

# Summary

On the request of KS, The Norwegian Association of Local and Regional Authorities, the project *Storms, slides<sup>1</sup>, floods, and oil spills - liability, authority, roles, and financing of protective measures* has been carried out by Western Norway Research Institute, in cooperation with Eastern Norway Research Institute, Norwegian Geotechnical Institute, and the University of Stavanger. The project originates in a demand voiced by the municipal sector, regarding the need for clarification of several aspects of municipal handling of climate-related natural hazards: a) Probable consequences of climate change for the situation regarding natural disasters in municipalities; b) the distribution of responsibilities between different societal actors regarding prevention and protective measures, including compensation responsibility; c) financing of protective measures.

This report looks at three main issues, the first originating in the current situation, whereas the second and third look ahead:

- 1) What is the current situation in the municipalities regarding the responsibilities, authority, roles and financing of protective measures related to natural disaster as a result of storms, slides, floods, storm surges, and oil spills?
- 2) How will future changes in climate and society change the way local communities are influenced by storms, slides, floods, storm surges, and oil spills?
- 3) How can the municipal effort to implement securing and prevention measures related to such events be strengthened, and how can the institutional capacity of municipalities be improved in preparation for the challenges associated with climate change (generally) and natural hazards (specifically)?

In assessing the societal consequences of climate change, it is important to include the perspective of *societal* change – and that this to a great extent takes place independently of how the climate changes. In order to highlight the sum effect of climate and societal change, local and regional climate scenarios and socio-economic scenarios for the years 2025 and 2060 have been developed. These scenarios have been combined in an attempt to uncover the possible impact of the future development in these realms on future vulnerability in local communities in Norway. Seven municipalities have served as cases: Hammerfest, Stjørdal, Ørland, Kristiansund, Lom, Tinn, and Fredrikstad. In all, these municipalities hold significant experience with handling a wide range of natural hazards.

Both climate scenarios and socio-economic scenarios rely on a "business as usual" methodology, i.e. showing the direction climate and society will develop if no measures are implemented. Naturally, a significant level of uncertainty is associated with these scenarios, in that they are narratives on the future resting on a range of prerequisites over which we hold little control. As for the climate scenarios, uncertainty is primarily related to imperfect modelling and understanding of physical conditions and connections in the highly complex climatic system. Eleven simulations of future temperature and precipitation have been accessed, displaying considerable variation. Communication of the width of this variation has been an important point, as no one scenario may be deemed more likely than the other. In the past, communication and dissemination of climate research has largely focused on average values, but these hold no greater explanatory potential than extreme values. The socio-economic scenarios utilized are based on a wide empirical and theoretical material within demography, economy, infrastructure, regional development, etc. The basis is a simple model which includes the following elements: (1) population, (2) employment and commerce, (3) demography and physical structures, and (4) outlook (mentality, way of thinking). A quantitative core of demography and employment projections carried out by Statistics Norway have been combined with various qualitative aspects holding significance for the course of development. The credibility of these future narratives is strengthened by the fact that historical development trends are drawn as far into the past as ahead in time. This has resulted in a narrative on Norway through 100 years, from 1960 to 2060.

## Municipal liability

According to the Planning and Building Act, municipalities hold the primary responsibility for securing against, and preventing, natural disaster. The Natural Damage Act assigns municipalities with the responsibility for developing precautionary measures against natural disaster, as stated by the Planning and Building Act (PBA), and as a rule,

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<sup>1</sup> By *slides* we mean both snow avalanches and landslides.

each municipality is to cover the expenses associated with municipal protective measures. The State's Natural Damage Scheme has reserved a budgetary line-item for financing preventive measures, and in addition, the Norwegian Water Resources and Energy Directorate (NVE) is in charge of managing an application-based mechanism for allocating funding for the implementation of protective measures. A public hearing on the proposed Natural Damage Act is will take place in 2008, following revision of the current legislation on securing and compensation by the Norwegian Agricultural Authority. Paragraph 25-5 (PBA) assigns the municipalities with the responsibility for preventing or setting requirements for development and construction in risk areas. Furthermore, § 68 (PBA) assigns municipalities with a special responsibility for directing attention at natural disasters in handling applications for building licenses. If municipalities have access to concrete knowledge of danger which falls under § 68, the application must be declined and securing measures must be implemented. On 15 February 2008, the Norwegian government presented a new planning section in the Planning and Building Act, expected to come into force on 1 July 2009. One of the legislation changes involves a demand for vulnerability and risk assessments (VAR) in land-use planning. In the proposed PBA, § 4-3 demands that municipalities, as planning authority, *ensure* that VAR are carried out in the area in question, or alternatively, must carry out such assessments themselves. Areas associated with danger, risk or vulnerability shall, according to § 11-8 in the new act be highlighted as 'special attention zones' in the part of the general plan pertaining to land use.

Previous reports have pointed to conflicting notions of whether, or the extent to which, municipalities may be obliged to offer economical compensation in the wake of events leading to natural disaster. Among the regress cases pertaining to natural disaster, there are several cases where municipalities have been charged with wrongfully granting building permissions in danger areas (PBA § 68). Among the newer cases, some are related to so-called 'urban floods', where damages occur as a result of back-flow in municipal pipelines, a type of damage which is expected to occur more frequently in the years to come. Twice in 2007, prosecuted municipalities were held not liable in court cases of this kind.

### **Climate changes and natural vulnerability**

Local scenarios for temperature, precipitation, and storm surges have been developed for each of the seven case municipalities. Climate scenarios do not provide any clear trends for *wind force* and storm frequency in Norway. The *average temperature* will most likely increase in all of the municipalities in question, shortening the winter, or even cutting it altogether. Both Fredrikstad and low-lying areas in Stjørdal will frequently experience absence of winter frost by 2060. The selected municipalities in Eastern Norway will have a distinct reduction in precipitation in the autumn and winter, as well as a smaller reduction in the summer, while the rest of the municipalities are likely to experience a precipitation increase all year. *Precipitation intensity* (in the three most precipitation-rich 24-hour periods) will increase during all four seasons. This forecast pertains to all of the case municipalities, except for wintertime in Stjørdal. The greatest increase (in percent) is found in Fredrikstad and Tinn in the winter, while Stjørdal will see a clear increase in the spring. *Sea-level rise* is, to a certain extent, compensated for by post-glacial rebound, which is still ongoing as a result of the last ice age. Kristiansund and Hammerfest will experience the greatest relative sea-level rise, 24 cm (mean value) from 2000 to 2060. Sea-level rise is expected to accelerate towards the end of the century. According to the scenario, Fredrikstad in 2100 will face a storm surge level between  $\frac{1}{2}$  and  $\frac{3}{4}$  meter higher than today. The projections of temperature and precipitation accessible today provide a basis for assessing the development of natural vulnerability for various types of landslides and floods, whereas data on wind, which is of great significance in relation to avalanches, have not been obtained. As for some types of landslides, some municipalities will, during certain seasons, see an improvement of the situation. As an example, shorter winters will probably lead to fewer avalanches (Hammerfest, Tinn), and increased evaporation may reduce the number of quick clay slides in the summer (Stjørdal, Fredrikstad).

### **Societal change**

Socio-economic projections for 2025 show a society which is not unlike today's society, but is characterized by even greater wealth and more private consumerism. Norway as a whole does, however, display great regional and local variation with regard to all four dimensions of the scenario: The *population* is, in brief, characterized by an age boom and high immigration levels. An imbalance between the working segment and the proportion of elderly will place a considerable burden on welfare services. According to the scenario, immigration will cause a population growth of 13 per cent from 2005 to 2025, almost three times greater than the growth expected without immigration. Among the case municipalities, only Fredrikstad appears to go clear of the age boom, due to a combination of high influx of young inhabitants and a low rate of aging. Some of the case municipalities report

positive tendencies which conflict with the demographical projection. As for *employment and commerce*, growth is expected in the private sector, especially in knowledge-based sectors. Fredrikstad, Ørland, Stjørdal, and Hammerfest are municipalities which will see service sector growth towards 2025. *Demography and physical structures* will be shaped by the fact that an increasing proportion of Norwegians live in urban areas, with  $\frac{3}{4}$  million more city-dwellers in 2025 than in 2000. A lack of space in the most attractive cities will spark commuting and rapidly increasing everyday mobility, largely based on private cars. People's *outlook* in 2025 will be strongly influenced by material abundance. The picture is not unequivocal; examples of counter forces include local pride in the industrial culture in Tinn and in the rural culture in Lom. In the socio-economic scenario for 2060, the case municipalities are portrayed as a part of larger regions, reducing the precision level. The period leading up to 2060 is referred to as a 'restoration period' following the 'hard thirties' sparked by an age boom and falling oil revenues. Immigration and concomitant working population growth will prepare the ground for new economic growth. Growth in the cities will not only affect sparsely populated rural areas negatively, but will also, to a greater extent, weaken small towns in the periphery.

Industry in the post-oil society has moved to rural Norway, whereas cities are de-industrialised and depend to a great extent on the service sector. A region-specific identity evolves as regional integration proceeds, spurred on by a high degree of mobility.

### **Norway towards 2060: more vulnerable or more resilient?**

The scenarios presented are intended to provide a foundation for assessing whether society is evolving in the direction of more vulnerability or more resilience towards climate change, and extreme weather and natural hazards in particular. *A weakening of the primary sector* will probably entail that marginal agricultural areas will be abandoned and subject to revegetation, while food production takes place in flat, easily accessible farm areas. Revegetation will offer reduced vulnerability for avalanches, landslides and rock slides. Marginal towns with few inhabitants and a maintenance-intensive road network may pose a challenge for civil protection. A service society with *increasing transport needs* represent similar challenges. A larger road network and transport infrastructure, which is to serve a growing stream of people and goods, increase our vulnerability for natural hazards. Increased dependence on frequent and reliable transport forms add to our vulnerability for breakdowns and delays in the transportation systems. The heightened demand for mobility may also increase the pressure to keep roads, railways and boat routes open, regardless of extreme weather.

Accelerating urbanisation may have different effects: Depopulation of peripheral areas will lower vulnerability related to exposed roads and other infrastructure. Strong city growth will lead to extensive urban sprawl generating large, connected city and suburbs. This generates a lot of traffic and demands large investments in transportation and communications which may lead to a de-prioritization of road maintenance and existing road networks. Strong centralization will furthermore produce a development pressure in areas close to the centre, despite risk of natural disaster, such as flood prone areas along rivers and seaside building lots exposed to sea-level rise and storm surges. The latter problem is added to by a tendency for *a population push towards the seaside*, and this will influence location of houses, second homes and tourism facilities.

### **Oil spills from ships**

An increase in the tank ship traffic along the coast of Norway is the single most influential factor with regard to vulnerability for oil spills from ships. Oil transport by ship from Northwest Russia to Europe and North America started in 2002, and currently comprises 10 million tonnes of oil per year. A new pipeline from Sibiria to Murmansk is underway, multiplying this volume by 15 times within 2015. Increased tank ship traffic near the coast will produce greater vulnerability for oil spills, especially in Northern Norway and Western Norway south of Stad. Large ships and higher speed add to this vulnerability, which may be tackled through a range of risk-reducing measures. A process which has already started includes surveillance of ship traffic in Northern Norway and selected parts of the coast in Southern Norway. The current system for oil spill preparedness does not hold the capacity to handle the largest accidents, but the experiences from the Server shipwreck in 2007 illustrate the point that well-organised preparedness may be essential for reducing the damage effects of smaller spills. The inter-municipal oil spill preparedness will not, however, be able to fulfil its tasks in future years, unless the needed equipment is renewed at a more frequent rate than today.

## Recommendations regarding protection against natural disaster and compensation

Climate change provides a basis for introducing a distinction between 'traditional' and 'new' themes in the realm of natural disaster. 'New' themes pertain to known mechanisms appearing with significantly altered frequency, magnitude, and time of year or locality. Examples of forms of natural hazards which may appear in a qualitatively new way include water-saturated landslides, rock slides released by freezing and melting processes, slushflows, precipitation-related floods in small rivers, urban floods, and sea-level rise.

The theoretical basis for this assessment is a typology of natural disaster themes, as well as perspectives on steering related to scope of action and steering measures. Steering strategies are discussed on the basis of the fact that municipal work in the field of natural disasters may be strengthened both by increasing the municipalities' scope of action, and by improving the degree of utilization of the already existing scope of action. Moreover, it remains important to counteract processes which contribute to reducing both the scope of action and its utilization. A possible reason for pursuing the latter course might be to strengthen the state or the market.

As a general rule pertaining to all types of natural disasters, municipalities and the landowners/developers hold the main liability for ensuring protection against natural disaster. Aside from this, considerable variation applies, according to the type of natural disaster in question, as to how well-defined responsibility is for professional and economical assistance in mapping, securing and prevention, and to what extent the law is complied with. For disasters resulting from *storms*, liability seems clearly defined, although it is only complied with to a certain degree. Weak building inspection and poor maintenance and upgrading of the distribution network for electrical power constitutes a case in point. Regarding the various types of *avalanches and landslides*, the situation is complex, both because of the wide range of avalanche types, and because responsibility for mapping and securing is highly fragmented. With regard to quick clay flows and landslides in the proximity of rivers responsibility is placed upon the Norwegian Water Resources and Energy Directorate (NVE), and is well complied within the framework of a tight budget. For other types of slides, the degree of public control and strictness seems more random, with some of the important factors being the type of special competence available, the existence of a County Geologist, and his or her capacity at a given point in time. State funding for mapping and securing areas defined as "hazardous" is limited, as demonstrated by the current situation with regard to geohazards in Norwegian municipalities.

In the case of *flooding*, responsibility is complied with to a greater extent, the central actor being the NVE. However, the Directorate's work within the field of flood inundation mapping and other protection measures is characterized by limited funding and strict cost assessments. The Water Resources Act includes *precipitation-related floods in small rivers* and *urban floods*, placing the same responsibility on the NVE as in the case of larger rivers. In these cases, however, local knowledge remains such a significant factor that an effort should be made to help municipalities identify and handle problem areas. Although the Planning and Building Act and the Pollution Control Act place general responsibility on municipalities, this is seldom followed up. However, the understanding of the future threat constituted by more extreme precipitation places a greater responsibility on municipalities both for avoiding development and construction near small rivers, and for ensuring that the drainage system holds a sufficient capacity to handle large amounts of surface water.

In the case of *storm surges*, responsibility is clearly defined with regard to building damages and transport infrastructure. General sea-level rise challenges the principle of landowner's responsibility for implementation of protective measures, to the extent that storm surges will occur with a significantly higher frequency in future years compared with today. Municipalities are responsible for mapping risk areas and for protective planning. However, with respect to impact of an extraordinary scale, the state will step in. Crucially, a significant level of scientific uncertainty is associated with data on the future scale of sea-level rise, as well as the rate at which sea-level rise will occur in years to come. *Ship oil spills* are best prevented through a general focus on security at sea, a task pertaining to the Coastal Administration. Shipping firms are financially liable for shipwreck pollution, whereas oil spill preparedness is, to a great extent, publically financed. Inter-municipal committees for acute pollution are to handle limited coastal spills, whereas the Coastal Administration takes care of large oil spills at sea.

So-called 'new' natural disaster themes represent the main responsibility gaps requiring attention. The formalities concerning responsibility relations between landowners, municipalities, the regional level, and state authorities partly resemble those pertaining to "traditional" natural disaster themes. Still, as a result of a general lack of

understanding of the challenges in this realm, the defined responsibility is hardly complied with. In addition, the fragmentation of responsibility characterizing the entire field of natural disaster applies here too, adding complexity to the matter.

A few overall challenges have been identified in the realm of allocating responsibility: *A causal orientation of protection measures*: Prevention of natural disasters is often characterized by an 'effect orientation', i.e. a focus on reducing the negative consequences of natural disasters, and to a lesser extent, a focus on avoiding the occurrence of negative consequences. Instead, providing incentives for a causal orientation in prevention work would entail a coordination of responsibility for prevention and the cost of repairs. As an example, municipalities, being responsible for protection against urban floods, wish to rid themselves of the burden of carrying out repairs by ensuring effective implementation of protection measures. *Institutional capacity*: Access to special competence and personnel resources are prerequisites for the municipal sector in complying with the defined responsibility in the realm of natural disasters. At the regional level, the recent competence enhancement seen in the field of preparedness and environment has not been followed up with a concomitant development in the municipalities. To the contrary, the institutional capacity has deteriorated over the last decade.

*Measures* can be presented on a scale from soft (e.g. information) to hard measures (e.g. institutional change). At the soft end of the scale, positive economical measures are found, and it is here that the municipalities are pressing for change. The current funding schemes for mapping, securing and preventing risk and natural disasters are viewed as very unsatisfactory. Although institutions such as the Geotechnical Survey of Norway (NGU), the Norwegian Water Resources and Energy Directorate (NVE), and the State's Natural Damage Scheme allocate funding for such purposes, the scope is too limited to fulfil the current need. The two state mechanisms for funding securing measures are assessed as well-functioning in terms of mandate and economical framework, and still the funding managed by the board of the State's Natural Damage Scheme is so limited that several important securing measures are not implemented, with obvious societal and human consequences. The pattern of natural disasters - and thus also the need for securing measures - seems likely to undergo considerable change in the years to come. On the basis of the climatic and socio-economic projections in this project, *urban floods* (problems related to surface water in urban areas), and in the longer run, *sea-level rise and storm surges* are singled out as particularly important focus areas. This judgement is based on the lacking state of current funding mechanisms and the potential scope of natural disasters related to these types of events in future years.

The proposed changes to the Planning and Building Act and the Natural Damage Act, together with a hearing note on a national strategy for climate adaptation, are all based on the understanding that the *need for change* is limited. In other words, the consequences of climate change are not expected to represent challenges great enough to require significant societal restructuring; rather, we are faced with minor adjustments of the steering measures currently in use, within the current *horizon of adaptation*. The above described analysis, which is to a significant extent based on the same scientific material as the various legislative and strategy-building processes, does not give reason to believe that the situation pertaining to natural disasters warrants dramatic societal restructuring of any kind. Still, for two reasons, one ought to consider the possibility that society is going to pass a threshold warranting more wide-ranging adaptation. First, a considerable level of uncertainty is associated with climate change and the impact of societal changes on the total future vulnerability for natural hazards. The uncertainty pertaining to climate change in our part of the world is particularly tied to the question of ocean ice melt, the geographical distribution of precipitation between Eastern and Western Norway, and – particularly – the question of more dramatic sea-level rise as a result of melting of the Greenland ice cap. Aspects of societal development with consequences for future vulnerability include increased levels of mobility (and in turn, heightened risk), accelerating centralisation, extensive seaside development (pressure on development in vulnerable areas), as well as a lag in the maintenance of public infrastructure. Today, we lack the scientific foundation for carrying out a comprehensive assessment of a worst case scenario.