

# Institutional adaptation to climate change: Flood responses at the municipal level in Norway

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## Abstract

The article examines the role institutions play in climate adaptation in Norway. Using examples from two municipalities in the context of institutional responses to floods, we find, first, that the institutional framework for flood management in Norway gives weak incentives for proactive local flood management. Second, when strong local political and economic interests coincide with national level willingness to pay and provide support, measures are often carried out rapidly at the expense of weaker environmental interests. Third, we find that new perspectives on flood management are more apparent at the national than the municipal level, as new perspectives are filtered by local power structures. The findings have important implications for vulnerability and adaptation to climate change in terms of policy options and the local level as the optimal level for adaptation.

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## 1. Introduction

Adaptation is increasingly seen as a necessary complement to greenhouse gas mitigation measures (Smit et al., 2001). Human-induced climate change is likely to present new, and to a large extent unpredictable, challenges to societies. This is of particular concern at a local level—first because scenario uncertainties are highest here, but also because studies of past climate-induced natural disasters (Quarantelli, 1987; Blaikie et al., 1994; Morrow, 1999), as well as climate variability and long-term climate change (Liverman and Merideth, 2002; O'Brien et al., 2004) show that vulnerability and its causes are location-specific. A large proportion of decisions regarding climate-induced hazards are local (Cutter, 1993, 2003). However, local decisions are shaped by interactions at the local level as well as interactions with structures at higher geographical scales that may mandate, encourage and inform actions

(Wilbanks and Kates, 1999). An underlying question addressed by this study is the extent to which the local is the optimal level of adaptation.

Norway displays characteristics that make it instructive in a European context. Its adaptive capacity is assumed to be high based on indicators such as economic resources, technology, information and skills, and infrastructure (O'Brien et al., 2004). At the same time, high adaptive capacity does not automatically lead to successful adaptation (Yohe and Tol, 2002; Smit et al., 2001; Burton et al., 2002). Furthermore, there are significant geographic differences within Norway as well as records of failures in adaptation (Lisø et al., 2003). An emerging challenge is, therefore, identifying how resources underpinning adaptive capacity can be translated into actions that reduce the societal vulnerability to climatic and other stressors.

An increasing body of literature, including work focusing on the role of social capital in vulnerability and resilience (Adger, 2000b), suggests that institutional factors are crucial in determining adaptation (Adger, 2000a; Bakker, 1999; The Heinz Center, 2002; Tol et al.,

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2003). Institutions affect the social distribution of vulnerability, as well as determine the management of climate-sensitive aspects of society and, in turn, the capacity to adapt successfully. The focus of this study is institutions connected to the formal municipal administration in Norway and their capacity to make decisions that reduce local vulnerability to future floods.

In this article, we analyse factors that constrain or facilitate the ability of local level institutions in Norway to carry out adaptation measures. Specifically, we examine measures taken in Skedsmo and Ringeby municipalities after the 1995 floods in Southeastern Norway. We examine how interactions between institutions at municipal level and other geographical and managerial levels, particularly the national level, shaped the measures that were carried out.

Findings suggest that there are disincentives to local adaptation inherent in current institutional structure. Local power structures and limited social learning<sup>1</sup> at the municipal level lead to the favouring of technical solutions to flood management. This pattern has implications for vulnerability to future climate change.

## 2. Framework for institutional analysis

### 2.1. Case studies

Experiences from past climatic events may provide useful insights into the constraints and barriers to adaptation to future climate change, especially since climatic events have been described as triggers for significant institutional changes (Miller et al., 1997). A local-level approach to historical extreme events provides empirical data that may hold important lessons for the future (Smit et al., 2001). It has been argued that interaction between humans and the environment in global change can be most effectively studied by focusing on particular events (Vayda and Walters, 1999). Applying an analogue approach, previously described by Glantz (1989), we analyse specific institutional aspects of responses to the 1995 floods in two municipalities in the Glomma–Lågen river basin, Southeastern Norway (see Fig. 1).

The Glomma–Lågen river basin has been exposed to a number of large floods over the past centuries.<sup>2</sup> The severity of the floods of 1995 was due partly to high snow accumulation levels in the spring<sup>3</sup> but more

importantly to the late onset of the snow melting combined with rapid temperature increases and sudden heavy rainfall (Eikenæs et al., 2000). The resulting sharp increase in water levels triggered widespread soil erosion and river sediment transport, in turn causing considerable damages to roads and railways, buildings, technical installations, and farmland (Brønne, 1995; Hindar et al., 1996; NIVA, 1996; NOU, 1996; Øygarden et al., 1996; Eikenæs et al., 2000). The floods had an overall return period of 100–200 years; in parts of the river basin it was the biggest since the great floods of 1789 (Skurdal et al., 2000). One person was killed and 7000 had to be evacuated from their homes (Lundquist et al., 1996). Flood-damage costs were estimated at a total of NOK 1.8 billion, of which NOK 1 billion was covered by private insurance and NOK 0.8 billion by government funds (Eikenæs et al., 2000).

The way in which institutions shape flood management is relevant to climate change adaptation for several reasons. Climate change may put new demands on existing institutions by either aggravating current flood problems or by creating new situations and new types of problems—such as floods in different parts of the year, or new types of floods (Miller et al., 1997; Tol et al., 2003; Brown and Damery, 2002). The *ability* (economically, politically and logistically) of a local community to carry out measures to reduce the risk of negative effects from future similar climatic-induced events may be closely related to the *capacity* and *ability* to prepare for climate change in future.

Wilbanks (2002) argues that climate change studies should pay attention to processes operating at several scales in order to avoid a too narrow focus on issues, processes, data, and theories associated with a single geographical or managerial scale. We define our investigation to the scale of decision-making unit as recommended by Cash and Moser (2000), in this case the municipality, but incorporate information from multiple scales by examining the interactions with other decision-making institutions that affect policy outcome.

A case study approach was chosen because of its suitability in explaining current phenomena where one has little control over the events, and where one seeks answers to questions of how and why (Yin, 1994). The complexity of relations among the social, environmental and economic processes that drive global change, as well as consequences of such change, can best be understood by ‘careful locality-specific research.’ Although case-specific research can be difficult to generalize, comparative studies using case studies as ‘natural experiments’ can facilitate theory-building (Wilbanks and Kates, 1999). By comparing two municipalities, Skedsmo and Ringeby, constraints borne out from institutional structures and processes can be distinguished.

The Skedsmo and Ringeby municipalities (see Fig. 1) were selected as study sites because they were both

<sup>1</sup>We define social learning as “the development of new knowledge by study or experience. New information alters prior beliefs about the world, and awareness of newly understood causes of unwanted effects often results in the adoption of different, and more effective, means to attain one’s ends,” (Nye, 1987, pp. 378–379).

<sup>2</sup>Major floods occurred in 1789 (‘Storofsen’), 1860, 1927, 1967 and 1995 (Eikenæs et al., 2000).

<sup>3</sup>130–150% of normal in April.

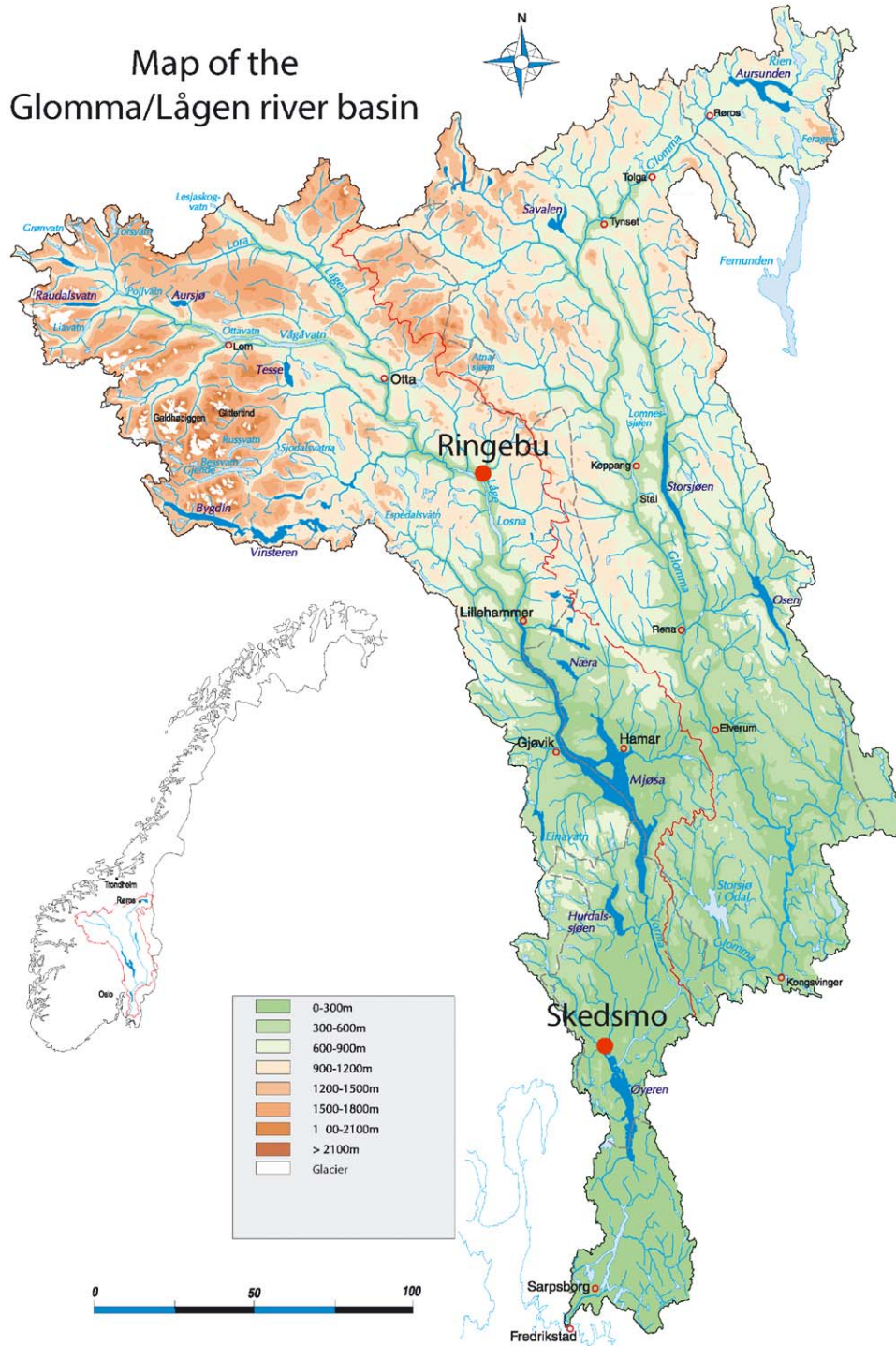


Fig. 1. Map of the Glomma/Lågen river basin. Source: modified from GLB, Oslo (1995).

severely, though differently, affected by the 1995 floods, and have both been required to follow new government legislation implemented as a result of the floods. Climate change is very pertinent to these two municipalities because not only do they face the risk of submerging from flooding in major rivers, they also face risks of

sudden increases in water flow in smaller, local rivers and urban areas. The demographic, socio-economic and geographic differences between the municipalities provide a valuable context for analysis, Skedsmo being a more populous and urbanized municipality than Ringebu. Ringebu municipality has 4644 inhabitants (as of

1 January 2003) and covers an area of 1250 km<sup>2</sup>.<sup>4</sup> Skedsmo municipality covers 77 km<sup>2</sup> and has 40,676 inhabitants (as of 1 January 2003), 95% of whom live in urban or semi-urban areas. Floods in Skedsmo have traditionally been a result of its proximity to Lake Øyeren and the three main rivers discharging into it, Nitelva, Leira and Glomma.<sup>5</sup>

Data collection included semi-structured interviews with open-ended questions regarding responses and the management of flood-prone areas in the aftermath of the 1995 floods. Fifteen officials were interviewed in Ringebru and Skedsmo municipalities, including heads of the technical, planning, environmental and agricultural departments involved in area planning and emergency management. A further seven interviews were conducted with representatives of other interest groups (e.g., fishing association, farmers' union, environmental organizations, planning consultancy company, political party). At the regional and national level, 12 officials were interviewed within the areas of water resources, planning, environment and emergency planning. Secondary information regarding the 1995 floods was reviewed, together with recent literature regarding institutions and adaptation to climate change, presented in Næss (forthcoming).

## 2.2. Research approach and questions

Our investigation focuses on how institutional relations and power structures interacted at national, regional, and municipal levels to determine the flood management regime in Skedsmo and Ringebru after 1995. We investigate institutions as systems of rules, decision-making procedures, and programs that give rise to social practices, assign roles to the participants in these practices, and guide interactions among the occupants of the relevant roles (Young, 1998). Institutions arise in all areas of human endeavour and can be either formal or informal. Our investigation focuses on the formal institutions relevant to management of flood prone areas, particularly area planning and water resources management institutions at three levels of government: municipalities, regional agencies, and the national level of governance.

Several distinct types of interactions and power relationships operate within an institutional structure,

determining both how the decision-making process develops and who has voice in the process. First, the degree of centralization in the policymaking process matters (Underdal, 1998). In Norway, *economic transfers* from the national level to a great extent determine the municipal budget for a given year. Within that budget, a range of tasks, such as healthcare and primary education, are legally binding. Other, less immediate tasks have lower priority. Hence, *national laws* determine the majority of tasks that a municipality must carry out. In addition, *national guidelines* for a range of policy issues determine a standard for local policies, including flood management. The centralized governmental structure in Norway, therefore, restricts most governing responsibility for flood management to the national level, and tightly controls the flexibility municipalities have to take independent action (Aall and Groven, 2003; Rattsø, 2003).

Second, decision-making processes—both within and across management levels in Norway—incorporate conflicts of interest, where the actors that have access and voice in the system struggle to win debates or votes and to convince opponents to concede their interests or preferences (Dahl, 1961). In addition, non-decisionmaking may occur when the societal elites have power to suppress unwanted issues, and to keep them away from the policy agenda (Lukes, 1974). Third, power in decisionmaking situations can be expressed as power by the elite to shape preferences and conceptions of a policy issue in a particular direction to avoid alternative conceptions from reaching the policymaking process, hence conserving own positions and own world-views (Lukes, 1974). Within a particular management regime, such as flood management in Norway, this can be reflected as conservation of old ideas or policy solutions at the expense of new ones. Social learning may thus be stalled.

In this study, we focus in particular on these three aspects of institutional relationships, and discuss how they determine adaptation measures carried out at the municipal level in Norway.

*First*, we examine how the structural relationships between the national, county and municipal levels of government frame local level ability to adapt. Local level institutions in Norway are tightly checked by detailed guidelines, laws and budgets decided at the national level (Rattsø, 2003). In particular, national flood management guidelines combined with specific budget transfers from the national to the local level earmarked for specific policies are common. Our hypothesis is that this may leave municipal institutions little leeway or incentive to act independently in flood management policies, and reinforce their structural dependency on the central government. Specifically, we investigate how structural relationships across scales and managerial levels affect adaptation and determine the room for political manoeuvre at the municipal level.

<sup>4</sup>The largest recorded floods in Ringebru are the great floods of 1789. In normal years, there are two largely unproblematic floods in Ringebru, following snow melting in the catchments of, respectively, the rivers of Lågen and Otta. A number of flood defences have been built along the Lågen River to straighten and stabilize the river, and thus prevent damage to properties and agricultural areas.

<sup>5</sup>Apart from the great flood of 1789, major flood years include 1860, 1863, 1867, 1890, 1895, 1910, 1916, 1927, 1934, 1966, 1967 and 1995. An important bottleneck has been the outlet into Glomma at Mørkfoss. The outlet of Øyeren was widened in 1860 and after the floods in 1967.

*Second*, we qualify our first hypothesis, acknowledging that under particular circumstances, there may be room for local institutions to act independently of the national level and implement a distinct adaptation policy. In a situation of urgency, local economic interests and powerful actors may have increased influence, and ad hoc decisions may be the result. In a course of action characterized as a ‘garbage can’ process (Flaa et al., 1985), decisions can be forced through quickly, driven by perceived opportunities available at the time and the convergence of interests of strong local actors. As the voices of less powerful actors are less likely to be heard, urgency situations can cement established power-structures. Within the established structure certain policy solutions become more preferred than others, and changing the status quo becomes difficult because alternative solutions are not presented at the decision-making arena (Bachrach and Baratz, 1962).

We investigate the extent to which the local room for manoeuvre changes as a result of extreme events like floods. Our hypothesis is that, in a crisis situation, the local degree of flexibility (room for manoeuvre) can be expanded, but that the extent and character of this is determined by alliances between politically and economically influential actors and their ability to exploit established institutional structures. Specifically, we investigate the degree to which influential actors have exploited this flexibility and local power relationships have shaped the types of measures that have been enacted.

*Third*, we investigate the degree to which social learning has altered the institutional structure and ruling perceptions about best flood management solutions. The local ability to adapt to climate change may potentially change as lessons learned from a flood event and new world-views are incorporated in the institutional structure. For example, one could expect to find processes of reorganization in the existing relationship between the three levels of governance in flood situations to improve flood management based on new experiences. Furthermore, local knowledge, or competing perceptions about preferred policy measures may be increasingly incorporated in decision-making. While specialized knowledge held by experienced individuals may be instrumental in achieving successful adaptation, the real question is to what degree this knowledge can be successfully transferred to the institution, that is, to what degree the society as a whole can ‘learn’ from the experiences of its individuals (Olsson and Folke, 2001). As argued above, preferences and conceptions of a policy issue are often skewed in a particular direction to avoid alternative conceptions from reaching the policymaking process (Lukes, 1974). Established organizations and actors in the decision-making process may resist changes in structures and

practices, in turn affecting local ability to adapt to climate change.

We study the extent to which it is possible for new perceptions and policy solutions to enter the policy-making process on adaptation. Our hypothesis is that new perspectives emerge within the institutional structures parallel with societal changes, filtered by existing power structures but to a certain extent allowing for changes in policy preferences. Specifically, we investigate the degree to which social learning has facilitated adaptation and shaped the types of measures that have been enacted since 1995.

### 3. Results: institutional responses to the 1995 floods

#### 3.1. Institutional structure and relationships

Our examination of the institutional structures after the 1995 floods confirms that the centralized institutional structures in Norway give municipalities few incentives for proactive flood management. The institutional framework for flood management consists of state, county and municipal actors (Figs. 2 and 3); however, the regional and municipal actors to a great extent function as implementing agents of policies determined at a national level. Roles and responsibilities are further elaborated in Table 1.

At the national level, the main actors are the ministries of environment, petroleum and energy, and justice; the latter two with directorates, the Norwegian Water Resources and Energy Administration (NVE) and the Directorate for Civil Protection and Emergency Planning (DSB), respectively. At the regional level, the County Governor (*Fylkesmannen*) forms part of Norway’s ‘regionalized state’, whose main function is to ensure implementation of regulations and advise municipal governments on issues such as environmental protection and emergency planning. NVE’s regional office also plays a key role in implementing flood abatement projects. The Planning and Building Act of 1985 assigns main responsibility for area planning to Norwegian municipalities, although in dispute cases, plans have to be formally approved by the Ministry of the Environment.

Flood damage to property is covered by two insurance systems, one private and one governmental. For objects and properties insured against fire, natural hazard insurance is compulsory. The funds are administered by the Norwegian Pool of Natural Perils (*Norsk Naturskadepool*). The Norwegian National Fund for Natural Damage Assistance (*Norsk Naturskadefond*) covers flood damages for privately owned objects not covered by fire insurance (such as roads, bridges, and agricultural lands).

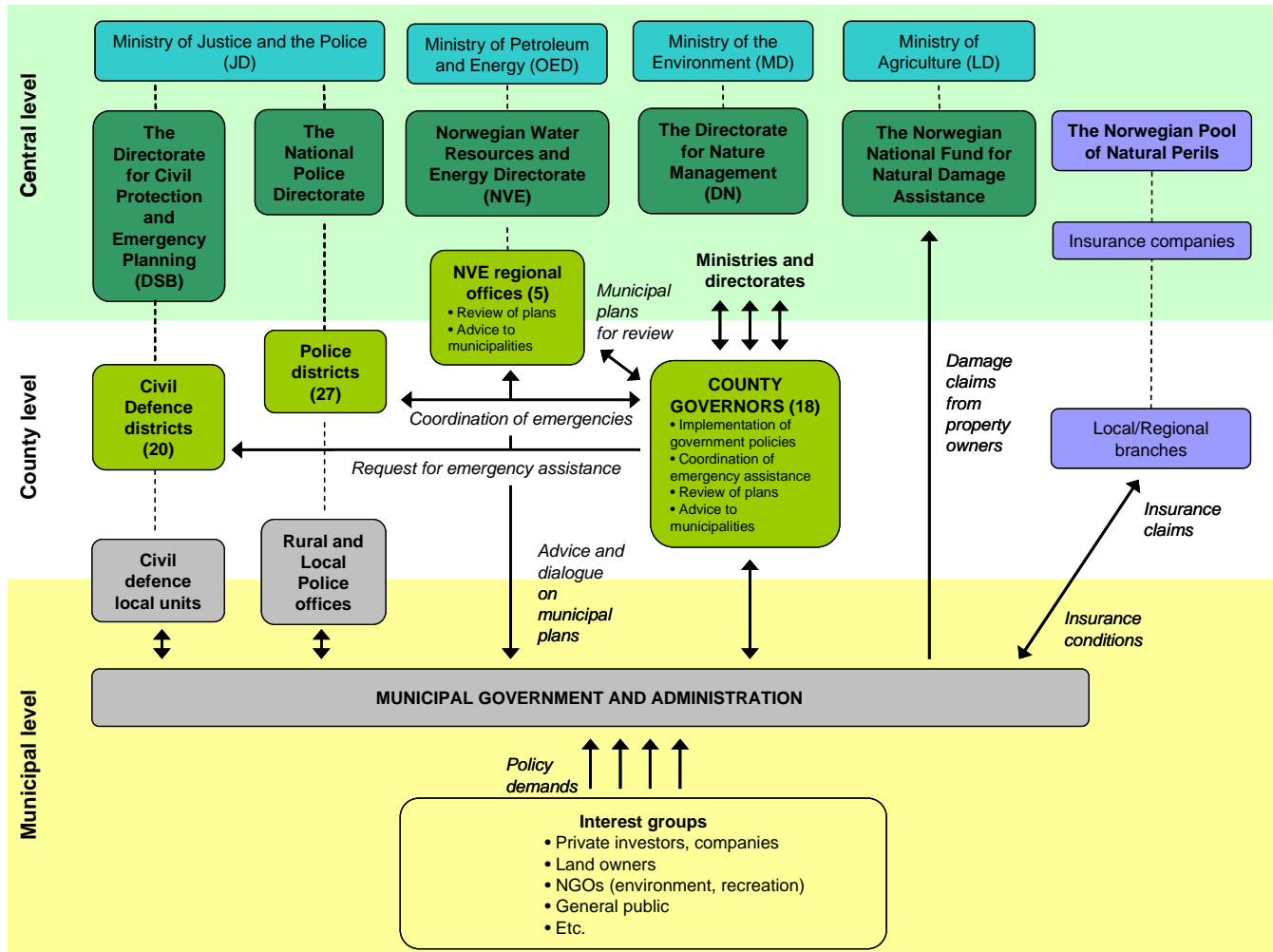


Fig. 2. Institutional framework for flood management in Norway.

A number of changes in the institutional structure governing flood management took place in the aftermath of the floods. A government commission on flood protection (*Flomtiltaksutvalget*) was established shortly after the floods. In addition, a number of assessments of flood impacts were undertaken for agricultural lands, technical installations, water quality, socio-economic systems, and ecosystems (Brønne, 1995; Hindar et al., 1996; NIVA, 1996; Øygarden et al., 1996). The work of the commission resulted in a government report (NOU, 1996) and two Government of Norway White Papers (No. 37, 1995–96, No. 42, 1996–1997). The commission also made recommendations for a research programme (HYDRA), initiated by NVE before the floods but expanded after the floods (Eikenæs et al., 2000).

The main changes that took place in the aftermath of the floods appeared to reflect a decentralization of the institutional structure. In reality, however, the institutional change entailed clarification of roles and strengthening of flood information activities and regulations

rather than actual decentralization of authority. First, the County Governor was given new authority to reject municipal plans (Ministry of the Environment and Ministry of Local Government and Labour, 1997). A directive was issued to better coordinate activities between the Police and the County Governor during emergencies (*Samordningsinstruksen*). Prior to the floods, there was no county level coordination of emergency situations, and responses during the floods were characterized by improvisation (DSB, 2003).

Second, NVE strengthened their flood forecast unit and were given increased planning capacity at the regional offices. This enabled an increased role in the review of new municipal plans. Clarifications were also made concerning flood forecasts, as conflicting forecasts from NVE and Glommen's & Laagen's Water Management Association (GLB) had caused confusion during the floods (Eikenæs et al., 2000). Flood forecasts are now issued by NVE to County Governors, who disseminate them to municipalities in cooperation with the Police.

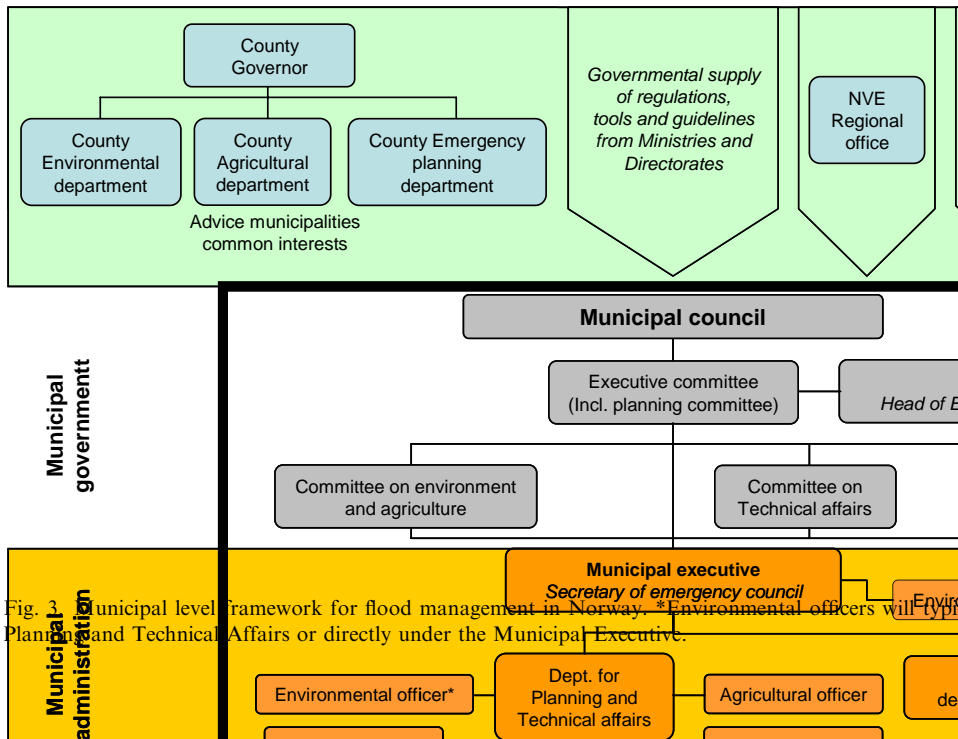


Fig. 2. Municipal level framework for flood management in Norway. \*Environmental officers will typically be placed under the Department for Planning and Technical Affairs or directly under the Municipal Executive.

Third, new standards and guidelines for building in and use of flood-prone areas were issued (NVE, 1999; Ministry of the Environment and Ministry of Local Government and Labour, 1997). NVE have developed flood zone maps since 1998, intended for use by municipalities to identify areas of high flood risk and needs for flood protection measures. Institutional changes, such as a change in the insurance act (1994), entailed increased responsibilities for municipal governments (Ministry of the Environment and Ministry of Local Government and Labour, 1997). At the same time, the environmental capacity at the local level has declined considerably over recent years since government funding for municipal environment officers ceased in 1997 (Aall and Groven, 2003; Bjørnæs, 2004). More attention has been given to the role of insurance as a tool to regulate planning in risk-prone areas. Insurance companies have increasingly warned municipalities of compensation claims in cases where construction is

allowed in risk-prone areas, and several court cases exist.<sup>6</sup>

At the same time, there are structural disincentives to proactive flood management. First, there was a clear perception expressed in interviews that the national government should step in and cover the costs of damages when large natural disasters similar to the 1995 floods strike. After a major hurricane in 1992, the total responsibility by private insurance was increased from 0.8 to 1 billion NOK. This amount has been further increased during the 1990s and is now 10 billion NOK. For the government fund, the maximum damage limit was removed altogether after the hurricane (Aall and Groven, 2003). In some cases, flood reparations after 1995 were in themselves seen as a benefit to the community, described by one municipality as the “best

<sup>6</sup> *Aftenposten*, January 13, 2002 and October 8, 2000; *Bergens Tidende*, July 12, 2003 (Norwegian daily newspapers).

Table 1  
Key formal institutions relevant for flood management in Norway

Level	Institutions				
	Water resources management	Civil defence and emergency planning	Environmental and resources management	Area planning	Insurance
National/policy level	<ul style="list-style-type: none"> <li>● Legislation on river flow</li> <li>● Regulations for flood protection</li> <li>● Mapping of flood zones</li> <li>● Issuing of flood warnings</li> </ul>	<ul style="list-style-type: none"> <li>● Legislation on civil defence and emergency plans</li> <li>● Regulations for crisis management</li> <li>● Advice on risk and vulnerability assessments</li> </ul>	<ul style="list-style-type: none"> <li>● Legislation on ecosystem protection</li> <li>● Programs for river delta protection</li> <li>● Protection of rivers from hydropower use</li> </ul>	<ul style="list-style-type: none"> <li>● Legislation on area planning</li> <li>● Regulations of the use of flood-prone areas</li> <li>● Settlement of planning disputes</li> </ul>	<ul style="list-style-type: none"> <li>● Legislation for damage compensation from natural perils (govt., private)</li> <li>● Rules for pool of natural perils</li> <li>● Settling of damage claims</li> </ul>
County/regional level	<ul style="list-style-type: none"> <li>● Planning and advice on flood protection</li> <li>● Implementation of water flow regulations</li> <li>● Distribution of flood warnings to municipalities</li> </ul>	<ul style="list-style-type: none"> <li>● Coordination of information/resources during emergencies</li> <li>● Contingency planning in County Emergency Council</li> </ul>	<ul style="list-style-type: none"> <li>● Advice on national management policies</li> <li>● Advice and distribution of state grants</li> </ul>	<ul style="list-style-type: none"> <li>● Advice on municipal planning</li> <li>● Development of county area plans</li> <li>● Overseeing of national planning regulations, mediating disputes</li> </ul>	
Municipal/local level	<ul style="list-style-type: none"> <li>● Implementation of new flood protection measures</li> <li>● Monitoring of existing flood protection schemes</li> </ul>	<ul style="list-style-type: none"> <li>● Reporting to County Governor during crises</li> <li>● Municipal Emergency Council</li> <li>● Risk and vulnerability assessments</li> </ul>	<ul style="list-style-type: none"> <li>● Implementation of environmental policies</li> </ul>	<ul style="list-style-type: none"> <li>● Responsibility for area planning</li> <li>● Responsible for actions to avoid flood damages</li> <li>● Undertaking of risk analysis related to planning</li> </ul>	<ul style="list-style-type: none"> <li>● Reporting and assessment of damages from natural perils</li> </ul>



thing that had happened”.<sup>7</sup> In a similar example of government willingness to pay for local damages, the Minister of Petroleum and Energy directed NVE to pay the bulk of the costs incurred by local entrepreneurs for flood protection work ordered by the police authorities during the 2003 floods in Oppdal, mid-Norway.<sup>8</sup>

Second, the institutional structure often puts flood management at the centre of conflicting interests. Flood-prone areas are commonly very attractive lands for agriculture, industry and residents. Municipal governments are keen to attract investors, and there is a willingness to take the risk of damages. For example, Bærum municipality near Oslo recently allowed a local company to construct a building in a flood-prone area. The municipal administration first rejected the proposal because of flood risk concerns, but the majority of the committee on planning and environment allowed the building after the company threatened to relocate its operation.<sup>9</sup> The political cost of not allowing investments may be large in terms of job loss.

Insurance and regulations should represent a powerful incentive for better standards, but do not seem as yet to be able to fully counteract the weight of short-term incentives and generous compensation schemes in the case of extraordinary events such as the 1995 floods. Private insurance is rarely denied in constructions in natural hazard-prone areas; instead, a set of conditions is given before the insurance is issued.<sup>10</sup> Although insurance companies have signalled a tougher policy, concerns have been raised that insurance companies are too lenient. Construction plans in flood prone areas are only stopped by NVE and the Ministry of Environment in extreme cases. One example is an extension to a shopping centre in Lillehammer, approved by the municipality less than 5 years after the centre was flooded by over a metre.

### 3.2. Local power structures and room for manoeuvre: the impact on policy outcome

There is room for manoeuvre even within an institutional structure which generally acts as a disincentive to local action. Whereas institutional changes after 1995 have given considerably less room for municipalities to implement ‘risky’ flood management policies, the incentive structure works to undermine proactive policies and promote an ‘event-driven’ pattern of responses.

A flood can create a momentum for flood protection and represent a window of opportunity that spurs local action both in terms of emergency measures during the flood and in the form of measures to prevent future floods. In the years before 1995, Skedsmo had given a low priority to emergency preparedness due to a strained financial situation.<sup>11</sup> In 1995, as the flood was moving southwards along Glomma, there were reports that Lillestrøm Township could be flooded. Several measures were taken to reduce impacts, including closing manholes and drains. However, the damages did not materialize and interviewees in Skedsmo argued that, in hindsight, the measures taken during the floods were too costly.

Impacts were, however, considerable at the psychological level, and the atmosphere after the floods was one of “we must never be in a situation like this again”.<sup>12</sup> Such a post-crisis atmosphere has in many cases led to the setting aside of existing procedures and rules and precipitated a rapid implementation of measures. Skedsmo municipality, for example, initiated the building of a flood dike around the township soon after the floods. The decision was made without prior approval of external financial contributions (which they received later) or any thorough environmental impacts assessment. Similarly, after the floods in Ringeby, NVE were said to be given relatively free hands to implement reparation and flood prevention measures even in environmentally protected areas.

On one hand, the Skedsmo dike represented independent action by the municipality (although with clear expectations of government funding); on the other hand, it became a measure against which it was politically impossible to raise objections. Such was the momentum that the dike was characterized by one interviewee as “never really a political issue, but a wave initiated by the Mayor and his party [Labour]. The dike would probably not have been built if it had not been an election year”.<sup>13</sup> Interviews suggested that the municipality to a large extent sees the dike as a ‘once and for all’ solution,

<sup>7</sup>Senior official in NVE, Interview April 2004.

<sup>8</sup>NVE first declined to pay, arguing that the flood protection work had been done without their prior approval as the responsible authority, that it had been harmful to the river environment, and that it was not solid enough to withstand future floods. NVE later paid 25% of the costs, as did the municipality. When no other parties agreed to pay, however, NVE was instructed by the Minister also to cover the remaining 50%. Memo by Mr. Einar Steensnæs, Minister of Petroleum and Energy, January 2004. [http://odin.dep.no/oed/norsk/aktuelt/taler/artikler\\_politisk\\_ledelse/026001-090014/dok-bn.html](http://odin.dep.no/oed/norsk/aktuelt/taler/artikler_politisk_ledelse/026001-090014/dok-bn.html) (Accessed May 2004); *Opdalingen* (Norwegian daily newspaper), October 21, 2003; *OPP* (Norwegian weekly newspaper), November 27, 2003.

<sup>9</sup>The minority of the committee expressed concern that the municipality may be held economically responsible, and even be sued by insurance companies, for future flood damages. *Asker og Bærums Budstikke* (Norwegian daily newspaper), November 15 and 21, 2003.

<sup>10</sup>Interview with the Pool of Natural Perils, April 2004.

<sup>11</sup>Directorate for Civil Protection and Emergency Planning, interview May 2004.

<sup>12</sup>Senior official, County Governor’s Office, interview May 2004.

<sup>13</sup>Friends of the Earth Skedsmo, interview April 2004.

respondents holding the view that Skedsmo is now secured against floods. Floods have been a low priority on the political agenda after 1995.

Reservations have emerged more strongly after its construction, however. In addition to the expected biodiversity loss, the flood dike has become an important recreation area and current calls for urban development along the river banks would further reduce biodiversity. Objections have also been raised regarding its technical weaknesses. The dike is unlikely to adequately protect against new types of flash floods (as experienced, e.g. in 2000 and 2004) or floods that are larger than the one in 1995.<sup>14</sup>

Such a decision-making process represents an opportunity for the promotion of particular political or economic interests. The pattern that emerges is that when strong interests coincide with state level willingness to pay and provide support for flood measures, the gravity of the situation leads to rapid measures where other interests, such as environmental or fishing interests, are ignored. The Skedsmo dike was a visible action that may have served to erase the public memory of earlier inaction by the municipality and help secure existing political power; the decision in favour of the dike was made less than 2 weeks before the local elections. Similarly, a planned flood dike aimed at eradicating mosquitoes in Ringebu also makes more areas available for agriculture and infrastructure, an economic interest fronted by the Mayor, who represents the agrarian Centre Party. In an unusual overruling of her own department, the Minister of the Environment finally approved the plan in 2001, after a visit to the municipality during the election campaign.

The types of measures thus reflect and contribute to consolidating the existing power structures. There have traditionally been strong ties between NVE regional offices and agricultural officers at municipal level, and much of the earlier flood measures were aimed at protecting agricultural lands. With changes in agricultural policy and less money available from the agricultural ministry, these ties have weakened, and measures today are more geared towards protection of houses and industry.

The study revealed that actions carried out after the floods are typically focused on expensive, large-scale technical measures, often at the expense of environmental or other concerns without a strong political voice in the current power structure. In Ringebu, sediments were removed from the main river as well as several smaller and even environmentally protected tributaries (e.g., *Moelva*) where the floods had caused damage, and large stones were placed in the river to stabilize the riverside. Several of these measures conflicted with environmental interests and recreational fishing. For

example, the local ornithological society were concerned about the removal of vegetation along an environmentally protected river (*Tromsa*), and a regional fishing association (*Lågen Fiskeelv*) argued that removal of gravel and sediments after the floods damaged spawning grounds and had a greater negative effect on river fish stocks than the flood itself. Similarly, the NGO Friends of the Earth in Skedsmo characterized developments after the floods in 1995, and again after a flood in 2000, as “Where nature had won before, it lost now”.<sup>15</sup>

### 3.3. *The role of social learning in facilitating policy formation and climate adaptation*

To what extent can learning from past events such as the 1995 flood lead to more diverse types of measures and local action that takes into account a broader range of interests? The learning and institutional changes that have taken place since the 1995 floods exhibit both barriers and driving forces for institutionalization at the local level.

Findings suggest that the floods facilitated learning at the national level, manifested as changes in rules and regulations. As shown in Section 3.1 above, there have been several institutional changes at the national level since the 1995 floods, including clarification of the roles and responsibilities of different actors, as well as new tools and guidelines, such as for flood zone mapping and planning. The planning capacity of NVE was strengthened as a direct consequence of the floods, and the assessment of flood risk has become part of formal area planning routines. The floods clearly contributed to such changes: although many initiatives on these issues had come up before 1995, their passage was politically feasible only after the floods.<sup>16</sup> For example, the need for better coordination of emergency planning was already recognized in Government White Paper No. 24 (1992–93) that pointed to the fact that civil emergency management was burdened by unclear responsibilities and insufficient coordination.

Changes have also occurred to organization profiles: While the staff of NVE was previously dominated by technical engineers, there are now increasing numbers of experts in biological and natural resources management. DSB has changed focus from military-based emergency management to proactive risk management. Although interviews suggest that such developments over the last decade reflect broader societal changes instead of being triggered directly by the floods, the floods appear to have added extra impetus to the changes. NVE had already been through processes of change over the past decades as a response to the increasing focus on environmental concerns in large-scale hydropower

<sup>14</sup>Senior official in NVE, interview April 2004.

<sup>15</sup>Friends of the Earth Skedsmo, interview April 2004.

<sup>16</sup>Senior official in NVE, interview April 2004.

projects. A major change in DSB came as the eastern bloc collapsed and the threat situation was redefined during the early 1990s to a post-Cold War conflict scenario.

Despite the learning and changes in world-view apparent at the national level, the integration of new perspectives, tools and guidelines in actual planning at the local level appears sketchy. Some local measures have even been carried out contrary to these perspectives. In Ringebu, a gasoline station was built in areas that were submerged in 1995. The construction went ahead on the condition that the ground was elevated, despite safety concerns raised by NVE.<sup>17</sup> More recently, the above mentioned flood dike intended to eradicate mosquitoes in a wetland area in Ringebu was initiated amidst opposition from the County Governor, the national Directorate for Nature Management as well as local environmental groups.<sup>18</sup>

The study confirms that new perspectives are filtered by the existing power structures. Where new perspectives, as well as local knowledge and learning from a flood, are incompatible with prevailing local political and economic interests, they are unlikely to be converted into local measures. As a result, the filtering of information and definition of solutions has three important characteristics: First, much learning at the local level takes place as personal learning rather than institutional learning and the documentation and incorporation of experiences in formal routines. This was particularly evident in Ringebu, where interviews revealed that little had changed in terms of formal routines since 1995 in area planning and emergency planning routines. Moreover, there had been little focus on the documentation and handover of experiences to new staff that had arrived after 1995. The municipal emergency council was criticized for “travelling too much around to look at the damages”, and less concerned with the day to day organization.<sup>19</sup> The organization during the floods was described as lacking in teamwork with unclear distribution of responsibilities, and a recent rehearsal of emergency routines were said to reveal many of the same shortcomings as in 1995.

Second, interviews revealed that key individuals may have a large say in determining municipal flood responses. DSB emphasized the importance of commitment from key individuals in the municipal leadership for the integration of risk and vulnerability analyses in municipal planning. The Mayor of Skedsmo was particularly instrumental in making the flood defence wall a reality in 1995, for example. In Ringebu,

respondents emphasized the importance of people with good knowledge of the municipality. As a result of the personalized learning, good flood responses and planning decisions were thus dependent on key persons in the administration exhibiting extensive local knowledge and experience from past events.

Third, a dominant feature of flood responses in the two municipalities was a weak interplay between municipal, county, and national levels in terms of information flow and learning. Interviewees in Ringebu, for example, expressed scepticism towards NVE and other national depositories of information, describing them as “too theoretical” and not being aware of, or interested in, concerns of the municipality. While flood zone maps were considered useful, the municipal administration focused less attention on flood warnings issued by NVE, as these warnings were deemed too general, often concerning events that were not very important in the Ringebu context, as well as sometimes being issued too late.

#### 4. Conclusions and implications for climate change adaptation

Three main conclusions emerge from the study. *First*, the current institutional framework for flood management gives weak incentives for proactive flood management at the municipal level. Our examination of the institutional structures after the 1995 floods confirms that the centralized institutional structures in Norway are an important factor behind this. The municipal actors to a great extent function as implementing agents of policies determined at the national level. A common perception is that large-scale flood events are outside the responsibility of municipalities and that damages should be covered by the national government.

*Second*, the actual policy measures carried out in the wake of the 1995 floods reflect local power structures. When strong local political and economic interests coincided with state level willingness to pay and provide support, flood prevention measures were implemented rapidly at the expense of environmental and other goals that had weak political representation at the local level. In spite of protests from environmental NGOs, technical measures became the preferred policy solutions in both municipalities. The urgency occurring after the floods resulted in an ‘event-driven’ pattern of responses where consequences of the measures were not thoroughly assessed before implementation. Many outcomes are a result of incidental circumstances and perceived opportunities and may be regarded as ‘garbage can’ type decisions.

*Third*, new perspectives have emerged within the institutional structures in line with broader societal changes, and these changes have been reinforced by the

<sup>17</sup>Director of Water Resources Department, NVE, Personal communication.

<sup>18</sup>Objections are concerned with the uncertain effectiveness of the measure as well as biodiversity loss.

<sup>19</sup>Officials, municipal administration in Ringebu, interview June 2003.

flood event. However, such changes seem more apparent at the national than the municipal level. The integration of ‘new’ perspectives, tools and guidelines from the national level in actual planning at the local level was, less apparent. We identified three specific factors that may contribute to explaining this: the high degree of personalized rather than institutionalized learning, the high reliance on key individuals, and the differences in culture and perceptions between the local and national level of governance. In other words, we found that established local institutional relations and power structures acted as a filter through which new perspectives must pass, slowing down the process of social learning.

Our findings have important implications for vulnerability to climate change. The main response pattern since 1995 reflects large-scale, technically oriented flood protection schemes. Yet new types of floods such as local, rain-induced flash floods, demand more locally specific, flexible solutions that integrate past experiences. The findings further suggest that while the local level is critical, adaptation in terms of reducing vulnerability may require measures carried out at several different scales. The study confirms the proposition by Cutter (2003) that appropriate measures demand local knowledge. However, institutional factors may limit the municipal capacity to carry out appropriate measures. In addition, there are adaptation measures that are outside the scope of the municipal level. Measures addressing barriers to adaptation may need to target power structures that filter adaptation options, so as to orient options towards a broader range of measures that are more flexible and take a wider set of local interests into account. Our findings further underscore the observations by Olsson and Folke (2001), namely that co-management systems across scales can help increase the robustness in the face of external changes.

Significantly, a considerable amount of local knowledge on floods exists among people in the municipalities. Floods have always been part of people’s lives and communities have adapted to them, for example in Ringeby by traditionally avoiding building farm houses in areas flooded in 1789. A new gasoline station on the floodplains represents a break in tradition. The value of local knowledge in adaptation to climatic stress is well documented (Lisø et al., 2003; Olsson and Folke, 2001), and Berkes and Folke (1998) show how traditional institutions at the local level have responded effectively to external perturbations throughout history. Berkes (2002) points to the need to create linkages across scales, between local knowledge systems and formal flood management systems at municipal, county and state levels. Our case study exemplifies how local knowledge is not well integrated into formal risk management procedures. More attention is thus needed to the role of local knowledge in formal institutions at various levels.

The factors found to limit adaptation capacity in Ringeby and Skedsmo are likely to be no less relevant to the capacity of other municipalities in Europe to carry out measures. The new EU Water Framework Directive aimed at enhancing basin-wide management of water resources appear to be a step in the right direction in terms of adaptation. Our study demonstrates that in order for the local level to realize its potential as an optimal level of adaptation, flexibility of institutions and social learning are important prerequisites.

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### References

- Aall, C., Groven, K., 2003. Institusjonell respons på klimaendringer. Gjennomgang av hvordan fire institusjonelle systemer kan bidra i arbeidet med å tilpasse samfunnet til klimaendringer. (Institutional responses to climate change. Review of the contributions of four institutional systems to climate change adaptation.) Report 3/2003, Western Norway Research Institute, Sogndal (in Norwegian).
- Adger, W.N., 2000a. Institutional adaptation to environmental risk under the transition in Vietnam. *Annals of the Association of American Geographers* 90, 738–758.
- Adger, W.N., 2000b. Social and ecological resilience: are they related? *Progress in Human Geography* 24, 347–364.
- Bachrach, P., Baratz, M.S., 1962. Two faces of power. *American Political Science Review* 56, 947–952.
- Bakker, K. (Ed.), 1999. A Framework for Institutional Analysis. Working Paper #3, Societal and Institutional Responses to Climate Change and Climate Hazards: Managing Changing Flood and Drought Risk (SIRCH), Environmental Change Unit, University of Oxford.
- Berkes, F., 2002. Cross-scale institutional linkages: perspectives from the bottom up. In: Ostrom, E., Dietz, T., Dolsak, N., Stern, P., Stonich, S., Weber, E.U. (Eds.), *The Drama of the Commons*. National Research Council, National Academy Press, Washington, DC.
- Berkes, F., Folke, C. (Eds.), 1998. *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*. Cambridge University Press, UK.
- Bjørnæs, T., 2004. Det lokale miljø- og bærekraftarbeidet forvitrer. (The local environmental and sustainability work is eroding.) Monitor 21 1/04, ProSUS Program for Research and Documentation for a Sustainable Society, Centre for Development and the Environment, University of Oslo (in Norwegian).
- Blaikie, P., Cannon, T., Davis, I., Wisner, B., 1994. *At Risk: Natural Hazards, People’s Vulnerability, and Disasters*. Routledge, London and New York.

- Brønne, J., 1995. Befaring og rådgivning for kulturetaten i Hedmark Fylkeskommune etter flommen i Østerdalen, juni 1995. (Inspection and advising for the cultural department, Hedmark County Council, after the floods in Østerdalen, June 1995.) Norwegian Institute for Nature Research, Oslo (in Norwegian).
- Brown, J.D., Damery, S.L., 2002. Managing flood risk in the UK: towards an integration of social and technical perspectives. *Transactions of the Institute of British Geographers* 27, 412–426.
- Burton, I., Huq, S., Lim, B., Pilifosova, O., Schipper, E.L., 2002. From impacts assessment to adaptation priorities: the shaping of adaptation policy. *Climate Policy* 2, 145–159.
- Cash, D.W., Moser, S.C., 2000. Linking global and local scales: designing dynamic assessment and management processes. *Global Environmental Change* 10, 109–120.
- Cutter, S.L., 1993. *Living with Risk*. Edward Arnold, London.
- Cutter, S.L., 2003. The vulnerability of science and the science of vulnerability. *Annals of the Association of American Geographers* 93, 1–12.
- Dahl, R.A., 1961. *Who Governs? Democracy and Power in an American City*. Yale University Press, New Haven, CT.
- DSB, 2003. Hva lærte vi av flommen i 1995? Evaluering av kommunenes flomberedskap 8 år etter storflommen på Østlandet. (What did we learn from the flood in 1995? Evaluation of municipalities' flood preparedness 8 years after the large floods in Eastern Norway.) Directorate for Civil Protection and Emergency Planning, Oslo.
- Eikenæs, O., Njøs, A., Østdahl, T., Taugbøl, T., 2000. Flommen kommer... (The flood is coming...) HYDRA end of project report. Norwegian Water Resources and Energy Directorate, Oslo (in Norwegian).
- Flaa, P., Gabrielsen, R., Hofoss, D., Hoven, F.H., Rønning, R., 1985. *Innføring i organisasjonsteori (Introduction to organisation theory)*, third ed. Norwegian University Press, Oslo, Bergen, Stavanger, Tromsø (in Norwegian).
- Glantz, M. (Ed.), 1989. *Forecasting by Analogy: Societal Responses to Regional Climate Change*. Summary Report. National Center for Atmospheric Research, Boulder, CO.
- Government of Norway White Paper No. 37, 1995–96. St. meld. No. 37: Om flommen på Østlandet 1995 og kriseberedskap i fred. (The floods in eastern Norway in 1995 and disaster preparedness in peace times.) (in Norwegian).
- Government of Norway White Paper No. 42, 1996–1997. St. meld. No. 42: Tiltak mot flom. (Measures against floods.) (In Norwegian).
- Hindar, K., L'Abbe-Lund, J. H., Jensås, J.G., Møkkelgjerd, P.I., Balstad, T., Arnekleiv, J.V., 1996. Effekter av flommen i 1995 på bestanden av laks- og ørretunger i Gaula. (The effects of the 1995 floods on the population of salmon and trout spawn in Gaula.) Norwegian Institute for Nature Research, Trondheim (in Norwegian).
- Lisø, K.R., Aandahl, G., Eriksen, S., Alfsen, K.H., 2003. Preparing for impacts of climate change in Norway's built environment. *Building Research and Information* 31, 200–209.
- Liverman, D.M., Merideth, R., 2002. Climate and society in the US Southwest: the context for a regional assessment. *Climate Research* 21, 199–218.
- Lukes, S., 1974. *Power: A Radical View*. Macmillan, Basingstoke.
- Lundquist, D., Lunde, A.E., Bøe, P.C., 1996. Flommen 1995 i Glomma og Lågen. (The 1995 floods in Glomma and Lågen.) Glommens og Laagens Brukseierforening (Glommen's and Laagen's Water Management Association), Oslo (in Norwegian).
- Miller, K.A., Rhodes, S.L., MacDonnel, L.J., 1997. Water allocation in a changing climate: institutions and adaptation. *Climatic Change* 35, 157–177.
- Ministry of the Environment, Ministry of Local Government and Labour, 1997. Arealplanlegging og utbygging i fareområde. (Area planning and building in high-risk areas). T-5/97. Circular. Ministry of the Environment and Ministry of Local Government and Labour, Oslo (in Norwegian).
- Morrow, B.H., 1999. Identifying and mapping community vulnerability. *Disasters* 24, 1–18.
- Næss, L.O., forthcoming. Institutions and adaptation to climate change: synthesis of issues, with particular reference to Norway. CICERO Working Paper, Oslo.
- NIVA, 1996. Flommen på Østlandet våren 1995. Sammenstilling av NIVAs undersøkelser med spesiell vekt på måleprogrammet i Glomma og Vorma. (The 1995 floods in eastern Norway. A comparison of NIVA investigations, with special emphasis on the measurement programme in Glomma and Vorma.) Norwegian Institute for Water Research, Oslo (in Norwegian).
- NOU, 1996. Tiltak mot flom. (Measures against floods.) Norges offentlige utredninger (Reports of the Government Commissions), Oslo (in Norwegian).
- NVE, 1999. Retningslinjer for arealbruk og sikring i flomutsatte områder. Retningslinjer 1/1999. (Guidelines for Land Use and Safety in Flood Prone Areas. Guidelines 1/1999.) Norwegian Water Resources and Energy Directorate, Oslo (in Norwegian).
- Nye, J., 1987. Nuclear learning and US–Soviet security regimes. *International Organization* 41, 371–402.
- O'Brien, K., Sygna, L., Haugen, J.E., 2004. Vulnerable or resilient? A multi-scale assessment of climate impacts and vulnerability in Norway. *Climatic Change* 64, 193–225.
- Olsson, P., Folke, C., 2001. Local ecological knowledge and institutional dynamics for ecosystem management: a study of Lake Racken watershed, Sweden. *Ecosystems* 4, 85–104.
- Øygarden, L., Eggestad, H. O., Standring, W.J.F. Goffeng, G., Vagstad, N., 1996. Flommen i 1995. Skader på jordbruksarealene langs Glomma og Gudbrandsdalslågen. (The 1995 floods. Damages to agricultural land along Glomma and Gudbrandsdalslågen.) Norwegian Centre for Soil and Environmental Research, Ås (in Norwegian).
- Quarantelli, E.L., 1987. What should we study? Questions and suggestions for researchers about the concept of disasters. *International Journal of Mass Emergencies and Disasters* 5, 7–32.
- Rattsø, J., 2003. Vertical Imbalance and Fiscal Behavior in a Welfare State: Norway. In: Rodden, J.A., Eskeland, G.S., Litvack, J. (Eds.), *Fiscal Decentralization and the Challenge of Hard Budget Constraints*. The MIT Press, Cambridge, MA and London, England.
- Skurdal, J., Østdahl, T., Taugbøl, T., Kaltenborn, B.P., Hertzberg, K., Arnesen, T., Hagen, S.E., 2000. The Glomma and Laagen River Basin in Norway. WCD Case Study. Secretariat of the World Commission on Dams, Cape Town.
- Smit, B., Pilifosova, O., Burton, I., Challenger, B., Huq, S., Klein, R.J.T., Yohe, G., Adger, N., Downing, T., Harvey, E., Kane, S., Parry, M., Skinner, M., Smith, J., Wandel, J., 2001. Adaptation to climate change in the context of sustainable development and equity. In: McCarthy, J.J., Canziani, O.F., Leary, N.A., Dokken, D.J., White, K.S. (Eds.), *Climate Change 2001. Impacts, Adaptation, and Vulnerability*. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge (Chapter 18).
- The Heinz Center, 2002. *Human Links to Coastal Disasters*. The Heinz Center, Washington DC [www.heinzctr.org](http://www.heinzctr.org). Accessed April 2004.
- Tol, R.S.J., van der Grijp, N., Olshoorn, A.A., van der Werff, P.E., 2003. Adapting to climate: a case study on riverine flood risk in the Netherlands. *Risk Analysis* 23, 575–583.
- Underdal, A., 1998. Explaining compliance and defection: three models. *European Journal of International Relations* 4, 5–31.
- Vayda, W.P., Walters, B.B., 1999. Against political ecology. *Human Ecology* 27, 167–179.

- Wilbanks, T.J., 2002. Geographic scaling issues in integrated assessments of climate change. *Integrated Assessment* 3, 100–114.
- Wilbanks, T.J., Kates, R.W., 1999. Global change in local places: how scale matters. *Climatic Change* 43, 601–628.
- Yin, R., 1994. *Case Study Research, Design and Methods*. Sage Publications, Thousand Oaks, London, New Delhi.
- Yohe, G., Tol, R.S.J., 2002. Indicators for social and economic coping capacity—moving toward a working definition of adaptive capacity. *Global Environmental Change* 12, 25–40.
- Young, O., 1998. Institutional dimensions of global environmental change, science plan. IHDP Report No. 9. [http://www.ihdp.](http://www.ihdp.uni-bonn.de/html/publications/reports/report09/)

[uni-bonn.de/html/publications/reports/report09/](http://www.ihdp.uni-bonn.de/html/publications/reports/report09/) (Accessed April 2004).

### **Further reading**

- Eikenæs, O., 2000. Å leve med flaum. (Living with floods.) HYDRA Project Report. Norwegian Water Resources and Energy Directorate, Oslo (in Norwegian).