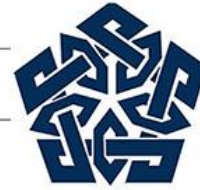

NORDRESS

Nordic Centre of Excellence
On Resilience and Societal Security



Resilience to natural hazards: An overview of institutional arrangements and practices in the Nordic countries

NORDRESS WP6.1 report 3.6.2016

*Atte Harjanne, FMI - Emmanuel Pagneux, IMO – Lisbeth Flindt Jørgensen, GEUS -
Adriaan Perreels, FMI - Peter van der Keur, GEUS - Farrokh Nadim, NGI – Jan Ketil
Rød, NTNU - Ellen Raats, GEUS*

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Abbreviations

DEMA	Danish Emergency Management Agency
DMI	Danish Meteorological Institute
DR	Danish Broadcasting Corporation
DRC	Danish Red Cross
DRR	Disaster Risk Reduction
DSB	Norwegian Directorate for Civil Protection
EIA	Environmental Impact Assessment
ELY Centre	Regional centre for economic development, transport and the environment (Finland)
EPCIP	European Programme for Critical Infrastructure Protection
FCP	Swedish Forum for Crisis Preparedness
FKL	Finance Finland
FMI	Finnish Meteorological Institute
FORF	Norwegian Voluntary Organizations' Forum for Rescue
GEUS	Geological Survey of Denmark and Greenland
ICE-SAR	Icelandic Association for Search and Rescue
ICI	Iceland Catastrophe Insurance
IES-UI	Institute of Earth Sciences of the University of Iceland
IMO	Icelandic Meteorological Office
IINN	Icelandic Institute of Natural History
MSB	Swedish Civil Contingencies Agency
NCIP-DCPEM	National Commissioner of the Icelandic Police – Department of Civil Protection and Emergency Management
NESA	Finnish Emergency Supply Agency
NVE	Norwegian Water Resources and Energy Directorate
RIB	Swedish Integrated Decision Support system
SAR	Search and rescue
SGI	Swedish Geotechnical Institute
SME	Small or medium enterprise
SPEK	Finnish National Rescue Association
SYKE	Finnish Environment Institute
SWOT	Strengths, weaknesses, opportunities, threats
YLE	Finnish Broadcasting Company
WIS	Swedish nationwide emergency information system
WP6	Work Package 6 (NORDRESS)

Executive summary

This report is the first from NORDRESS Nordic Centre of Excellence work package 6.1. It provides an overview of the institutional arrangements of natural hazard management in the five Nordic countries (Denmark, Finland, Iceland, Norway and Sweden). The review is structured around six domains: governance, financial risk sharing mechanisms, legal scope of hazard and risk assessments, mitigation, awareness raising and education and psychosocial support. The report is based on information gathered through literature, expert online survey, interviews and a two day expert workshop.

The main institutional principles are similar in each of the countries. Both the responsibility to prepare and the capability to react are distributed across political and administrative actors. Typically each ministry, agency, municipality or any private organization or even household is expected to be prepared to reasonable extent for disruptions. Subsidiarity principle guides responses and the aim is to manage disruptions at the lowest level possible, escalating (i.e. to state level) only if necessary. Central and state agencies typically have guiding, coordinating and supervising roles only; the main operative level is typically a municipality or county.

Despite the similarities, also differences exist. Some are due to differences in the hazard landscape. From Icelandic volcanoes to Danish low lying lands the institutions reflect to some extent the most prominent hazards faced. Financial risk sharing mechanisms show some differences as well. Finland and Sweden have abandoned state backed mechanisms and mandatory insurances, while in Iceland, Denmark and Norway these have a central role in financial risk sharing.

The challenge for the future is whether the existing institutional arrangements can flexibly react to changes in the society, economy and physical environment due to drivers like climate change, urbanization, globalization and diffusion of new information technologies.

1. Introduction

Natural hazards are costly and potentially dangerous phenomena to any society. Compared to many other countries the Nordic countries are relatively fortunate in terms of natural hazard risks. As stable welfare societies they are among the least vulnerable societies in the world. The risks stemming from natural hazards in Nordic countries are nonetheless notable and the management of these risks depends on well planned and effective institutional arrangements and practices. The significance of these risks gets further charged by global trends such as climate change and ubiquitous information flows. This report discusses the current state of natural hazard management in the Nordic countries based on research and assessment work conducted within the NORDRESS project.

1.1. The NORDRESS Centre of Excellence

NORDRESS is a Nordic Centre of Excellence (NCoE) focusing on the management of natural hazards with the aim of enhancing societal resilience. It is funded by NordForsk under the Societal Security programme, entails 15 research organisations and 7 stakeholder organisations from all Nordic countries, and runs from 2015 to 2019. The NCoE carries out research, education and communication activities.

NORDRESS sets out to work with the concept of “Nordic Societal Resilience”, capitalizing on the strengths of these societies, while looking for ways to develop their resilience further. Ways of increasing societal resilience include transferring of knowledge and expertise and searching new solutions to an increasing variety of threats that these societies face. In terms of disasters caused by natural hazards, resilience must permeate the entire cycle of emergency management: prevention, preparedness, response and recovery. Today, while still disputed, the term resilience denotes a dynamic approach to societal security. While robustness may be seen as the ability of a system to maintain its functions under the influence of shocks without changing its fundamental modes of operation, resilience implies a view of societal security as a property that cannot merely be built into technological or socio-economic systems, but derives from the intricate interplay between four building blocks, being: *individuals, communities, infrastructures, and institutions*¹.

In each of these building blocks work packages focus on selected topics. Topics include physical and mental health effects and their prevention, citizen involvement in preparedness, warning and observation, effects and measures for infrastructure, and

¹ More information can be found at the NORDRESS website: <http://nordress.hi.is/>

the *institutional fitness of hazard management*. The present report is the first one for a work package (6.1) related to the latter topic.

1.2. Purpose of the work package and this report

In the NORDRESS project description, the scope of work package 6.1 is defined as follows:

1. A review of the current management regimes for handling natural hazards in the Nordic countries will be performed, focusing on scales of governance, risk-sharing policies, risk mitigation strategies, land use planning, incentive structures, and types of stakeholder participation.
2. An assessment of the strengths and weaknesses found in step (1) in connection with the dynamics in effective hazards exposure due to societal dynamics and climate change.
3. The identification of options for improvement in each of the four areas of action listed in the introduction to WP6, while also accounting for the findings in WP6b regarding the role of the Nordic welfare state.

Within each of the above mentioned steps guiding questions are:

- How is natural hazard risk assessment incorporated into land use and urban spatial planning in the Nordic countries?
- How are public or private insurance compensation regimes designed?
- How can these measures be coordinated and improved to clarify responsibility, reduce conflicts, maintain or promote equity, and incite preventive behaviour and decision making?

This report deals with step 1 '*review of current natural hazard management regimes*'. The objective of the review is to identify the institutional structures and mechanisms involved in the management of natural hazards in the Nordic region. For feasibility, the scope of the review is limited to institutional aspects of primary importance and to natural hazards significant to the region studied. A scoping note was made to provide a coherent methodology for the review.

1.3. Reviewing approach

1.3.1. Analytic framework

One can make a distinction between central elements (Raadgever *et al.*, 2008), institutional dimensions (Huntjens *et al.*, 2010), or priorities (United Nations, 2005) when management regimes are investigated. For the purpose of the present review, the analytic framework given by Huntjens *et al.* (2010) was rearranged into seven domains of investigation: (1) *Governance*, (2) *Financial risk-sharing mechanisms*, (3) *Legal scope of hazard and risk assessment*, (4) *Mitigation*, (5) *Awareness raising and education*, (6) *Information management and sharing*, and (7) *Psychosocial support*.

1.3.2. Prioritisation / selection criteria

In choosing the approach it was acknowledged that a good part of a country's hazard management regime would have generic characteristics, even though variations in the collection of information on relevant hazards and their severity can affect, to some extent, the general structure. In addition a hazard management regime will have specific provisos for particular natural hazards, notably the most significant ones for a country. For this reason the review is partly panoramic and partly focused.

Natural hazards relevant for the review were selected with respect to their significance or ubiquity within the NORDRESS region.

1.3.3. Tools

The review was subsequently carried out by following three information collection and interpretation routes:

1. Desk research (descriptions of systems, statistics, management regime models)
2. Internet based questionnaire (with a part of the questions differentiated by sector of the responder) (see Annex I)
3. Interviews of key actors (partly identified in advance as important decision makers or experts, and partly identified on the basis of complementing representation of sectors with few questionnaire respondents. The list of interviewees is presented in Annex III).
4. Project workshop in Helsinki, January 28-29 2016 (collection of feedback and ideas based on initial review findings) (Summary in Annex II)

A preliminary summary of the findings is presented in the next chapters.

2. Country profiles

The Nordic countries share many similarities but also differ all from each other by their environmental and societal conditions. This chapter consists of country overviews that describe the natural hazard management systems in each of the countries. Brief descriptions of the countries are also presented. The overviews are loosely structured around the domains presented in section 1.3. Interesting, differing aspects and recent changes are emphasized, and the overviews are not directly comparable.

Additional country profiles, for countries outside the Nordic realm, will be made available thanks to another project. These country profiles will be published in a supplementary Annex IV, expected by the end of 2016.

2.1. Denmark

Key facts

- Population (2016): 5.71 million. 85 % live in cities or towns, 1.26 million in the capital metropolitan area.
- Area: 43 094 sq. km.
- Population density: 133 inhabitants per sq. km.
- GDP per capita (2015): 46,900 €
- Main natural hazards: Summer and winter storms, cloudbursts, flooding.

Currently 5.7 million people live in Denmark with 1.3 million living in the Copenhagen area. 38 % of the population lives in the 10 biggest cities. The median age is 41.1 years. About 1.2 million people live in cities with between 1000 and 9999 inhabitants whereas 1.5 million people live in cities between 10000 and 99999 inhabitants. Approximately 545000 people live in cities with a population in excess of 100000.

In January 2015, immigrants and descendants comprised 11.6 per cent of the total Danish population (657,473 persons) — about 8.9 per cent are immigrants and 2.8 per cent are descendants. 53 per cent of all immigrants and descendants originate from a European country (Statistics Denmark, 2015).

Large concentrations of tourists can be found in summer at the West coast of Jutland and some of the Danish islands. Copenhagen has year round tourism. Yet, tourist numbers remain modest as compared to Mediterranean countries. In 2015, the GDP per capita in Denmark was 46 900 € and the national economy is stable, showing a modest rate of growth (Statistics Denmark, 2016).

Denmark consists of multiple islands that contribute significantly to approximately 7300 km of coastline of which around 1000 km is protected by dikes. The topography in general has no very outspoken features nor much relief, the highest point being around 170 metres, while several coastal areas are close to sea level, and consequently several areas are vulnerable to flooding. Besides coastal flood risks, damages caused by storms and cloudburst are the main threats that can be described as natural hazards.

Historically, there are records of severe inundations caused by storm surges in the southern part of Jutland. The two worst events occurred in 1362 and 1634 with several thousand fatalities in the Frisian area. Since 1891, 173 storms and hurricanes have been registered by the Danish Meteorological Institute, of these 13 in the strong storm or hurricane category (winds $>32,6$ m/sec) have occurred with an increasing frequency until date (1902, 1921, 1967, 1968, 1976, 1981, 1983, 1984, two in 1990, 1991, 1999, 2005, two in 2013, and two in 2015). The main impacts were inundations and forest damages (e.g. 750 000 trees fell during the hurricane in 1968) resulting in economic losses and expenses but also casualties at sea and inland from falling trees, collapsing buildings, flying roof tiles. Seven persons were killed during the 1999 hurricane, estimated as the worst registered storm event in Denmark; four in 2005 and one person during the last of the two events in 2013). Other impacts were damages in agriculture and horticulture due to wind borne saltwater sprays (DMI, 2016).

The vulnerabilities to flooding are based on the sea-level rises predicted for the future under climate change. Also, the storms causes problems on a regularly base when climate change will further develop itself because of the sea level rising and more frequent and severe storms. The storms by itself also cause higher water levels and potential damage of coasts.

2.1.1. Governance

In Denmark, preparedness against natural hazards includes the community as a whole. Citizens, decision makers, authorities, media, businesses, and other players are all important elements in the preparedness, and the ability of the society to handle accidents and crises depends upon the degree of readiness and response of each individual when hazards occur. The Danish Emergency Management Agency (DEMA), which is placed under the Ministry of Defence, has a coordination role and works to strengthen the preparedness in general, but authorities are responsible at all the administrative levels of efficient emergency plans at their respective level. A special dedicated flood action group for the Danish West Coast of Jutland has been established by the Danish Coastal Authority in cooperation with the police. The Danish Coastal Authority (Kystdirektoratet) is the official coastal government agency - a division of The Danish Ministry of the Environment. The Coastal Authority is responsible for coastal protection at the main parts of the West Coast of Jutland, and provides technical advice to the local maintainers of the dikes and has the supervisory

control of the Wadden Sea Dikes in Southern Jutland and the dikes on the islands of Lolland and Falster (South-eastern Denmark) (Danish Coastal Authority, 2013).

Jurisdictional levels

All Danish authorities — the 98 municipalities, 5 regions, and the central authorities — must plan for maintaining their most critical functions in case of major accidents and crises. At national level all ministries are in charge of planning within their respective areas of responsibility. Their tasks are to maintain the functions of the Government and public administration, producing necessary legislation and providing guidance to regional and municipal authorities. This principle of sector responsibility is outlined in the Danish Emergency Management Act², thus municipalities and regional councils must prepare contingency plans for all assignments that they are responsible of, e.g. fire and rescue service.

The distribution of responsibilities between authorities remains the same when the national crisis management system is activated. Each individual authority involved has and maintains full responsibility for managing the response within its own sector. Likewise, each individual authority is responsible for informing its own political level, as well as for communicating to the public. This feature - that each authority participates with its own competence - applies to procedures in any cross-sectoral staff, and is referred to as the 'principle of sector-responsibility' (DEMA, 2015).

However, some incidents are so severe, extensive, prolonged or complex, that they require crisis management involving several authorities, both at national and local level. In such cases the response is coordinated within the framework of the national crisis management system that can operate at one or more of four levels: the government's crisis management organisation; the National Operative Staff; 12 local operational staffs (corresponding to Denmark's 12 police districts), and the local incident command in the response area (corresponding to the municipality or municipalities in question). The authorities can activate the national crisis management system, or parts of it, if it is assessed that a given incident cannot be managed effectively, or sufficiently fast, by ordinary measures, or when cross-sectoral coordination and mutual orientation is necessary. The national crisis management system also supports effective and swift application of society's collective resources during a crisis.

The primary tasks for the Danish crisis management system are:

- To establish and maintain an overview of the current situation, enabling involved authorities at all levels to make decisions quickly and effectively;

² English translation of the legislation available at:
http://brs.dk/eng/legislation/act/Pages/the_emergency_management_act.aspx

- To ensure active cooperation and efficient coordination of actions and resources across different authorities and administrative levels;
- Inform the public about the situation and provide instructions for citizens to take appropriate self-protecting measures.

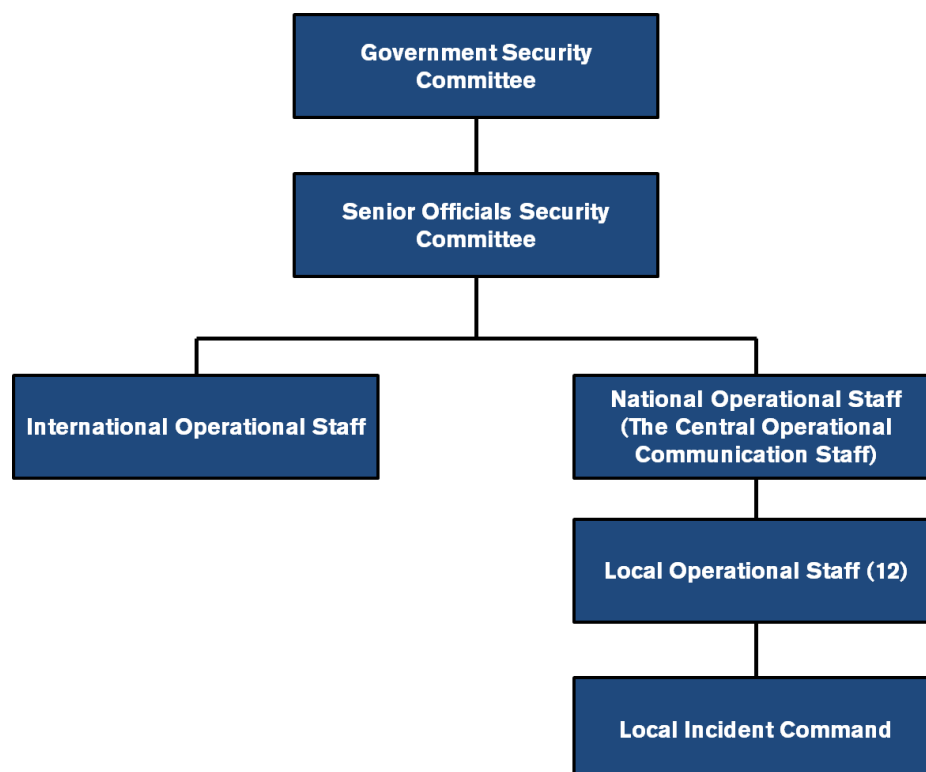


Figure 1: Structure of the Crisis Management Organisational Framework. Source: DEMA (2015)

Monitoring and warning

The Danish Meteorological Institute (DMI) offers a number of possibilities to be warned about dangerous weather in Denmark, among these are cloud bursts, flooding and heavy wind. Warnings are announced in the media (web-pages, news in radio and television) and an app for warnings is also available. DMI also monitors and reports climate data from both daily weather conditions as well as data from extreme events.

DEMA, the Danish police and the municipalities have the option to use social media as Twitter, Facebook etc. in case of emergencies.

The Danish Coastal Authority plays a central role in relation to storm surge warning along the coast of Jutland and run monitoring programmes on the coastal development and the potential impact by future storms on the constantly changing coast line landscape.

Regulatory authorities

Legislation in relation to natural hazards is issued by the Ministry of Defence in cooperation with other relevant ministries as well as with the municipalities.

Major volunteer organisations

Some local fire departments have a network of trained volunteer helpers that can be mobilised in case of emergencies. Most of these are organised in the Danish Civil Protection League, a non-profit organisation with 7,000 members. It comprises predominantly volunteers in local rescue teams working for the safety of the civil population and aims to be the uniting groundwork for the volunteers engaged in the municipal or the national rescue preparedness. The league also serves support members. Moreover, the League aims to increase the knowledge of preparedness and prevention among the population and through the education of the population to increase their level of self-preservation and robustness. The Danish Civil Protection League is involved in training and educating the volunteers in respect of the following measurements: food provisioning and temporary housing, fire service, rescue work, use of rescue dogs, communication and SAR-teams (Search and Rescue). Additionally, the League offers courses in first aid to all members as well as management courses to a selection of members. Furthermore, the League is involved in first aid training of the population, including the capability to extinguish small fires and handle accidental situations before they become major disasters. Moreover, the League offers training in the so-called Heart-Starter (defibrillator) and mediates between supplier and firms needing a Heart-Starter.

The Danish Home Guard is a volunteer military organisation with more than 46 000 members of which one third is active volunteer soldiers. The Home Guard resorts under the Ministry of Defence and the main task is support the Armed Forces, but also to support the police, emergency services and other authorities in case of emergencies, e.g. in terms of traffic management, barriers etc.

The Danish Red Cross also have a volunteer organisation that is mainly used in non-emergency situations but could be mobilised if necessary.

International cooperation

Denmark contributed to the Hyogo framework and will also contribute to the Sendai framework, and has implemented all relevant European directives issued by the European Commission. The responsible ministers from the Nordic countries (Finland, Iceland, Norway, Sweden and Denmark) meet every year to strengthen cooperation within preparedness for accidents (the Haga-cooperation), also internationally. At the operational level, the same five countries cooperate in the NORDRED to assist each other in case of emergencies within their own geographic area.

Besides, Denmark contributes to international humanitarian help in a number of international organisations (under the auspices of UN, IHP, EU, NATO etc.) in case of emergencies as natural disasters.

Trends in governance

To our knowledge there are no plans to change the present governance framework in a way that could affect the emergency management.

2.1.2. Financial risk-sharing mechanisms

In Denmark, financial risk sharing in case of natural hazards is mainly covered by private insurance; however, most insurance have clauses on force majeure. If damages for some reason are not covered by the private insurance or if the insurance company refuses to cover damage, the insurance holder can ask the Danish Storm Council to evaluate or raise the case.

The Danish Storm Council is an independent council handling cases concerning three types of natural hazards: storm surge, flooding from surface water bodies, and storm damages. It was established in the 1990s in pursuance of the Danish act relating to storm surges and damages from storms. The Council decides whether a storm surge has taken place and special insurance conditions enter into force ensuring coverage (as opposed to damages that could be due to lacking maintenance by the claimant resulting in damages to be expected as a result of ordinary bad weather). Besides, the Council handles cases involving compensation following flooding from waterways and lakes where the claimant can apply for coverage from a dedicated (national) insurance scheme. In addition, the Council makes decisions in cases concerning subsidies for reforestation after windfall. The Danish Storm Council also supervises and considers complaints about insurance companies' processing of storm surge cases.

As e.g. earth quakes are extremely rare in the Danish area, Danish insurances do not cover damages caused by such an event, considered as force majeure.

2.1.3. Legal scope of hazard and risk assessments

DEMA issued an assessment report on national risks in 2013 ('Nationalt Risikobillede³'), the first of its kind in Denmark. The main natural hazards that could threat Denmark are in this assessment described as 1) Hurricanes, storms and floods; 2) Heavy rain and cloud burst; 3) Pandemic influenza; and 4): Livestock diseases and zoonoses.

³ Full assessment in Danish:
http://brs.dk/viden/publikationer/Documents/Nationalt_Risikobillede.pdf,

The assessment was made partly as a result of DEMA's own initiative, partly as the European Commission encouraged member states to develop national risk assessments. The report is to a large degree retrospective as it mainly looks at events that have already taken place to learn from experiences more than try to do scenarios on future possible events, as this is done in other contexts by responsible authorities or companies/industries. The main focus is to assess the impacts of the described events more than their probability. Input derived from authorities, insurance companies etc., and national reports on the same issue from the Scandinavian countries as well as the UK and the Netherlands have also been used for inspiration.

In 2013, the Danish government made an agreement with the 98 Danish municipalities that obliges the latter to pursue complete risk mapping and prepare action plans for climate adaptation. The mapping includes identification of areas in risk of flooding, and providing planning a ranking of possible efforts to mitigate threats. The action plans are a part of the compulsory planning at municipality level and must integrate all other relevant planning, e.g. on spatial planning, water supply and sewer networks, contaminated sites, nature planning, groundwater protections etc. Beside, each municipality has the possibility to issue dedicated local climate plans, if they find it beneficial.

2.1.4. Mitigation

DEMA is presently working on a national hazard mitigation strategy to be prepared in the first six months of 2016. As mentioned above, the municipalities must prepare risk maps – e.g. appoint areas prone to flooding to prevent development and instead plan and implement e.g. green areas for retaining rainwater in these areas - and prioritize mitigation measures that are financed by a levy charged via the water supply and sewage fee.

The 'Climate Adaptation' platform⁴ established by the Danish Nature Agency provides advice and guidance for citizens, municipalities and business. Citizens can find advice on how to prepare for cloudburst, how to act in case of damage, how to secure your property etc. Municipalities and businesses can find help to establish climate plans, read about experiences, find relevant legislation and other relevant news on the issue, networks, data and maps, etc.

2.1.5. Awareness raising and education

Awareness raising is a part of the general planning and information strategy implemented by DEMA and the municipalities, but is not as such a task dedicated to a specific organisation in Denmark. As described above, the volunteer organisation

⁴ www.klimatilpasning.dk

Danish Civil Protection League educate volunteers in different tasks relevant in crisis, and on their webpage DEMA encourages citizens to have basic knowledge on preparedness.

Television is still used in Denmark as a major natural hazard communication tool. The Danish public broadcaster DR broadcasts educational “OBS” videos in TV that include guidance in preparedness and prevention of natural hazards.

The recent severe flooding events have raised awareness of natural hazards. This has resulted in a shift of mind set, as more people have realized that the help from authorities is not always available. Awareness has also channelled into more active volunteering, as the volunteer organizations have seen a new influx of volunteers also from groups that have traditionally been underrepresented such as young males.

2.1.6. Psychosocial support

In 2014, the Danish Health Authority issued a report on how to strengthen the Danish psychosocial effort in case of emergency incidents (Sundhedsstyrelsen, 2014). Psychosocial support is a task to be covered by both municipalities and regions and depending on the situation, the necessary and most appropriate resources and tools will be activated. The Danish regions manage the hospital and healthcare system in Denmark, including crisis and catastrophe psychiatry (as well as post-traumatic stress syndromes etc.), and each of the five regions has an Acute Medical Coordination Centre that can be activated and used in coordinating psychological support in case of emergencies. Besides, all Danish municipalities have established a crisis unit as a part of the preparedness planning, to handle emergencies. In reality, the two authorities will cooperate in case of natural hazard where psychosocial support is needed and in practice, the regions will take care of the psychotherapy in the acute phase of emergencies, assisted by the municipality crisis unit while the municipalities are in charge of the necessary follow-up support related to hazards or emergencies.

As mentioned earlier, volunteer organisations can have a big role to play in case of hazards or emergencies, and e.g. the Danish Red Cross also is capable of supplying psychological support in the acute phase of emergency situations.

2.2. Finland

Key facts

- Population (2015): 5.44 million. 85 % live in cities or towns, 1.12 million in the capital metropolitan area.
- Area: 338 424 sq. km.
- Population density: 17.64 inhabitants per sq. km.
- GDP per capita (2014): 37,351 €
- Main natural hazards: Summer and winter storms, floods

Finland has a population of 5.44 million people of which 85 % live in cities or towns. The capital Helsinki and its surrounding metropolitan area are home to 1.12 million people while ten biggest cities together account for around 40 % of the population. The median age is 41.6 years. In 2014 around 4 % of the population had another nationality than Finnish (Statistics Finland, 2016).

Foreign tourism is concentrated in Helsinki and in Lapland. In rural municipalities with many summer houses the population may rise during summer months by 2 to 3 times the resident population. The GDP per capita in Finland was 37351 € in 2014. The economy has been in decline for four years in a row (Statistics Finland, 2016).

The geography of Finland protects the country from the most intense natural hazards. The country is far from areas with tectonic or volcanic activity. The peaks are comparably low (highest peak at 1 324 meters) and gradual, decreasing the risks of gravitational flows. Avalanches are however not unheard of in the mountains of Finnish Lapland⁵ and have caused two fatalities within the last 20 years (YLE, 2014). While there are numerous long rivers that cause flooding in their basins, their discharge and thus the potential severity of floods is low compared to those in e.g. central Europe. The climate in general is more continental compared to the rest of the Nordic countries. Storm winds can occur across the year, but are most frequent in late autumn caused by major depressions and during convective thunderstorms in summer months. Hurricane level wind speeds (over 33 m/s) have not occurred during the modern observation record (FMI, 2015).

All this does not mean that there are no natural hazards in Finland. Natural hazards cause nuisance, economic losses and potentially dangerous disruptions to key infrastructure. Most significant risks are related to storms and floods. Storms damage forests, crops, real estate and infrastructure, cause blackouts and block roads. Protracted blackouts in winter are usually quite localized, but may entail health risks, especially for vulnerable people. Floods caused by rivers, sea level and heavy rain

⁵ FMI's avalanche warning service: <http://ilmatieteenlaitos.fi/lumivyoryennuste>

threat real estate. In addition, snowing and especially blizzards disrupt road and rail transportation and electricity distribution. For all hazards combined the biggest economic losses are born by forest owners, insurance companies and electricity distribution companies.

2.2.1. Governance

The main governance principle regarding natural hazards in Finland is that each authority, organization and individual is responsible for their operations both in normal and exceptional conditions. Natural hazard management is decentralized and distributed to large number of authorities on different levels, and there is no single authority or agency responsible for it. Municipalities have in principle broad autonomy but are in practice controlled largely by legislation that defines detailed and general responsibilities.

Jurisdictional levels

The main jurisdictional levels in Finland are the national (state) level and local (municipal) level. These are the levels directly controlled by public elections. Regional level administration is a combination of the two, where some responsibility lies within the regional and local administration derived from the state and some within joint authorities formed by the municipalities. The 18 provinces (not including the Åland islands) as they now exist fall in this category. Figure 2 illustrates the Finnish governance model.

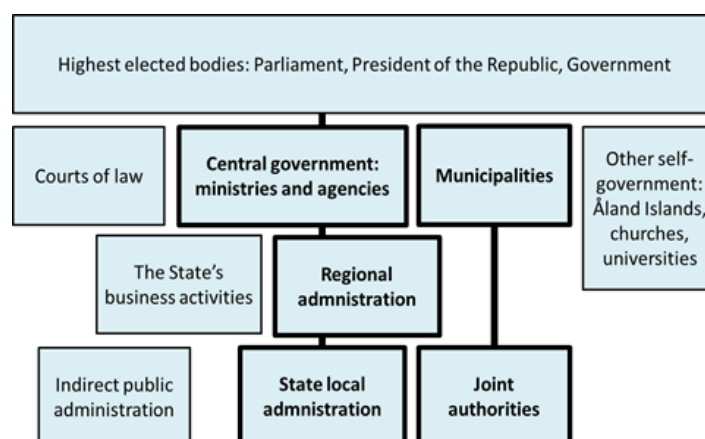


Figure 2: Finnish public administration. The main levels associated with natural hazard management are bolded. (Source: www.suomi.fi⁶)

⁶https://www.suomi.fi/suomifi/english/state_and_municipalities/state_administration_and_central_government/index.html

The responsibility for preparing for and responding to natural hazard risks in Finland is divided among the 317 municipalities and various state agencies and bureaus, some of which also have regional branches. In addition some functions are provided by municipal co-operation either voluntarily or by law (such as hospitals and rescue services).

The Ministry of Interior is responsible for emergency management and disaster response services. The Ministry of the Environment is responsible for land-use related risk mitigation, while the Ministry of Forestry and Agriculture is responsible for coordinating adaptation to climate change. Furthermore, several key authorities are governed by other ministries, e.g. the National Emergency Supply Agency operates under the Ministry of Employment and the Economy and the Finnish Meteorological Institute, having the operational responsibility for the official natural hazard early warning service LUOVA, operates under the Ministry of Transport and Communications.

The main actors and their responsibilities within national hazard risk management are thus the following:

- 317 municipalities, responsible for land-use planning, provision of social and health services and civil engineering. Municipalities can form joint local authorities to combine their resources in service provision (often related to healthcare, education or transport).
- 6 Regional State Administrative Agencies (AVI), responsible for the basic public services, legal rights and permits, environmental permits, rescue services and preparedness. AVIs do not mainly provide services but control, govern and monitor the actions of municipalities and joint authorities.
- 15 Centres for Economic Development, Transport and the Environment (ELY-centres), responsible for implanting environmental legislation (only 13 centres of 15 involved) and other regional development decisions.
- 22 Rescue departments led either by a single largest municipality within the area or joint authorities. Rescue departments are responsible for rescue services and can also provide ambulance services. They are responsible for the operational level response to natural hazard events.
- The Ministry of the Interior – state administration responsible for civil security and safety and related civil crisis management, including the following agencies:
 - The Emergency Response Centre Administration
 - National Police Board, 11 regional police departments
- The Ministry of Employment and the Economy, responsible for the National Emergency Supply Agency (NESA). NESA is responsible for coordinating the

emergency supply and readiness in Finland, including promotion of quick recovery of supply systems after disruptions.

- The Ministry of Transport and Communications, responsible for the following agencies:
 - Finnish Transport Safety Agency
 - Finnish Meteorological Institute (research and service institute)
- Ministry of the Environment, including the following agencies:
 - Finnish Environment Institute (Partly)
- Ministry of Agriculture and Forestry, including following agencies:
 - Finnish Environment Institute (Partly)
 - Natural Resources Institute Finland
- The Prime Minister's Office, including the National central awareness centre
- Several state affiliated strategic companies (in the energy and transport sector). Such critical infrastructure operators are responsible for maintaining their service levels also during exceptional conditions.

The institutional arrangement regarding natural hazard management is hence a complex mix of local, regional and state level organizations. Regulatory, monitoring and operational responsibilities are diffused across different jurisdictional levels. Described as a “mess” by an expert in the project workshop, this does not necessarily imply ineffectiveness but undoubtedly poses a challenge for coordination and development.

Regulatory authorities

Regulatory roles within the natural hazard management regime in Finland are highly distributed as well. The Parliament is the highest legislative authority, while the government and ministries prepare the legislative changes. The government and separate ministries can also set binding decrees regulating natural hazard management. In addition, municipalities can set detailed regulations for their areas (related to i.e. building codes and land use) based on rights and responsibilities that the general state laws assign to them.

Major volunteer organisations

In addition to the public authorities there are several major volunteer and non-governmental organizations that are involved in natural hazard management. Volunteer fire brigades are responsible for services in around 90 % of the area in Finland⁷. The Finnish Red Cross (FRC) has large volunteer and professional base and capability to emergency relief and first aid operations. FRC also coordinates the volunteer rescue service network Vapepa⁸ which consists of nearly 22 000 volunteers

⁷ Estimate by the Finnish association of volunteer fire brigades, www.sspl.fi

⁸ Vapepa web site in English: <https://vapepa.fi/en/vapepa-2/>

available to support authorities in tasks related to search, rescue and evacuation. Another key non-governmental organization is the Finnish National Rescue Association SPEK⁹ which develops hazard management knowledge base and communicates hazard and preparedness information.

Cross-sectoral cooperation between actors

Due to the distributed responsibilities within the natural hazard management regime, diverse systems and mechanisms of cross-sectoral cooperation have evolved. The roles of Regional State Administrative Agencies and Centres for Economic Development require them to bring together processes and information from different sectors at least on principle. At local level the readiness for cross-sectoral cooperation in municipalities differ: large cities typically have more systematic processes, but smaller municipalities may benefit from the smaller scale as key actors are better aware of each other's' work.

At national level each ministry has appointed a Head of Preparedness responsible for preparation planning in her/his sector of administration. Heads of Preparedness have regular meetings on monthly basis that also include experts from key sectoral agencies¹⁰. As part of the Hyogo process, the Finnish Ministry of Interior also appointed a National Disaster Risk Reduction Platform network that consists of representatives of all major organizations involved in natural hazard management. The network is permanent, but participants are appointed for fixed terms. The term of the current network ended in 2015. The aim of the network is to improve disaster risk management by bringing together the work and knowledge of different organizations involved in natural hazard management. The network itself has no authority for binding decisions and each suggested action requires a decision by the competent authority (Ministry of the Interior Finland, 2012).

The private sector is closely involved in contingency and preparedness planning. The National Emergency Supply Agency (NESA) has the responsibility to promote the coordinated or even in some cases jointly organized recovery of regional infrastructures across affected infrastructure companies (NESA, 2016).

International cooperation

Much of the guiding legislation in Finnish natural hazard management is derived from the EU. Prime examples are the Floods Directive¹¹ which is the foundation of Finnish detailed flood management legislation and the EU Civil Protection Mechanism, which

⁹ Spek web site: www.spek.fi

¹⁰ See the Security Committee web site for more information:
<http://www.turvallisuuskomitea.fi/>

¹¹ See the European Commission web site for more information
http://ec.europa.eu/environment/water/flood_risk/

among other responsibilities prompted the preparation of the first national risk assessment in Finland in 2015.

Finland has been active in preparing and implementing the Hyogo and Sendai frameworks for action. The country has had a high international profile in the related negotiations and has organized co-operation networks and reporting according to the framework. These efforts have however had marginal guiding impact, and have mostly been compiling together information of activities under way regardless of the pact.

Trends in governance

Currently there are two ongoing and partly competing governance trends. On the one hand there has been an effort to reduce direct regulation-based state control on all levels of administration. On the other hand a major regional reform effort is currently under preparation. The current plan, which may still be altered to some extent, aims to establish a provincial level as the common level for various spatially disaggregated services, which up to now often have varying (and disparate) spatial extents, and are purely administrative branches of national administrations or ministerial departments. The provinces would also get political responsibilities for these devolved services. The reform concerns in particular health and social care, emergency preparedness and management, as well as land use planning. This reform is likely to change the organizational setting of natural hazard risk management in all its domains. For example the rescue services (currently provided by 22 departments organized around municipalities) will be connected to the new health and social service units. (Ministry of Social Affairs and Health, 2016)

The debate is still however ongoing with different political parties expressing different interests. The Finnish Constitution restricts the reform in two ways: on the one hand each citizen has the right for democratic participation (i.e. the new levels of administration need to have elections or a direct connection to elected bodies); on the other hand each citizen has to have access to basic services (i.e. the new administrative bodies need to be able to provide them).

2.2.2. Financial risk-sharing mechanisms

Financial risk sharing in Finland relies mostly on voluntary insurances. In general the Finnish model of financial risk-sharing relies largely on the principle of individual responsibility, where each household and business is expected to take care of their own insurance cover, while the role of the society is to mitigate the risk to tolerable levels and disseminate information to support correct risk awareness.

Insurance cover

There are no national compensation schemes for natural hazard losses. The national flood compensation scheme was dismantled in 2013 and the national crop damage compensation scheme in 2015 (Finnish Agency for Rural Affairs, 2016). The household insurance rate is however high, with around 95 % of households insured (Finance Finland, 2014). The insurance coverage depends on the exact insurance. Typically the basic home insurances cover storm damages. Flood damages are covered to some extent by broad home insurances. Damages due to snow or ice load are not typically covered. Some insurance companies also offer coverage of forest damage caused by natural hazards. Even though wind throw in forests is a significant cause of damage, the number of forest owners and also the share of forest area covered by such insurances is quite low.

Legal framework

There are no legal definitions for exceptionality of a flooding or other natural event. Insurance companies typically consider flooding exceptional, if its water level is associated with events with an annual occurrence probability of less than 2%, i.e. a so-called return time of 50 years (Aarre, 2014). Official flood risk maps are publicly available to assess the risks. The insurance pricing is at the moment mainly a flat rate.

Although municipalities have responsibilities regarding mitigation of natural hazard risks, they do not have general legal responsibility to cover damages. In a case where the negligence towards legal responsibilities would be directly shown, the municipality could be ordered to cover certain damages. This far the administrative courts have however not made such rulings in cases of exceptional natural events¹². State Treasury is the insurer of all state agencies. Should a major disaster occur, budget reallocation on state level could be used to fund the recovery.

2.2.3. Legal scope of hazard and risk assessments

There are few specific risk assessments mentioned in legislation itself, but the broad responsibility assumed by authorities in practice means certain assessments are necessary. For flood risks, the law is more explicit and requires that preliminary flood risk assessments and identification of flood prone areas are updated every six years¹³. The regional the Centres for Economic Development, Transport and the Environment (ELY Centres) are responsible for these assessments (these ELY Centres are part of the state administration, not the municipalities). Municipalities need to take these assessments into account in accordance with flood risk guidance provided by the state environmental administration. The assessments are binding in the sense that the ELY

¹² Based on a project interview.

¹³ Law on flood risk management: <http://www.finlex.fi/fi/laki/alkup/2010/20100620> (in Finnish)

Centre can prevent development that it considers too risky or hazardous. The assessments themselves however do not contain clear limitations or restrictions.

In addition, municipalities are guided by the national land-use targets set by the state. These broadly state that natural risks and climate change adaptation needs to be considered in any land-use planning. The ambiguous nature of these goals means that few directly binding restrictions come out of them.

Other legally defined risk-assessments include the mandatory Environmental Impact Assessments (EIAs) and the post-disaster or post-near-disaster assessments by the Safety Investigation Authority. EIAs are used when evaluating the permits for a given construction project both during the initial permit evaluation and when assessing continuous activities. The ex post assessments by the Safety Investigation Authority can only make suggestions, not binding decisions.

2.2.4. Mitigation

The so-called national land-use targets set by the state guide the overall planning process. These targets stipulate that impacts of extreme weather, floods and other natural hazards need to be mitigated and the adaptation to climate change needs to be enabled. How this should be done is specified in guiding documents by the affiliated ministries, such as the guidebook “Preparing for floods in construction - Guide for defining the lowest building elevations in coastal areas” (Parjanne & Huokuna, 2014).

The actual zoning is largely in the hands of the municipalities. However, municipal decisions contradicting expert views on flood risk are likely to get repealed in court should lawsuits be engaged. Zoning is a slow process because of the ease to appeal. Decisions considered legal after appeal are very difficult to overturn.

For individual building projects “Rakentamismääräyskokoelma” (official collection of building codes) is the key regulation in Finland. The codes state that buildings need to take into account the climatological and hydrological conditions, but floods are the only natural hazards explicitly addressed in the collection¹⁴.

2.2.5. Awareness raising and education

The basic principle in Finland is that all officials distribute information openly and publicly. The strategy of the Ministry of the Interior states that preventive communication is developed and new media such as social media are utilized, but this remains to be applied in practice. The Ministry of the Interior also provides educational

¹⁴ See the full collection (in Finnish) online: <https://www.edilex.fi/rakentamismaaraykset>

material as does The Finnish National Rescue Association SPEK. In addition many municipalities and rescue departments provide guidance material.

The National Emergency Services College (Pelastusopisto) is the national training and education centre for different types of rescue workers, and also engages in international cooperation and service innovation.

Individual and corporate preparedness

In general the law requires everyone to be prepared for exceptional conditions, but the exact level of preparedness is not set. The Finnish National Rescue Association SPEK has produced guidelines for preparation and an extensive online material bank. The guidelines of Ministry of the Interior suggest stockpiling a week's worth of essential in households. Ministry of Defence has also produced guidelines for dealing with extended blackouts. (Electricity distributors are legally obliged to pay compensations to customers if they are without power over 12 hours. This 12 hours can thus be seen as a certain level of expected preparedness. The compensation amount grows as the blackout lasts longer¹⁵.) According to the interviewed experts there seems to be clear difference between the risk awareness and preparedness between rural and urban areas. Those living in big cities are not as well prepared for disruptions.

2.2.6. Information management and sharing

There are well developed natural hazard information available for professional users, while general public is somewhat less catered. The LUOVA system for authorities and other professional users provides two types of early warning services of different natural hazards:

- LUOVA announcements are prepared by FMI and distributed via email to subscribers.
- LUOVA warnings are sent via a centralized system in which FMI, SYKE and the Seismologic Institute (University of Helsinki) prepare warnings for hazardous events; recipients are the highest government officials and security authorities. Some types of hazards are monitored globally to enable warning of Finns and Finnish interests abroad.

The National Emergency Supply Agency maintains HUOVI information portal for preparation and mitigation measures by authorities and critical infrastructure operators. It also enables confidential information sharing between different

¹⁵ These limits are set in the law on electricity markets:
<http://www.finlex.fi/fi/laki/alkup/2013/20130588>

organizations within the service. Participation in the HUOVI system is voluntary (NESA, 2016).

The official citizen information portal (www.suomi.fi) has a section on preparedness, but it is basically only a link list to various information sources and is not limited to natural hazard management (nor does it cover this topic completely). Various official and non-governmental organizations working within natural hazard management have guidance websites for different hazards (for example SPEK, FKL, FMI). Privately maintained web site for disaster preparedness and management exists¹⁶.

2.2.7. Psychosocial support

The general responsibility for psychosocial support belongs to health and social services which are provided by municipalities (although this is changing by 2019 as discussed above). Psychosocial support is required to be addressed in municipal preparedness planning. In cases where municipal resources are not enough, the action can be escalated to national level in which case the responsible lead is the Ministry of Social Affairs and Health together with HUS - The Hospital District of Helsinki and Uusimaa and social services of the city of Vantaa in case of disasters taking place abroad (Ministry of Social Affairs and Health, 2009).

Main partners in the psychosocial support are the Finnish national churches (Lutheran and Orthodox), Finnish Red Cross and the Finnish Association for Mental Health. In major disasters the health service provider is responsible for management and coordination of response (incl. psychosocial support), but if local circumstances require a different approach, it can be delegated to social services or other actors.

2.3. Iceland

Key facts

- Population (2015): 330,000 *thereof 210,000 in the Capital area.*
- Area: 103,000 km².
- Population density: 3.2 *inhabitants / km²*
- GDP per capita (2014): 34,267 €, *current PPPs.*
- Main natural hazards: Earthquakes, volcanic eruptions (incl. glacial outburst floods), gravitational flows (avalanches, debris flows), storms, floods.

¹⁶ Site (in Finnish): www.poikkeustilanne.info

As of end 2015, Iceland has a population of ~330,000. About two-thirds of the population live in the Capital area¹⁷, which covers about 1% of the Icelandic territory. The population density is approximately 1 inhabitant/km² on the remaining 99% of Iceland. The mean age is 37.7 years. Due to fertility of around 2 children per woman and continuous positive net immigration, the Icelandic population is expected to reach 440,000 at the horizon 2065 (Statistics Iceland, 2016).

Located on the Mid-Atlantic Ridge, the country is widely exposed to earthquakes and volcanic activity (Sigmundsson, 2006; Nadim *et al.*, 2008; Gudmundsson *et al.*, 2008). The risk of direct fatalities due to volcanic eruptions is mostly limited to flood-prone areas that are located on the slopes of large, steep-sided ice-clad volcanoes such as Öræfajökull and Eyjafjallajökull, and subject to strong seasonal variations in population exposure (Pagneux, 2015) as a result of increasing tourist activities¹⁸. Located at the margin of the active volcanic belt and away from ice-capped active volcanoes, the capital area is safe from glacial outbursts and important tephra fall, but is at risk of significant toxic gas emissions should a long-lived, effusive eruption occur on the Reykjanes Peninsula. In the fjords, where most of the historical fishing communities can be found, the risk of fatalities and injuries due to natural hazards is mainly associated to gravitational flows, which have claimed more than one thousand lives since the time of settlements (Jóhannesson and Arnalds, 2001) — the highest death toll due to natural hazards in Iceland on land.

2.3.1. Governance

Iceland is characterised by the absence of intermediate, elected regional governments between the central government and the municipalities. The national policy on natural hazards is formulated and enforced at the upper level of the central government (ministries and belonging state agencies). State services such as police and administration are present locally in the form of regional jurisdictions.

Municipalities are legal entities whose right to self-governing is protected under article 78 of the Constitution of Iceland. The municipalities are not competent for monitoring natural hazards and have *de facto* a marginal role in assessing the risks but are acknowledged as key authorities in the mitigation and prevention effort in their quality of local governments responsible, within the limits of their jurisdiction, for matters such as civil protection, health, spatial planning, and education:

- In accordance with provisions given by national laws and regulations;

¹⁷ Reykjavík and satellite municipalities (Kópavogur, Hafnarfjörður, Garðabær, Mosfellsbær, Seltjarnarnes, Kjósarhreppur)

¹⁸ More than 6,500,000 annual overnights (300% increase from 2005) and 19,000 jobs as of 2015 (Statistics Iceland, 2016)

- Under the supervision of state agencies and in collaboration with the regional police (*Lögreglustjóraembætti*) and health state-services (*Heilbrigðisþjónustur*). Cooperation between the regional state services and the municipalities on these issues usually takes the form of mandatory local committees (e.g. civil protection committee).

Limitation to polycentric governance is not only of a legal nature as indicated above, but also and foremost of a practical one: many municipalities cannot effectively engage themselves in risk governance as a result of their size (

Table 1).

Difficulties of the smallest municipalities in performing local governmental functions and providing services comparable to those in the largest ones has led to a significant, voluntary reduction in the number of municipalities in the last 20 years (Table 2). In parallel, a forced reduction in the number of regional state offices has been engaged (Table 2).

Table 1: Evolution in the number and size of Icelandic municipalities. Source: Statistics Iceland.

Year	1998	2006	2015
Municipalities	163	101	74
Average size (km ²)*	630	1020	1390
Average population*	1700	3000	4500
Population ≤1000	131	69	40
Thereof with population ≤100	36	13	7

* Rounded figures

Table 2: Evolution in the number of administrative and police jurisdictions (state-run services) in Iceland. Source: Þorvaldssdóttir et al. (2008), National Commissioner of Police (2016).

Year	2008	2015
Administrative jurisdictions (<i>Sýslumannsembætti</i>)	27	9
Police jurisdictions (<i>Lögreglustjóraembætti</i>)	15	9

Regulatory authorities

The key authorities involved in the regulation on natural hazards in Iceland are the Ministry of Finance, the Ministry for the Environment and Natural resources, the Ministry of the Interior, the Ministry of industries of Innovation, and the Ministry of Welfare.

The Ministry for the Environment and Natural resources is the authority with the widest responsibilities as it formulates and enforces the Icelandic policy on environmental monitoring, environmental impact assessment, assessment of natural hazard risks, and mitigation (incl. spatial planning, building codes, defence structures, and

restoration). Financial risk-sharing mechanisms are ruled by the Ministry of Finance and the Ministry of Industries and Innovation. Civil Protection is the responsibility of the Ministry of the Interior. Formulation and enforcement of Icelandic policy on health, including emergency and long-term health issues associated with natural hazards, is the responsibility of the Ministry of Welfare.

Environmental monitoring

Monitoring of geophysical hazards is to a large extent the responsibility of the Icelandic Meteorological Office (IMO). According to Regulation 367/1996 (articles 2 and 3) and Act 70/2008 (article 3), IMO is responsible for weather forecast and weather-related warnings as well as for the monitoring and warning of gravitational flows, earthquakes, volcanic eruptions, storm surge, glacial outbursts and riverine floods, icing, and sea ice. IMO is also responsible for the following measurements: hydro-meteorology, glaciology, seismicity and crustal deformation, volcanic activity (magma migration, tephra fall, etc.), and pollution of air and water. The responsibility of monitoring of air and water quality on land is shared with the Environment Agency of Iceland. Monitoring of pollution at sea is the responsibility of the Icelandic Coast Guard. An extended list of the different state agencies involved in environmental monitoring is given in Table 3.

Assessing hazards and risks

Assessment of hazards and risks is performed by a core of key state actors including IMO, the Icelandic Institute of Natural History (IINN), Iceland Catastrophe Insurance (ICI), the Institute of Earth Sciences of the University of Iceland (IES-UI), and the Department of Civil Protection and Emergency Management of the National Commissioner of Police (NCIP-DCPEM) (Table 3).

As for monitoring, IMO is a statutory institute in the assessment of hazards and risks with a large mandate. The Icelandic Met Office is entitled to perform assessments for any kind of natural hazard risks on behalf of the Icelandic government (Act 70/2008). This includes gravitational flows, in cooperation with IINN (Act 49/1997; Regulation 505/2000), volcanic hazards (Act 22/2012), floods from rivers and the sea (Act 127/2014), as well as risk assessments on behalf of the Civil Protection.

The scope of assessments performed by IMO is mostly bounded to the identification of risks while NCIP-DCPEM mainly intervenes, as a key emergency response authority, during the subsequent risk characterisation phase, using information provided by IMO and others (Table 4). Participation of ICI to the risk assessment process is limited *de facto* to estimations of potential monetary losses due to direct damage to physical assets and valuables covered by the insurance scheme. Also not being a statutory body in the assessment of hazards and risks, IES-UI has established itself as a major actor in the identification of volcanic hazards. The participation of the

municipalities to the risk assessment process is in practice limited to establishing their own risk profiles, with the assistance of NCIP-DCPEM.

Due to fragmentation of knowledge and assessment mandates, vertical cooperation between key assessing actors is often needed, *nolens volens*, in performing comprehensive assessment projects. It has become a routine in the assessment of risks posed by volcanic hazards, as exemplified by Gosvá — the Icelandic Volcanic Risk Assessment Programme (e.g. Ilyinskaya *et al.*, 2015; Pagneux *et al.*, 2015). The lack of a corporate culture common to the different actors and significant differences of agenda are persistent obstacles to a higher level of cooperation.

Emergency Management

Emergency Management throughout Iceland, on land, in the air and at sea is the responsibility of NCIP-DCPEM. The local authorities are responsible for civil protection at the local level in conjunction with central government in accordance with the provisions of Civil Protection Act 82/2008.

Participation of non-governmental structures to monitoring, risk assessment, and decision-making

Consultation of the general public is a legal obligation during the elaboration of EIA and spatial plans. According to Planning Act 123/2010, the general public should be consulted in a way that ensures a true influence on the planning decisions. Regulation 660/2015 on Environmental Impact Assessment specifies that the general public should be given the possibility to formulate observations before the National Planning Agency delivers a statement.

Although not required by law, association of the public in monitoring and assessing natural hazards is not rare. Local population is factually associated to the collection of historical data in areas subject to risk assessments conducted by IMO (project-based) and results of hazard mapping projects presented to local stakeholders for examination before validation. Upon needs, the Icelandic Met Office (IMO) contact farmers at specific locations to collect information on water levels in rivers. On a permanent basis, IMO gives the general public the possibility to send information on ongoing or past meteorological events¹⁹, earthquakes²⁰, and gravitational flows²¹. Further implications of the public in monitoring are investigated as part of NORDRESS wp4.3 (participatory monitoring and warning).

¹⁹ IMO online reporting form: <http://www.vedur.is/vedur/skraning/>

²⁰ IMO online reporting form: <http://skraning.vedur.is/skra/jardskjalfra/>

²¹ IMO online reporting form: <http://skraflod.vedur.is/skra/snjoflod/>

Major volunteer organisations

The Major volunteer organisations are the Icelandic Association for Search and Rescue (ICE-SAR) and the Icelandic Red Cross.

ICE-SAR is a consortium of about 100 search and rescue teams all over the country and has about 18,000 members. The main activities of the consortium consist of search and rescue, patrolling, cleaning and valuable protection operations.

Table 3: Key aspects of natural hazard management covered by Icelandic state agencies.

Domains	State agencies
Building codes	Iceland Construction Authority
Civil protection	Icelandic Coast Guard National Commissioner of Police, Department of Civil Protection and Emergency Management
Defence structures	Soil Conservation Service of Iceland Icelandic Road and Coastal Administration Avalanche Mitigation Fund (financing)
Emergency management	National Commissioner of Police, Department of Civil Protection and Emergency Management
Environmental Impact Assessment (EIA)	National Planning Agency
Environmental monitoring	Environment Agency of Iceland Icelandic Coast Guard Icelandic Meteorological Office Institute of Earth Sciences, University of Iceland
Financial risk-sharing	Farming Rescue Fund Iceland Catastrophe Insurance
Hazard and risk assessment	Iceland Catastrophe Insurance Icelandic Institute of Natural History Icelandic Meteorological Office Institute of Earth Sciences, University of Iceland National Commissioner of Police, Department of Civil Protection and Emergency Management Avalanche Mitigation Fund (Financing)
Health issues	Directorate of Health

Maintenance / restoration of ecosystem services	Icelandic Forest Service Soil Conservation Service of Iceland
Spatial planning	National Planning Agency

Table 4: Key actors involved in the assessment sphere of risk governance in Iceland. Non-statutory actors are shown in italic.

Knowledge phase	Knowledge type	Key actors
Pre-assessment	Monitoring and early-warning	IMO
Risk identification	Hazard identification	IMO, IINN, <i>IES-UI</i>
	Risk estimation (likelihood)	IMO, <i>IES-UI</i>
	Exposure & vulnerability assessment	IMO, NCIP-DCPEM, <i>ICI</i>
Risk characterisation	Risk profile	NCIP-DCPEM, municipalities

Cross-sectorial cooperation between actors

Cross-sectorial cooperation on civil protection and security is steered at the highest level by the Civil Protection and Security Council (act 82/2008, article 3). The council is composed of top representatives from all the ministries and state agencies involved in the management of natural hazards along with representatives from the major volunteer organisations and the Union of Local Authorities.

Day-to-day cooperation between cross-sectorial actors can be nevertheless difficult, due in particular to the lack of harmonised databases and information flow insufficiently structured.

International cooperation

Iceland is signatory to the Hyogo Framework for Action 2005-2015 (United Nations, 2005) and Sendai Framework for Disaster Risk Reduction 2015-2030 (United Nations, 2015). The International Strategy for Disaster Risk Reduction of the United Nations (UNISDR), to which the two above-mentioned frameworks apply, is the base for all the risk assessment projects that have been conducted by the Icelandic Meteorological Office on behalf of the Icelandic government.

Although not being an EU member, Iceland has transposed many European directives, including:

- The EIA Directive (85/337/EEC) transposed in Iceland by Act 106/2000
- Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on public access to environmental information transposed in Iceland by Act 23/2006.
- Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE) transposed by Act 44/2011.

At present, there is no plan for implementing the Directive 2007/60/EC on the Assessment and Management of Flood Risks, although attempts of implementation were made during the short-lived, pre-accession process to the EU.

2.3.2. Financial risk-sharing mechanisms

Financial support against natural hazards is provided by (i) the Central State through a mandatory insurance scheme — Iceland Catastrophe Insurance — and a reserve fund, and (ii) private insurance companies on a voluntary basis. As for the monitoring and assessment of natural hazard risks (3.3.1), the role of the Central State is essential.

Iceland Catastrophe Insurance

The government plays the role of a direct insurer via the Iceland Catastrophe Insurance (ICI) mandatory scheme (Act 55/1992). A flat-rate premium is used that allows solidarity at the national level (Regulation 83/1993).

The natural hazards insured against are volcanic eruptions, earthquakes, landslides, snow avalanches, and floods of water either unforeseen or of which the likelihood cannot be ascertained (Regulation 83/1993). Definitions of hazards given in the regulation do not rely on quantitative thresholds, to the advantage of the insured parties. ICI is about to engage consultations with risk assessment experts on how the definition of perils could be improved²².

ICI is not willing to provide coverage against storms, which historically have been covered by the private sector. The policy is instead to provide coverage against natural hazards that the private sector is unwilling or unable to cover²³. The capacity of insurance companies operating in Iceland to negotiate premiums with reinsurers is certainly lesser than of ICI, which as a governmental special entity has more leverage to manoeuvre with reinsurers (The risks covered by ICI are ceded to 22 reinsurers)²⁴.

Coverage extends to all buildings and liquid assets that are fire insured with an insurance company having an operating license in Iceland, but also to some facilities irrespective of whether they are fire insured or not (Regulation 83/1993). Covering business disruption is excluded as the cost of disruptions could exceed the ICI bearing capacity in the case of worst-case scenarios, such as a widespread shortage of electricity caused by damages to hydropower plant facilities²⁵.

²² Interview 28 October 2015 with Iceland Catastrophe Insurance CEO

²³ *Idem*

²⁴ *Idem*

²⁵ *Idem*

In theory, ICI has a right of recourse against insured parties or third parties when the extent of damages caused by a natural event is due, in part or totally, to inappropriate engineering or land-use/spatial planning. In practice, ICI is reluctant to engage lawsuits as their outcome is much uncertain (as exemplified by procedures engaged in the past) and the cost of procedures significant²⁶.

Use of a flat-rate premium, lack of quantitative thresholds in the definitions of natural hazards, reluctance of ICI to engage laws suits — The ICI scheme looks particularly accommodating for the insured parties and may be regarded as an incentive to risk-taking behaviours in the long run.

The Farming Rescue Fund (Bjargráðasjóður)

The government also proceeds by budget allocation to *Bjargráðasjóður* — the Farming Rescue Fund — which is aimed at compensating damages to farm land (Act 49/2009). The fund is owned equally by the Icelandic State and the Farmers Association of Iceland) and aimed at providing financial assistance to individuals or organisations involved in farming activity:

- To parties as a result of damages caused to (i) assets subject to tax on the incomes of municipalities, fences, cultivated land, and electric lines necessary to farming, (ii) hay stock, and (iii) production loss due to exceptional cold, drought, damp weather, or winterkill.
- To individuals and organisations (excluding municipalities) for damages caused by disease, unusual weather, or accidents that are not imputable to careless actions of the parties eligible to assistance. Are compensated: (i) damages to livestock and derived products as well as (ii) production losses.

The fund is financed by tax paid by farmers, direct allocation by the Central State, and the fund bank interests. Compensation at the discretion of the Fund management board. Assistance is given through grants.

Private insurance companies

Insurable parties are free to subscribe to an insurance coverage against hazards not covered by ICI.

2.3.3. Legal scope of hazard and risk assessments

The scope of hazard and risk assessments performed in Iceland is not uniform. The legislation is embryonic in most cases, but seems to evolve quickly towards an upward

²⁶ Interview 28 October 2015 with Iceland Catastrophe Insurance CEO

homogenisation of scopes for all hazards covered by legal texts (A summary view is given in Table 5).

Level of compulsion

Risk assessments are required by law for gravitational flows only. According to Act 49/1997, it is an obligation to perform a risk assessment in inhabited areas and ski domains prone to gravitational flows (article 4) and assess the causes of every gravitational flow having led to injuries or fatalities (article 8). Assessments of flood risks (Act 127/2014) and volcanic risks (Act 22/2012) are in an exploratory phase at present and therefore are not compulsory.

Acceptable risk

Regulatory acceptable risk is defined in Regulation 500/2000 on the hazard assessment of gravitational flows, classification and use of risk zones, and making of preliminary risk assessment (articles 2 and 11). Transdisciplinary expert groups are currently working on the definition of acceptable risks for floods and volcanic hazards as part of new national risk assessment programmes (Acts 22/2012 and 127/2014).

Level of coercion (effect on land-use planning)

The legal effects of risk assessment conclusions on land-use planning are not perfectly clear. Planning Act 123/2010 specifies that exposure to natural hazards should be “taken into account” in land-use / spatial planning (chapter IV, article 12; chapter IX – article 45) while Planning Regulation 90/2013 states that plans should conform to risk assessment conclusions where available (article 4.3.1). However, the regulation does not specify whether the conclusions should come from a regulatory assessment only or also from an exploratory assessment. The possibility that assessment results may be binding for both types of assessments is introduced in article 5.3.2.18, where it is stated, without further explanation, that it is forbidden to build in areas prone to floods from lakes, rivers, and the sea.

Table 5: Legal scope of risk assessments for three populations of natural hazards significant to Iceland

	Gravitational flows	Riverine floods, storm surges	Volcanic hazards*
Legislation and Regulation	Mature	Embryonic	Embryonic
Risk assessment	Regulatory	Exploratory	Exploratory
Acceptable risk	Yes	Under investigation	Under investigation
Level of compulsion	Compulsory	Not compulsory	Not compulsory
Level of coercion	Binding	Advisory	Advisory

* Including glacial outburst floods

2.3.4. Mitigation

As for the scope of hazard and risk assessments, the nature and level of mitigation vary with the type of natural hazards present in Iceland (A summary view is given in Table 6). Overall, structural mitigation is largely preferred to land-use restrictions.

Building codes

Generally speaking, building supporting structures should be designed such as to withstand static and dynamic pressures in accordance with the EUROCODES and the Icelandic National Annexes to EUROCODES. The natural hazards specifically covered by the EUROCODES and the Icelandic annexes are fire, snow, wind, temperature, and earthquakes.

Avalanches are covered by building codes given in Regulation 505/2000 (article 19). Vulnerability of the building stock to volcanic hazards, particularly tephra load, is currently under investigation as part of the Gosvá volcanic risk assessment programme. Upon project completion, one may expect changes in the building codes for areas subject to critical tephra fall. Moisture is addressed in building regulation 112/2012 which specifies that buildings should be proof against damage due to (i) groundwater, soil moisture, rain, and snow, and (ii) condensation that could threaten building integrity, fully or in part, or threaten human health in the short and long term (article 10.5.1); whether and how the building stock located in flood-prone areas should be flood-proof designed or retrofitted is nowhere mentioned in this regulation.

Defence works

Defence structures are widely used in avalanche and landslide protection, as well as against floods from rivers and the sea and volcanogenic floods. Protection against snow avalanches is mainly ensured by recourse of public defence works owned by the municipalities. Participation of the municipalities to the structural mitigation effort is nevertheless modest as 90% of the building costs and 60% of the maintenance costs are supported directly by the Central State, via subsidies from the Avalanche Mitigation Fund.

Spatial planning

Mitigation by recourse of land-use restrictions is strictly required by the Planning Regulation (90/2013) for floods as well as for seismic and geothermal hazards: It is forbidden to build in areas known to be (i) at risk of floods from rivers, lakes, and the sea, (ii) located on faults or fissures, or (iii) close to geothermal sources (article 5.3.2), irrespective of considerations on the likelihood of events and their potency. Approved

municipal plans²⁷ or local plans not meeting this requirement are known in the case of floods, as a result of “local” interpretations not identified as such by the supervisory authorities. Indeed, information on the spatial grip of flooding events (either historical or scenario-based) made available to the municipalities by the key risk assessment state services is not always reported correctly by the local planning authorities in the plans submitted to approval by the ministry and not systematically consulted by the National Planning Authority as part of its supervisory operations.

Environmental impact assessment

EIA plans should feature information on land-use limitations / obligations resulting of the presence of natural hazards; in preliminary EIA reports, information on the natural hazards present in areas subject to plans should be featured.

Table 6: Mitigation of natural hazards in Iceland

	Building codes	Defence structures	Land-use restrictions
Earthquakes	Required	n.a.	Required
Gravitational flows	Required	Widely used	Required unless specified otherwise in local risk assessment conclusions.
Floods from rivers and the Sea	No regulatory coverage	Widely used	Required
Volcanic hazards	No regulatory coverage	Common for GLOFS*	Not required

* Glacial outburst floods

2.3.5. Awareness raising and education

Awareness raising and education relies essentially on education and warning material from NCIP-DCPEM, ICI, IMO, and IES-UI.

NCIP-DCPEM has made available education material on their website for use at school and home, and works with non-governmental organizations such as Kiwanis on campaigns to educate school children about natural hazards and response. The Civil Protection visits communities when some natural hazard situation is at hand with big open meetings in public places where people can come and meet Civil Protection officials and hazard experts. Large exercises are held regularly in districts in cooperation with civil protection local committees and police commissioners where

²⁷ Twelve-year term

contingency plans and response are tested. This applies especially for all airports in Iceland in cooperation with ISAVIA.

The Icelandic Red Cross participates in awareness raising with special campaigns urging households to have 3 days supplies ready at home in case of emergency situations.

2.3.6. Information management and sharing

Right of access to information and consultation of the public

The right of access to information on natural hazards is enacted by Act 23/2006 on the right of access to information on environmental matters, article 3 on the state of the environment, but is restricted to information that is neither prejudicial to private interests that should legitimately remained undisclosed nor to higher public interests (Act 50/1996 on Information, article 4 to 6). The right of access to spatial information on natural hazards addressed by Act 44/2011 (INSPIRE Directive), article 1.

According to Planning Act 123/2010, the general public should be consulted during the elaboration of land-use / spatial plans in a way that ensures a true influence on the planning decisions. Regulation 660/2015 on Environmental Impact Assessment specifies that the general public should be informed of the environmental impact of projects subject to EIA and given the possibility to formulate observations during the consultation process.

Source of information

Official information on natural hazards is provided by a core of state agencies and institutes (IMO, NCIP-DCPEM, IES-UI, Icelandic Road and Coastal Administration, Environmental Agency), using social media and cross referencing websites/mobile applications. The websites include cutting-edge web map applications featuring spatial information on various natural hazards, such as avalanches²⁸.

The feasibility of joint websites is under investigation by IMO and the Icelandic Road and Coastal Administration.

Warning protocols

Several warning protocols are used in Iceland. A single response-based, three-phase protocol (uncertainty-alert-emergency) is used by the Civil Protection. A danger-

²⁸ The app is available at: <http://en.ofanflodakortasja.vedur.is/ofanflod/>

based, 5-scale protocol²⁹ is used by the Icelandic Met Office for gravitational flows; use of a multi-hazard, awareness-based protocol similar to those used in the UK³⁰ and France³¹ is under investigation.

2.4. Norway

Key facts

- Population (2015): 5.2 million. 81 % live in urban areas.
- Area: 385,186 km²
- Population density: 13.5 inhabitants km²
- GDP per capita: 64,856 euros
- Main natural hazards: Storms, floods (including urban flooding), landslides, storm surge

There are 5.2 million people living in Norway, of which around 81 % live in urban areas ('tettsteder'). The median age is 38 years (2014 figures). The share of immigrants of the whole population is 13.4 % with higher shares in larger cities (for example 24.8 % in Oslo). The GDP per capita is 64,856 euros (2014 figures) and as such among the highest per-capita income in the world (Statistics Norway, 2016).

Norway has a rugged coastline that includes several fjords and islands. The coastline stretches from Skagerak in the south to the Barents Sea in the North and is about 25 000 kilometres long. The entire coastline is exposed to storms. The rugged and steep terrain makes Norway exposed to landslide, particularly in the western part as well as some areas in the north. The large inland rivers in the central south (Gudbrandsdalen) make this region particularly exposed to riverine flooding, but flood has caused damages in nearly every Norwegian municipality. Storm surge is causing damages along the coast which has particularly hit the southern parts of Norway. Due to more densely populated urban areas with impermeable surfaces and more rain burst events, urban flooding is an increasing problem in many urban areas (Haug *et al.*, 2011; (Torgersen *et al.*, 2014).

²⁹ The scale ranges from low to very high. More information at: <http://en.vedur.is/avalanches/forecast>

³⁰ Met Office warnings: <http://www.metoffice.gov.uk/public/weather/warnings/>

³¹ Meteo France warnings: <http://vigilance.meteofrance.com/>

2.4.1. Governance

The Norwegian natural hazard management regime is based on the principle of responsibility: whoever is responsible for an activity in normal conditions should maintain that corresponding responsibility, as well as initiating cross-sectoral cooperation, during exceptional conditions.

Three other principles guide the management as well. Principle of subsidiarity states that disturbances are dealt with at the lower possible administrative level and escalated only when necessary. Another principle is that the organizational structures dealing with crises and disasters should be as similar as possible to organizing in normal conditions. Finally, cooperation is stated as a general guiding principle (Norwegian Ministry of Climate and Environment, 2013).

Jurisdictional levels

The responsibility for natural hazard management is distributed to three levels of government (national, regional and local). On national level the Ministry of Justice and Public Security has overall political responsibility for disaster preparedness, supported by the Norwegian Directorate for Civil Protection (DSB). At the regional level the county administrative boards of 19 counties are responsible for the coordination of natural hazard management and to follow-up and to instruct the municipalities. The Planning and Building Act requires the county- and municipality governments to assess societal security issues in their planning, including risk and vulnerability assessments. Finally on local level the 428 municipalities are responsible for all civilian command and crisis management. Both county- and municipality governments are supported by DSB in their emergency preparedness planning.

In addition to the Ministry of Justice and Public Security and DSB there are other key state level actors with specified responsibilities. The Norwegian Civil Defence provides resources for operational support during emergencies and disasters and the Council for Emergency Preparedness in the Construction Sector, appointed by the Ministry of Trade and Industry, provides expertise and construction resources needed in clean-up of major natural hazard events (Norwegian Ministry for Climate and Environment, 2012). The Norwegian Ministry of Petroleum and Energy has the overall responsibility in flood and landslide prevention. The operational responsibility in these issues have however been delegated the Norwegian Water Resources and Energy Directorate (NVE). NVE has two main roles. First, it is responsible for national flood warning services. Secondly, it provides support and expert assistance in natural hazard management for other public authorities (DSB, 2013).

Volunteer organizations

Norway has a strong volunteer base, as non-profit and non-governmental organizations are highly involved in the civil security system. The Norwegian Red

Cross and the Voluntary Organizations' Forum for Rescue (FORF) formed by multiple NGOs working in civil defence are among the most important ones. Altogether the volunteer and non-governmental actors are estimated to have around 25 000 active members (Hollis and Ekengren, 2013).

2.4.2. Financial risk-sharing mechanisms

The costs of the damages due to extreme weather events are in Norway mainly covered by:

- National Fund for Natural Disaster Assistance if agricultural land, forest resources and private parts of infrastructure are damaged due to river flooding, storm, storm surge, or landslides.
- Norwegian Natural Perils Pool if buildings are damaged due to river flooding, storm, storm surge, or landslides.
- Individual insurance companies if buildings are damaged due to urban flooding.

A property that is insured against fire in Norway is also automatically insured against damage caused by natural hazards, such as storm, storm surge, flood, and landslides. It's worth noting that urban flooding is not considered a natural hazard, but a man-made condition. The fire insurance is mandatory (Ahvenharju *et al.*, 2011). Pricing is not risk-based, thus making the mandatory scheme a solidarity-based system.

The national Natural Peril Pool arranges the payouts which have been taken place since 1980. Storm dominates the payments, but riverine flooding represents about 1/3 of the costs for the period 1980-2014. However, there are considerable damages to private property due to rainfall that are covered by neither the fund nor the pool. The costs of these are estimated to be nearly 3.5 times as much as the payment due to riverine flooding. These losses, compensated by the primary insurers themselves, are the source of increasing concern for future climate scenarios with more frequent heavy precipitation. Already, insurance companies notice an increase in damages related to extreme weather events.

2.4.3. Legal scope of hazard and risk assessments

The Norwegian Building Act obliges planning authorities to ensure that a risk and vulnerability assessment is carried out in the preparation of any development plans. Flood risk assessments are part of these mandatory risk and vulnerability analyses (RVA) (Garne *et al.*, 2013). These RVAs also need to be undertaken every four years as part of the municipalities' general planning work. Should a major risk or vulnerability be identified, the plan should indicate such an area as requiring special consideration, and development can't be allowed unless safety is at an "acceptable" level (NVE,

2015). Land-use plans as well need to take into account risk and be prepared so that damage and loss prevention is taken into account (including prohibitions of area use)³².

Acceptable risk levels are based on frequency of exposure. They are thus more hazard-based rather than risk-based. For some hazards the risk zonation has been more flexible than for others³³.

While municipalities are responsible for the risk assessments, they often lack the skills and resources to conduct the RVAs. The Norwegian Water Resources and Energy Directorate (NVE) acts as a supporting expert and offers support such as flood and landslide risk maps as well as acceptable safety levels. The directorate recommends a risk assessment approach in which on the municipal plan potential hazards are identified; on zoning plan the actual hazards are described and their risk is quantified; and for individual building a satisfactory level of safety is documented. NVE can also object planning decisions where risks have not been taken into account to the necessary extent. Regional authorities (Fylkesmannen) can also reject the plans (Garne *et al.*, 2013).

2.4.4. Mitigation

Norwegian building codes have a specific chapter for acts of nature, requiring a satisfactory level of protection against damage or significant nuisance. Specific requirements are listed for protection against flooding, storm surges, avalanches and landslides.³⁴

2.4.5. Awareness raising and education

DSB is the main state level actor raising awareness regarding natural hazard management in Norway. It uses broad range of different media to raise awareness for different audiences. Examples include films for kids³⁵ and the information portal Kriseinfo.no that is used to disseminate both static information and dynamic forecasts. In practice municipalities are responsible for the awareness raising, and run drills and

³² Norwegian Planning and Building Act of 2008:

<https://www.regjeringen.no/en/dokumenter/planning-building-act/id570450/>

³³ Based on an expert comment.

³⁴ English translation of the regulation available online at:

https://dibk.no/globalassets/byggeregler/regulations_on_technical_requirements_for_building_works.pdf

³⁵ See more on DSB web site: <http://www.dsb.no/no/Ansvarsomrader/Opplaring-og-kompetanse/Filmer-for-barn/>

campaigns. Some municipalities with specific hazards also maintain own or joint monitoring web sites such as Åknes³⁶ and Kafjord³⁷.

The risk and vulnerability processes are part of the general planning process, and as such open to public commentary and participation. Legislation obliges municipalities to ensure participation by groups that require special facilitation such as children and youth³⁸.

Education on civil security matters is provided by the National Emergency Planning College (NUSB) that provides various courses for public officials and volunteers. NUSB is managed by DSB, which also supervises the courses offered by the Norwegian Civil Defence (Hollis & Ekengren, 2013).

2.4.6. Information management and sharing

Information sharing between the public and private actors has been perceived to be limiting in preventive work. While insurance companies collect damage data, this is not accessible for municipalities and does thus not guide effective risk management in planning.

2.4.7. Psychosocial support

Municipalities have the main responsibility for provision of psychosocial support. According to the guidelines prepared by the Directorate of Health on psychosocial interventions in crises, accidents and disasters, municipalities should establish emergency teams to provide psychosocial care. These emergency teams should be connected to other municipal contingency work³⁹.

In addition to the municipal and state level offices, there are five regional resource centres for psychosocial support (RVTS) and the Center for Crisis Psychology in Bergen that conducts research and provides education on the topic but also does clinical work and emergency preparedness agreements to companies and organizations⁴⁰.

³⁶ Site available at: <http://www.aknes.no/>

³⁷ Site available at: <http://www.kafjord.kommune.no/>

³⁸ The Norwegian Planning and Building act of 2008
<https://www.regjeringen.no/en/dokumenter/planning-building-act/id570450/>

³⁹ The Norwegian Directorate of Health: <https://helsedirektoratet.no/folkehelse/psykisk-helse-og-rus/psykososial-oppfolging-ved-ulykker-kriser-og-katastrofer>

⁴⁰ Center of Crisis Psychology: <https://krisepsyk.no/english>

2.5. Sweden

Key facts

- Population (2015): 9.8 million. 85 % live in urban areas.
- Area: 450,295 km²
- Population density: 21 inhabitants/km²
- GDP per capita: 44500 euros
- Main natural hazards: Floods, storms, landslides

Sweden is the largest Nordic country both in terms of land area and population. There are 9.8 million people living in Sweden, of which around 85 % live in urban areas. The median age is 41.2 years. Sweden has drawn more immigrants compared to the other Nordic countries and about 15 % of the population is foreign born. The GDP per capita is 44500 euros and during recent years Sweden has been able to maintain one the highest economic growth figures in Europe.

The geography of Sweden ranges from low-lying coasts in the south to the Scandinavian mountains in west and north, causing a diverse hazard landscape. Coastal and riverine floods, storms and landslides all occur and forest fires are a considerable risk as well. Flooding (including urban flooding caused by heavy rainfall) and storms are the costliest phenomena.

2.5.1. Governance

The Swedish natural hazard management regime is based on the principle of responsibility: whoever is responsible for an activity in normal conditions should maintain that corresponding responsibility, as well as initiating cross-sectoral cooperation, during exceptional conditions.

Jurisdictional levels

The responsibility for natural hazard management is distributed over three levels of government (national, regional and local). On national level the Ministry of Justice has overall political responsibility for disaster preparedness. At the regional level the county administrative boards of 21 counties are responsible for the coordination of natural hazard management, including risk and vulnerability analyses. Finally on local level the largely autonomous 290 municipalities are responsible for all civilian command and crisis management. The Swedish jurisdictional levels are illustrated in Figure 3.

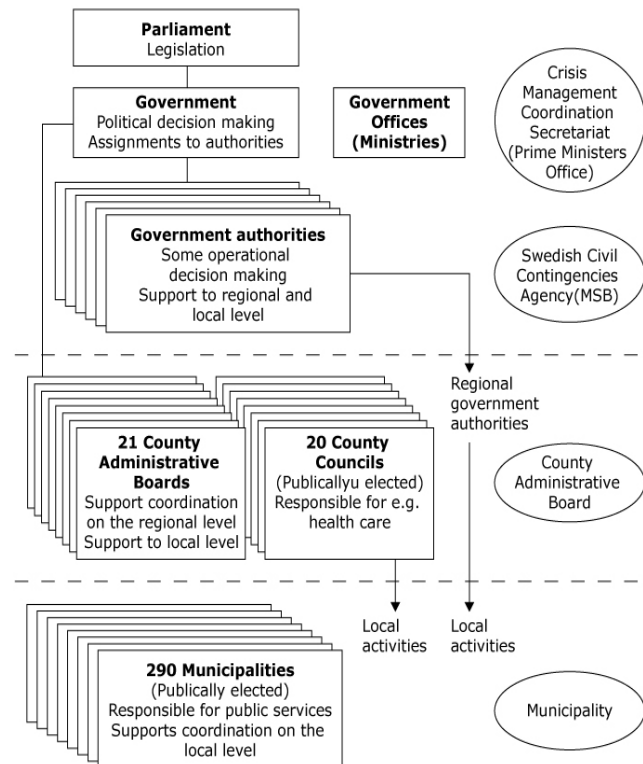


Figure 3: Swedish jurisdictional levels in natural hazard management (Source: the European Commission Vademecum Portal⁴¹)

In contrast to this otherwise decentralized nature of the Swedish approach there is a designated agency responsible for coordinating the civil emergency planning. The Civil Contingencies Agency (MSB) Swedish is also responsible for the holistic review of emergency and disaster management in Sweden and for all hazards. MSB works in close cooperation with key public and private actors on all administrative levels and is also tasked to monitor and assess the effectiveness of natural hazard management system and measures. The role of MSB could be described as being both responsible for everything and nothing. On one hand all authorities are responsible for their fields of administration, on the other MSB should coordinate the regime as a whole and work to correct the gaps in preparedness.

⁴¹ http://ec.europa.eu/echo/files/civil_protection/vademecum/se/2-se-1.html

Major volunteer organisations

Non-governmental organizations such as non-profit associations, religious communities and volunteer organizations have an important role in Swedish natural hazard management. 18 voluntary defence organizations have an official national role stated in the regulation. These organizations possess skills, people and resources useful such as civil defence, aviation, vehicles and engineering, and have altogether over 400,000 members (Bakken & Rhinard, 2013). The Swedish Red Cross is among the 10 organizations. MSB is the public body responsible for coordinating the co-operation with volunteer organizations and also provide general and task specific funding to them⁴². An organized cooperation framework exists also at the local level. Municipalities can set up voluntary resource groups to facilitate the collaboration between the municipality and available volunteer resources.

While the frameworks for collaboration between public and volunteer organizations exist, the activities are mainly related to response and recovery. As mentioned in our questionnaire, the NGOs are not as much engaged in preventive work at the moment.

Cross-sectorial cooperation between actors

The principle of responsibility and the coordinating role of MSB provide the main basis for cross-sectorial cooperation in Sweden. MSB administrates six Forums for Crisis Preparedness (FCP) that are each responsible for improving preparedness and reducing vulnerability by bringing together the relevant authorities to exchange information and to participate in national and international projects and in collaboration with private stakeholders. The FCPs are structured around the following themes: Technical infrastructure; Transportation; CBRNE; Economic security; Protection, rescue and care; and Geographic responsibility (MSB, 2014). The Swedish Geotechnical Institute (SGI) is however not part of these FCPs and subsequently the geotechnical hazards (such as landslides) are excluded from the FCP work.

MSB is also involved some local level activities, an example being River coordination groups. These groups bring together stakeholders sharing a river's drainage basin. MSB initiates the groups but County administrative boards are responsible for convening them (MSB, 2010).

The national implementation of Hyogo framework for action in Sweden focused on creating national networks and forums that bring together relevant authorities. Altogether 17 agencies and organizations are involved, with MSB serving as the focal point and coordinator. The action plan set for the period of 2013-2015 also included some measures to gather more risk and vulnerability data and support information sharing among stakeholders (MSB, 2010). The Hyogo framework driven National

⁴² MSB web site: <https://www.msb.se/sv/Forebyggande/Frivilligorganisationer--trossamfund/>

platform for natural disasters no longer exists and the discussions on the successive arrangements based on Sendai framework is still ongoing.

2.5.2. Financial risk-sharing mechanisms

The financial risk sharing relies largely on private insurances, as there are no national compensation schemes for individuals or industries. There is also no insurance pool system in place and individual insurance companies cover natural hazards. 95 % of households have home insurance (Insurance Sweden, 2015). Pricing for households and SMEs is flat, but larger commercial and industrial insurance contracts can be risk based. Insuring is voluntary and the comprehensive household insurance covers natural hazards with the exception of water entering through roofs or walls (Garne *et al.*, 2013).

Municipalities are liable for water management in drainage systems. If an insurance company can prove damage caused by insufficient technical preparedness, it can file a recourse claim (Garne *et al.*, 2013).

National subsidies

There exists a national subsidy scheme for preventive measures undertaken by municipalities for built-up areas. Municipalities can apply for a subsidy from an annual budget allocation for example to construct embankments and dykes, install pumping equipment or to stabilize slopes to prevent landslides. Compensation for recovery measures is also possible: a municipality hit hard by a natural disaster has the right to claim state compensation if the costs exceed the capacity of the municipality (MSB, 2009).

2.5.3. Legal scope of hazard and risk assessments

In Sweden, all government agencies are expected to produce their own annual risk and vulnerability analyses. This responsibility covers regional level as well, and county administrative boards conduct annual risk and vulnerability analyses too. These are based on the analyses conducted on the local level by the municipalities. The municipalities however are expected to carry out risk and vulnerability analysis once per every term of office. These analyses also affect zoning decisions and the municipalities have the power to refuse development of areas considered too risky. The municipalities are responsible for general safety and are expected to take the identified risks into consideration. There are also occasion in which a municipality has decided to demolish property damaged by flood instead of rebuilding it.

MSB provides guidance for the risk and vulnerability analysis work. In addition MSB collects information on and analyse past hazardous events. The agency maintains and databases that combine the description of the event with the response information and

damage data (including economic losses). These analyses do not directly result in any binding decisions, but are used in risk and vulnerability assessments and preparedness work. MSB also compiles and maintains general flood maps for built areas at risk close to watercourses, and carries out general stability mapping in areas with existing buildings in order to prepare for landslides (MSB, 2009).

2.5.4. Mitigation

Municipalities have broadly defined responsibility to take natural hazards into account in their land use planning. According to 1§ of the *'Act on Measures to be taken by Municipalities and County Council in Preparedness for and during Extraordinary Incidents during Peacetime and Periods of Heightened Alert'* (2006:544), local and regional governments shall analyse the extraordinary events that can occur in times of peace and how these events can affect their own activities. The result of the work should be evaluated and compiled in a risk and vulnerability assessment. The risk and vulnerability analyses mentioned above form the basis for this. MSB has produced guidance material on how to actually conduct the analyses, but the actual process is not regulated in detail (MSB, 2012). The large autonomy of the municipalities results in difference between how risks are analysed and also how they are in practice managed. There is for example variance in the standards set for sewer system (Garne *et al.*, 2013).

In building codes the only specifically mentioned natural hazard is flooding, but the codes oblige buildings to be designed so that environmental conditions are considered (including possible changes required by changes in conditions)⁴³. Climate change adaptation is not directly addressed in the building codes. The EIA legislation does not specifically label natural hazards, but naturally requires taking likely risks into account.

2.5.5. Awareness raising and education

The responsibility for providing public with risk and preparedness information follows the principle of responsibility as well. In principle municipalities and counties are responsible for communicating risk information to their residents (Bakken & Rhinard, 2013). MSB is tasked to assist in this and in practice MSB is probably the most active authority in awareness raising. The agency runs for example online information services and social media campaigns. Most prominent web service is DinSäkerhet.se portal that combines together all relevant natural hazards and other civil safety information. The site also has guidelines for household preparedness. If necessary, MSB can utilize traditional media broadcasters in order to reach wider audience.

⁴³ See full building codes on Boverket web site: <http://www.boverket.se/>

MSB has the task of providing support and training to help key public and private entities to manage natural disasters. MSB collaborates with schools to provide preparedness education. In addition to this, hazard teaching is part of curricula in Sweden (Komac *et al.*, 2010).

2.5.6. Information management and sharing

MSB maintains two decision-support systems that are aimed for authorities and professional users but are in principle open for anyone: WIS and RIB. WIS is an internet-based nationwide information system, with the idea to facilitate information sharing before, during and after emergencies between different organizations involved in the Swedish emergency management. The Integrated Decision Support system RIB combines an extensive material library on chemicals with dispersion models, risk management tools and a command and control system (MSB, 2009).

For the general public the main information sharing service is DinSäkerhet.se portal (see above). For emergencies there are also direct warning systems in place that utilize sirens and co-operation with commercial and state TV and radio channels. This is facilitated by MSB (MSB, 2009).

2.5.7. Psychosocial support

In the Swedish model responsibility for health care is mostly distributed to the regional level to the County Councils and a number of more recently formed Regions (which assume the healthcare responsibilities of the County Councils as well as transport infrastructure and regional development initiatives. Yet the most of the work of the County Councils and Regions is related to health care and social services. On the state level the National Board for Health and Welfare (Socialstyrelsen) is the lead authority on health care and social services. During a disaster event the role of the Socialstyrelsen is to support the counties with equipment and expertise.

3. Discussion: Nordic model of natural hazard management

The natural hazard management regimes in the Nordic countries share many similarities but also differ in some of the ways activities are organized and risks are addressed. Information collected through questionnaires and interviews suggests that there are no huge deficiencies or problems in any of the countries scrutinised. The issues identified pertain mainly to cooperation between different jurisdictional levels or cross-sectorial actors, or the balance between mitigation measures, preparedness and response.

Despite differences some principles seem generic. Firstly, in all countries potentially affected organisations and authorities are in the first place supposed to cater for their own preparedness, i.e. involving crisis management plans and, at least, a notion of the relevant risks. The protocols in principle also prescribe under what conditions what other organisations have to be informed and activated, and usually indicate under what conditions crisis management responsibility has to be scaled up and transferred to or shared with other organisations. Yet, protocols may not always be clear enough and/or exceptional situations are not well covered by existing protocols. So, whether these principles actually play out in practice is a different story.

A second common feature is polycentric governance, manifest through both administrative (Ribot, 2002) and political (Larson, 2004) decentralisation. Regional state administrations and local governments have a major role and extensive decision power in many of the discussed domains. Subsidiarity is the guiding governance principle, meaning that problems should be managed from the lowest possible administrative and/or governmental level. The role of state agencies such as DEMA or MSB is often limited to information steering, collaboration facilitation and providing expert support instead of having major authority or power over local institutions. This decentralization enables flexible legislation and locally adapted measures, but can lead to diversity in the quality and extent of hazard management, not the last due to insufficient sharing of information. Subsidiarity can also help in managing the differing conditions of urban and rural areas, but one risk is over-burdening small counties or municipalities with rigid legal responsibilities, which they are unable to manage. In urban areas the risk can be remote relationship between citizens and authorities. Many authorities share the worry that as urbanization progresses the risk awareness and preparedness of the general public decreases.

The following sections discuss common and differing elements within the Nordic countries in each of the domains. The aim is not to provide a complete cross-country comparison but to point out key similarities and differences, as well as identify potential good practices.

3.1. Governance

The overall governance structures in the Nordic countries resemble each other. A high level of regional and municipal autonomy is a distinctive feature of Nordic governance, although there are slight variations. As Table 7 shows, Denmark, Norway and Sweden have a form of three-tier territorial governance, whereas Finland and Iceland have two jurisdictional levels, though Finnish national authorities may have regional offices. For Finland, the two level system is about to change into a three level one as a regional reform is under preparation. In all of the countries, state administration has also regional branches and responsibilities, so state is not responsible only for national level actions.

The branch of governance responsible with overall or major responsibility for natural hazard management differs between the countries, but in practice co-operation is the basis in all of them. In this sense, drawing governance schematics may not be the proper way to describe governance system. Instead the actual level of co-operation between actors is the key.

Denmark, Iceland, Norway and Sweden have a designated national agency with a broad mandate in disaster preparedness and response, Finland doesn't. Again, the mere existence of such an organisation does not necessarily tell much about its effectiveness or functionality. However one beneficial aspect of these agencies is typically improved clarity and access to general natural hazard risk and preparedness information.

Table 7: Summary of governance structures in the Nordic countries

	Denmark	Finland	Iceland	Norway	Sweden
Government levels	Central State Regions Municipalities	Central State Municipalities (Regional level of governance to be introduced in 2018)	Central State Municipalities	Central State Counties Municipalities	Central State Counties Municipalities
Ministries with major responsibility	Ministry of Defence	Ministry of the Interior	Ministry for the Environment and Natural Resources Ministry of the Interior	Ministry of Justice and Public Security	Ministry of Justice
Central Civil Protection and Emergency Management organization	Danish Emergency Management Agency (DEMA)	No central agency.	Department of Civil Protection and Emergency Management of the National Commissioner of Police (NCIP-DCPEM)	Directorate for Civil Protection and Emergency Planning (DSB)	Civil Contingencies Agency (MSB)

3.2. Financial risk-sharing mechanisms

There are considerable differences between the financial risk-sharing mechanisms between the Nordic countries. Denmark, Iceland and Norway have official, national insurance schemes that are either defined in legislation or completely state backed. These systems also involve mandatory participation. Finland and Sweden do not have such schemes in place, but the compensations are instead based on voluntary insurances. Almost all households are insured with home insurances, but not all of the basic insurances cover natural hazards comprehensively. Insurance cover of forest damages has been lower, but the recent severe storms have increased the rate of insurance. In 2015 40 % of Finnish private forests and 90 % of Swedish private forests were covered by forest damage insurance (Penttilä, 2015).

Despite these differences the compensation in each country could be described as being solidarity-based. The prices for insurances do not reflect the actual risk levels. Thus, the main incentives guiding risk taking are not stemming from insurance pricing

but are based in land-use and building restrictions instead. There are however cases of uninsurable property due to e.g. flood risk.

Table 8: Summary of financial risk-sharing mechanisms for natural hazards in Nordic countries

	Denmark	Finland	Iceland	Norway	Sweden
Public insurance schemes	Public storm surge scheme managed by Danish Storm Council with state backed extra funding opportunity	None (National flood and crop damage schemes ended recently)	Iceland Catastrophe Insurance (ICI) Farming Rescue Fund	Norwegian Natural Disaster Fund Natural Perils Pool	None
Level of compulsion for home insurances	Mandatory purchase	Voluntary purchase (95 % coverage)	Mandatory purchase	Mandatory extension	Voluntary purchase (95 % coverage)
Pricing	Risk-based or flat rate Preventive measures taken into account	Flat rate	Flat rate	Flat rate, but some risk considerations	Flat-rate for households Risk-based for commercial/industrial clients.
Hazard coverage	Storm surges, coastal flooding	Home insurance coverage varies: most cover exceptional storms and flooding	Volcanic eruptions, earthquakes, landslides, snow avalanches, floods of water	Riverine flooding, storms, storm surges and landslides (urban flooding excluded)	Home insurance coverage varies, typically covers natural hazards.

3.3. Assessment and mitigation of risks

National and local governments are responsible for the physical safety of their residents in all of the Nordic countries, but this is reflected in legislation in different ways. Denmark, Norway and Sweden require the municipalities to conduct regular risk and vulnerability analyses, whereas in Finland and Iceland such assessments only consider selected hazards. As the EU is increasingly stepping up crisis management legislation and common standards, it gains influence, promotes minimum standards and convergence in approaches across Member States and Associates Countries (e.g. EU's Programme for European Critical Infrastructure Protection (EPCIP) (European Commission, 2013) and the EU Internal Security Strategy in Action (European Commission, 2010).

Nordic countries have been proactive in developing climate change adaptation plans. National and local action plans exist as well. There are few if any mentions about climate change in particular in the legislation framing land-use and construction. Existing climate legislation focuses mainly on emission mitigation. Whether or not adaptation has been mainstreamed to local planning and building is thus not clear from legislation; it depends on practical actions on local scales (which are likely to differ substantially).

Similarly, specific levels for acceptable risks rarely exist in the national legislations. Iceland and Norway have some defined, but typically these are defined case-by-case by authorities based on expert advice from organizations such as IMO, FMI or NVE. According to our questionnaire, the outcomes are not always clear or easily predicted.

Table 9: Summary of land-use, mitigation and risk management legislation

	Denmark	Finland	Iceland	Norway	Sweden
Regulatory risk assessments (excl. EIA/SEA)	Municipalities required to complete risk mapping and prepare adaptation action plans	Municipal flood risk assessments every 6 years	Gravitational flow risk assessments for inhabited areas and ski domains	Mandatory risk and vulnerability analysis for municipalities every 4 years and for any development plans	Mandatory municipal risk and vulnerability analyses per term of office Annual analyses for government offices and counties
National climate change adaptation strategy	Adopted	Adopted	Adopted	Adopted	Adopted ⁴⁴
Climate change in local planning and building	Climate change adaptation plans required as part of municipal level planning	National land-use targets for areas require adaptation measures	Not explicitly included	Not explicitly included	Not explicitly included
Regulatory acceptable risk	Not defined	Not defined	Gravitational flows	Some defined, based on frequency of exposure	Not defined

⁴⁴ There is no national strategy per se, but instead the Energy and climate bill from 2008 has similar elements. Each of the 21 counties also has climate action plans.

3.4. Awareness raising, education and information management

Public access to information is guaranteed by law broadly in all Nordic states and typically the authorities involved in natural hazard management also have specific duties related to awareness raising and education. Countries with central natural hazard management agencies have also introduced official preparedness information portals; although in Denmark the service was discontinued in 2012. In Finland, this type of information content is dispersed on multiple sites maintained by officials and NGOs. Some of the early warning systems are only aimed for professionals (such as LUOVA in Finland) while others are in principle open for anyone interested.

It is perhaps notable that a Nordic joint online tool for general public to manage weather related natural hazards also exists. VisAdapt⁴⁵ was developed in a Nordic project led by Linköping University.

Table 10: Summary of awareness raising and information management and sharing

	Denmark	Finland	Iceland	Norway	Sweden
Official preparedness information portals for general public	Kriseinfo.dk closed in 2012, now DEMA web site	No official one	NCIP-DCPEM site Almannavarnir.is (almannavarnir.is)	DSB-maintained Kriseinfo.dk www.kriseinfo.no	MSB-maintained DinSäkerhet.se
Operational natural hazard communication portals	DEMA portal at brs.dk (Also mobile warning app available)	LUOVA early warning system for authorities and professionals National Flood Center information service	Several real-time risk and hazard maps on IMO-maintained Vedur.is NCIP-DCPEM Warning service	-	WIS-portal maintained by MSB
• International	METEOALARM (joint warning system for adverse weather circumstances initiated by EUMETNET and the WMO)				
Public climate risk and adaptation services	Climatology and climate impact prediction portal Klimatilpassning.dk.	Climate information portal ClimateGuide.fi	-	Climate adaptation portal http://www.klimatilpassning.no/	Climate adaptation portal http://www.klimatilpassning.se/

⁴⁵ Service available at: <http://visadapt.info/>

4. Concluding remarks and next steps

The Nordic countries share certain internationally recognized characteristics, such as welfare state legacy, promotion of transparency, and the inclination to bottom-up governance approaches. In this context, it is no surprise that the institutional arrangements for natural hazard management have formed along similar lines, although specific details vary for both historical reasons and due to hazard scope differences. The hazard landscape is diverse and the legislation and practices in each country reflects these differences.

Taking into account these premises, it is no surprise that the institutional approach to natural hazard management in Nordic countries is quite systematic and comprehensive. However, the key challenge in both gathering information and coordinating actions is to reach a holistic, system-level view of the dynamics involved. Especially three aspects rise that are critical, but easy to miss in evaluating the natural hazard management regimes:

- 1) *Hiatus between principles and practices.* The reality of the processes, responsibilities and roles in the field is sometimes further from laws, regulations or official statements. It is not rare, for instance, that local governments lack the human and financial resources required to fulfill their legal obligations. Conversely, effective grass root-level practices sometimes exist despite the lack of clear mandatory responsibilities and roles.
- 2) *Implicit incentive structures.* Nordic governance models and regulation often combine broadly defined responsibilities with detailed requirements and distributed authority. This can lead to dynamics such that the built-in, implicit incentives focus resources ineffectively or even lead to maladaptation instead of working towards overall risk mitigation and preparedness.
- 3) *Connections to wider development.* While climate change is often acknowledged in natural hazard management, if not always acted upon, other significant socio-technological trends may easily be omitted. Demographic segmentation, technological innovations, shifts in media use and other behavioural shifts can have major impacts on the risk landscape of natural hazards, even if the hazards themselves remained the same. In changing conditions the confidence on existing systems with good track record may backfire.
- 4) *New flows of data and information.* The increasing connectivity throughout the society stemming from social media services, internet of things and ubiquitous computing and observations create a new and more complex landscape for

natural hazard management and may change the degree of control over responses.

Combining data from literature and expert opinions, this report tries to paint a picture of Nordic natural hazard management that takes into account these three challenges. In doing so, we have identified certain shared aspects within the countries. This could be considered as a Nordic Model for Natural Hazard Management that builds upon shared responsibility, locality and open information flows. These ideas will be further developed in future NORDRESS work. The country specific analyses will also be complemented with more thorough SWOT analyses in the next phase of WP6.1.

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Annexes

I – Expert questionnaire summary

II – Helsinki workshop memo

III – List of interviewees

IV – Additional country reviews outside the Nordic realm (separate Annex to be published later)

I - Expert questionnaire summary

To complement literature based sources used to review natural hazard management systems in the Nordic countries, an online expert questionnaire was conducted. The questionnaire was aimed at 114 experts identified by the project group to represent various domains and different (Nordic) countries. The questionnaire had five sets of questions: General governance, financial risk sharing, land use, health and risk awareness and communication that were then targeted to respondents based on their expertise. Altogether 47 responses were collected during fall of 2015. In addition to the multiple choice questions, many open comments were collected and proved more useful for the final analysis.

The following summary presents selected results from the questionnaire. Financial risk sharing and health are not presented because of the modest number of quantitative responses.

Respondent profiles

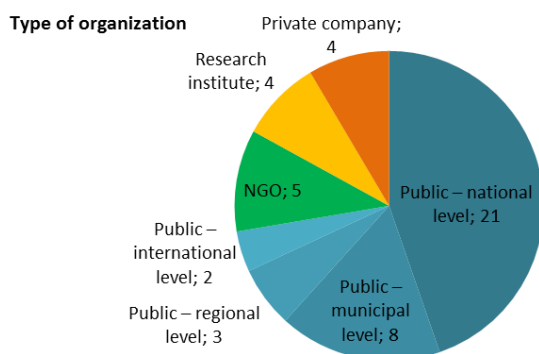


Figure 4: Types of organization represented

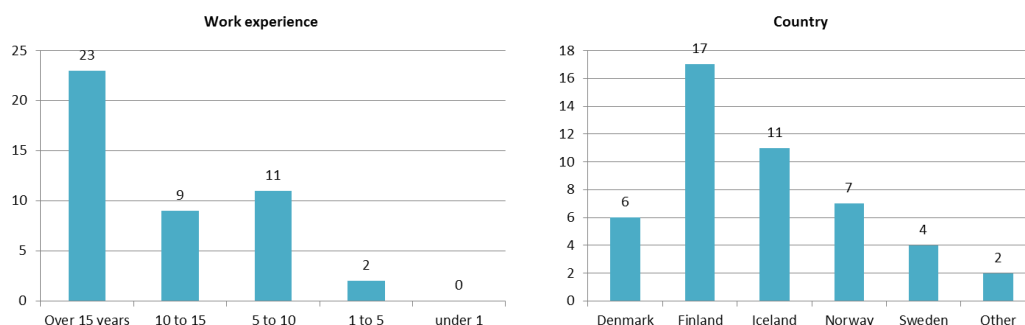
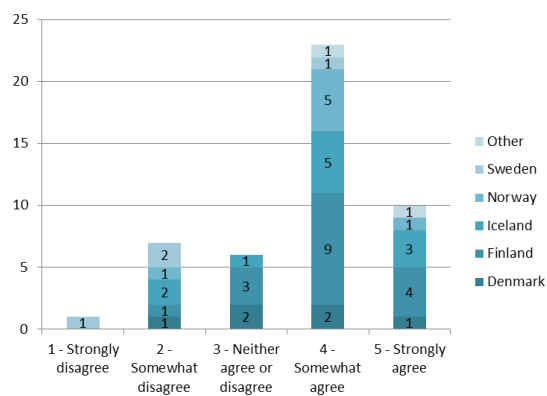


Figure 5: Work experience and country of residence of the respondents

Governance

"The distribution of responsibilities among authorities in natural hazard related risk management is clear "



"The distribution of responsibilities among authorities in natural hazard related risk management is efficient. "

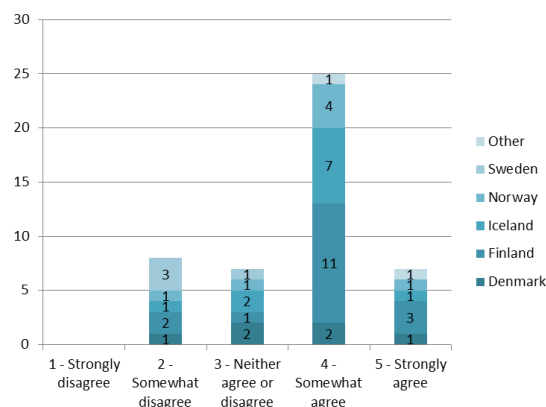
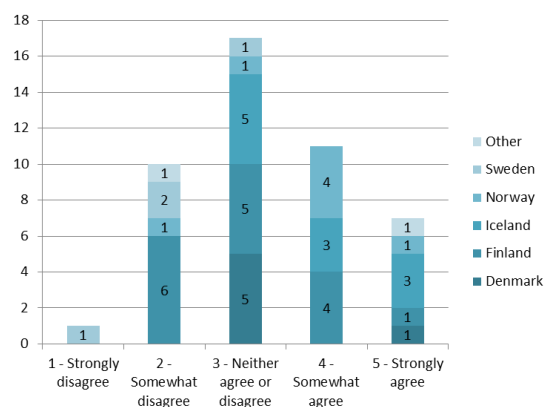


Figure 6: Most of the respondents agreed strongly or somewhat that the distribution of responsibilities is clear and efficient.

"The co-operation between public and private organizations (including private enterprises and non-governmental organizations) in natural hazard related risk management is efficient."



What is the most relevant framework for international co-operation in natural hazard related risk management?

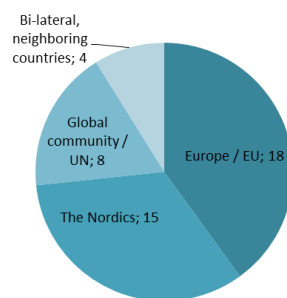


Figure 7 (Left) Less than half of the respondents considered public-private co-operation efficient. (Right) Europe and the Nordic countries were typically considered most relevant international connections.

"Current national scheme for disaster risk management of natural hazards is effective in..."

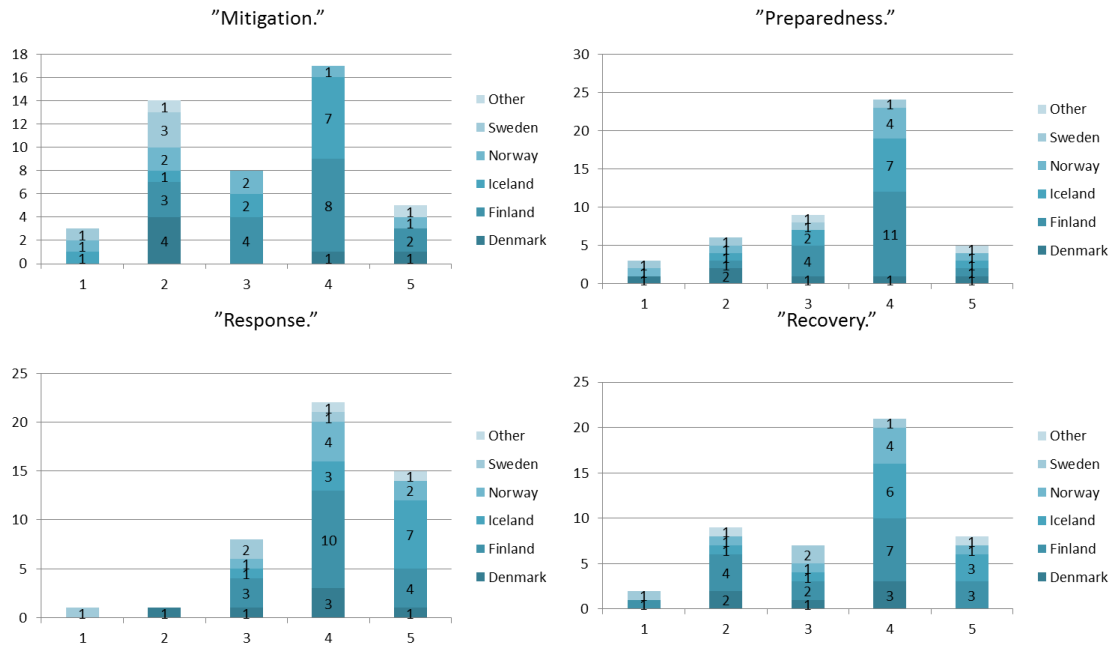
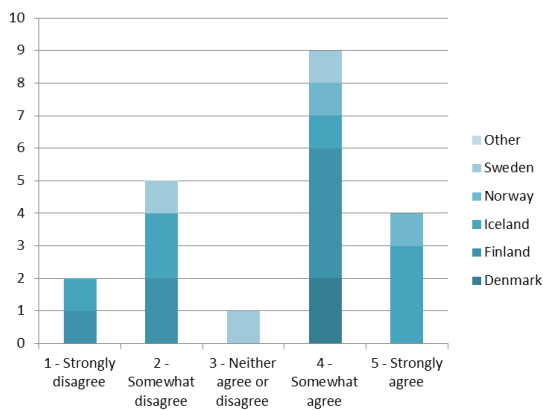


Figure 8: Effectiveness of mitigation was considered lower than of preparedness, response and recovery.

Land use

"Risk assessments required by law for operating and building major infrastructure are adequate to manage the risks posed by natural hazards."



"Risk assessments (such as those included in environmental impact assessments and/or supporting risk zoning) are adequately taking into account environmental changes."

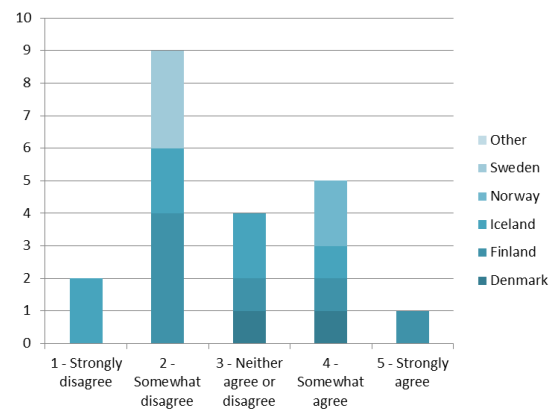
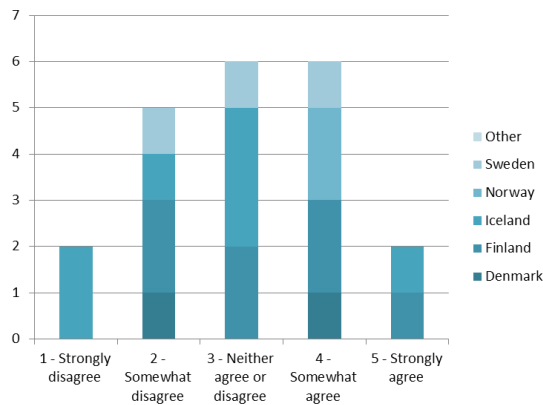


Figure 9: Some respondents considered the level and quality of risk assessments inadequate.

"Possible environmental changes are adequately considered in building codes."



"Clear definitions of acceptable risks exist in the regulation."

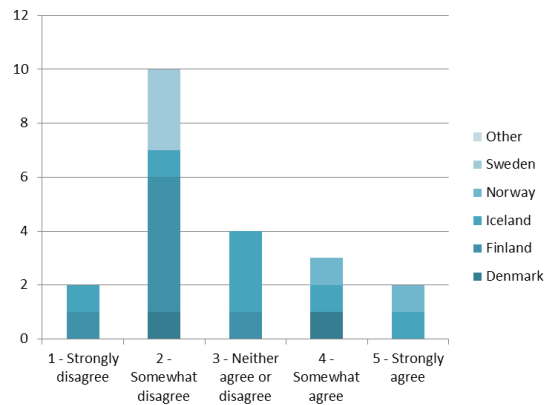
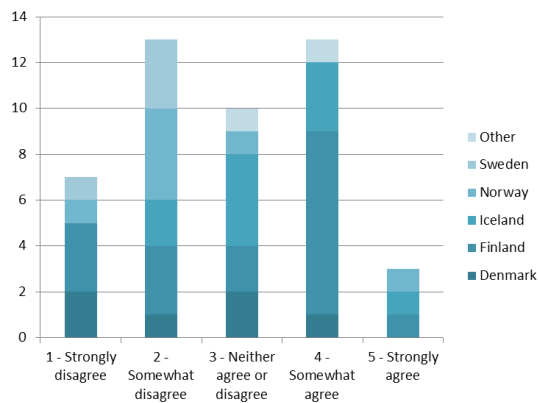


Figure 10: (Left) Opinions on building codes were divided, whereas many of the respondents considered definitions of acceptable risks unclear (Right).

Risk awareness and communication

"The public perception of risks is in phase with the risk estimations provided by the scientific community."



"The potential of informal, local knowledge (citizen observations, NGO work, etc.) is utilized in disaster risk management related to natural hazards."

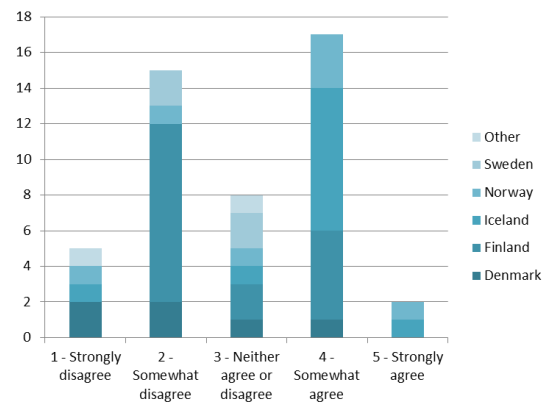
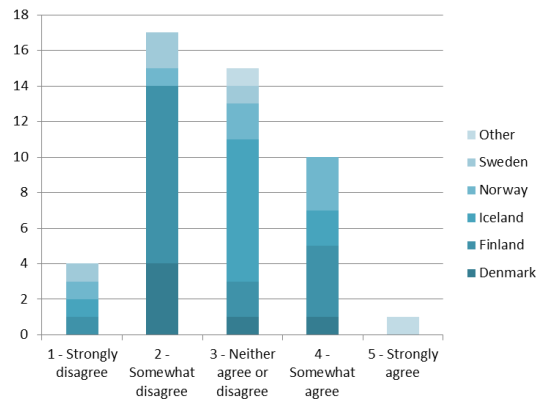


Figure 11: (Left) Public risk awareness and the potential of informal and local knowledge divide opinions.

"Level of preparedness expected from general public and private companies is on a correct level considering the risks and available information and resources."



"Lack of information is an obstacle for effective natural hazard related risk management for authorities, companies and other organizations."

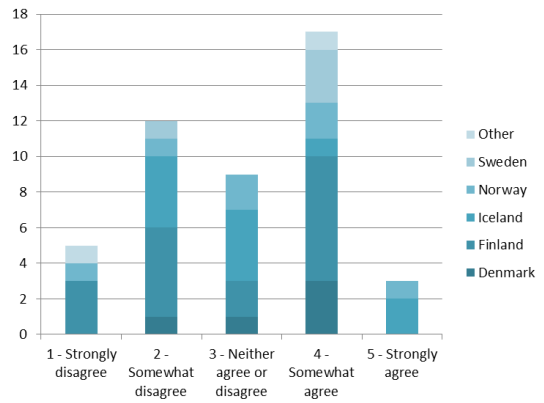


Figure 12: Some respondents pointed out a mismatch between available information and preparedness (left). Question on lack of information resulted in divided answers: in open comments sector differences and the lack of integration and use were also pointed out (right).

II - Helsinki workshop memo

Aims

The aim of the Helsinki workshop in January 2016 was to validate the initial results of the review, identify gaps in the approach and collect ideas on drivers of change and successful solutions for improving the Nordic natural hazard management regimes.

Programme and methods

The workshop consisted of an introductory presentation followed by three facilitated group work sessions.

Session 1

The purpose of the first session was to collect feedback on the preliminary results of the study (provided to the participants as a draft report beforehand). To this end, the participants were divided in three groups, each group having to examine the following domains in three successive, 25-min rounds:

- Governance / Financial risk-sharing mechanisms (Facilitator: Adriaan Perrels)
- Legal scope of hazard and risk assessment / Mitigation, building codes and spatial planning (Facilitator: Emmanuel Pagneux)
- Awareness raising and education / Information management and sharing (Facilitator: Atte Harjanne)

Session 2

The second session was devoted to the identification of the most significant drivers of change in the management of natural hazards in the near future. The participants were divided in three facilitated groups (Facilitators: Adriaan Perrels, Atte Harjanne and Emmanuel Pagneux).

Session 3

The third session was devoted to the identification of measures and approaches that enable addressing the identified change drivers. The participants were divided into three groups that all had the same assignment. In the groups each participant first wrote down their vision on change resilient hazard management. These were presented to the group and used as a basis to form combined presentations. In the final plenary discussion each group presented their conclusions to the others.

Participants

Participated to the workshop specialists representing diverse disciplines and domains of practice in the management of natural hazard risks in the NORDRESS region.

Table 2: Workshop participants

Name	Title	Country	Organization
Mia Ebeltoft	Deputy Director	NO	Finance Norway
Christian Fjäder	Visiting Senior Research Fellow	FI	Finnish Institute of International Affairs (FIIA)
Ágúst Gunnar Gylfason	Project manager	IS	National Commissioner of the Icelandic Police, Department of Civil Protection and Emergency Management
Atte Harjanne	Researcher	FI	Finnish Meteorological Institute
Einar Pétur Heiðarsson	Researcher	IS	National Commissioner of the Icelandic Police, Department of Civil Protection and Emergency Management
Hans Jørgen Henriksen	Senior advisor	DK	GEUS
Heikki Laurikainen	Researcher	FI	Finnish National Rescue Association
Anne Mette Meyer	Advisor, DRR & CCA	DK	Danish Red Cross
Farrokh Nadim	Technical Director	NO	Norwegian Geotechnical Institute
Emmanuel Pagneux	Research scientist	IS	Icelandic Meteorological Office
Ellen Raats	Intern researcher	DK	GEUS
Adriaan Perrels	Research professor	FI	Finnish Meteorological Institute
Anders Rimne	MSc in Engineering	SE	Boverket - Swedish National Board of Housing, Building and Planning
Kristiina Sääntti	Account Manager	FI	Finnish Meteorological Institute
Peter van der Keur	Sr. Researcher	DK	GEUS

Results

Gap analysis and ideas for the review

In general, the participants agreed with the results, but pointed out some missing details (e.g. additional agencies involved and the role of volunteer action) and expressed a wish for more consistent descriptions of how legislation in practice guides governance. The differences between urban and rural conditions and the consequences for natural disaster management were also emphasized. The necessity of accounting, in the review, for time scales and cycles of governance processes was underlined.

Governance / Financial risk-sharing mechanisms. Governance could be addressed in alternative ways, such as from functional and territorial points of view. Differences between urban and rural situations were pointed out, especially with regard to the different roles civil protection has in rural and urban areas. In urban areas multiple options for use of critical infrastructure exist, e.g. for roads and energy/water supply whereas in rural areas such options do not (always) exist (e.g. one road, and one critical infrastructure for water and energy). In addition, the legal base for liability is different. Timescales should be identified and the scales of organizations and activities, including renewal of planning, should be described at least crudely. Degree of integration of emergency and resilience management should also be discussed. Cross-border and other international cooperation need to be described. Other issues that could be elaborated included the interplay of formal governance and NGO/citizen action, public-private partnerships, and consequences of regulatory changes and shifts in ownerships for the governance model. Regarding the use of financial risk-sharing mechanisms, it was pointed out that incentive structures are important, especially those that focus on mitigation. Urban flooding was brought up as being essentially a man-made hazard, as it results to a great extent from the (i) multiplication of impervious surfaces such as parking lots and roads, and (ii) inappropriate design of sewer systems (for example in Norwegian insurance scheme it is treated as such).

Legal scope of hazard and risk assessment / Mitigation. Emphasis was placed upon the importance of analysing the institutions in terms of levels of compulsion (mandatory vs. voluntary processes) and of coercion (binding vs. advisory results). In connection to this, the monitoring and enforcement roles should be discussed. It is important to note who is the authority responsible for following up whether required measures are actually taken and what resources does this entity has at its disposal. Planning and legislation mechanisms induced from EU to national and finally to municipal level do not always function. The significance of cultural values was also emphasized. In addition to the general comments, several points regarding individual countries were brought up (such as the practical challenges related to Norwegian risk and vulnerability analyses and lack of definitions for acceptable risk levels in many cases).

Awareness raising and education / Information management and sharing. Many participants pointed out general trends that should be taken into account while reviewing any natural hazard management related communication. The “linear” (one-way) media consumption is losing ground to interactive and social media channels (two way). Still channels such as radio, TV and newspapers should not be ignored and still have an important role in awareness raising and alerts for (imminent) natural disasters. Emphasis should be on the actual reach of the communication measures (limitations and what is actually used) — there are for example a lot of “passive” information sources and campaigns and sites that merely exist and require an active effort to find. There is need for division between what exists and what is easily available, accessible and actually used. Vulnerable, isolated groups (such as e.g. Poles in Iceland or tourists elsewhere) need to be identified. Significant events provide opportunities to recruit volunteers, but overexploitation in minor events can erode commitment. In addition to these general comments, many country specific points of interest were mentioned.

Drivers of change

Based on the final discussion, the facilitators formed a list of the most significant change drivers of change:

- Exposure goes up due to population increases in risk prone areas
- Urbanization
- Climate change
- Geopolitics
- Behavioural changes
- Land use change (agricultural land abandoned)
- Increasing mobility and self-reliance (leading to unperceived risky behaviours)
- Deregulation – notably regarding urban development and building
- Evolution in information technology (access; open data; big data; social media; participatory obs.)
- Increasing social divides (long term unemployment; hereditary poverty)
- Interaction with terrorism (in terms exploiting natural hazard risks; budgetary competition)
- Tourism – more individual; more to difficult areas; more from Asia (other cultures; new languages)
- Migration flows to Western Europe
- 'New nomadisms' (footloose workers; mobile experts; migrants; short term workers)

Ideas for change resilient hazard management in Nordic countries

Group 1

- A flexible degree of decentralization should be reached that is not achieved to the detriment of clarity. There is probably not a single model that fits all conditions. Responsiveness to the characteristics of areas (urban/rural, matching hazard areas with administrative levels).
- More international and cross-border co-operation should be achieved
- More attention should be given to learning options and feedback collection afterwards.
- Nordic countries can have a role as examples.
- Technology should be used to enhance prevention, protection and rescue. Better access to international, public and private information should be secured.
- Enhanced co-operation enabled by information sharing, also at action level. Clear structures for public-private co-operation and involvement of citizen observations.
- Attention should be given to the role of ecosystem services in preparedness and remediation

Group 2

- Governance should be territorial, i.e. a multi-level governance tailored to territories defined as particular inherited settings (geographical, historical, cultural, etc.).
- Any governance model should be consistent and intrinsically complete within a given territorial setting (which can be local, regional, national, etc.). For instance, a model relying heavily on democratic values (bottom-up processes, strong stakeholder participation, etc.) may not be adapted to territories without democratic habitus (i.e. where democracy as a set of anchored customs has no ground).
- Emphasis should be placed on stakeholder participation, with attention given to education, perceptions and communication. Knowledge should be co-produced, with emphasis on usability in the context of adaptation.
- A specific effort should be engaged on mapping resilience, using at territorial level indicators of adaptive capacity, vulnerability, and social learning.

Group 3

- Management of natural hazards should be goal-oriented, guided by meaningful indicators. The indicators should be connected to “deep resilience” and include factors such as social cohesion, shared awareness on risk and responsibilities as well as commitment.
- Flexibility in actions should be secured, using flexible response planning. Clear response plans with responsibilities should be prepared for diverse conditions including extreme events.

- Emphasis should be placed on urbanization, with more focus on vulnerability and exposure instead of just risks and hazards.
- Discussion should be engaged and agreement concluded on levels of acceptable risks and related responsibilities. Acting accordingly, with strict restrictions if necessary.
- Uptake of new technologies should be achieved quickly, but without creating reliance. Technology used especially in proactive communication.
- Providing necessary resources for handling immigration is crucial, so that it does not strain organizations required to work in exceptional events already in their day-to-day activities.

Conclusions

The workshop was successful in collecting expert feedback on the NORDRESS Work Package 6 progress so far. The results will be used in crafting the final version of the review report and in guiding the (near) future work within the project.

In addition to the numerous detailed comments and additions, the main take home messages can be summarized as following:

- The review so far is on the right track and does not require major revisions. However, many sections need elaboration and more clarity.
- The division between urban and rural is an important factor that should be addressed across the review and in any policy suggestions. The issue is not however a straightforward dichotomy, but urban and rural can be blended in each other. Key issue is recognizing regional characteristics and differences.-
- Incentive structures guide action and should be critically analysed. This is especially true in financial risk-sharing but also in any other activities.
- High-level policies may not in practice result in effective actions at the grass root level. Here too the urban and rural differences show partly as the differences in available resources. Monitoring and enforcing roles of the authorities or the lack thereof are important aspects in any natural hazard management regime.
- Co-operation and information sharing are closely linked. There are both examples of very good and poor practices within the Nordic countries.
- The important drivers of change are intertwined and require flexibility and ability to learn and implement structural changes swiftly if necessary.

III – List of interviewees

Hulda R. Arnadóttir, Iceland Catastrophe Insurance

Tuomo Bergmann, Finnish Meteorological Institute

Jón O. Bjarnason, Iceland Catastrophe Insurance

Antti Irjala, Ministry of the Environment (Finland)

Jukka Kotiniemi, City of Pori

Sampsa Matilainen, the Association of Finnish Local and Regional Authorities

Hafsteinn Pálsson, Ministry for the Environment and Natural Resources (Iceland)

Taito Vainio, Ministry of the Interior (Finland)