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Adapting to climate change in Finland: Research priorities

Proceedings of the FINADAPT seminar
Finnish Environment Institute (SYKE)
Helsinki 14 November 2003

Edited by Timothy R. Carter and Susanna Kankaanpää

FINADAPT Working Paper 1

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Preface

The Intergovernmental Panel on Climate Change (IPCC) defines adaptation as "adjustment in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts"¹. The IPCC lists two reasons why adaptation is important in the climate change issue. First, an understanding of expected adaptation is fundamental in evaluating the costs or risks of climate change. Second, adaptation is a key response option or strategy, along with mitigation. Even with reductions in greenhouse gas emissions, some climate change is regarded as inevitable, and it will be necessary to develop planned adaptation strategies to deal with the associated risks as a complement to mitigation actions.

The seminar summarised in this report is probably the first multidisciplinary meeting to have been held in Finland specifically on the theme of climate change adaptation. It was organised to provide an impetus for two new national initiatives, one research- and the other policy-orientated, that address the issue. The former is the FINADAPT consortium, a set of research projects co-ordinated by the Finnish Environment Institute, which is designed to provide an initial picture of adaptive capacity under a changing climate across a range of systems and activities in Finland. The latter is the revised National Climate Strategy, to be completed by late 2004, in which adaptation to climate change is to be considered for the first time.

The themes represented at the seminar were diverse, ranging from human health to the built environment, from biodiversity to economics, and from land use planning to tourism. However, taken together, the discussions illustrated how exposed the Finnish environment and society really is to weather and climate, how adaptation is likely to play a key role in coping with future climate change, and how important new research is for identifying and evaluating the various adaptation options available for responding to climate change.

The organisers would like to thank all speakers, chairs, moderators and participants for their contributions to this most stimulating seminar. We are also very grateful to Maria Vuorinen and Stefan Fronzek for logistical assistance, and to the Environmental Cluster Programme and the Finnish Environment Institute for financing the seminar.

Timothy Carter and Susanna Kankaanpää
Helsinki, January 2004

¹ Smit, B., O. Pilifsova, I. Burton, B. Challenger, S. Huq, R.J.T. Klein, and G. Yohe, 2001. Adaptation to climate change in the context of sustainable development and equity. In: *Climate Change 2001: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change* [McCarthy, J.J., O.F. Canziani, N.A. Leary, D.J. Dokken, and K.S. White (eds)]. Cambridge University Press, Cambridge and New York, pp. 877-912.

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ADAPTING TO CLIMATE CHANGE IN FINLAND: RESEARCH PRIORITIES

1. Background to the seminar

Anthropogenic climate change is expected to have significant impacts on different facets of the natural environment and society in Finland during the coming decades. Despite international efforts at climate change mitigation (i.e. reducing emissions of greenhouse gases thought to be responsible for modifying the climate), atmospheric concentrations of greenhouse gases continue to rise and some future climate change is now regarded as inevitable. Therefore, society must be prepared for its consequences, and climate change adaptation will be a necessary and complementary policy response to mitigation.

Adaptation refers to actions designed to reduce the adverse impacts of climate change and to enhance beneficial impacts. A recent review of information on adaptation to climate change in Finland² revealed quite a strong record of research into the impacts of climate change, but a relatively weak treatment of adaptation across all socio-economic and environmental sectors.

This report is an account of a one-day seminar organised at the Finnish Environment Institute (SYKE) as part of the preparatory phase of the FINADAPT consortium. It was attended by 80 participants from government, research institutions, business and the private sector. The seminar had four main goals:

1. To draw attention to the role of climate change adaptation in complementing emissions reduction (mitigation) as a response to changing climate in Finland
2. To invite participants representing different sectors and constituencies to present their opinions on the key research challenges posed in adapting to future climate change in Finland
3. To provide input for the final planning of research projects proposed in the FINADAPT consortium.
4. To discuss the possible establishment of a national research programme on climate change adaptation.

The report summarises the information presented at the seminar and also records some of the discussion. Section 2 covers the three short introductory presentations and sections 3 and 4 then describe two moderated panel sessions that had a sectoral focus – four panelists speaking on aspects of the natural environment and four on themes related to infrastructure and human well-being. The experiences of three guest speakers of national climate change research programmes in Norway and the United Kingdom are related in section 5 and section 6 reports the final panel session on themes that cut across the field of climate change adaptation. The concluding section is a summary of some of the main issues and recommendations raised in discussion. The seminar programme and list of participants can be found in the appendices.

² Carter, T.R. and Kankaanpää, S. 2003. A preliminary examination of adaptation to climate change in Finland. *The Finnish Environment* 640, Finnish Environment Institute, 66 pp (In Finnish and English).

2. Introductory presentations

2.1. The FINADAPT consortium

Some research priorities for climate change adaptation in Finland were listed by **Timothy Carter** (Finnish Environment Institute). He observed that:

- impacts research is needed in *some* sectors, e.g. human health, construction, insurance, community planning, tourism and recreation
- adaptation research is needed in *all* sectors
- stakeholder involvement is essential
- a distinction should be made between autonomous adaptation and planned adaptation
- a key focus should be on the timing of adaptation measures
- assessments should distinguish between adaptation to mean climate change vs. extreme climate events
- if possible, “no regrets” adaptation measures should be identified, which make sense with or without climate change
- research is needed on methods of evaluating adaptation strategies
- it is important to gain an understanding of the processes of adaptation

In order to strengthen research in the field of adaptation, the Finnish Environment Institute is co-ordinating the FINADAPT consortium. FINADAPT (Assessing the adaptive capacity of the Finnish environment and society under a changing climate) is part of the Finnish Environmental Cluster Research Programme run by the Ministry of the Environment with funding from a number of ministries and agencies. The research phase of FINADAPT, scheduled for 2004-2005, comprises projects undertaken at different institutions throughout Finland.

2.2. Climate change adaptation and the National Climate Strategy

The Finnish National Climate Strategy and preparation of an adaptation programme within the Strategy were reported by **Johanna Pohjola** on behalf of **Veikko Marttila** (Ministry of Agriculture and Forestry). The Strategy is being updated as countries await a decision from the Russian Federation on ratification of the Kyoto Protocol – a positive decision would cause the Protocol to come into force. In its communication on the National Climate Strategy in 2001, the Finnish Parliament required the Government to draft a programme for adaptation to climate change. The Strategy is updated every 2-3 years, and a separate programme for adaptation will be integrated into a revised Strategy in late 2004. The Ministry of Agriculture and Forestry (MMM) is responsible for coordinating the development of the programme, in co-operation with four other ministries: Finance (VM), Transport and Communications (LVM), Trade and Industry (KTM) and Environment (YM). The SYKE report *A preliminary examination of adaptation to climate change in Finland*² will serve as a basis for drafting a programme. On 10 November 2003 the Ministry of Agriculture and Forestry organized a seminar on adaptation in the forest sector, with several experts invited to present information on both ecological and economic aspects. This seminar was one of the concrete steps in the drafting process of the programme for adaptation, and will be followed in early 2004 by similar seminars and meetings covering some other sectors.

The focus of the FINADAPT seminar is on research priorities. In previous years several research programmes on climate change, starting from the Finnish Research Programme on Climate Change (SILMU), have provided a reasonable knowledge basis on climate change and its potential impacts. It is essential now to move on from the analysis of impacts towards an analysis of the adaptation measures that are needed. It seems that for many issues there is a gap in knowledge about adaptation, both in the short term and especially in the long term. There is also a lack of information on specific adaptation measures that might be required. It is likely that the information needed should be sector-specific and practical by nature – appropriate for both current and future conditions.

At the same time, it is essential to emphasize that even though there is apparently a lack of knowledge, before embarking on an extensive research programme there has to be a thorough analysis of the situation and the needs for research must be identified and addressed at a detailed level. Thus it is necessary for the FINADAPT consortium to undertake extensive groundwork and provide a first assessment of needs – otherwise it will be difficult to find wide enough support to ensure sufficient resources for research, amid tightening competition for limited resources. A research programme based on this preliminary work, assuming a wide consensus is achieved between the ministries involved – should provide a good combination of knowledge directly applicable for policy making, understanding how to apply that knowledge, and information on costs. It should also identify which sectors are most vulnerable and provide a prioritisation of measures needed. In other words, the question is, (a) with the potential impacts known, how should we move on to implement measures that ensure successful adaptation in a productive and cost-effective way, while ensuring continued socio-economic development in Finland? (b) what is the level of preparedness to cope with climate change, especially in the sensitive and vulnerable sectors or areas? (c) how can the functioning of industries, livelihoods and societal infrastructure be assured in the face of a changing magnitude and frequency of extreme climate events?

At the same time as analysing adaptation measures it is also essential to take into account mitigation activities, so as to integrate them in a cost-effective way. In some cases, adaptation and mitigation may even imply contradictory measures. This can be illustrated with an example from forestry. Global warming is likely to increase productivity and the rotation period could potentially be shortened. On the other hand, climate change could be mitigated by sequestering carbon in forests, which probably implies lengthening the rotation period.

Autonomous adaptation should be clearly distinguished from planned adaptation, and research should indicate when there is need for planned actions. It is likely that the public sector may have a more limited role in adaptation than in the case of mitigation. Private decision makers have more incentives to implement adaptation actions themselves, both in anticipation and in reaction to climate change, as they can have a more direct effect on their own ability to cope with climate change. However, the public sector will still also have a central role in adaptation: for example, it provides information needed by the private sector in planning and implementing adaptation measures, it issues standards and codes that assist the adaptation process, and it can provide compensation for losses by supplementing the private insurance markets.

2.3. Projections of future climate in Finland

Projections of future climate in Finland were described by **Mikko Alestalo** (Finnish Meteorological Institute). There is scientific consensus that the composition of the atmosphere

is changing, thereby altering the radiative balance of the earth-atmosphere system, and producing global warming. Temperatures have increased globally during the 20th century, and at sites in Finland there has also been warming over the same period (Figure 1). Climate change during the remainder of the 21st century is projected to be rapid and large, although the associated uncertainties are also substantial. It is also generally accepted that some change cannot be totally prevented. It has been estimated that global mean CO₂ concentration, sea level and temperature will continue to rise long after emissions have been reduced. Therefore, mitigation is not the only viable response option for society, but adaptation must also be considered.

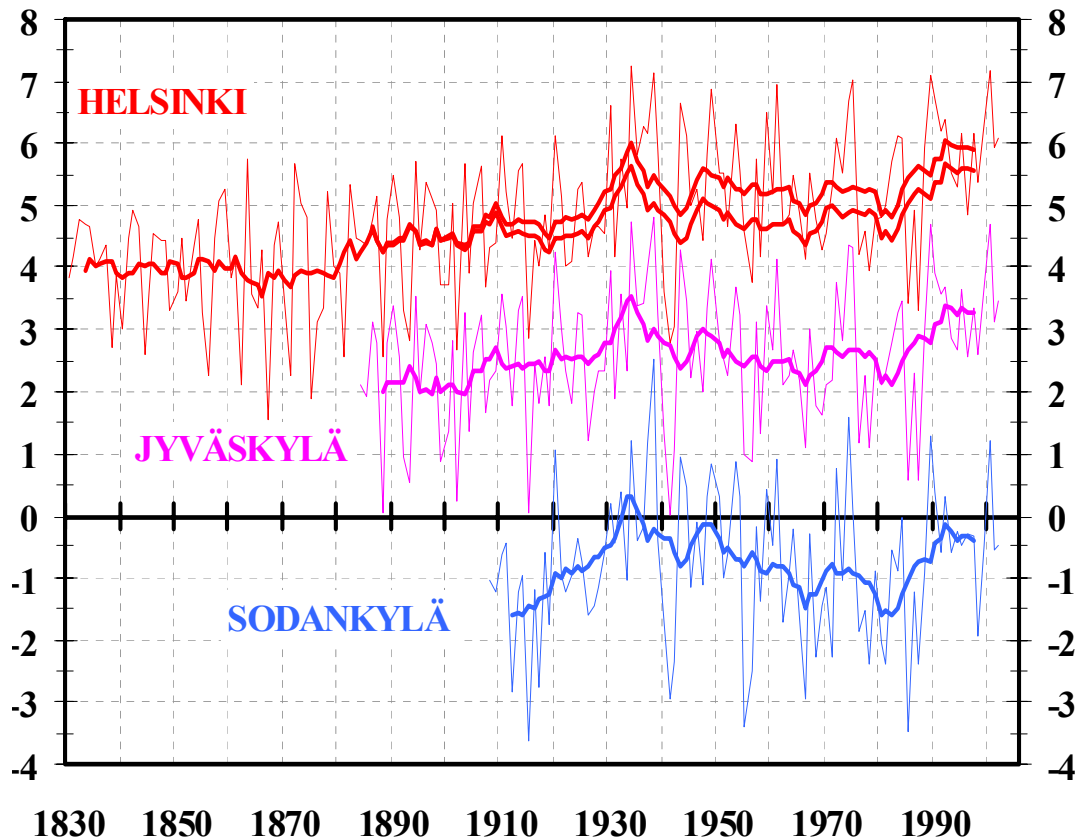


Figure 1 Mean annual temperature at Sodankylä (1908-2002), Jyväskylä (1885-2002) and Helsinki (1831-2002). Thin lines connect annual values; thick lines are 10-year running means. The lower line for Helsinki is corrected for urban warming effects; the upper line is uncorrected.³

The most reliable knowledge about climate change is connected to global mean conditions. Less is known about regional or local changes. Moreover, the variability of future climate is more difficult to estimate than changes in the mean. A special feature of this variability is the occurrence of extreme conditions. They are potentially the most harmful events for society as we are usually not fully prepared for them. Extreme conditions include, for example, the occurrence of anomalously high or low temperatures, precipitation amounts, or windspeeds. Extreme conditions may also be observed as a consequence of two or more rare events, of themselves not especially damaging, but if occurring consecutively, capable of causing disproportionate damage and loss of income. Decisions must thus be made under uncertainty, accepting that there are risks to be accounted for.

³ Source: Heikki Tuomenvirta, Finnish Meteorological Institute (unpublished)

To illustrate the types of studies required to understand extreme climate events, Figure 2 presents an extreme value analysis of absolute minimum temperatures in Northern Finland undertaken by **Jaakko Helminen** at the Finnish Meteorological Institute. Even in the circumstances of a general climate warming, extreme cold spells are still possible and would cause damage. The same type of analysis can be applied to other extreme events as well.

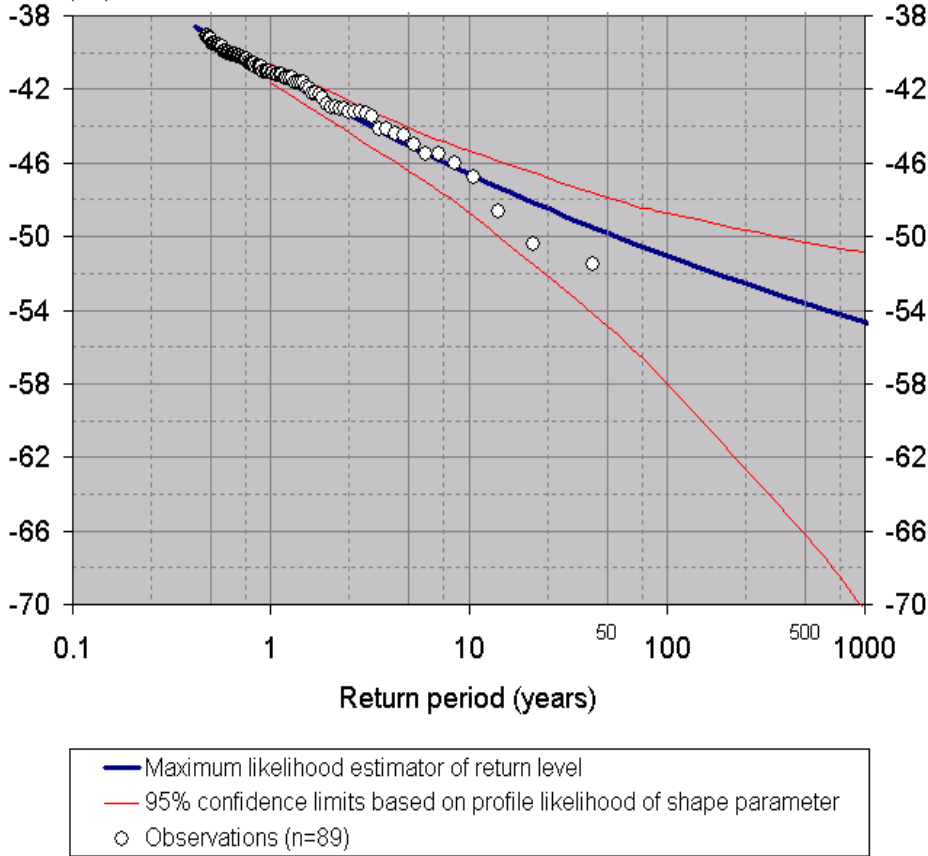


Figure 2 Extreme value analysis of regional absolute minimum air temperatures during extremely cold episodes (n = 89) at sites in northern Finland, 1959-2001.⁴

Alestalo concluded that there are many complex dependencies of society on the weather and climate that are not yet fully understood. It is important to focus research on changes not only in the mean values of atmospheric variables, but also in their variability, including extreme events. It is also important to recognise the inherent randomness of some aspects of the climate, which will continue to be an impediment to forecasting skill.

⁴ Source: Jaakko Helminen, Finnish Meteorological Institute (unpublished)

3. Sectoral issues: natural environment

The second session considered sectoral issues for adaptation to climate change. Moderated by **Outi Berghäll** (Ministry of the Environment), the first part of the session was a panel on the natural environment, covering forestry, agriculture, biodiversity and water resources.

3.1. Forestry

The significance of human activity in forests from the point of view of adaptation was stressed by **Lauri Valsta** (Department of Forest Economics, University of Helsinki). The Intergovernmental Panel on Climate Change estimates that the largest and earliest impacts induced by climate change are likely to occur in boreal forests, through changes in weather-related disturbance regimes and nutrient cycling (IPCC, 2001). The SILMU programme estimated that climate change impacts in Finnish forests would include:

- changes in species abundancies
- increased growth rate and higher stocking
- shorter rotation
- weather-related risks for Norway spruce

Most of the Finnish forests (around two-thirds) are family-owned concerns and therefore the actors in Finnish forestry are mostly private individuals. Their behaviour is crucial in adaptation decisions; some parts of their behaviour can be affected by policies, but a large component of their actions is also uncertain. Private owners have multiple goals, such as income, recreation, non-timber products (berries, mushrooms), biodiversity conservation and hunting. Income still has a high priority for many forest owners, but the picture might be more diverse in the future. There has also been a societal change over time: the importance of forest income has decreased, forest owners have become more urban and their knowledge about and connection to forestry is decreasing.

The time horizon is another factor affecting adaptation in forestry. Trees for commercial use mature in 50 – 150 years (rotation length). Long-term adaptation decisions (full-rotation) are:

- which species to grow
- which genetic origin to grow
- what initial density to create

Medium-term decisions (half-rotation) are:

- what forest structure to maintain (age, size, species)
- peatland water-level management

Short-term decisions (decade-scale) are:

- when to regenerate
- which method of regeneration to use
- what density to apply (thinnings)
- forest road network
- fertilization

Model-based results suggest that it would be advantageous already now to follow some adaptive changes in forest management. It would be profitable, for example, to increase the amount of birch in stands currently being regenerated (based on expected net revenues) and to decrease the amount of spruce. Some changes in wood quality due to changing climate can be expected. The best adaptability would require an even spatial distribution of tree species and shortened rotation times. Additional regeneration may be needed due to catastrophes (e.g. large scale damage due to pests, storms, etc.), which can cause capacity problems in silviculture, roundwood market disturbances and loss of carbon stock in forests.

On the one hand, an increased level of growth enhances productivity, but on the other hand, a decrease in wood quality would reduce profitability. As a consequence, there are likely to be changes in industrial processes and in the roundwood price structure. Increased risks lead to decreased expected returns, though these may be compensated by increased growth levels. Higher risks also increase interest rates.

The operability of forests and roads can change with climate change. A shorter period of frozen ground brings on difficulties in harvesting and increased harvesting costs. Therefore, technologies have to be improved and road carrying capacities need to be increased. As a result, road investment and maintenance costs will increase.

Forest-based industries will also need to adapt. Global wood production is predicted to increase slowly. Wood demand will also increase, but the structure of demand is also expected to change, with less newsprint and possibly less paper in general in the long run. The spruce-based fine paper industries have a high competitive advantage, but the availability of spruce raw materials, on which they are crucially dependent, might change in the future. The fine paper industries also use a lot of energy (electricity) for production. In the future woody products may gain popularity due to a favourable carbon balance compared to substitutes.

There are alternative and competing uses of wood products: as industrial products with dissimilar life cycles, as products for primary use, recycling or energy production, as a carbon sink in the forest (compare a fuel tax of 12 €/m³ with the pulpwood price of 14-20 €/m³), as a non-market good (for biodiversity, recreation, etc.). These uses are partly conflicting and there is a need for integrated analyses.

Finally, policy and research issues include determining:

- how to reduce risks and their effects
- how to balance resilience and productivity when facing biological and economic risks (scenario analyses)
- which silvicultural adaptation measures are timely now
- what forest policy measures support adaptability
- alternative uses of woody products through integrated analyses.

3.2. Agriculture

Impacts of climate change on agriculture in Finland can be extensive, as **Pasi Rikkonen** (Agrifood Research Finland) explained. Some of the changes are positive (such as a lengthened growing season and increased productivity) while others are negative and uncertain (such as the risk of erosion and floods and the incidence of pests and diseases).

There are two perspectives to climate change in agriculture: first, climate change will have impacts on agriculture, presumably requiring adaptation policy measures, and second, agriculture itself has an impact on the climate through emissions of greenhouse gases, requiring mitigation policy measures.

In the SILMU programme there was an emphasis on biophysical impacts of climate change on agriculture. These impacts include: changes in growing season, plant productivity and yields, changes in occurrence of diseases and pests, pressures on plant breeding, impacts on water resources, and new crops. The results indicated that the profitability of Finnish agriculture is likely to increase. The impacts of agricultural production on climate include greenhouse gas emissions from fertilizer use and organic soils, livestock (crops, manure, etc.) and fodder plants.

As part of the Research Programme on Sustainable Use of Natural Resources (SUNARE) a Delphi study has been carried out at Agrifood Research Finland focusing on Finnish agriculture in 2025. A high proportion of the experts from the agri-food sector who were consulted in the study identified a major challenge in combining the time scales of agricultural policy planning (short term) with those of climate change (long term). The study concluded that long term planning perspectives would need to be scaled down to the short time scales that characterise policy planning, and that it would be advisable to take climate change into account immediately in the planning of agricultural policies (Figure 1).

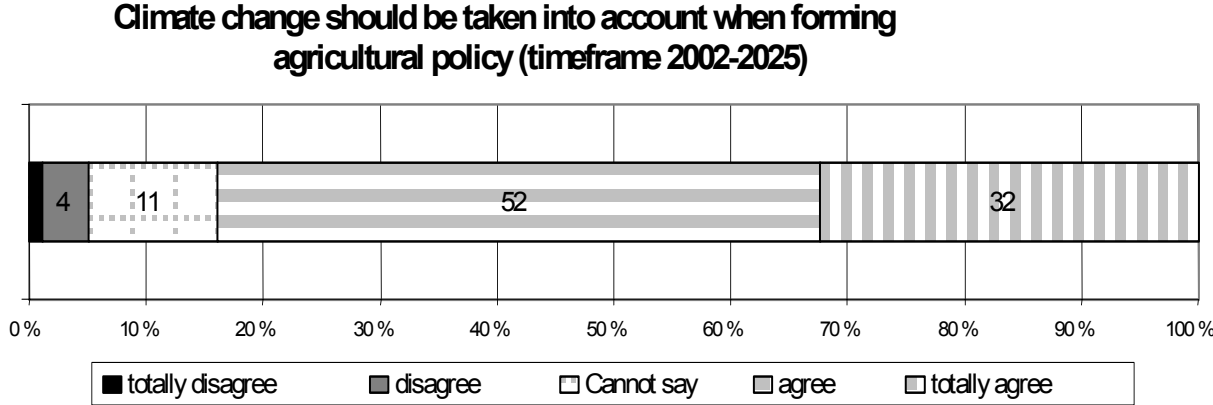


Figure 3 Opinions on the role of climate change in determining agricultural policy – results of a Delphi study on Finnish agriculture by 2025.⁵Source: Rikkonen (2003).

In public sector strategic planning the formation of adaptation policies can be based on two approaches: 1) arguments about climate change based on observations of impacts (e.g. information available on indicators, historical data or other evidence) and 2) preparedness to meet the challenges of estimated future climate change outcomes. The second option requires information on alternative directions and pathways of development and an evaluation of preferred adaptation strategies, using boundary scenarios as tools. The basic premises and the key uncertainties would need need to be known.

There is a need for discussion about alternative outcomes (positive and negative) and about the broader consequences (ecological, economic and social) of climate change for agriculture.

⁵ Rikkonen, P. 2003. Maatalouden tulevaisuun vuoteen 2025: Elintarvikeketjun asiantuntijoiden tulevaisuuden kuvia Suomen maataloudesta (The future of agriculture up to 2025. Food chain experts' visions of the future for Finnish agriculture). Väiliraportti. *MTT:n selvityksiä* 32, 51 pp. + 3 appendices.

In past studies, the emphasis has been on the evaluation of biophysical impacts. However, economic, social and technological perspectives on climate change and agriculture also need to be emphasised in future research.

Three points underline the importance of considering agriculture in climate change research: 1) climate change has a strong direct impact on agriculture (soil, weather conditions, requirement for new crops/varieties), 2) reliable food supply is an important long term societal goal (i.e. food supply security, degree of self sufficiency) and 3) climate change may enhance the relative importance of Finnish agriculture in comparison to other EU countries.

In discussion, **Martti Esala** (Agrifood Research Finland) pointed out that although there has been considerable progress in researching the biophysical impacts of climate change in the agricultural sector, it would be unwise to suggest that all aspects have yet been sufficiently studied.

3.3. Biodiversity

Important issues related to biodiversity and climate change were presented by **Seppo Neuvonen** (Kevo Subarctic Research Institute, University of Turku). Biological diversity is defined in Article 2 of the Convention on Biological Diversity (CBD) as “the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems”⁶. In addition to a purely biological definition, some would argue that cultural diversity should also be accounted for.

Biodiversity is important for ecosystem services. Ecosystems provide many goods and services crucial for human well-being, including:

- Provisioning services (food, fuel wood, fiber, natural medicines, genetic resources, fresh water etc.)
- Regulating services (air quality, climate, floods, water purification, pollination, biological control, etc.)
- Cultural services (non-material benefits such as cultural diversity and identity, spiritual values, educational values, recreation)
- Supporting services (soil formation and retention, nutrient cycling, etc.)

Ecosystem goods and services have significant economic value, even if some of these goods and most of the services are not traded by the market.

There are national, international and global issues related to biodiversity and climate change. National issues are independent of events in other countries and include:

- Climate change impacts on biodiversity in Finland
- Biodiversity as an adaptation measure to climate change
- Impacts of climate change mitigation and adaptation activities on biodiversity
- New kind(s) of conservation approach(es) that will be needed in a (too) rapidly changing climate

⁶ UNEP, 1992. Convention on Biological Diversity, United Nations Environment Programme, Nairobi, 31 pp.

The international issues include:

- Migrating birds (climate changes and land use changes in overwintering – resting areas)
- Networks of protected areas with neighbouring countries ("Biological Corridors") as an adaptation to negative biodiversity impacts
- Developing EU directives to better consider "the Northern Dimension" also with respect to new conservation issues under rapidly changing climate

Global issues include:

- Use of the Clean Development Mechanism (CDM) as a tool to advance sustainable development for developing countries
- Societal and economic considerations important as well (in addition to biodiversity)
- Recognising the interface between biodiversity and climate change, which has been addressed through the establishment of an Ad Hoc Technical Expert Group (AHTEG) on Biological Diversity and Climate Change under the CBD (co-chaired by Outi Berghäll, Finland) and in a recent IPCC Technical Paper that was requested by the CBD⁷

There are important biodiversity and climate change issues that should be taken into consideration in Finland. Adaptation (to climate change) activities can have negative or positive impacts on biodiversity. Consequently, the potential effects of different climate change adaptation measures on biodiversity must be carefully evaluated. High latitude and altitude ecosystems and species are a specific responsibility of Finland in respect to biodiversity. These species have limited or no space to move into if their living environments change. Boreal forests and freshwater ecosystems are an other concern, especially primary (old-growth) forests. In addition to establishing "biological corridors" with neighbouring countries, management of "matrix" areas at ecotones (treeline areas that have feedbacks, both positive and negative, to climate change), should also be considered. Wetlands are another important biodiversity issue in connection to climate change.

3.4. Water resources

Expected impacts of climate change on the seasonal distribution of runoff, the effects of an increase of maximum precipitation and evaporation in summer in Finland, and possible adaptation measures to these changes were reported by **Bertel Vehviläinen** (Finnish Environment Institute). Adaptation to changes in the seasonal distribution of runoff include changes in regulation rules for lakes and reservoirs (to provide additional storage capacity in winter, requiring less capacity in spring, and maintaining higher levels of storage in summer), better preparedness for flood protection in winter conditions, and increased capacity of turbines at water power plants to reduce spill-off.

Increases of maximum precipitation by up to 50-80 % have been projected for Finland (Figure 4). This would affect dam safety, and in small catchments increased outflow capacity would be a necessary adaptation measure. In Northern catchments moderate or no adaptation is needed. However, in lake systems the regulation of reservoirs will need to be modified.

⁷ Gitay, H., Suárez, A. and Watson, R.T. 2002. Climate change and biodiversity, *IPCC Technical Paper V*, Intergovernmental Panel on Climate Change, Geneva, 77 pp.

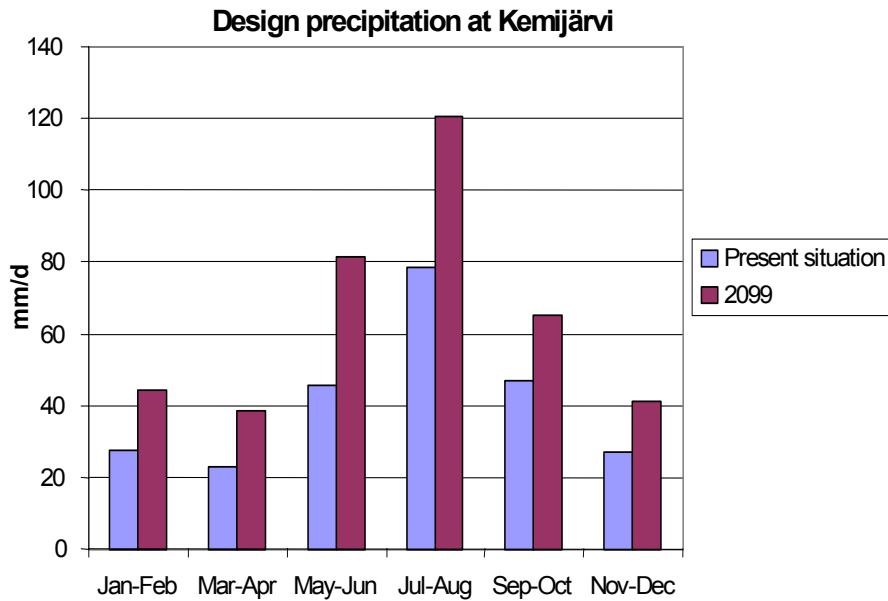


Figure 4 Design precipitation at Kemijärvi under present conditions (1961-1990) and under projected future conditions (2070-2099).⁸

Urban areas should prepare for additional flooding by increasing the capacity of storm water pipes and through temporary storage of water.

An increase of evaporation in the summer due to higher temperatures would require adaptation measures in water supply. Private households should join community water works, surface water could be used and groundwater may need to be produced artificially.

⁸ Veijalainen, N. and Vehviläinen, B. 2004. Ilmastonmuutoksen vaikutus P – patojen mitoitusvirtaamiin. Kemijoki ja Oulujoki. (The impact of climate change on design flow of P-category dams. Kemijoki and Oulujoki) Internal Report 15.1.2004, Finnish Environment Institute, Hydrological Services Department, 51 pp.

4. Sectoral issues: infrastructure and human well-being

The second part of the session on sectoral issues for adaptation to climate change focused on issues in the human environment. A four-member panel gave presentations on human health, the built environment and transport, energy infrastructure, and tourism and recreation. The panel was again moderated by **Outi Berghäll** (Ministry of the Environment).

4.1. Human health

At present, low temperature and thermal variations are the climatic factors that have the major health effects in Finland, as reported by **Juhani Hassi** (Centre for Arctic Medicine, University of Oulu). There are biological, chemical and physical factors influenced by climate that can affect human health. These effects are both direct and indirect.

Mortality rates in Finland show a strong inverse correlation to daily temperature at temperature below about 5°C (Figure 5). It has been estimated that there are 1.5-2.5 million people suffering from cold-related diseases in Finland. These diseases include cardiovascular diseases (hypertension, coronary disease, cerebrovascular and peripheral circulatory diseases that cause circulation constriction), respiratory diseases (asthma or asthmatic symptoms, chronic diseases of the respiratory tract), skin diseases (cold urticaria), early freezing injuries, and diabetes-related disturbances of peripheral circulation. Note also that the temperature threshold in Figure 5 is lower in Finland than in warmer climates, providing an indication of the likely direction of acclimation as climate warms in Finland.

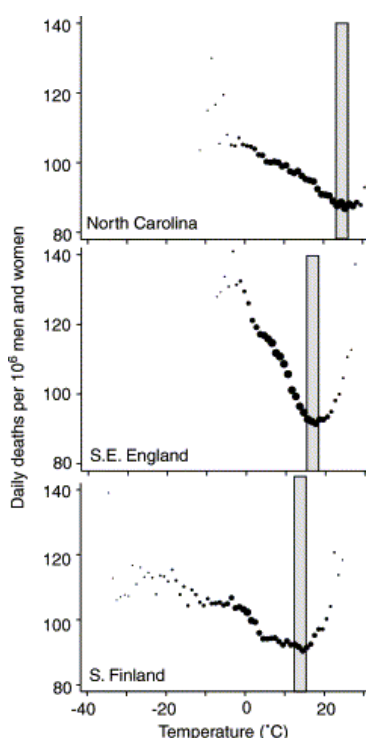


Figure 5 Mortality at different mean daily temperatures. Pooled data for each region at age 55+, 1971–1997. The areas of circles are proportional to the number of days at each temperature. The grey shaded areas show the temperature band at which mortality is lowest.⁹

⁹ Donaldson, G.C., Keatinge, W.R. and Näyhä, S. 2003. Changes in summer temperature and heat-related mortality since 1971 in North Carolina, South Finland, and Southeast England. *Environmental Research* 91, 1-7.

Climate warming can have direct consequences on human health in Finland, including:

- physiological adaptation types may change and will offer weaker protection against cold peaks of climate
- behavioural adaptation may not develop to protect against cold peaks
- the cooling rate of humans may increase, provoking more cold-related sickness attacks
- the temperature of the mortality minimum is likely to increase

Indirect consequences of climate warming on human health include:

- increase of ozone concentrations
- increase of living organisms in natural waters, which may cause increased infections
- problems related to waste management and sewage in small communities
- increased pollen in the air

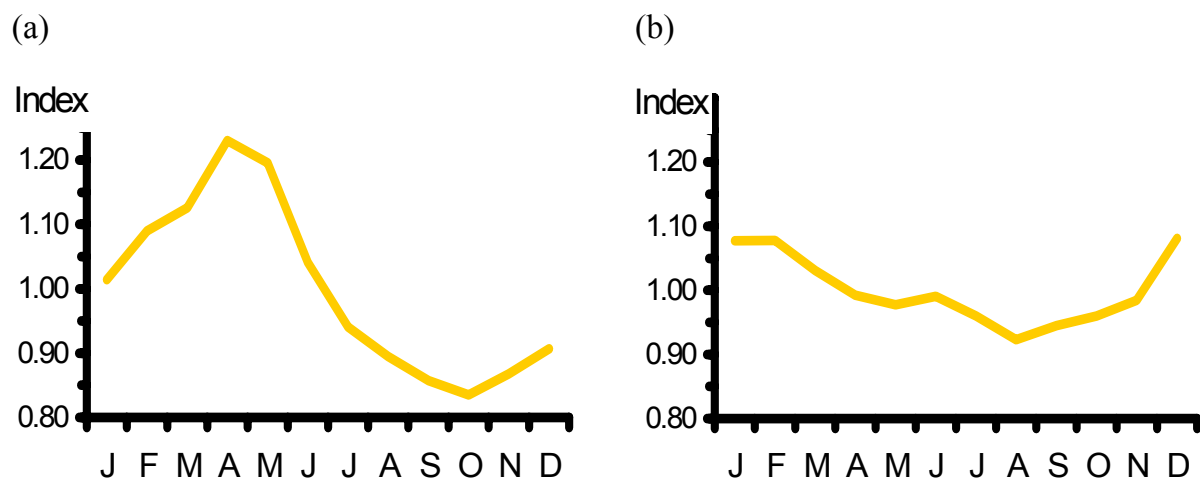


Figure 6 Seasonal variation of deaths from all causes, by month: (a) Sweden-Finland 1749-63; (b) Finland 1961-95.¹⁰

Several future actions can be identified that may be of relevance in relation to adaptation to climate change. A seminar of experts to evaluate and estimate the health consequences of global warming in Finland would be a useful exercise to scope the problem. Scientific projects should focus on identified uncertainties. A risk management model for the prevention of adverse health effects should be developed. The raising of awareness in the general public is also an important adaptation goal.

In discussion, **Antti Otsamo** (Ministry of Agriculture and Forestry) asked how rapid the process of cold adaptation is in humans. Juhani Hassi replied that 70% of individual adapt in 10 days and the maximum adaptation time is 30 days. **Eila Lahdes** (Finnish Institute of Marine Research) asked about the effect of darkness and increasing temperature combined on human health. Hassi explained that darkness-related physiological effects are based on the

¹⁰ Sources: Wargentín, P. 1767. Ut hvilka månader flera människor årlige dödas och dö in Sverige. *Kongl. Svenska Vetenskapsakademiens Handlingar för månaderna October, November, December 1767*, 249-258; Simo Näyhä, University of Oulu, personal communication.

melatonin effect¹¹. It is difficult to differentiate at present the effects of cold and darkness. In general about 15% of the Finnish population suffer mental problems related to cold and darkness.

4.2. The built environment and transport

The vulnerability of the built environment and transport to climate change were discussed by **Seppo Saarelainen** (VTT Building and Transport). He illustrated the pathways by which climate change impacts can occur using a flow diagram (Figure 7).

With respect to road transport, frost protection will still be needed under a warming climate in the future as it is today, but the risk of frost damage may be lower at a given level of protection. For the winter maintenance of roads, an increase in friction control would require more salting. On the other hand, to reduce pollution, salt use should be minimised.

Future winter precipitation is projected to increase, but mean summer rainfall may even decrease, although maximum precipitation events are likely to become more intense (cf. Figure 4). Sites at risk of future flooding include:

- built areas (insufficient drainage)
- transport routes
- storage sites of environmentally harmful materials
- water courses (shoreline structures)
- seashores (due to sea-level rise, mainly in southern Finland)

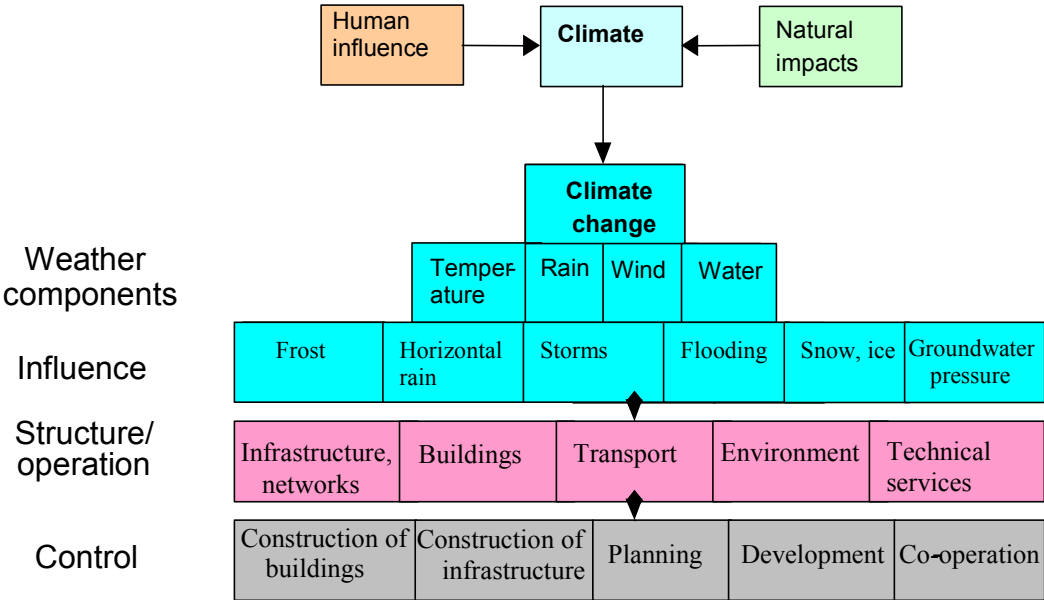


Figure 7 Pathways of climate change impacts on the built environment and transport.¹²

¹¹ Melatonin is a natural hormone synthesized from serotonin and secreted by the pineal gland (at the base of the brain) especially in response to darkness. It causes humans to feel less alert, body temperature starts to fall and sleep becomes more inviting.

¹² Source: Seppo Saarelainen, VTT-Building and Transport (unpublished).

Some adaptation measures for flooding can be identified. The areas at risk of flooding in current urban areas should be mapped. In addition, design methods of stormwater systems should be improved. Drainage systems should be modified to account for the changed conditions, allowing for percolation and storage as well as pipelines.

Changes in groundwater levels require the development of methods for drainage and moisture control. In connection with projected sea-level rise, the current recommendations of the Ministry of the Environment should be applied in practice, sites and transport routes under flooding risk should be mapped and construction within sites at risk of flooding should be limited.

Climate change can also affect the occurrence of erosion and landslides. An increase in precipitation is likely to lead to a rise in water levels and increased discharge in water courses as well as an increase in soil moisture. The risk of slope failure will increase, and erosion and landslides would become more common. Adaptation measures include mapping and investigating the risk of slope failure and controlling and limiting construction in high risk areas.

Potential themes for further research in the built environment include:

- The influence of increased precipitation on flooding of stormwater drainage
- Mitigation of moisture damage in buildings and earth structures
- Minimisation of flood damage
- Leaching risk at polluted sites and landfills
- Slope erosion and failure risk
- Change of frost damage risk

In conclusion, some recommendations for future action were presented. Regulations are already in place for the kinds of impacts described. However, the total impact is often a result of several components and their influences rather than just one. The current design may not be accurate enough to account for projected changes in occurrence and risks of future events. Furthermore, improved control of the potential impacts of climate may also decrease the risk of damage under present practice, even without climate change. Research is needed to control impacts today as well as in the future, and simulation is necessary to describe the impacts of climate change and to justify any response measures.

Martti Tiuri (Finnish Parliament) raised the question of sea-level rise and land uplift. Seppo Saarelainen replied that according to projections, land uplift will continue to exceed sea-level rise on the Finnish coast for some time, but that this effect will reverse in later decades of this century, and sea-level rise will eventually dominate. **Timothy Carter** (Finnish Environment Institute) commented that according to results from the recently completed FINSKEN project, there is a greater than even chance that relative sea level along the southern coast of Finland will begin to rise during the second half of this century, while in the Gulf of Bothnia it is more likely that land uplift will continue to exceed sea-level rise (i.e. producing a relative sea-level fall), but by an ever-decreasing margin throughout the century¹³.

¹³ Johansson M.M., Kahma K.K., Boman H., and Launiainen J. 2004. Scenarios for sea level on the Finnish coast. *Boreal Environment Research* (in press).

4.3. Energy infrastructure

Some important facets of the Finnish energy system that are vulnerable to climatic influences and could be affected by climate change were described by **Sanna Syri** (VTT Processes). Climate change could have significant effects on renewable energy resources, on energy demand and on the energy distribution network, with important linked effects throughout the whole energy system. Potentially large costs can be involved. Some of the important aspects of climate change to be considered include: average long-term changes, possible changes in seasonal, annual and extreme conditions, confidence levels and uncertainties, and time horizons.

Some issues of adaptation to climate change in the energy sector were identified. For hydropower production the problem is how to ensure year-round production under changed climatic conditions that are likely to be characterised by rainier winters, drier summers and heavier storms. The bioenergy sector will face the questions of how to minimise the possible adverse impacts on biomass growth such as drought, how to exploit positive effects such as an extended growing season and how to prepare for changes in regional availability. For windpower production problems such as increased storms and changes in the icing of blades need to be examined. The design values for the loading of blades will probably need to be changed so that impacts of load variations on the network are minimised. Solar power production will be affected if there are changes in annual solar radiation to the surface.

For energy system the questions of how to ensure the availability of peak power and changing production costs will have to be addressed. The potential for mitigation of greenhouse gases in the energy system is a high priority, and will need to be assessed. For the electricity distribution infrastructure issues affecting the design and maintenance of the network need to be studied. These issues include effects of higher temperatures (e.g. on peak power demand), effects of increased severity and/or frequency of storms (longer outages), and impacts on the condition of the network (faster deterioration).

Possible collaboration and relevant recent and ongoing activities in Finland in relation to adaptation to climate change in the energy sector include:

- Regional climate scenarios for Finland: the FINSKEN (2002), PRUDENCE (ongoing) and ENSEMBLES (ongoing) projects of the Finnish Meteorological Institute (IL) and Finnish Environment Institute (SYKE)
- The ILMAVA project of CLIMTECH (2002): average changes in renewable energy resources in Finland due to climate change by the 2030s (IL, SYKE, Fortum)
- Nordic Project on Climate and Energy (2003-2006): impacts of climate change on renewable energy sources and their role in the Nordic energy system (VTT, Finnish Meteorological Institute, Joensuu University, SYKE in co-operation with other Nordic agencies).¹⁴

Bengt Tammelin (Finnish Meteorological Institute) provided more information about the Nordic Project on Climate and Energy, explaining that it covers five areas: (i) hydropower: snow and ice, (ii) hydropower: hydrological models, (iii) biofuels, (iv) solar energy, and (v) wind power. Statistical analyses will be carried out on long-term time climatological and hydrological time series and extremes, and the Rossby Centre regional climate model will be

¹⁴ <http://www.os.is/ce/>

used to supply climate scenarios based on the SRES A2 and B2 emissions scenarios¹⁵. Reference groups have been formed that represent stakeholders from the energy industry.

4.4. Tourism and recreation

Some questions related to the adaptive capacity of the tourism and outdoor recreation sector under changing climate in Finland were presented by **Eija Pouta** (Department of Forest Economics, University of Helsinki). International studies of climate change impacts on tourism cover mainly water and snow activities, but there have been no previous studies in Finland. However, the first national inventory of outdoor recreation has recently been carried out, and this provides new opportunities to analyse issues such as adaptation to climate change. Moreover, Finland is well placed to initiate work in this field, having already established a Finnish University Network for Tourism Studies that represents 17 university departments nationwide.

The main actors in tourism and recreation with a potential interest in climate change include:

- participants in outdoor recreation activities (97% of Finns – Table 1)
- suppliers of outdoor recreation services (municipalities, Forest service, voluntary organisations)
- entrepreneurs in nature tourism (e.g. there are 32 000 jobs in nature tourism and tourism income on ski resorts totalled 454 million euros in 2002)

Table 1 Participation in outdoor activities in Finland.¹⁶

Activity	Participation (%)	Times/year	Activity	Participation (%)	Times/year
Walking	68	114	Outdoor activities with children	30	56
Swimming	67	26	Dog sledding	25	248
Berry picking	56	8	Hiking	23	31
Summer cottage activities	56	31	Picking herbs and flowers	17	7
Bicycling	55	48	Running and jogging	16	61
Studying nature	48	55	Downhill skiing	15	8
Boating	47	24	Birdwatching	14	120
Fishing	46	31	Camping	12	6
Mushroom picking	38	7	Snowmobiling	10	13
Cross-country skiing	38	19	Leisure time forest management	10	9
Sunbathing on the beach	31	7	Hunting	8	22
Picnicking	30	7	Backpacking	8	9
Collecting small wood	30	12			

For example, a sizeable proportion of the Finnish population engages in some form of skiing (Figure 8). The actors with a potential interest in climate change include the skiers themselves, entrepreneurs and providers of skiing services. Cross-country skiers can adapt to warmer conditions, for example, by changing their style from conventional skiing to skate

¹⁵ Nakićenović, N. and 27 others, 2000. *Emissions Scenarios. A Special Report of Working Group III of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, UK and New York, NY, USA, 599 pp.

¹⁶ Source: Pouta, E. and Sievänen, T. 2001. Luonnon virkistyskäytön kysyntätutkimuksen tulokset – kuinka Suomalaiset ulkoilevat? (Results of the outdoor recreation questionnaire – how do Finns use the outdoors?) In: Sievänen, T. (Ed.). *Luonnon virkistyskäyttö 2000. (Outdoor recreation 2000)*, *Forest Research Institute Communications 802*, 37-76 (in Finnish with English summary).

skiing, by changing the time at which they prefer to participate from late winter to midwinter, and by making skiing trips to more northerly parts of Finland. As a result, the expenses incurred are likely to increase, and skiers may search for substitute activities. Entrepreneurs and service suppliers can start to use artificial snow on cross-country tracks as they already do for downhill skiing, prepare more skate skiing tracks, illuminate tracks to promote midwinter skiing in darker and colder conditions, and offer alternative or parallel activities. Adaptation would require increasing energy use and costs, possibly an increased concentration of the activity to northern Finland and hence a need for larger resorts. Meanwhile, resorts in southern Finland may face problems.

Of the foreign visitors visiting Finland in winter, 19% take part in outdoor activities (values from 1999-2000), and in general snow based tourism has increased in Finland. Snow cover remains an attraction for tourists in Lapland, especially around Christmas.

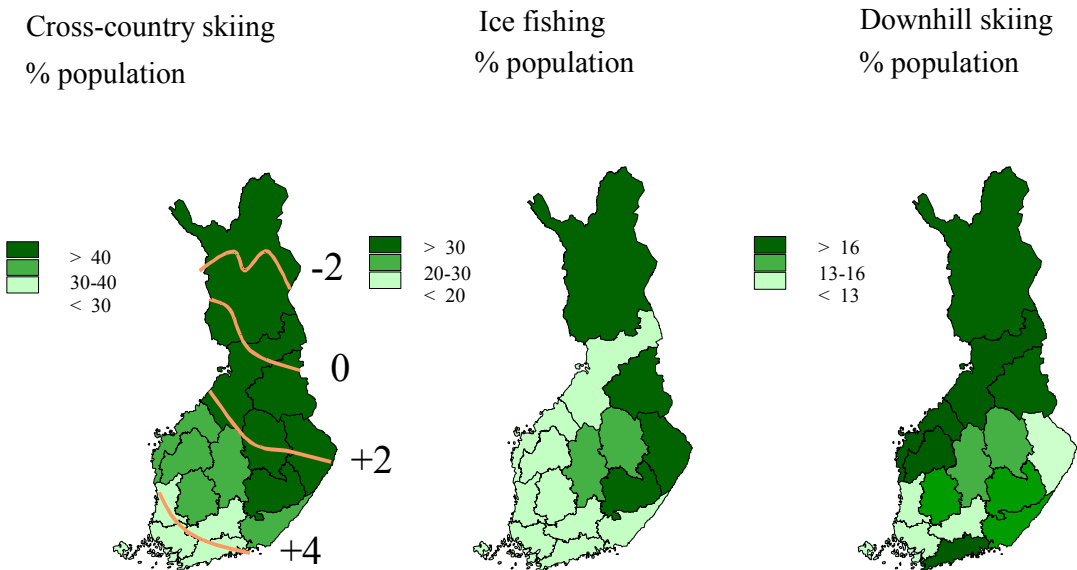


Figure 8 Winter participation of Finns in outdoor activities. Orange lines show mean annual temperature, 1961-1990.¹⁷

Issues meriting further study include, on the demand side:

- effects of climate change on the behaviour of Finns with respect to outdoor recreation
- implications of climate change for tourism flows to Finland

and on the supply side:

- sensitivity of the tourism sector, including resort areas, to climate change – information applicable for strategic planning in the travel industry
- sustainable adaptation to climate change

¹⁷ Source: Sievänen, T., Pouta, E. and Neuvonen, M. 2003. Luonnon virkistyskäyttö maakunnittain (Outdoor recreation by province). *Forest Research Institute Communications* 885, 32 pp. (in Finnish)

5. Examples of national research programmes on climate change adaptation

The third session, chaired by **Aimo Aalto** (Ministry of Trade and Industry), offered the audience an opportunity to learn about national research programmes on climate change adaptation in two other countries: Norway and the United Kingdom.

5.1. The Norwegian NORKLIMA programme (2004-2013)

Fridtjof Mehlum (The Research Council of Norway) spoke about the NORKLIMA (Climate change and impacts for Norway) programme¹⁸. This is a ten-year programme (2004-2013) with a budget of US\$15 million, covering research on the climate system and on the expected effects of climate change in Norway and the surrounding region. It is an inter- and multidisciplinary research programme.

The main goal of the NORKLIMA programme is to provide the necessary new knowledge related to:

- the climate system and changes in climate in the past, present and future
- direct and indirect effects of climate change on nature and society
- providing a basis for adaptation policies and measures

The scientific sub-goals of the programme are to improve understanding of:

- the climate system and its variability and quantifying uncertainty
- climate changes and their effects on abiotic, managed and human systems
- climate changes and their effects on natural ecosystems
- climate change and society

The programme's strategic sub-goals are:

- National division of labour: to promote a well-balanced national division of labour among scientific groups in order to engage the best national competence in the different fields of research
- Quality: to ensure that Norwegian climate research meets high international scientific standards
- Multi-disciplinarity: striving to fulfil the potential of multi- and inter-disciplinary research in Norwegian climate research
- Communication strategy: to establish good contacts with different components of society and to develop an effective strategy for dissemination of programme results
- Recruitment: to promote the recruitment of Ph.D. and postdoctoral researchers and to provide general opportunities for recruitment to positions in climate related research

At the start-up of the programme it comprised the following three activities:

1. Programme on climate and climate change (2002-2011)
2. Programme on effects of and adaptations to climate change (2002-2011)

¹⁸ <http://www.program.forskningsradet.no/klimaprog/en/index.html>

3. Special research funds for "Polar Climate Research" (2002-2006)

In the context of this seminar, Mehlum's main focus was on the second programme. However, the research areas of the other two programmes can be briefly summarised as follows.

Climate and climate change programme: climate processes in the atmosphere, climate processes in the ocean, regional climate modelling, paleoclimatology, ozone and UV, and non-biological effects studies. One component of this programme is the RegClim project (Regional Climate Development under Global Warming), which provides regional climate data and scenarios for use in impact and adaptation assessment (Figure 9).

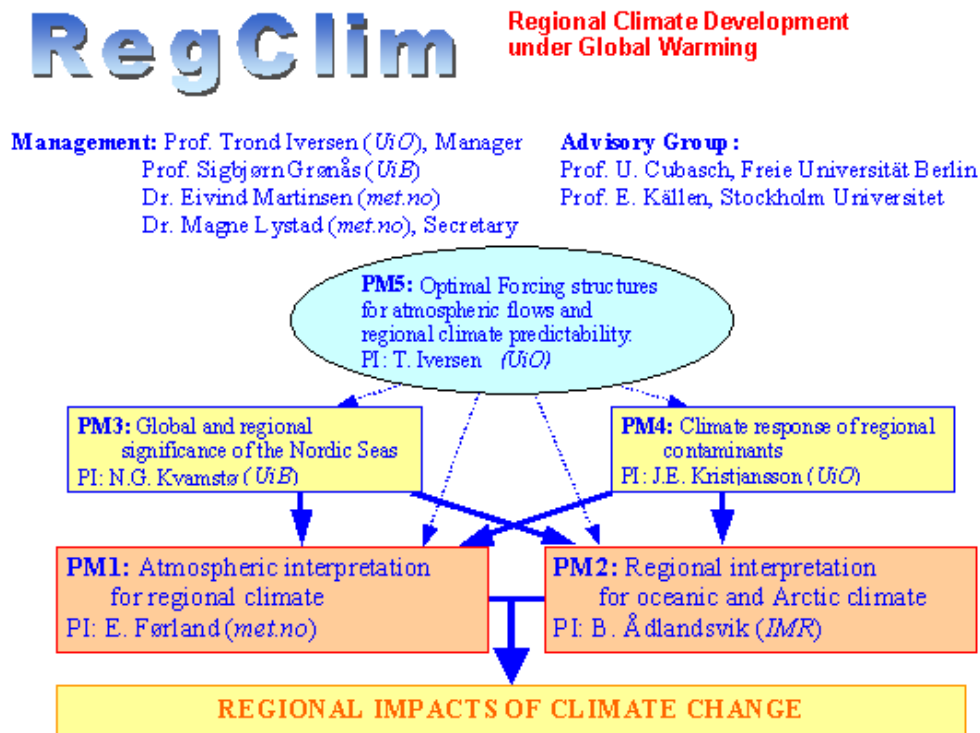


Figure 9 Structure and management of the RegClim project¹⁹

Polar Climate Research: (i) marine climate in the northern parts of the Norwegian Sea including the Greenland Sea, the Fram Strait and the Barents Sea, (ii) the ecological consequences of climate change in the above-mentioned areas and on Svalbard, and (iii) technology and methods for Earth observations and oceanographic measurements in the deeper oceans seen in relation to the above-mentioned problems.

The programme on effects of and adaptations to climate change has five main aims:

- Climate variables and ecosystems: to identify climate variables of high direct and indirect importance for key ecosystems, and how effects of these variables may be separated from the endogenous dynamics of the ecosystems and effects of other anthropogenic activity.
- Climate change and society: to relate climate driven changes in ecosystems and natural resources to changes in society and identify regions and sectors of particular vulnerability to climate change during the next 30 -50 years.

¹⁹ Source: RegClim project. For more details, see: http://regclim.met.no/index_en.html

- National adaptation strategy: to identify elements in a national adaptation strategy to expected climate changes.
- Outreach strategy: to provide an effective presentation of results of the programme to all parts of society.
- Recruitment: to secure recruitment of competent scientists for climate research.

Some underlying needs identified for this programme include:

1. Basic research – to improve understanding of the functioning of ecosystems and society and the relationships between these as a basis for producing knowledge on possible impacts of climate change
2. Sectoral perspective – to provide science-based knowledge to the authorities with responsibility for sectors of society that might be highly vulnerable to future climate changes in Norway
3. Regional societal perspective – to encourage integration of research between natural science and social science at a regional level
4. International societal perspective – to increase our understanding of effects of climate change in other countries, particularly developing countries, and how these effects may influence the Norwegian society via changes, for example, in trade patterns, tourism and immigration.

The RegClim scenarios for Norway to year 2050 indicate that there are likely to be increases in climate variability. Winters will be milder and temperatures slightly increased in the summer. Precipitation intensity and wind speeds will increase. Higher waves and sea levels are estimated during severe storms.

As an affluent country Norway is thought to be resilient to the impacts of climate change, and at the national level Norway will probably benefit from climate change. However, after accounting for regions, localities and social groups, the picture becomes more complex. Thus, policy makers, sectorial associations, and local institutions have to address the climate vulnerability at regional and local levels. From this perspective, some of the key research topics include:

- the development of methods and theory for socio-economic vulnerability and adaptation at a local scale
- studies of the role of institutions related to socio-economic vulnerability and adaptation
- development of regional economic accounts and models in the Arctic from the local to the circumpolar scale.

Martin Forsius (Finnish Environment Institute) commented that he personally appreciated the approach of the NORKLIMA programme, with its long-term perspective and funding and its simultaneous work on scenarios and effects of climate change. **Fritjof Mehlum** commented that the programme would be evaluated every 5 years. He also stressed the importance of foresight studies, indicating that these should proceed after the programme has been completed. **Petteri Taalas** (Finnish Meteorological Institute) asked about the provision of climate information from the programme. Mehlum replied that all climate data used in impact studies is publicly available and communication between data providers and users was being actively promoted in the programme. Only one climate scenario has been adopted up to now, and empirical downscaling of climate model projections has been used in some regions.

5.2. Climate change adaptation research in the United Kingdom

5.2.1. UK government perspective

Ken Wright (UK Department for Environment, Food and Rural Affairs – Defra) offered a perspective on climate change impacts and adaptation from a UK government department (Defra). The Energy White Paper (2003) puts the UK on a path towards a 60 % cut in CO₂ emissions by 2050. 20% of electricity should be from renewable energy sources by 2020. Both adaptation and mitigation policy is included in the White Paper.

UK work on impacts and adaptation covers research to provide guidance for public and private stakeholders and to assess risks for government departments, informing the development of new policies and measures. UK research on climate change impacts and adaptation is undertaken by the Hadley Centre for Climate Prediction and Research²⁰, the Tyndall Centre for Climate Change Research²¹ (comprising nine research institutions) and UKCIP (the UK Climate Impacts Programme – described at the seminar in the following presentation), as well as by universities, consultancies, etc. The research has adopted a stakeholder led approach and feeds information to the stakeholder community.

The Global Atmosphere Division of Defra has an Impacts and Adaptation Research Programme that undertakes:

- International studies: China / India
- Global impacts ("Fast Track") studies
- Support for IPCC Working Group II, Fourth Assessment Report (AR4)
- Model data dissemination (the LINK project)
- Stabilisation scoping study
- UK indicators (and review)

Research is already underway for Defra in some key areas, e.g. water resources and flood management but more work is needed on protection of marine environment and on plant and animal diseases. Other Departments are now following suit, including planning, transport, energy supply, tourism and international development. The government's role in adaptation includes: investment appraisal for infrastructure projects (e.g. transport), regulatory and planning frameworks (e.g. the water industry), contingency planning (e.g. threats from wildlife pests and diseases), sustainability of long term policy frameworks (e.g. biodiversity policy), and working with stakeholders to find solutions (e.g. UKCIP tools).

Climate Change has been mainstreamed into policy in several sectors:

- In water resource management in the National Strategy (2001) and the Water Company 25-year water plans and drought plans
- In flood and coastal defence, climate change guidance for coasts (1989) and rivers (2000) has been prepared and there will be increased spending (> £550m per annum by 2005/6)
- Planning guidance on floodplain building regulations has been prepared
- Other policy areas where climate change has been considered include agriculture, forestry and biodiversity

²⁰ <http://www.met-office.gov.uk/research/hadleycentre/index.html>

²¹ <http://www.tyndall.ac.uk/>

An example of where climate change has been taken into account in decision-making is the new plans for the defences on the Thames Estuary in London, which protect £80 billion of assets. Higher allowances are being built-in to planning regulations to protect against river flooding and sea-level rise. At the same time there is an emphasis on flexibility of options, for example soft versus hard engineering solutions to sea-level rise.

5.2.2. The UK Climate Impacts Programme (UKCIP)

The UK Climate Impacts Programme (UKCIP)²² was introduced by **Chris West** (UKCIP). UKCIP is a central resource provided by the government to help organisations assess how they might be affected by climate change, so they can prepare for its impacts (Figure 10). The programme was set up in 1997 and is funded by Defra (c. 900k€ / year). The UKCIP is applying stakeholder-led research using resources such as common tools and experience, intelligent access to datasets, guidance and support for studies and efficient dissemination of results and tools. There is web access to all tools.

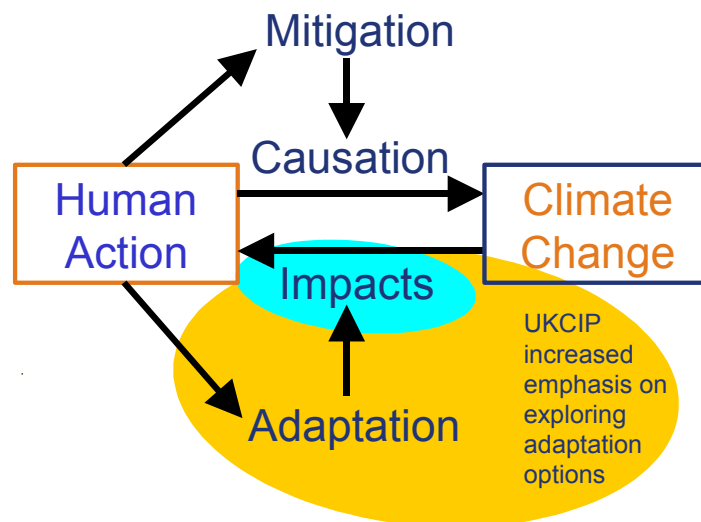


Figure 10 Scope of the UK Climate Impacts Programme (yellow area).²³

Scientists and stakeholders often have difficulties understanding each other and therefore a participatory research approach has been adopted. The Canadian McKenzie River Basin Study has been used as a model for undertaking this approach. Networks have been created (Regional Partnerships, local governments, business). In some cases local governments lead the research while in others they follow. UKCIP helps and gives guidance to all participants. Stakeholders involved in UKCIP include:

- government departments
- agencies and utilities
- devolved administrations and regions (12 partnerships regionally)
- local government
- business (trade associations)
- decision-makers and planners
- researchers

²² <http://www.ukcip.org.uk/>

²³ Source: UK Climate Impacts Programme

The value of a stakeholder approach is in:

- a shared view of issues
- the development of a common language
- involvement in the research process
- ownership of solutions
- application of results
- building trust among partners
- further joint action

The UKCIP studies cover several sectors: health, nature conservation, gardens, water demand and integrated multi-sectoral regional study – Regis 1. Ongoing sectoral studies include: nature conservation (MONARCH Phase 2), Marine biodiversity, Regis 2 and Building Knowledge for a Changing Climate. For the future several sectoral studies are under consideration: healthcare, transport, tourism, coasts and soils.

A recent report on "Climate adaptation: Risk, uncertainty and decision-making"²⁴ provides a mechanism for including climate change into decisions. A future "meta-tool" is under development that is intended to lead decision-makers from a simple understanding of climate change to integration of climate change into decision-making.

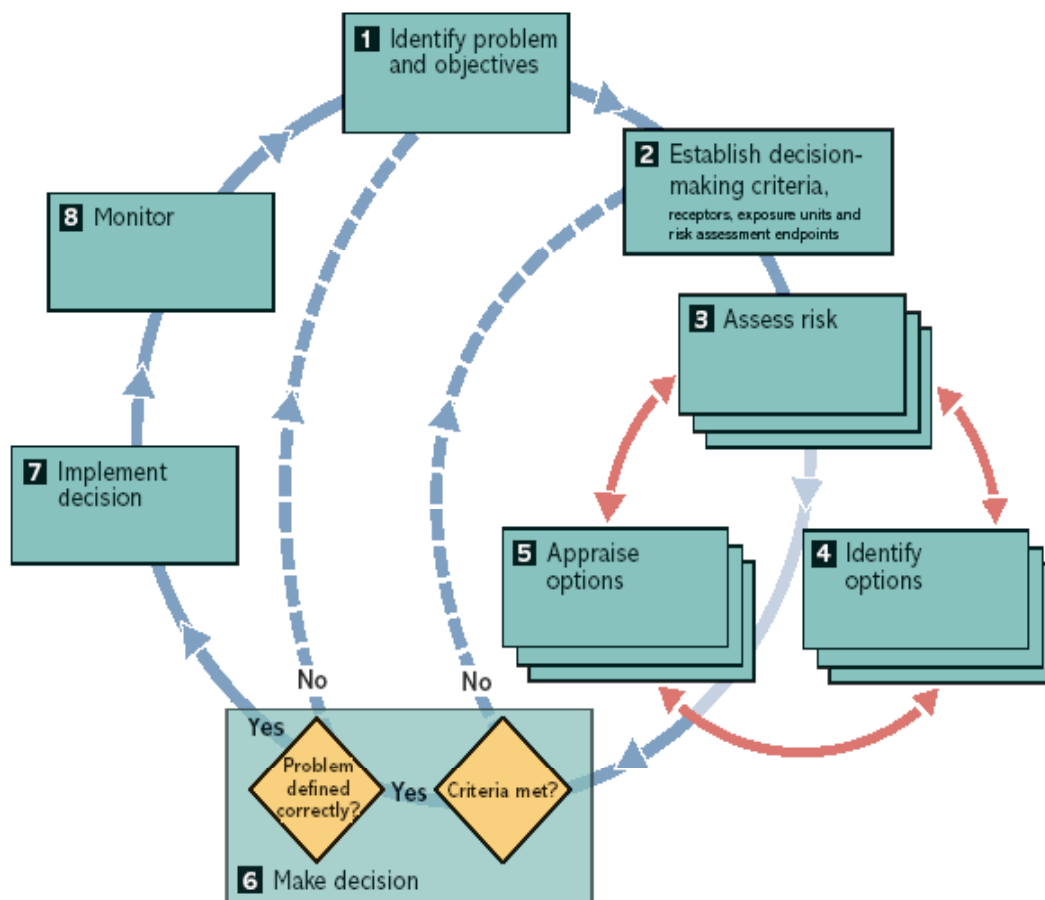


Figure 11 A mechanism for including climate change into decision-making.²⁴

²⁴ Source: Willows, R. and R. Connell, 2003. *Climate adaptation: Risk, uncertainty and decision-making*. UKCIP Technical Report, UK Climate IMpacts Programme, Oxford, 154 pp.

The focus of adaptation in UKCIP is on a practical approach and guidance. Some typical key issues to consider include:

- Assess adaptation to current climate
- Find out scale of risk/opportunity
- Identify highest priorities
- Consider whether to act now, to plan, or to wait
- Keep options open
- Don't restrict future decisions
- Try to find "no regrets" options

Integration is difficult and there are few theories but it is necessary. Integration implies:

- across scales, regions, departments, and sectors
- that the sum of the whole is greater than the individual parts
- common issues for studies: tools, datasets, downscaling, uncertainty, costing, materials
- knock-on impacts or responses from one sector to another
- uneven knowledge – studies take different routes but can also learn from each other

There can also be barriers to effective action, including:

- a mismatch between scale, site, and timing of the problem and of potential responses
- the bystander effect - “ Nobody else is doing anything, so why should I do anything; it can't be that serious”
- denial– of the truth and/or of responsibility.

Lauri Valsta (Department of Forest Economics, University of Helsinki) commented on the difficulty of dealing with problems about which there is only incomplete scientific knowledge. How much consensus is required before one can act? **Chris West** replied that when using scenarios in UKCIP, it is made clear that these are not predictions because the uncertainties are too great to enable confident prediction. Rather they are plausible pathways into the future that assist analysts in interpreting possible outcomes. A risk-based approach is adopted in which stakeholders are explained the uncertainties of given events and are asked if they can afford not to take the risk into consideration. **Ken Wright** added that there are different levels of risks in different sectors. For example, resource managers are not likely to overlook climate change where vital infrastructure is concerned, but other sectors may conclude that immediate action is premature. An obvious method of enhancing the preparedness for extreme climate events is through improved seasonal weather forecasts, and **Jaakko Helminen** (Finnish Meteorological Institute) described a pilot study to investigate the socio-economic benefits of such forecasts.

6. Cross-cutting research themes

The final panel discussion, moderated by **Lea Kauppi** (Finnish Environment Institute), covered themes that cut across many aspects of adaptation assessment: technology, community planning, economic analysis and policy analysis. The roles of TEKES and the Academy of Finland in supporting research were also raised, and the final general discussion touched on the possible development of a new national research programme on climate change adaptation.

6.1. Technological development and the role of TEKES

The objectives and activities of the National Technology Agency of Finland (TEKES) were described by **Sami Tuhkanen** (TEKES). The primary objective of TEKES is to promote the competitiveness of Finnish industry and the service sector by technological means. Activities undertaken by TEKES aim to diversify production structures, increase production and exports, and create a foundation for employment and social well-being.

There are two basic questions posed by TEKES in relation to climate change adaptation:

- What kind of new technology is needed in Finland and in other countries to adapt to climate change?
- Which of these technologies can be developed in Finland?

TEKES has funded many technology programmes concerning climate change mitigation, including CLIMTECH, WOOD ENERGY, DENSY, STREAMS, CUBE, and some others. A new technology programme is currently being prepared: "Mitigation of Climate Change and Business Opportunities, CLIMB", in which adaptation may have a small role (Figure 12).

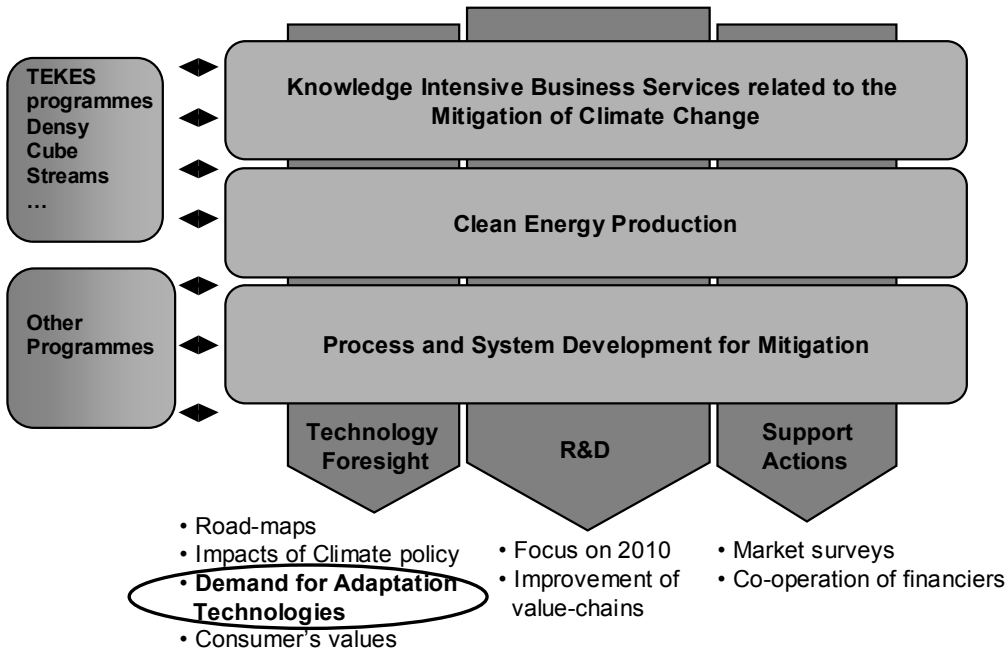


Figure 12 Preliminary focus areas and tools of the CLIMB technology programme (under preparation).²⁵

²⁵ Source: Sami Tuhkanen, TEKES (unpublished).

6.2. Community planning

Vulnerability and adaptation issues in community development and urban planning were described by **Rauno Sairinen** (Helsinki University of Technology, YTK). The effects of climate change in the urban environment may include:

- Sea-level rise, flooding (e.g. basements, cellars, tunnels, sewage systems at risk)
- Changes in weather conditions (e.g. fewer extremely cold winters, rapid changes, extreme conditions, risks of accidents, risks for technical infrastructure such as traffic, etc.)
- Changes in groundwater levels (e.g. risk of erosion, humidity in construction, drying out of soil)
- Effects on urban ecology (impacts for greenspace structures, ecology and recreation areas)
- Effects on economic life and business (e.g. tourism, traffic, industry, etc.)
- Effects for neighbourhoods, communities, housing and lifestyles

Of these, the effects of climate change on urban ecology, in economic life and business, and for neighbourhoods, communities, housing and lifestyles, are areas in which few studies have been carried out.

Knowledge gaps concerning adaptation and vulnerability issues in community development and urban planning include:

- Differences or similarities in climate change mitigation and adaptation policies (space-specific)
- Information on the capacity for recovery or change (population density, economic welfare, different social groups, spatial characteristics, local conditions)
- Where are the vulnerable? (targeting geographical regions, types of area or activity, socio-economic class)
- How to develop stakeholder involvement and conditions of shared knowledge?
- Earlier experiences in managing fluctuations and disturbance?
- How to assess community impacts and changes in urban governance? Problems of governance.

There are several issues concerning the capacities of local communities to respond to climate change effects:

- Social mechanisms (possibilities for social response; changes in life styles or local business activities; perceptions of risks; interactions between institutional resilience and ecosystem resilience)
- Institutional capacities (stimulating the development of institutions and activities that respond to environmental change; assessing the adaptive significance of local institutions, such as land-use practices, property rights or cultural norms)
- Local knowledge base (understanding how environmental information is produced, interpreted and linked to local or regional planning and decision-making systems; accounting for uncertainty of scientific information)
- Monitoring of environmental and societal changes (mechanisms by which local and regional actors can participate in monitoring and interpret the results; determining the kinds of change that should be monitored for important signals; describing what types of information are currently ignored and why)

- Role of scale (determining the right scale for each question; communicating environmental information across institutional levels)
- Management practices (developing socio-ecological practices, adaptive resource management and resilience; identifying cases in which choices can be offered)
- Governance (requirements to alter the rules, guidelines or regulations; understanding the process by which rules are altered; identifying the relevant actors/stakeholders; examining the interaction between adaptive strategies and measures to reduce greenhouse emissions)
- Governance and conflict (choices for responding to environmental changes entail potential conflicts because they involve redistribution of rights and opportunities. What kind of fit is there between those who benefit and those who bear the cost?)

The capacities of urban planning for climate change adaptation are in:

- The knowledge base, including: the transformation of climate change data sets and impact studies into information to satisfy the needs of regional planners; guidelines for co-operation and communication between spatial planners and scientists; the integration of expertise and knowledge from many diverse sources; analysis of earlier experiences with similar kind of risks (e.g. delineation of flood risk zones for planning)
- Policy instruments and techniques, for example: restrictions on waterfront construction; setting guidelines on minimum elevations for construction; modifying the capacity for urban rainwater drainage and methods for drying; definitions of responsibilities for construction sites and technical infrastructure; protection of buildings, cultural heritage and other infrastructure

Some features of the potential impacts of climate change pose challenges for adaptation and for society's preparedness. Effects are unpredictable and surprises are to be expected. This means that it is difficult to detect change early enough to allow for effective solutions or scientific consensus. The signal of change can also be displaced in place and time from the source, so that motivation for action is small. Conventional market mechanisms are expected to be inadequate in dealing with the problems of climate change.

YTK is currently undertaking some projects in relation to climate change:

- SEAREG – Sea level change effecting the spatial development in the Baltic Sea region (INTERREG IIIb, 2002-05)²⁶
- HAZARD - The spatial effects and management of natural and technological hazards in general and in relation to climate change (ESPON, 2002-04)²⁷
- EXTREFLOOD – Flood hazards in Finland: modelling and mapping of extreme floods, producing flood scenarios and delivering flood information to stakeholders (Environmental Cluster Research Programme, 2003-05)²⁸

6.3. Economic analysis

The role of economic analysis in research on adaptation to climate change was discussed by **Juha Honkatukia** (Government Institute for Economic Research, VATT). The question of how to measure the economic costs of adaptation has not yet been thoroughly studied and few

²⁶ <http://www.gsf.fi/projects/seareg/partners.html>, contact Kaisa.Schmidt-Thome@hut.fi

²⁷ http://www.espon.lu/online/documentation/projects/thematic/thematic_60.html, contact Lasse.Peltonen@hut.fi

²⁸ http://www.sci.utu.fi/maantiede/extre_flood/Extreflood/Index.htm, contact Lasse.Peltonen@hut.fi

up-to-date studies exist of the costs of adaptation. It is crucial to note that adaptation takes place at the micro-economic level. The SILMU programme produced some micro-level estimates of adaptation. Simple economic cost evaluations were carried out but no full-blown macro-economic analysis was conducted. However, macro-economic cost estimates are useful for policy-making, and sectoral linkages can be very important as reactions by one sector can affect other sectors. Moreover, micro-economic estimates can be readily incorporated into macro studies.

Measuring adaptation and mitigation is still a problem, and the choice of the baseline for comparisons is not clear. An assessment of the cost of adaptation is needed to determine if policy interventions could be helpful, but in order to do this a "no-adaptation" scenario would also be necessary. Other scenario assumptions that are important for economic analysis concern whether adaptation is reactive or anticipatory. The cost of mitigation could be based on recent experience, but it should also be understood that mitigation can affect adaptation.

Some points to consider in proceeding with adaptation research include:

- Sectoral evaluations need to be up-dated
- Scenarios need to be created
- Available methods include sectoral studies and macro-economic models

Macro-economic models, in particular computable general equilibrium (CGE) models, could be helpful because they can be based on micro-economic theory but also account for macro-economic linkages including public finances and policies, they can assess costs of sectoral developments and policies, they are useful for developing consistent scenarios, detailed sectoral data helps to incorporate sectoral results, they can account for macro linkages which helps in assessing the (macro) feasibility and compatibility of sectoral results, and they can be used to assess welfare effects (e.g. current/future generations)

6.4. Policy analysis

Analysis of the policy-making process in relation to climate change adaptation was described by **Eeva Furman** (Finnish Environment Institute). A framework for policy analysis is shown in Figure 13. Adaptation to climate change is mainly a question of the resilience of society, but the outcome of policies is not always the intended one. The social and natural environment are changing around us and those changes also affect policies. An important question in forming knowledge systems for environmental governance is the management of adaptation risk and how this risk is evaluated and communicated.

The social dimensions of climate change adaptation in different sectors (agriculture, forestry, tourism, housing) need to be considered and assessments of supportive measures carried out. Existing networks of institutions need to be examined for their adequacy to provide support for local communities in adapting to climate change.

In the evaluation of existing adaptation measures and strategies the following questions should be considered:

- What measures and strategies are available?
- How effective are they?
- What kinds of direct and indirect impacts do they have?

- What is their cost to the public sector and to other stakeholders?

Liability as a juridical concept should also be taken into account in adaptation issues. It is relevant to ask how economic, social and ecological costs and responsibilities of adaptation are shared or should be shared. Currently, responsibility for the effects of climate change is shared by all, but it is unclear who should take responsibility for adaptation questions in the future.

The roles of environmental authorities might also change at international, national, regional and local levels, as well as between these levels. It is worth considering what kinds of requirements national adaptation strategies might set for actions at local municipal level. Adaptation to the effects of mitigation policies should be considered as well, and is also relevant for private companies with respect to their interaction with environmental authorities.

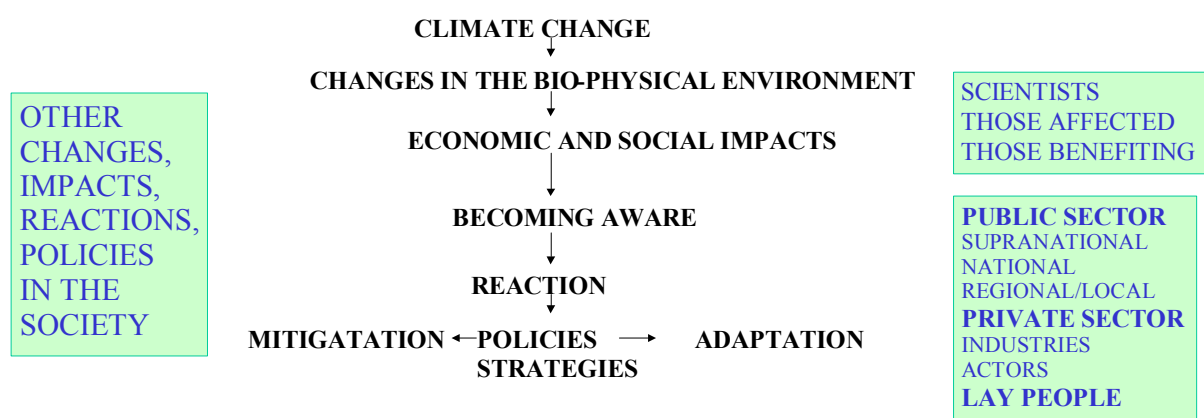


Figure 13 A framework for the policy analysis of climate change adaptation.²⁹

6.5. The role of Academy-funded research in addressing climate change

The function and research programmes of the Academy of Finland were introduced by **Jaana Roos** (Academy of Finland). The function of the Academy is to enhance the quality and prestige of basic research in Finland by providing funding allocated on a competitive basis, by carrying out systematic evaluation and by influencing science policy. Funding is allocated mainly through research projects, programmes and posts. The Academy has no fixed research themes or areas and therefore research concerning climate change adaptation has no privilege over any other field.

Climate change adaptation was a subject included in the Finnish Research Programme on Climate Change SILMU (1990-1995) and the Finnish Global Change Research Programme FIGARE (1999-2002). These are described in more detail below. Two out of the 42 National Centres of Excellence in Research are working in the field of global change research. Furthermore, in the Nordic Centre of Excellence Programme, four Nordic Centres focus on basic natural science in the field of global change in the context of ecosystem processes within climate change, atmospheric processes and oceanographic processes. Of the Academy posts, two of 39 Academy Professors are working in the field of global change research.

²⁹ Source: Eeva Furman, Finnish Environment Institute (unpublished)

The objectives of the Research Programmes are:

- promotion of multidisciplinary, interdisciplinarity and where possible cross-disciplinarity
- promotion of internationalisation
- creating and reinforcing of a new type of scientific tradition
- upgrading of the scientific quality of research in a given field
- promotion of the networking of researchers
- coordinating scattered research capacities
- promoting researcher training and professional careers in research
- developing research environments
- developing national and international cooperation between researchers, research organisations and funding bodies

The Finnish Research Programme on Climate Change SILMU (1990-1995) was a multidisciplinary national research programme on climate and global change. It comprised 80 projects, 200 scientists, 7 universities and 11 research institutes. Its four goals were: (i) to increase our knowledge on climate change, its causes, mechanisms and consequences, (ii) to strengthen the research on climate change in Finland, (iii) to increase the participation of Finnish researchers in international research programmes and (iv) to prepare and disseminate information for policy makers on adaptation and mitigation. The main research areas in SILMU were: 1) quantification of anticipated climatic changes 2) assessment of impacts 3) development of adaptation and mitigation strategies.

The Finnish Global Change Research Programme FIGARE (1999-2002) was a multidisciplinary national research programme on global change comprising 18 projects and with total funding of 6.7 million euros from 7 funding organisations. Its objectives were to analyse and understand changes in the global system and their underlying causes and effects, as well as prevention of and adaptation to change.

The objectives of the National Strategy for Centres of Excellence in Research are: (i) to create the information base required for cultural, social and industrial development, (ii) to create a solid base for a national innovation system (consists of factors affecting the development and use of new information and expertise), (iii) to be integrated into the Finnish research, training and technology policy, including sectoral research, and as applicable, enterprises, and (iv) to lay the foundation for the emergence of creative and efficient research and training environments that can generate top international research

7. Discussion and recommendations

7.1. Role of adaptation in decision making

Outi Berghäll noted that one overarching concept, the issue of risk management, seemed to have been common to all of the sectoral presentations. Other issues that arose were the question of vulnerability of different sectors, the complexity of cause and effect relationships at different levels from climate change through impacts and adaptation, the need for an analysis of the *process* of climate change adaptation, and the importance of matching adaptation actions to the time horizon of the investment cycle.

There was discussion about the relationship between adaptation and mitigation as responses to climate change. It was agreed that *both* adaptation *and* mitigation are required; they are *supplementary* and should not be regarded as alternatives. The importance of taking climate change into account in decision-making and policy planning was also stressed. Some basic underlying questions were re-emphasised:

- a distinction needs to be drawn between autonomous and planned adaptation
- actors (of adaptation) need to be defined
- the instruments that actors have at their disposal need to be identified
- both risks and opportunities need to be considered
- different time perspectives have to be reconciled
- the different spatial scales from local to global need to be considered
- we have to be aware of geographical and temporal variations and need to identify ways of addressing these variations

7.2. Stakeholder involvement

The methodological problems of stakeholder involvement in research were discussed. It was stressed that increased attention should be paid to involving relevant stakeholders in research projects, as much can be learnt from their expertise in different sectors. **Chris West** (UKCIP) pointed out that UKCIP research had both to meet the users' needs and be of high academic quality. Stakeholders may not always need new research to be conducted; sometimes they only require a representation of existing knowledge based on previous research.

In an intervention following the earlier session on the natural environment, **Pirkko Heikinheimo** (Ministry of the Environment) invited panel members to comment on stakeholder perceptions of climate change impacts and adaptation in the sectors presented.

- *Forestry* (**Lauri Valsta**). The issue was discussed widely in the forest sector in the early 1990s, but since then biodiversity and carbon issues have become the major issues at the top of the environmental agenda. **Seppo Kellomäki** (Faculty of Forestry, University of Joensuu) pointed out that the Forestry Development Centre Tapio is currently developing guidelines for forest owners on how to respond to climate change.
- *Biodiversity* (**Seppo Neuvonen**). Some climate change issues are addressed in discussions within Finland concerning climate change and biodiversity. However, adaptation is addressed more at an international than national level.

- *Agriculture (Pasi Rikkonen)*. The results of the Delphi study of stakeholder perceptions indicate that climate change (over a time scale of 20 years ahead) features quite strongly on their agendas, especially with respect to mitigation. In terms of strategic planning in the agricultural sector, future changes over the longer-term are recognized but not emphasised, the emphasis being on short-term strategies.
- *Water resources (Bertel Vehviläinen)*. In the water sector climate change is still perceived as uncertain, but interest is high in relation to some key issues. Climate change is not yet included in long-term planning. For dam safety responding to climate change could be very expensive, so this is a sensitive area. Most adaptation activities in both households and at government level involve immediate responses to present-day problems of climate variability (drought or flooding) rather than long term planning.

7.3. FINADAPT and a possible research programme

The first, preparatory phase of the FINADAPT consortium is ongoing during 2003. The research phase is planned for 2004-2005 with funding from the Environmental Cluster Programme. It is intended that FINADAPT will perform the groundwork for a possible future national climate change research programme. The needs and scope of the future programme need to be discussed between researchers and potential funding agencies. It was suggested that the programme should consider both adaptation and mitigation to climate change.

The procedure of drafting a national research programme on adaptation was discussed. Experience from previous programmes can be utilised, though adaptation is a new research field with very little prior treatment. It was suggested that the programme might be led by the sectoral ministries and include a package of both basic and targeted research. The approach adopted in the SILMU and FIGARE programmes may not be appropriate here; rather an approach similar to that adopted in the HAPRO programme might be more suitable. HAPRO was closely co-ordinated and focused around a central theme of acidification, whereas SILMU and FIGARE were more academically driven, in part because key scientific and policy questions were greater in number and less well-defined. The Academy of Finland would still have an important role in supporting adaptation research, for example, by focusing on key cross-cutting themes that require basic research. The bulk of the funding would logically be covered by the ministries, focusing on more applied, policy-orientated questions.

It was stressed that an international perspective should be included in any research programme, as it is very important. Finland will not only need to adapt to climate change within its own borders, but to the effects of changes elsewhere in Europe and worldwide. International issues to consider include, *inter alia*, EU policies, migration, employment, international trade, technology, mobility and development aid.

The multidisciplinary research approach, such as that proposed in FINADAPT, was also discussed. Strong co-ordination will be required to ensure that consistency is maintained in the research methods. One suggestion would be to adopt the same scenario methodology in all sectors, to share datasets and involve a common set of stakeholders across the consortium. Consistency is also important in the case of cross-cutting studies. For example, an economic assessment of the costs of climate change adaptation that draws upon information from sectoral studies requires an integrated approach that presumes consistent underlying background assumptions about future conditions across all sectors and regions. An holistic approach will also be needed at a later stage for studying policy packages. It was also stressed

that it is dangerous to try to isolate and put a figure on climate change adaptation alone, as adaptation to climate change is only a part of a wider set of adaptations to a changing world.

Multidisciplinary research is relevant in all research programmes. Some multidisciplinary programmes have succeeded better than others, but maybe we have learned something from all of them. Flexibility is important if social sciences are to be promoted in the research programme and it should be recognised that social science approaches do not necessarily fit the same formula as is applied in natural science disciplines. Given that adaptation research has a strong emphasis on the interface between human decision-making and changes in the natural environment, the question of multidisciplinary is even more relevant than usual.

The role of the social sciences in studying climate change issues was commented on. The social sciences are very valuable for addressing important problems which may be hard to define, having no clear answers, but which cannot be put aside. Social science is often interpretative research, analysing the perspectives and motivations of different actors in relation to critical questions. It also introduces useful organising principles which can be useful in the diverse and multi-faceted field of climate change.

The behaviour of biophysical systems is inherently more predictable than that of human systems. This is especially true of long-term projections decades or centuries into the future. The unpredictability of social systems over these time horizons could be one reason why social scientists have been reluctant to participate in climate change research projects to date. It was suggested that we should be circumspect in selecting social science research topics that can say something sensible about climate change impacts and adaptation over the long run. Feasibility studies would be very useful, and we should try to identify those sectors that are more sensitive to climate change and where most research is needed.

7.4. Research funding issues

Michael Starr (Forest Research Institute) commented that environmental monitoring, particularly the maintenance of long time series data, is very important for global change research in general and the detection of impacts of climate change in particular. However, many research institutions are currently having difficulties in ensuring funding of monitoring programmes. This is an important issue that requires appropriate recognition and willpower from funding agencies.

Questions concerning the quality of basic research were raised. Many cross-cutting issues address policy-relevant questions and combine expertise and methods from different sectors. However, there might be a danger that the depth and quality of basic research could be compromised by the need to obtain rapid, overarching results that are of use for policy. It was suggested that such an eventuality might be avoided by involving several funding organisations in a programme, each having its own methods of evaluation and quality control that are tailored to the types of research questions to be addressed.

Jaana Roos (Academy of Finland) stated that climate change adaptation does not appear in the near-term programme planning of the Academy of Finland. However, there may be possibilities to obtain smaller amounts for project funding, and it would be very good from the Academy's point of view to have an international component in these projects. **Sami Tuhkanen** (TEKES) commented that the best way for TEKES to be involved would be for it

to fund relevant projects within a larger programme. He restated that projects should be connected to technological development.

In summing up the final discussions and the seminar as a whole, **Lea Kauppi** reminded participants that the FINADAPT consortium has been assigned responsibility for a scoping study on climate change adaptation. It has already contacted representatives from a range of sectors and disciplines, many of which were represented at the present seminar. Others will also need to be contacted to provide a basis for developing a future research programme. The timely overlap between FINADAPT and the preparation of the National Climate Strategy should also assist in this process.

Seminar on "Adapting to Climate Change in Finland: Research Priorities"
Friday 14 November 2003, Finnish Environment Institute, SYKE (Auditorium), Helsinki

8:00 – 8:30 **Registration and coffee**

Session I Introduction (Chair: Pirkko Heikinheimo, Ministry of the Environment)

8.30 – 8.35 Welcome

Lea Kauppi, Finnish Environment Institute, Helsinki

8.35 – 8.50 The FINADAPT consortium and the purpose of this seminar

Timothy Carter, Finnish Environment Institute, Helsinki

8.50 – 9.00 Climate change adaptation and the national climate strategy

Veikko Marttila and Johanna Pohjola, Ministry of Agriculture and Forestry

9.00 – 9.20 Adapting to what? Projections of future climate in Finland

Mikko Aaltonen, Finnish Meteorological Institute, Helsinki

Session II Sectoral issues for adaptation to climate change in Finland

9.20 – 10.30 **II.1 Natural environment** (Panel and general discussion – Moderator: Outi Berghäll, Ministry of the Environment)

– Forestry

Lauri Valsta, Department of Forest Economics, University of Helsinki

– Agriculture

Pasi Rikkinen, Agrifood Research Finland, Helsinki

– Biodiversity

Seppo Nuononen, Kevo Subarctic Research Institute, University of Turku

– Water resources

Bertel Vehviläinen, Finnish Environment Institute, Helsinki

10.30 – 11.00 **Coffee**

11.00 – 12.10 **II.2 Infrastructure and human well-being** (Panel and general discussion – Moderator: Outi Berghäll, Ministry of the Environment)

– Human health

Juhani Hassi, Centre for Arctic Medicine, University of Oulu

– Built environment and transport

Seppo Saarela, VTT–Building and Transport, Espoo

– Energy infrastructure

Sanna Syri, VTT–Energy, Espoo

– Tourism and recreation

Eija Pouta, Department of Forest Economics, University of Helsinki

12.10 – 13.10 **Lunch**

Session III Examples of national research programmes on climate change adaptation (Chair: Aimo Aalto, Ministry of Trade and Industry)

13.10 – 13.40 The Norwegian NORKLIMA programme (2004-2013)

Fridtjof Mehlum, The Research Council of Norway

13.40 – 13.55 Climate change adaptation research in the United Kingdom

Ken Wright, UK Department for Environment, Food and Rural Affairs

13.55 – 14.10 The UK Climate Impacts Programme (UKCIP)

Chris West, UKCIP, University of Oxford, UK

14.10 – 14.40 **Coffee**

Session IV Cross-cutting research themes

14.40 – 16.00 (Panel and general discussion: Moderator: Lea Kauppi, Finnish Environment Institute)

– Technological development and the role of TEKES

Sami Tuukkanen, National Technology Agency of Finland, TEKES, Helsinki

– Community planning

Raimo Sallinen, Helsinki University of Technology, Espoo

– Economic analysis

Juha Honkatukia, Government Institute for Economic Research, Helsinki

– Policy analysis

Eeva Purman, Finnish Environment Institute, Helsinki

– The role of Academy-funded research in addressing climate change adaptation

Jaana Roos, Academy of Finland

16.00 **Close**

For more information on FINADAPT and the Environmental Cluster Research Programme, in Finnish and English, see:

<http://www.ymparisto.fi/butkimus/ohjelma/klusteri/ekoyhtku/hanke181.htm>

<http://www.ymparisto.fi/eng/research/cluster/clustind.htm>

Appendix 2: List of Participants

Aimo Aalto

Ministry of Trade and Industry
P.O. Box 32, 00023 Government
aimo.aalto@ktm.fi

Tiina Ala-Outinen

VTT Building and Transport
P.O. Box 1602, 02044 VTT
tiina.ala-outinen@vtt.fi

Mikko Alestalo

Meteorological Research
Finnish Meteorological Institute
P.O. Box 503, 00101 Helsinki
mikko.alestalo@fmi.fi

Iiona Bärlund

Research Programme for Environmental Policy
Finnish Environment Institute (SYKE)
P.O. Box 140, 00251 Helsinki
ilona.barlund@ymparisto.fi

Outi Berghäll

International Climate Project
Ministry of the Environment
P.O. Box 35, 00023 Government
outi.berghall@ymparisto.fi

Timothy Carter

Research Programme for Global Change
Finnish Environment Institute (SYKE)
P.O. Box 140, 00251 Helsinki
tim.carter@ymparisto.fi

Simon Cousins

Ministry of Transport and Communications
P.O. Box 235, 00131 Helsinki
simon.cousins@mintc.fi

Achim Drebs

Meteorological Research, Climate Research
Finnish Meteorological Institute
P.O. Box 503, 00101 Helsinki
achim.drebs@fmi.fi

Martti Esala

Environmental Research
Soils and Environment
Agrifood Research Finland (MTT)
31600 Jokioinen
martti.esala@mtt.fi

Alec Estlander

Environmental Management Division
Finnish Environment Institute (SYKE)
P.O. Box 140, 00251 Helsinki
alec.estlander@ymparisto.fi

Martin Forsius

Research Programme for Global Change
Finnish Environment Institute (SYKE)
P.O. Box 140, 00251 Helsinki
martin.forsius@ymparisto.fi

Stefan Fronzek

Research Programme for Global Change
Finnish Environment Institute (SYKE)
P.O. Box 140, 00251 Helsinki
stefan.fronzek@ymparisto.fi

Eeva Furman

Research Programme for Environmental Policy
Finnish Environment Institute (SYKE)
P.O. Box 140, 00251 Helsinki
eeva.furman@ymparisto.fi

Kaija Hakala

Plant Production Research
Agrifood Research Finland (MTT)
Building E, 31600 Jokioinen
kaija.hakala@mtt.fi, kvo6@mtt.fi

Antti Hannukkala

Agrifood Research Finland (MTT)
Tutkijantie 28, 96900 Saarenkylä
antti.hannukkala@mtt.fi

Pekka Harju-Autti

Environmental Protection Department
Ministry of the Environment
P.O. Box 380, 00131 Helsinki
pekka.harju-autti@ymparisto.fi

Irmeli Harmaajärvi

VTT Building and Transport
P.O. Box 1800, 02044 VTT
irmeli.harmaajarvi@vtt.fi

Juhani Hassi

The Centre for Arctic Medicine
University of Oulu
P.O. Box 5000, 90014 Oulu University
juhani.hassi@oulu.fi

Pirkko Heikinheimo

Climate Project
Ministry of the Environment
P.O. Box 35, 00023 Government
pirkko.heikinheimo@ymparisto.fi

Risto Heikkinen

Research Programme for Biodiversity
Finnish Environment Institute (SYKE)
P.O. Box 140, 00251 Helsinki
risto.heikkinen@ymparisto.fi

Jaakko Helminen

Finnish Meteorological Institute
P.O. Box 503, 00101 Helsinki
jaakko.helminen@fmi.fi

Juha Honkatukia

Government Institute for Economic Research
P.O. Box 269, 00531 Helsinki
Juha.Honkatukia@vatt.fi

Pekka Huttula

Finnish Oil and Gas Federation
P.O. Box 1405, 00101 Helsinki
pekka.huttula@oil.fi

Petteri Huuska

Environmental Office
Helsinki Metropolitan Area Council (YTV)
Opastinsilta 6 A, 00520 Helsinki
petteri.huuska@ytv.fi

Arto Hämäläinen

Regional Council of South Karelia
Raatinmiehenkatu 18, 53100 Lappeenranta
arto.hamalainen@ekarjala.fi

Högne Jungner

Dating Laboratory
University of Helsinki
P.O. Box 64, 00014 University of Helsinki
hogne.jungner@helsinki.fi

Kirsti Jylhä

Meteorological Research
Finnish Meteorological Institute
P.O. Box 503, 00101 Helsinki
kirsti.jylha@fmi.fi

Susanna Kankaanpää

Research Programme for Global Change
Finnish Environment Institute (SYKE)
P.O. Box 140, 00251 Helsinki
susanna.kankaanpaa@ymparisto.fi

Niko Karvosenoja

Research Programme for Global Change
Finnish Environment Institute (SYKE)
P.O. Box 140, 00251 Helsinki
niko.karvosenoja@ymparisto.fi

Lea Kauppi

Director General
Finnish Environment Institute (SYKE)
P.O. Box 140, 00251 Helsinki
lea.kauppi@ymparisto.fi

Seppo Kellomäki

Faculty of Forestry
University of Joensuu
P.O. Box 111, 80101 Joensuu
seppo.kellomaki@joensuu.fi

Annina Kostilainen

Department of Forest Ecology
University of Helsinki
P.O. Box 27, 00014 University of Helsinki
anniina.kostilainen@helsinki.fi

Antti Kulmala

Council for Natural Resources
Ampumaradankatu 54, 08150 Lohja
antti.kulmala@kolumbus.fi

Pasi Kuoppamäki

Sampo Bank
P.O. Box 1026, 00075 SAMPO
pasi.kuoppamaki@sampo.fi

Sirpa Kurppa

Environmental Research
Agrifood Research Finland (MTT)
L-house, office 263, 31600 Jokioinen
sirpa.kurppa@mtt.fi

Esko Kuusisto

Hydrological Services
Finnish Environment Institute (SYKE)
P.O. Box 140, 00251 Helsinki
esko.kuusisto@ymparisto.fi

Simo Kyllönen

Department of Social and Moral Philosophy
University of Helsinki
P.O. Box 9, 00014 University of Helsinki
simo.kyllonen@helsinki.fi

Juha Kämäri

Research Director
Finnish Environment Institute (SYKE)
P.O. Box 140, 00251 Helsinki
juha.kamari@ymparisto.fi

Kirsti Kärkkäinen

Ilmastonmuutoksen viestintäohjelma
Dagmarinkatu 7 B, 00100 Helsinki
kirsti.karkkainen@ilmastonmuutos.fi

Toni Laaksonen

Section of Ecology, Department of Biology
University of Turku
20014 Turku
tokrla@utu.fi

Jussi Laanikari

Ministry of Agriculture and Forestry
P.O. Box 30, 00023 Government
jussi.laanikari@mmm.fi

Eila Lahdes

Finnish Institute of Marine Research
P.O. Box 33, 00931 Helsinki
eila.lahdes@fimr.fi

Johanna Lammi

Unit for the Northern Dimension
Ministry for Foreign Affairs of Finland
P.O. Box 176, 00161 Helsinki
johanna.lammi@formin.fi

Tuomas Laurila

Air Quality Research
Finnish Meteorological Institute
P.O. Box 503, 00101 Helsinki
tuomas.laurila@fmi.fi

Jukka Leskelä

Finnish Energy Industries Federation (Finergy)
P.O. Box 21, 00131 Helsinki
jukka.leskela@finergy.fi

Juha-Pekka Maijala

Housing and Building Department
Ministry of the Environment
P.O. Box 35, 00023 Government
juha-pekka.maijala@ymparisto.fi

Lasse Makkonen

VTT Building and Transport
P.O. Box 1806, 02044 VTT
lasse.makkonen@vtt.fi

Veikko Marttila

Natural Resources
Ministry of Agriculture and Forestry
P.O. Box 30, 00023 Government
veikko.marttila@mmm.fi

Fridtjof Mehlum

The Research Council of Norway
P.O. Box 2700, 0131 Oslo, NORWAY
fme@forskningsradet.no

Varpu Mitikka

Research Programme for Global Change
Finnish Environment Institute
P.O. Box 140, 00251 Helsinki
varpu.mitikka@ymparisto.fi

Jyri Mononen

Department of Forest Ecology
University of Helsinki
P.O. Box 27, 00014 University of Helsinki
jyri.mononen@helsinki.fi,
jmononen@mappi.helsinki.fi

Seppo Neuvonen

Kevo Subarctic Research Institute
University of Turku
20014 Turku
sepne@utu.fi

Antti Otsamo

Ministry of Agriculture and Forestry
P.O. Box 30, 00023 Government
antti.otsamo@mmm.fi

Johanna Pohjola

Natural Resources
Ministry of Agriculture and Forestry
P.O. Box 30, 00023 Government
johanna.pohjola@mmm.fi

Eija Pouta

Department of Forest Economics
University of Helsinki
P.O. Box 27, 00014 Helsinki University
eija.pouta@helsinki.fi

Mari Ratinen

Research Programme for Environmental Policy
Finnish Environment Institute (SYKE)
P.O. Box 140, 00251 Helsinki
mari.ratinen@ymparisto.fi

Pasi Rikkonen

Economic Research
Agrifood Research Finland (MTT)
P.O. Box 3, 00411 Helsinki
pasi.rikkonen@mtt.fi

Jaana Roos

Academy of Finland
P.O. Box 99, 00501 Helsinki
Jaana.Roos@aka.fi

Seppo Saarelainen

VTT Building and Transport
P.O. Box 1606, 02044 VTT
seppo.saarelainen@vtt.fi

Rauno Sairinen

Centre for Urban and Regional Planning (YTK)
Helsinki University of Technology
P.O. Box 9300, 02015 TKK
rauno.sairinen@hut.fi

Jyrki Salmi

Indufor Oy
Töölönkatu 11 A, 00100 Helsinki
jyrki.salmi@indufor.fi

Pekka Salminen

Land Use Department
Ministry of the Environment
P.O. Box 35, 00023 Government
pekka.salminen@ymparisto.fi

Jari Silander

Water Resources Management
Finnish Environment Institute (SYKE)
P.O. Box 140, 00251 Helsinki
jari.silander@ymparisto.fi

Mike Starr

Vantaa Research Centre
Finnish Forest Research Institute (METLA)
P.O. Box 18, 01301 Vantaa
michael.starr@metla.fi

Sanna Syri

Emission Control
VTT Processes
P.O. Box 1606, 02044 VTT
sanna.syri@vtt.fi

Petteri Taalas

Director General
Finnish Meteorological Institute
P.O. Box 503, 00101 Helsinki
petteri.taalas@fmi.fi

Bengt Tammelin

Meteorological Research
Finnish Meteorological Institute
P.O. Box 503, 00101 Helsinki
bengt.tammelin@fmi.fi

Virva Terho

Department of Agriculture
Ministry of Agriculture and Forestry
P.O. Box 30, 00023 Government
virva.terho@mmm.fi

Martti Tiuri

Finnish Parliament
00102 Eduskunta
martti.tiuri@eduskunta.fi

Sami Tuhkanen

National Technology Agency of Finland (TEKES)
P.O. Box 69, 00101 Helsinki
sami.tuhkanen@tekes.fi

Heikki Tuomenvirta

Meteorological Research, Climate Research
Finnish Meteorological Institute
P.O. Box 503, 00101 Helsinki
heikki.tuomenvirta@fmi.fi

Raisa Valli

Ministry of Transport and Communications
P.O. Box 235, 00131 Helsinki
raisavalli@mintc.fi

Lauri Valsta

Department of Forest Economics
University of Helsinki
P.O. Box 27, 00014 Helsinki University
lauri.valsta@helsinki.fi

Bertel Vehviläinen

Hydrological Services Division
Finnish Environment Institute (SYKE)
P.O. Box 140, 00251 Helsinki
bertel.vehvilainen@ymparisto.fi

Maria Vuorinen

Research Department
Finnish Environment Institute (SYKE)
P.O. Box 140, 00251 Helsinki
maria.vuorinen@ymparisto.fi

Pauli Wallenius

Forestry
Metsähallitus
P.O. Box 94, 01301 Vantaa
pauli.wallenius@metsa.fi

Chris West

UK Climate Impacts Programme
Union House, 12-16 St Michael's Street, Oxford
OX1 2DU, UK
chris.west@ukcip.org.uk

Ken Wright

Global Atmosphere Division
UK Department for Environment, Food & Rural
Affairs (Defra)
Ashdown House 3A2, 123 Victoria Street, London
SW1E 6DE, UK
ken.wright@defra.gsi.gov.uk

Tom Ylkanen

Finnish Tourist Board (MEK)
P.O. Box 625, 00101 Helsinki
tom.ylkanen@mek.fi

Tiia Yrjölä

Ministry of Agriculture and Forestry
P.O. Box 30, 00023 Government
tiia.yrjola@mmm.fi

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Abstract	<p>This report is an account of a one-day seminar organised at the Finnish Environment Institute (SYKE) as part of the preparatory phase of the FINADAPT consortium. It was attended by 80 participants from government, research institutions, business and the private sector. The seminar had four main goals: 1) to draw attention to the role of climate change adaptation in complementing emissions reduction (mitigation) as a response to changing climate in Finland, 2) to invite participants representing different sectors and constituencies to present their opinions on the key research challenges posed in adapting to future climate change in Finland, 3) to provide input for the final planning of research projects proposed in the FINADAPT consortium, and 4) to discuss the possible establishment of a national research programme on climate change adaptation. The report summarises the information presented at the seminar and also records some of the discussion. Section 2 covers the three short introductory presentations, and sections 3 and 4 then describe two moderated panel sessions that had a sectoral focus - four panelists speaking on aspects of the natural environment and four on themes related to infrastructure and human well-being. The experiences of three guest speakers of national climate change research programmes in Norway and the United Kingdom are related in section 5 and section 6 reports the final panel session on themes that cut across the field of climate change adaptation. The concluding session is a summary of some of the main issues and recommendations raised in discussion. The seminar programme and list of participants can be found in the appendices.</p>		
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Tiivistelmä	<p>Raportti on kooste yksipäiväisestä seminaarista, joka pidettiin Suomen ympäristökeskuksessa (SYKE). Seminaari oli osa FINADAPT-konsortion esitutkimusvaihetta ja siihen osallistui 80 hallinnon, tutkimuslaitosten, elinkeinoelämän ja kansalaisjärjestöjen edustajaa. Seminaarilla oli neljä päätavoitetta: 1) ilmastonmuutokseen sopeutumisen huomioonottaminen rajoittamistoimien lisäksi keinona vastata ilmastonmuutokseen Suomessa, 2) saada kartoitetuksi osanottajien näkemykset keskeisistä ilmastonmuutokseen sopeutumisen tutkimustarpeista Suomessa, 3) saada aineistoa FINADAPT-konsortion hankkeiden suunnitteluun, ja 4) käydä keskustelua mahdollisesta kansallisesta ilmastonmuutokseen sopeutumisen tutkimusohjelmasta. Tässä raportissa esitetään yhteenvedot seminaarin esityksistä sekä siellä käydyistä keskusteluista. Raportissa kuvataan ensin seminaarin lyhyet aiheita esittelevät esitykset ja sen jälkeen pidetyt kaksi paneelia, joissa käsiteltiin sektorikohtaisia kysymyksiä luonnon systeemeistä sekä infrastruktuurista ja ihmisen hyvinvoinnista. Seminaarissa kuultiin myös kolmen ulkomaisen puhujan kokemuksista kansallisista ilmastonmuutostutkimusohjelmista Norjassa ja Isossa-Britanniassa. Raportissa käsitellään myös sektorit ylittäviä ilmastonmuutokseen sopeutumiseen liittyviä aiheita. Lopuksi esitetään yhteenvedo tärkeimmistä aiheista sekä suosituksista, jotka tulivat esille keskusteluissa.</p>	
Asiasanat	Ilmastonmuutos, vaikutukset, sopeutuminen, Suomi	
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This report summarises a multidisciplinary seminar organised by FINADAPT in November 2003, one of the first held in Finland on the theme of climate change adaptation. The themes represented at the seminar were diverse, ranging from human health to the built environment, from biodiversity to economics, and from land use planning to tourism. However, taken together, the discussions illustrated how exposed the Finnish environment and society really are to weather and climate, how adaptation is likely to play a key role in coping with future climate change, and how important new research is for identifying and evaluating the various adaptation options available for responding to climate change. The seminar also provided useful input for the preparation of a new National Climate Strategy, to be released in 2005, in which adaptation to climate change is being considered for the first time.

Tässä raportissa esitellään tulokset monitieteellisestä seminaarista, jonka FINADAPT-hanke järjesti marraskuussa 2003. Tilaisuus oli ensimmäisiä Suomessa, jossa käsiteltiin ilmastonmuutokseen sopeutumista. Seminaarissa oli esityksiä eri aloilta terveydestä rakennettuun ympäristöön, luonnon monimuotoisuudesta talouteen ja maankäytön suunnittelusta matkailuun. Keskusteluissa kävi ilmi, että Suomen ympäristö ja yhteiskunta ovat alttiita säälle ja ilmastolle, ja siksi sopeutumisen rooli tulevaisuuden ilmastonmuutoksesta selviytymisessä on todennäköisesti tärkeä. Uutta tutkimusta tarvitaan myös, jotta erilaiset mahdollisuudet toimia ilmastonmuutoksen suhteen tunnistettaisiin ja niitä voitaisiin arvioida. Seminaari toi myös tarvittavaa tietoa kansallisen ilmastostrategian päivitystä varten. Uudistettu kansallinen ilmastostrategia valmistuu vuoden 2005 alussa ja ensimmäistä kertaa siinä on myös mukana ilmastonmuutoksen sopeutumisstrategia.

This report is also available at the FINADAPT Web site:
<http://www.ymparisto.fi/Syke/Finadapt> or from www.environment.fi/publications
Finnish Environment Institute, Box 140, 00251 Helsinki, Finland, tel: +358 9 40 300

FINADAPT (Assessing the adaptive capacity of the Finnish environment and society under a changing climate) is a consortium co-ordinated at the Finnish Environment Institute (SYKE). It is part of the Finnish Environmental Cluster Research Programme, co-ordinated by the Ministry of the Environment.



Finnish Environmental Cluster
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