vulnerability analyses;
- developing a set of vulnerability and resilience indicators through the joint effort of researchers and practitioners that can be used at the municipal-level nationwide;
- investing in the (further) development of a geo-visualization tool (such as the ClimRes tool) that can provide easy, user-friendly access to relevant hazard information.

# Introduction

In Norway, the majority of the population lives along a weathered coastline where weather-related natural hazards, such as storms, storm surges, floods, and landslides, have always been regular occurrences. Yet as climate change progresses, things may get worse. It is anticipated that temperatures in Norway will rise by 3.3-6.4 degrees by 2100[1], probably leading to more extreme weather with more intense precipitation, potentially causing more frequent and more damaging floods and landslides[2]. So far, these hazard events have mostly been spatially limited, mainly damaging buildings and infrastructure, and causing very few casualties[3]. Nevertheless, they have had severe social and material consequences for the affected communities.

In order to minimize the impact of any natural hazard event on human and built environments, the ability of local communities to prepare for, act during, and recover after a crisis is of vital importance. This capability is commonly referred to as community resilience. A community that is well-informed, well-prepared, has adequate resources, and is able to adjust under difficult circumstances is better positioned to deal with the unexpected consequences of a natural hazard event than a community that is not.

The importance of local-level preparedness and resilience has recently been highlighted through a governmental white paper on societal security[4] and the public awareness campaign "Du er en del av Norges beredskap" [You are part of Norway's preparedness] that was launched by the Norwegian Directorate for Civil Protection (DSB) in 2018. When disaster strikes, the affected local population, local emergency institutions and volunteer organizations often act as first responders and therefore play a crucial role in preparation, response and recovery.

The research project *Climate change and natural hazards: the geography of community resilience in Norway* (climres.no) based at the Department of Geography at NTNU set out to investigate what community resilience to natural hazards looks like for different Norwegian communities and how it can be strengthened.

ClimRe

# Community Resilience

The notion of resilience, when applied to humans, is based on a powerful idea; the idea that we can overcome aversity, that we struggle and grow stronger, that we fall and rise again. This idea is not a new one. Ancient philosopher Confucius (551-479 BC) said: "Our greatest glory is not in never falling, but in rising every time we fall". However, the idea of resilience has only recently been adopted as a new paradigm in the disaster management community. In this context, it is seen as a unifying concept, bringing together previously separate activities and actors. It is not intended to replace well-established disaster management concepts and practices but rather to reframe them – in a more positive light – under a common umbrella. Instead of reducing vulnerabilities and risks, we now build resilience [5].

Disaster resilience can be understood as "the ability of individuals, communities, organizations or countries exposed to disasters and crises and underlying vulnerabilities to anticipate, reduce the impact of, cope with, and recover from the effects of shocks and stresses without compromising their long-term prospects" [6]. What this definition highlights is that resilience is highly contextual. It always depends on what we are looking at (see Figure 1 for a simple resilience framework). Are we looking at individual people, communities, or organizations? What are the stresses and shocks we consider (e.g. natural hazards, terrorist attacks, food insecurity)? What are the local resilience resources and how can they be used? And what is the expected outcome?
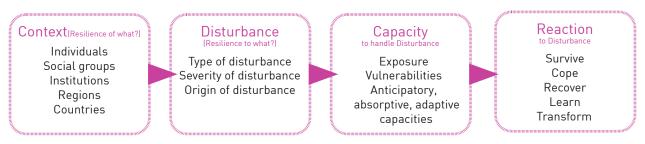
| Context (Resilience of what?) | Disturbance (Resilience to what?) | Capacity to handle Disturbance | Reaction to Disturbance |
|---|---|---|---|
| Individuals Social groups Institutions Regions Countries | Type of disturbance Severity of disturbance Origin of disturbance | Exposure Vulnerabilities Anticipatory, absorptive, adaptive capacities | Survive Cope Recover Learn Transform |

*Figure 1: Elements of a resilience framework (by the UK Department for International Development [7]; adapted version)*

Resilience is frequently depicted as a set of networked or interlinked capacities [8,9]. It is based on the assumption that social systems, such as communities, have a number of properties that allow them to function 'well' in times of crisis, preserving a sense of stability, security and communal well-being. Their ability to deal with adverse events is derived from various capacities that can be enhanced through collective and individual actions. Bahadur and colleagues from the Overseas Development Institute (ODI) [9] proposed to divide these capacities into three interlinked groups: anticipatory, absorptive, and adaptive capacities. Anticipatory capacities allow us to plan and prepare for something that may well happen; absorptive capacities allow us to cope with negative consequences of a shock or stress; and adaptive capacities allow us to adjust and become better suited to a changing environment.

Since enacting resilience, through the application of interlinked capacities, is commonly seen as a dynamic process with ups and downs and unexpected turns, it is hard to imagine an ideal resilient state. Depending on the situation, we (as individuals, or part of a community or organization) may show some degree of resilience, and we may even fare better than our neighbours, but we will never be perfectly resilient. We may strive to be as resilient as possible, but since resilience is essentially about dealing with uncertainty, change and surprise in an unforeseeable future, we need to accept that some things may be beyond our capabilities. Resilience is thus about accepting the inevitability of adverse events occurring, while at the same time anticipating possible consequences and working hard to prevent or mitigate them.

Hence, there is no one recipe that can be applied to all communities (or other social systems) to make them resilient to all shocks. Nevertheless, we can find some recurring traits in the research literature that are believed to help communities to better adapt to changing circumstances, to deal with difficult situations, to be more resilient. These are, for instance, community networks and relationships, good governance and leadership, local knowledge, communication, resources and economic investment, preparedness, good health and a positive mental outlook [10].

# The ClimRes Project

The KLIMAFORSK-funded research project *Climate change and natural hazards: the geographies of community resilience in Norway* (ClimRes) was designed to study community resilience from three different angles.

1    A set of qualitative case studies has explored cultural and social factors that contribute to local-level resilience. Amongst other things, the cases have investigated actors' resources and networks as they unfold in situations where communities are in crisis.

2    From a quantitative angle, community resilience was studied from a distance. To measure it, community resilience dimensions and indicators were identified, and an index constructed based on publicly available statistics. To gain further insights into people's perceptions of natural hazard risks, preparedness and their communities' level of resilience, data from nationally representative surveys were analysed.

3    As visualization is a powerful way to communicate with the public, policymakers, practitioners, and other stakeholders, an interactive visualization tool was developed that allows users to explore their levels of resilience and the history and geography of natural hazard damages. The tool could also be used as a platform for a participatory assessment of community resilience (http://folk.ntnu.no/opach/tools/climres/).

Following is the presentation of some of the key findings of the ClimRes project.

# Community Resilience and the Elusive Concept of Community

At the heart of community resilience lies the community. In this context, community is commonly viewed as a group of people who are knowledgeable and resourceful, and who together have the ability "to take meaningful, deliberate, collective action to remedy the impact of a problem, including the ability to interpret the environment, intervene, and move on" [11]. However, defining community is not a straightforward process as the term community can have many different meanings. One can see community as a territory or place, as linked to or completely free of place; one can also see community as a social unit with or without strong emotional ties, as an entity imbued with collective agency, or a socially constructed idea.

Based on empirical data from a national survey, Sabrina Scherzer, Nina Gunnerud Berg, Haakon Lein and Gunhild Setten (forthcoming)* have examined how nearly 1,400 Norwegians conceptualize *lokalsamfunn* (or local community). People's responses mirror the linguistically and conceptually complex aspects of the term. In addition, the study reveals tendencies and patterns amongst the survey responses. The answers contain references to, in descending order of frequency: *lokalsamfunn* (1) as a geographic area, (2) as people, (3) as provider of goods and services, (4) as attachment to place and people, and (5) as joint activities and involvement. The overwhelming emphasis put on *lokalsamfunn* as a spatial unit is perhaps not very surprising, whereas the relatively few references to the relational aspects of *lokalsamfunn* are. A common, lay understanding may be that people see *lokalsamfunn* as a vaguely defined, but limited, geographical unit filled with people who to varying degrees know each other and interact.

Another study by Aleksi Räsänen, Haakon Lein, Deanne Bird and Gunhild Setten (forthcoming)* has investigated conceptualizations of community in Finland, Norway and Iceland. This study was carried out in collaboration with the NordForsk-funded Nordic Centre of Excellence on Resilience and Societal Security (NORDRESS). Drawing on policy documents as well as selected case studies from the three Nordic countries, the study explores the actual roles communities are assigned in disaster risk management practices.

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*Scherzer, Sabrina, Nina Gunnerud Berg, Haakon Lein and Gunhild Setten (forthcoming). The many faces of local community: exploring lay conceptualisations of the Norwegian *lokalsamfunn*. Special issue on Climate change and natural hazards: the geography of community resilience. *Norsk Geografisk Tidsskrift-Norwegian Journal of Geography.*

*Räsänen, Aleksi, Haakon Lein, Deanne Bird and Gunhild Setten (2020). Conceptualizing community in disaster risk management. *International Journal of Disaster Risk Reduction*: 101485. https://doi.org/10.1016/j.ijdrr.2020.101485

# Community Resilience and the Importance of Local Knowledge

One crucial element supporting the collective ability needed to enhance community resilience is local knowledge. Though an elusive and contested term, local knowledge can be understood as "a body of knowledge existing within and acquired by local people over a period of time through accumulation of experiences, society-nature relationships, community practices and institutions" [12]. When disaster strikes, what and who local people know, in their official and unofficial roles, can drastically shape the immediate response and thus the outcome of an adverse event.

Two ClimRes studies have investigated the local responses to the wildfires in Flatanger and Lærdal in January 2014, respectively. Gunhild Setten and Haakon Lein (2019)* explore the role of local knowledge and practices in the response to the wildfire in Flatanger, which over a period of 12 hours spread across 15 km2, burning 63 buildings to the ground. Through the analysis of 17 interviews with the local fire chief, fire fighters, county emergency planners, safety security officials, and people affected by the fire, Setten and Lein paint a picture of the invaluable nature of local knowledge. There is agreement that without people's knowledge about the local landscape, the weather, the places where people lived, their social relationships, and the physical infrastructure, things could have been much worse. Being physically and socially close to the crisis allowed the fire fighters and volunteers to make decisions not only informed by their professional expertise but also by everyday skills and relations. Setten and Lein therefore stress that in any crisis "there are multiple potential 'experts' with valuable and necessary competence" (p. 7). In order to make use of the local expertise, they argue for establishing bridging institutional arrangements that allow local people to interact with the professionals and vice versa.

In her study of the wildfire in Lærdal, which consumed 40 buildings and caused an electricity and telecommunications outage, Silje Aurora Andresen (2017)* comes to similar conclusions. Through the analysis of interviews with the mayor of Lærdal, ten municipal workers and two volunteers, she underlines the value of local knowledge and local people's capacities in the response to the fire. According to the mayor, it was "the consolidated effort and the mix between organized rescue personnel and the unorganized that made the difference" (p. 32). People stood together, using what they had and what they knew to keep the fire in check. One municipal worker described this as "resources just found each other" (p. 32) because people knew each other and knew who could do what. Farmers used their liquid manure spreaders to water down houses; and a bus driver brought his bus to the nursing home for possible evacuation. People improvised and took initiatives using their knowledge of the place and the people and the resources they had.

The studies by Setten and Lein* and Andresen* thus highlight the crucial role of local community involvement in the management of disasters. Local people are not mere victims in an emergency, they are also first responders with knowledge, skills and resources, and caretakers of their own recovery.

*Setten, Gunhild and Haakon Lein (2019). "We draw on what we know anyway": The meaning and role of local knowledge in natural hazard management. *International Journal of Disaster Risk Reduction* 38: 101184. https://doi.org/10.1016/j.ijdrr.2019.101184

*Andresen, Silje Aurora (2017). In the heat of the moment: A local narrative of the responses to a fire in Lærdal, Norway. *International Journal of Disaster Risk Reduction* 21: 27-34. https://doi.org/10.1016/j.ijdrr.2016.11.009

## BOX 1: LOST IN TRANSLATION

In January 2014, another wildfire burnt in Norway. On the island of Frøya, about 10 km2 of uncultivated land were affected. However, as it was extinguished before reaching any settlements, it received relatively little media attention. Nevertheless, it served as an impactful experience for Frøya municipality. Although the quick and effective response to the fire was seen as a success by the municipality, it nonetheless resulted in the re-evaluation of some of its disaster management practices.

In her master's thesis studying the wildfire on Frøya, Julie Uttian Alstad (2016) highlights, amongst other things, that having a multicultural, multilingual population in a small municipality like Frøya can drastically impair the effectiveness of disaster communications and response. Not only may individual residents be unable to understand disaster alerts, they may also have limited social networks and be less familiar with their local environment. To ensure that everyone is included, and nobody 'lost in translation', the municipality of Frøya consulted the local non-Norwegian population to learn more about their needs. In this consultation, it was agreed that crisis information in English and Norwegian should be sufficient. However, plans have been put in place to also provide access to a translation service if the need should arise among the numerous migrant workers in the fishing industry.



Photo: Henrik Sundgård, NTB Scanpics

# Natural Hazard Risk and Preparedness

In order to prepare, we need to be aware of the risks that surround us. Although nature is an integral and often cherished part of our everyday lives, it can at times turn hazardous. With climate change progressing, we need to accept that natural hazard events in Norway, such as storms, floods and landslides, will increase in frequency and possibly severity. Even though there is considerable variation in levels of exposure and vulnerability across Norway, all of us – no matter where we live – should at least have some idea of what could await us.

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### BOX 2: PREDICTABLE YET UNPREDICTABLE

In very rare instances, natural hazard events are foreseeable. We may not know when exactly they will happen, nor their exact magnitudes, but what we know is that they will happen. One of these events is the expected rockslide from Åkerneset in Stranda municipality. At some point or other, it is expected that up to 54 million cubic meters of rock fall into the fjord below causing a tsunami that is estimated to be 70 meters high when making landfall. The village Geiranger at the very end of Geiranger fjord is one of the communities that will be hardest hit when the rockslide happens.

In her master's thesis, Inger Bakken Gjørva (2017) explored how residents of Geiranger perceive and deal with this risk, and what they think about local-level risk communication and preparedness. Overall, the interviewees seem to have faith in the 24/7 observation of Åkerneset and the ability of the authorities to evacuate them early when the slide comes. However, they miss good communication with and information from the municipality and experts. The resulting information vacuum leads to rumours and speculation, which in turn can feed into feelings of anxiety and insecurity. As a fairly simple remedy, the interviewees proposed a website providing all relevant information. Moreover, in order to increase trust in existing disaster management plans and practices, the interviewees would welcome an evacuation exercise that would allow them to gain first-hand information about how they should react, where they should go, who would be responsible, and what they could expect more generally.

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Two ClimRes studies have investigated people's perceptions of climate change and how they are shaped by different factors, and another study took a closer look at people's feelings of preparedness and safety with regard to natural hazard events. Päivi Lujala, Haakon Lein and Jan Ketil Rød (2015)*, analysing nationally representative survey data from 2010, found that differences in attitudes toward and perceptions of climate change are partially explained by gender, educational background, and political leaning. For instance, people voting right are less likely to list climate change as a mayor challenge for Norway, whereas people voting left or centre are more likely to do so. Considering

personal consequences of a changing climate, women and the relatively more educated are overall more concerned. However, one important factor explaining people's perceptions of climate change and its consequences is direct personal experience. People who have experienced damages from a natural hazard, such as a flood or landslide, are more likely to be concerned about personal consequences from climate change and are more likely to believe that there will be more natural hazards locally. Interestingly though, merely living in an exposed area but not having direct experience seems not to affect people's concerns regarding climate change.

In a similar study using nationally representative data from 2015, Päivi Lujala and Haakon Lein (forthcoming)* found that also personal observations of changes in nature are linked to higher levels of concern regarding climate change and more positive attitudes toward personal adaptation and mitigation measures. Perhaps surprisingly, the study also found that direct personal experience of a natural hazard is connected to reduced levels of concern for climate change. Corroborating this, Sabrina Scherzer (forthcoming)*, studying people's feelings of preparedness and safety with regard to natural hazard events, has found that direct personal experience seems to enhance people's feelings of preparedness rather than to diminish it. It seems that people who have been harmed by a natural hazard, in most instances through damage to property, have learned that it is manageable and are therefore less concerned about climate change and possible consequences. People may not feel completely safe, but they are prepared to handle future events, and know that they most likely are able to handle it (in part due to an extensive national insurance scheme, see the section on Mapping Resilience below).

## BOX 3: BEING WELL-PREPARED IS TO BE PREPARED FOR THE UNPREDICTABLE

In August 2011, Holtålen municipality in Central Norway was hit by a 200-year flood. The flood was caused by a cold front that remained stationary for a long period of time. As a result, massive amounts of rain (150mm) fell on the same place in only a few hours. The river Gaula swelled and the Lund bridge that initially served as a dam for Ålen centre gave way to the water masses that had collected upriver. The resulting damages to residential, commercial and communal properties as well as infrastructure were substantial.

In her master's thesis, Siri Valen (2017) investigated how local people experienced the flood and how they and the municipal authorities dealt with its aftermath. None of her interviewees felt like they were prepared to deal with a flood of such magnitude, describing the experience as unreal and shocking. They expressed – to varying degrees – feeling unsafe after the flood and when contemplating the possibility of a new flood hitting their community. Regarding the handling of the flood, they felt that good communication between the authorities and the population was crucial, and that tight social networks increased their ability to deal with it. Moreover, it became apparent in Valen's work that material measures, such as flood prevention, can reduce feelings of insecurity among the population. From a more institutional angle, the local councilman stressed that one can never be completely prepared for adverse events; nonetheless, a thought-through preparedness plan with clear role assignments can provide much needed guidance when a hazardous event occurs.

*Lujala, Päivi, Haakon Lein and Jan Ketil Rød (2015). Climate change, natural hazards, and risk perception: the role of proximity and personal experience. *Local Environment* 20(4): 489-509. https://doi.org/10.1080/13549839.2014.887666

*Lujala, Päivi and Haakon Lein (in press). The role of personal experiences in Norwegian perceptions of climate change. Special issue on Climate change and natural hazards: the geography of community resilience. *Norsk Geografisk Tidsskrift-Norwegian Journal of Geography.*

*Scherzer, Sabrina (work in progress). Safe and prepared? Exploring attitudes toward natural hazard events among the Norwegian population.

# Mapping Resilience

In Norway, it is relatively rare that people lose their lives because of natural hazard events, but these events can nonetheless have dramatic economic consequences. Luckily, Norway has one of the most extensive insurance schemes in Europe when it comes to the coverage of natural hazard damages; which is why it is generally considered to be a very resilient country. However, there are large geographic variations at the local level. How climate change affects local communities and how resilient these communities are to deal with consequences of natural hazards varies across Norway. In order for Norway to be able to deal with future natural hazard events, we need to know where the most exposed and vulnerable areas are, but also which characteristics help communities to be more resilient.

## BOX 4: FLOOD MODELLING USING GIS

Geographic information systems (GIS) are immensely valuable tools in mapping past, present and future natural hazard events. They allow us, for instance, to look at exposed areas, trace the progression of a hazard, or examine hazard damages and recovery.

In two master's theses, Henning Sigstad (2018) and Martin Vestnes Sæter (2018) use GIS software to model flooding and flood damages in Gudbrandsdalen in 2011 and 2013. Both floods were caused by heavy rain in the days before the event; and most damages were attributed to flash floods in tributary rivers. Sigstad investigated the accuracy of inundation maps using HEC-RAS, a GIS tool for hydraulic modelling. His work focussed specifically on those small tributary rivers with steep catchment areas that caused most of the damages. Sæter, on the other hand, looked at the usefulness of spatially defined damage data for the prevention and mitigation of future flooding events. He found that although damage data derived from appraisal documents may have flaws, it can nonetheless be used to identify areas were protectory measures can be put in place. It can also be used to replicate and validate likely flood paths.

In the ClimRes project, we have developed an interactive visualization tool that can be used to view the history and geography of insurance compensation from the Natural Perils Pool. We also created an index which shows how resilient different Norwegian municipalities are when it comes to natural hazard threats; and we integrated this information in the visualization tool to allow people to have a closer look at the resilience index, and possibly provide feedback.

## Historic and Geographic Overview of Natural Hazard Insurance Compensation

In Norway, all buildings with fire insurance are by law automatically insured against natural hazards. All insurance companies that sell fire insurance in Norway are members of the Norwegian Natural Perils Pool. The natural hazard premium is for the time being set at 0.07 per thousand of the fire-insured sum. It is the same for all, no matter where one lives in Norway or which insurance company one uses. According to data from the Natural Perils Pool, the natural hazards storm, storm surge, flood and landslide caused NOK 22.6 billion in damages during the period 1980-2018 (adjusted to 2018 values using the consumer price index). Figure 2 shows the historical development of the insurance payouts, showing an increasing trend (represented by the black dotted line).
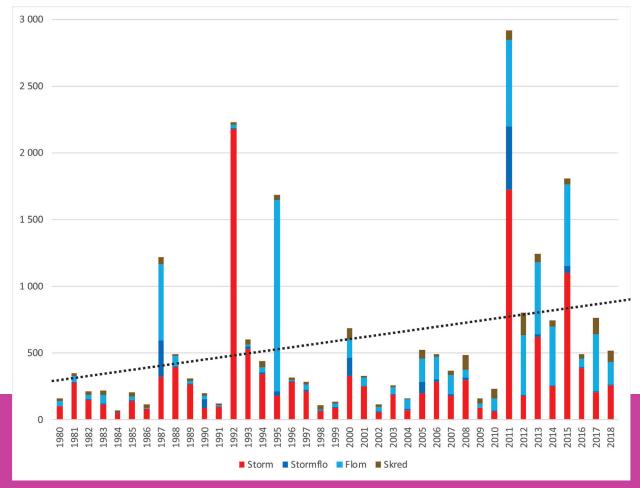


*Figure 2: Historical records of yearly compensations from the Natural Perils Pool from 1980 till 2018 split by storm, storm surge, flood and landslides*

The visualization tool developed by Tomasz Opach and Jan Ketil Rød (2018)* can be used to analyse this data interactively (http://folk.ntnu.no/opach/tools/climres/). It allows the user to not only investigate when and where a natural hazard event resulted in insurance claims and payouts in Norway but also to compare different locations and hazards. Figures 3 and 4 show screenshots of the tool. Figure 3 shows insurance compensation (in NOK) due to storm surge for Vågan municipality in Northern Norway for the year 2011: the year for which the Natural Perils Pool recorded the highest ever payouts due to storm surge damage. Figure 4 provides an overview of insurance compensation (in NOK per capita) due to water intrusion for the southern municipalities. In several articles, Opach and Rød* accentuate the value of visualization tools, such as the ClimRes tool, for the communication of and decision-making processes regarding climate change adaptation.



*Figures 3 and 4: Screenshots of the ClimRes visualization tool*

*Opach, Tomasz and Jan Ketil Rød (2018). Developing a dashboard visualizing compensation data on damages caused by extreme events. *Kart og Plan* 78: 207-220. http://www.kartogplan.no/Artikler/KP3-2018/Utvikling%20av%20et%20verktoyspanel%20som%20visualiserer.pdf

Bohman, Anna, Tina-Simone Neset, Tomasz Opach and Jan Ketil Rød (2015). Decision support for adaptive action – assessing the potential of geographic visualization. *Journal of Environmental Planning and Management* 58(12): 2193-2211. https://doi.org/10.1080/09640568.2014.973937

Glaas, Erik, Anne Gammelgaard Ballantyne, Tina-Simone Neset, Björn-Ola Linnér, et al. (2015). Facilitating climate change adaptation through communication: Insights from the development of a visualization tool. *Energy Research & Social Science* 10: 57-61. https://doi.org/10.1016/j.erss.2015.06.012

## How Resilient are Norwegian Municipalities?

All Norwegian municipalities are required to perform a risk and vulnerability analysis (ROS-analysis), but they generally do not have a good overview of their resilience capacities. Whereas the ROS-analysis identifies risks and vulnerabilities in a community, resilience looks into how well prepared a community is, what its ability is to deal with large accidents and catastrophic events, and how quickly it can return to a normal state afterwards. To create resilient communities is a primary task for crisis management all over the globe. Communities with higher levels of resilience will experience fewer losses and will recover more quickly after an adverse event. Since all municipalities have the objective of strengthening their work on climate adaptation, it is therefore crucial to investigate how well prepared they are and can be when facing a natural hazard event.

Commonly, resilience assessments make use of indicators which are operationalized representations (variables) of characteristics or traits of a geographic unit. Every trait tells its own little story of what makes a community resilient or not. In order to present a numerical summary of the resilience concept, we need to consider many different traits. The advantage of such a numerical summary is that we can rank and compare communities based on how resilient they are (or not), and we can track their development over time revealing whether their ability to handle extreme events has increased (or not).
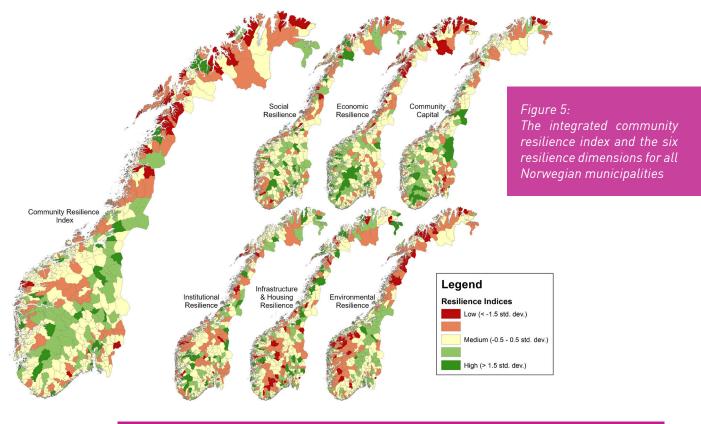
In the ClimRes project, Sabrina Scherzer, Päivi Lujala and Jan Ketil Rød (2019) have constructed a community resilience index for all Norwegian municipalities (using the municipality division that existed in 2014, i.e. 428 municipalities). The index is based on 47 indicators that are divided into six thematic areas:

1. **Environmental resilience** (e.g. natural flood buffers, food security)
2. **Institutional resilience** (e.g. resources for fire and accident prevention, financial health of the municipality, proximity to county capitals)
3. **Infrastructure and housing resilience** (e.g. housing quality, evacuation capacity, road safety, proximity to airport or hospital)
4. **Social resilience** (e.g. age distribution, education level)
5. **Community capital** is related to social resilience but kept separate to highlight capacities of the whole community (e.g. sources of innovation, childcare, broadcasters, voluntary organizations)
6. **Eonomic resilience** (e.g. employment rate, number of firms, access to resources)

Figure 5 presents the community resilience index for Norway and the six thematic areas.

The highest overall resilience score is 3.94 and the lowest 0.92. In the maps in figure 5, relatively high levels of resilience are presented in green (the darker the green the more resilient) whereas relatively low levels of resilience are orange and red. The city municipalities Oslo, Bergen, Stavanger, Trondheim, Drammen, Tromsø and Bodø all have relatively high resilience scores.

It might be seen as controversial to create a resilience index that ranks and grades Norwegian municipalities. However, one should not consider the resilience index to be a definitive of how resilient or not resilient Norwegian municipalities are. Instead, it is to be hoped that such a mapping of resilience can increase awareness of how important it

is for Norwegian municipalities to be more resilient, and initiate a debate on how that can and should be achieved. As an aid for such exploration, we have included the resilience indicators in the ClimRes visualization tool and created a participatory function that allows the user to investigate individual resilience indicators as well as to create an alternative resilience index. Figure 6 shows a snapshot of the integrated resilience index to the left and a selected indicator to the right.
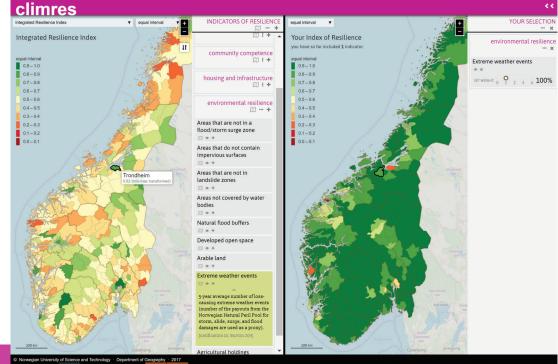


*Figure 5:*
*The integrated community resilience index and the six resilience dimensions for all Norwegian municipalities*



*Figure 6:*
*Screenshot of the ClimRes tool; integrated resilience index (left) and selected indicator (right)*

*Scherzer, Sabrina, Päivi Lujala and Jan Ketil Rød (2019). A community resilience index for Norway: An adaptation of the Baseline Resilience Indicators for Communities (BRIC). *International Journal of Disaster Risk Reduction* 36: 101107. https://doi.org/10.1016/j.ijdrr.2019.101107

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# Recommendations

- Much of Norway's disaster management infrastructure is top-down, focussing on the effectiveness and robustness of public emergency institutions, often overlooking the capacities of local people and local-level institutions. ClimRes acknowledges that good disaster management requires strong and well-connected institutions and an organized response, but **we recommend engaging local people and their resources in disaster planning and response efforts when and if possible.**

- The notion of community resilience emphasizes local people's ability to engage with uncertainty, change and surprise and to deal with difficult situations using existing resources, skills, knowledge and networks. In a crisis situation, the affected people are not only victims, they are also first responders. Their ingenuity and resourcefulness can be crucial until professional emergency personnel arrive, but they can also be useful in collaboration with the formal organized response, that is, if effective means of communication can be established between professionals and local people. **We therefore recommend planning for and building bridging institutional arrangements that can connect local people with emergency managers and official responders.**

- One important aspect of disaster preparedness planning is the analysis or risks and vulnerabilities, a well-established practice in Norway. To strengthen local preparedness planning, **we recommend including local resources (resilience capacities), such as people with certain skills or access to certain machinery, in the existing risk and vulnerability analyses.**

- For planning purposes, it can often be useful to operationalize concepts such as vulnerability and resilience, that is to break them into smaller constituent parts that can be described with measurable indicators. In order for these sets of indicators – that may or may not be merged into an index – to be of any use, **we recommend developing a set of vulnerability and resilience indicators, through a joint effort of researchers and practitioners, that can be used at the municipal-level across the country.**

- An interactive overview of natural hazard exposure, damages, vulnerabilities and resilience capacities can be a valuable tool for planning and communication in disaster risk reduction and climate change adaptation. **We therefore recommend investing further in the development of a geovisualization tool (such as the ClimRes tool) that can provide easy, user-friendly access to relevant hazard information.**

# ClimRes Researchers

**Gunhild Setten**, project leader, Professor of Geography at NTNU

*Gunhild has a background in landscape research with extensive experience from research on cultural heritage management, outdoor recreation and landscape policy. In addition to leading the ClimRes project, her contributions have been to investigate the role and enactment of local knowledge in crises, and to explore the notion of community within the context of community resilience.*

**Päivi Lujala**, Professor of Geography at Oulu University, Finland (formerly at NTNU)

*In her work, Päivi has focused on socioeconomic vulnerability to natural hazards and climate change, and natural resources and natural resource management in the context of armed civil conflict, peacebuilding and development. Within the ClimRes project, she was responsible for the quantitative work package.*

**Haakon Lein**, Professor of Geography at NTNU

*Haakon has a background in development studies. Some of his recent work has looked into vulnerability mapping in Norway. Within the ClimRes project, he has contributed by investigating people's perceptions of climate change and natural hazards, the role of local knowledge as well as notions of community.*

**Jan Ketil Rød**, Professor of Geographic Information Science at NTNU

*At present, Jan works on applications of GIS for studies on climate change adaptation and climate change communication, and the use of citizen science for climate change awareness, biodiversity and natural resource management. Within the ClimRes project, he was responsible for the visualization part of the project.*

**Tomasz Opach**, Senior Researcher at NTNU

*Tomasz has a background in cartography and GI science. He has extensive experience from research on geographic visualization, cartographic animation, and thematic mapping. His contribution to the project has first and foremost been the development of the visualization tool.*

**ClimRes**

**Sabrina Scherzer**, PhD Candidate at NTNU

*Sabrina has a background in economics and development studies. She contributed to the ClimRes project through the development of a community resilience index for Norway and the statistical analysis of nationally representative survey data.*

**Silje Aurora Andresen**, PhD Candidate at NTNU

*Silje has a background in development studies. She contributed to the ClimRes project through her in-depth analysis of the Lærdal fire.*

# Advisory Board

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