

REPORT

No 7

# CLIMATE CHANGE

## ADAPTATION IN SWEDISH

### FORESTRY: DRIVING FORCES,

### RISKS AND OPPORTUNITIES



## GENERAL CONCLUSIONS RESULTING FROM MISTRA-SWECIA'S RESEARCH

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- ▷ There is a relatively high level of practical knowledge about and experience of risk mitigation, and these two factors, together with trust in climate science, risk awareness and experience of extreme events, are key drivers behind adaptation processes.
- ▷ Information on climate change adaptation should be user-oriented, built upon insights about social barriers to adaptation and shared by actors who are in a position to communicate effectively, such as forest advisers. At the same time, opportunities for learning between peers need to be created to turn the information into practical adaptation measures.
- ▷ To create greater stakeholder engagement with climate change adaptation, adaptation research needs to become more interactive and practice-oriented, involving both scientists and stakeholders in a process of co-production and joint development of research. This process requires adaptation research to be conducted in multiple steps, giving scientists and stakeholders time and space to jointly evaluate the research process and findings, assess adaptation needs and build mutual trust.
- ▷ In order to get a comprehensive view of a country's or a sector's vulnerability to the impacts of climate change, both direct and indirect impacts need to be considered. Consequently, adaptation planning needs to be more "systemic" and involve actors beyond national borders.

### Mistra-SWECIA

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Mistra-SWECIA is an interdisciplinary research programme, embracing climate, impacts and adaptation. The programme brings together researchers from the fields of climate science, economics, life sciences and social sciences. After eight years of research (2008-2015), the Mistra-SWECIA research programme has increased knowledge of how different emission trajectories affect changes in regional climates, forests and other ecosystems. The programme has also identified opportunities for adaptation within forest management, as well as for improving adaptation processes. Mistra-SWECIA is funded by the Swedish Foundation for Strategic Environmental Research. The programme involves SMHI (the programme host), SEI, Lund University and Stockholm University.

# CLIMATE CHANGE ADAPTATION IN SWEDISH FORESTRY: DRIVING FORCES, RISKS AND OPPORTUNITIES

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3

For forests and forestry, climate change means both increased risks and new opportunities. From a social science perspective, it is possible to study how actors with responsibility for management and long-term planning of forests perceive the challenges posed by climate change and the implications for their own activities. Studies of forest owners and forestry advisers provide insights into their perceptions, driving forces and reasons for decisions. At the same time, complex effects may be felt from climate change in other parts of the world. Knowledge of climate issues, personal experiences and effects of climate change, communicated clearly, play a major part in how forest owners – and forest stakeholders – can adapt their activities.

The Earth's climate is changing, and the effects have already begun to manifest themselves in different ways<sup>1</sup>. Surface temperature has become warmer, sea levels have risen and the ice caps are melting. The seasons and growing seasons are gradually shifting, extreme-weather patterns are emerging, and the combination of species in ecosystems on land, in lakes and in the sea are changing.

Today, it is evident that human activities are causing this change through the emissions of greenhouse gases. The emissions derive from the use of coal, oil and natural gas for energy and also land use, particularly deforestation. The extent of the effects of climate change will

depend on how mankind's global impact on the climate develops. With strong measures to reduce greenhouse gas emissions, the effects of climate change can be limited, though it may be too late to avoid a global increase in temperature of up to 2°C. On the other hand, if current emission trends continue, a world that is four to six degrees warmer is a real possibility. Today, the level of warming measured is about one degree.

The gradual changes in the climate mean changed conditions for both human systems, such as cities, infrastructure and managed land areas as well as natural systems such as virgin forests and oceans. We may need to

1. IPCC 2014

change the way we build, and how we manage our lands, as well as which different raw materials and products we use and produce, and how. By identifying which preventive measures can be taken to reduce vulnerability both today and in the future, particularly in areas with long decision-making horizons, we can reduce the negative consequences and make the most of our opportunities.

Climate change and adaptation raise major social issues that often affect one another. Decisions on climate change adaptation affect, for example, environmental protection and future economics. By integrating or coordinating issues associated with climate change adaptation in existing processes, tools and work functions, there is a greater chance of more effective adaptation than if they are dealt with as completely separate issues. The needs and changes that could arise as a result of climate change may also need to be balanced against other

targets and weighed against each other.

A changing climate will mean both increased risks and new opportunities for forestry in Sweden. The challenges include the impact on production resulting from both changes in growth rates and the risks of damage from heavy winds and insect attacks, drought and fires as well as felling and new plantations and other measures. Biodiversity is also affected when the climate changes and nature conservation strategies may also need to be adapted. Forest owners, both companies and private individuals, will have to tackle the changed conditions while dealing with other forestry targets. At the same time, it is important to remember that Sweden as a country, and its export-oriented forestry industry in particular, may be affected by climate changes in other parts of the world, something that will create greater complications in its process of adaptation.

## Climate change adaptation

Climate change adaptation involves making decisions under uncertainty, and this concerns both how the climate will change and how society will develop in the future. It is therefore necessary to take account of the consequences of climate change, social progress and changes in the world around.

Adaptation measures may be commenced at different points in time and implemented gradually. The correct action will vary between, for example, risk levels and risk tolerance, decision-making horizons and the capacity to quickly review earlier decisions. Adaptation measures should be effective today while taking into account climate change further in the future.

Adaptation may involve technical measures, such

as new machinery, better roads and new surface water systems, but it may also involve investment patterns and social and institutional structures. Some examples are strategies in health care for dealing with the effects of a heat wave or procedures for reprocessing storm-damaged timber but also consolidating individuals' ability to tackle the changes.

Climate adaptation affects everyone: individuals, organisations, companies, governments and authorities at local, regional and global levels. Roles and responsibilities vary, depending on the context, but generally, increasing awareness, learning from weather variations and achieving synergies with other processes are goals that many stakeholders can work towards.

### Forests and forestry in Sweden

Forests cover roughly 50 percent of Sweden's land surface, from southern beech forests to the north's expansive pine and spruce forests. Throughout the ages, mankind has utilised the forest as a source of food, fuel and timber. As a result of industrialisation in the 19th century, the use of forest products increased in the sawmill industry as well as the pulp and paper industry that later emerged. Since then, wood has been used in the chemicals industry and the majority of Swedish forest industry output is exported. Forestry is one of the most important economic sectors in Sweden, employing approximately 16,000 people and the forest industry 60,000–70,000 people<sup>2</sup>. In 2011, the forest sector made up more than 10 percent of the manufacturing industry's total value added and, in the same year, the forest industry and forestry's added value was 2.2 percent of Sweden's GNP<sup>3</sup>. In addition, approximately one-tenth of all Swedish exports are linked to the forests<sup>4</sup>.

At the same time forests are important for everyone living in and visiting Sweden – for outdoor life and recreation, including berry and mushroom picking. The Swedish Right of Public Access Act forms the basis for everyone's entitlement to access natural environments at the same time as it entails a responsibility for the individual not to damage or destroy. Forest environments that are particularly developed for recreation and the outdoor life may be managed so as to be both more attractive and more accessible, which applies, for example, to forests close to urban areas. These sites have a particularly high recreational value and many municipalities are working towards preserving these forests for the well-being of their residents.

Forest environments are also home to a great number of plant and animal species. Both the management strategies employed and the management itself affect the environmental condition of forests and the ability of various species to survive. Other factors that also affect the condition of the forest are climate change and air pollution. One-tenth of Sweden's estimated forest-dwelling species are on the IUCN (International Union for Conservation of Nature) Red List<sup>5</sup>. Nature reserves

and national parks play a major role in preserving valuable natural environments and thereby maintain habitats for vulnerable species to survive. Forests that are voluntarily set aside for conservation purposes and retention forestry help protect biological diversity and endangered species. The achievement of Sweden's environmental quality objectives, "Sustainable Forests" and "A Rich Diversity of Plant and Animal Life" is of importance for the biological diversity of forest environments<sup>6</sup>.

In Sweden, the objective is for forestry to be conducted in a sustainable manner. This is defined in the Forestry Act (1979:429) and international agreements as well as at the Earth Summit of 1992, which discussed sustainable development. The UN General Assembly defines sustainable forestry as "[a] dynamic and evolving concept [that] aims to maintain and enhance the economic, social and environmental values of all types of forests, for the benefit of present and future generations"<sup>7</sup>. According to this definition, the term sustainable forestry will change over time, but its aim is to maintain all the values of the forest for all time.

### Forestry stakeholders

The Swedish forestry sector attracts many stakeholders with different roles and interests. The owners of Swedish forestry land can be split into five major owner categories: i) Non-industrial private forest owners own roughly half of the land; ii) Forest industry own approximately one-third of the area with iii) state-owned Sveaskog as the biggest individual forest owner; iv) Authorities such as the Swedish Fortifications Agency and the Swedish Property Board own and manage large areas of forest, particularly protected land and nature reserves; v) The remaining group of owners includes municipalities, the Church of Sweden and various foundations<sup>8</sup>. In addition to the major groups of owners, there are also other stakeholders who do not own forests themselves but have major interests in and influence over the forestry sector, such as the sawmill and paper industries, the general public (outdoors life, recreation and health aspects), environmental NGOs and energy companies (bioenergy and wind power).

2. Sveaskog: <http://www.sveaskog.se/forestrytheswedishway/>

3. The Swedish Forest Agency 2014

4. The Confederation of Swedish Enterprise 2014

5. Larsson, A. (ed) 2011

6. The environmental objectives portal: [www.miljomal.se](http://www.miljomal.se)

7. FAO: <http://www.fao.org/forestry/sfm/85084/en/>

8. The Swedish Forest Agency 2014

Another stakeholder is LRF Skogsägarna (the Federation of Swedish Family Forest Owners), the trade association for the four forest-owner associations, Södra, Mellanskog, Norrskog and Norra Skogsägarna, which, among other things, looks after forest owners' economic policy interests nationally and internationally. The forest-owner associations also offer advisory services to forest owners and act as an intermediary for the supply of wood from non-industrial private forests to industry consumers. In addition to these, a number of organisations, foundations and companies offer advisory services and act as an important link between research, politics and practice.

The Swedish Forest Agency is the authority responsible for issues affecting forests in Sweden. As part of its responsibility for promoting and ensuring that forestry policies are realised among forest owners and others who use the forest, the Swedish Forest Agency's work involves supervision, support and advice, inventories of the condition of the forest and statistics etc. These responsibilities also include climate change adaptation. Other authorities of relevance to forestry are the Swedish Environmental Protection Agency, which, among other things, is responsible for the creation and control of nature reserves together with the County Administrative Boards and which manages forests meriting conservation. In addition to nature reserves, the County Administrative Boards deal with issues relating to game preservation, water matters and rural development. The County Administrative Boards have the overall responsibility for coordinating climate change adaptation work at a regional and local level.

A number of organisations produce new knowledge and data for decision-making. Skogforsk (the Forestry Research Institute of Sweden) is a research institute

financed by the government and the forestry industry, which conducts, applied research into forestry<sup>9</sup>. Several universities, such as SLU (the Swedish University of Agricultural Sciences), and colleges conduct forestry-related research as well.

The export-based Swedish forestry industry is affected to a great extent by changes in the international demand for forestry products. For example, an important development is the increased demand for environmental consideration for consumers. Today, approximately half of the productive forestry land in Sweden is certified in accordance with the FSC (Forest Stewardship Council) with roughly the same area certified under the PEFC (Programme for the Endorsement of Forest Certification). Some land is certified by both organisations. There are approximately 18,500 affiliated Swedish forest owners in the FSC (with forest holdings of up to 1,000 hectares of forestry land each). A number of the larger companies and almost 40,000 forest owners are certified in accordance with the PEFC<sup>10</sup>.

Forest owners therefore find themselves in a landscape featuring many stakeholders and interests. These can influence management choices and strategies, both directly through advice and measures in the forest and indirectly through changes in demand and pricing. When it comes to adaptation to climate change, all of these stakeholders are important in different ways, for example, by creating the conditions for decision-making or producing a knowledge base, guidelines and recommendations but also for carrying out adaptation measures and reviewing management strategies. When it comes to management of the forest and, by extension, the adaptation of forestry to climate change, the 330,000 private forest owners are very important actors.

9. See [www.skogforsk.se](http://www.skogforsk.se)

10. FSC: <https://se.fsc.org/statistik-och-fakta.242.htm>, and PEFC: <http://pefc.se/>

## RISKS AND CLIMATE – FORESTRY STAKEHOLDERS' PERCEPTIONS AND ATTITUDES

There is strong scientific evidence that climate change will affect the forests and forestry. It is important to understand how the stakeholders with responsibility for management and long-term planning perceive risks and what this means for their own activities. This is of key importance in understanding driving forces and obstacles to adaptation planning and implementation as well as what form of support and resources are necessary and/or in demand.

### Social science research regarding climate change adaptation

Over the course of Mistra-SWECIA, an interdisciplinary and integrative methodology has been developed, combining climate impacts and adaptation studies (Figure 1). This unique methodology builds on the concept of science-based stakeholder dialogues<sup>11</sup>. It has been refined during the programme to improve the communication of climate change research to practitioners and to enable a more interactive science-stakeholder dialogue for the exchange of knowledge and learning among forest practitioners and researchers, as well as to support adaptation policy in the context of forestry and beyond.

The methodology comprises different qualitative research methods, such as stakeholder identification and analysis, individual pre-interviews, focus groups and workshops and is characterized by its integrative approach to combining different knowledge bases of local practitioners and scientists. The results in this report regarding adaptation in forestry are based on a series of focus group meetings, workshops and interviews with forest owners and forest officers in Kronoberg and Västerbotten counties in 2010-2011 and forest owners in Skåne, Jämtland, Västerbotten and Gävleborg counties in 2013-2014. A total of about 60 private forest owners and 13 forest officers from different organisations and forestry companies, the sawmill industry, forest owner societies and the Swedish Forest Agency took part in the study.

The methodology also includes quantitative methods in the form of a national survey and a social network analysis. The purpose of the quantitative survey has been to examine the subjective factors and processes behind adaptation. This study grew out of recognition of

a lack of quantitative studies in the existing literature on adaptation processes and climate change communication<sup>12, 13</sup> and an ambition to target a wider number of forest owners throughout Sweden. Our work encompassed a survey of 6,000 forest owners, 50 percent of whom had previously participated in one of the Swedish Forest Agency's training programmes about adaptation to climate change, and 1,000 forestry professionals. The survey included questions focusing on personal experiences of extreme weather events, perceptions and attitudes of climate change risks and adaptation measures, personal knowledge of climate change adaptation, and a social network analysis. A total of 2,568 forest owners and 329 forestry advisers completed the survey. The survey was developed with participants of focus group interviews in line with our participants-driven research approach. The results have been analysed through the application of statistical, analytical methods. Data from this survey was also used in the Agent Based Model (ABM) in collaboration with the University of Edinburgh.

The results of Mistra-SWECIA's survey-based study show that at least one-third of forest owners and forestry advisers believe that climate change will entail serious risks for the forest. A slightly smaller number of advisers express concern over the impact of climate change on the forests where they are active. At the same time, more than one-fourth of forest owners and advisers state that they believe that climate change will have a positive effect on Swedish forestry. The study also shows that forest owners and forestry advisers are generally less concerned about climate change than the general public.

Like the survey-based study, the focus groups and interviews with forest owners and forest officers show a general perception that climate change could benefit the forestry sector in the future but could also lead to more difficult conditions and new challenges. Examples of positive changes are an expected increase in forest growth. Some also mention that efforts to reduce fossil emissions could open up new markets for forest products in tandem with increased demand for forest-based energy and other resources from the forests. Generally speaking, participating forest owners from northern Sweden seem to have a more positive attitude to climate

11. Welp et al. 2006

12. O'Brien and Wolf 2010

13. Moser 2010



Figure 1. Case study based participatory methodology (Gerger Swartling et al. forthcoming). Showing the combination of qualitative and quantitative methods in Mistra-SWECIA. The left column in blue represents the different methods used as part of the participatory process and the right column in purple represents quantitative methods as part of both the participatory process and the national survey. The green box represents the work employing an agent-based model that is informed by the qualitative and quantitative studies. The orange box illustrates the science-policy interface that is to be supported by the research.



change than forest owners from southern areas. There also exists awareness that other climate-related factors could counteract the expected increased growth, such as changed precipitation patterns, an increased risk of storm damages, insects and pests, browsing damages, spring frosts and snow breakages. Forest fires are not raised in the discussions. However, the study was completed before the great forest fire in Västmanland in the summer of 2014, which destroyed approximately 13,100 hectares of forest land and was the biggest forest fire in recorded Swedish history<sup>14</sup>. At the same time, the discussions show that several of the risks that are expected to increase following climate change are already being experienced as a problem today in forestry. For example, it is mentioned that timber transports are expected to be more affected in a warmer and damper climate, in combination with an increased demand for supplies of timber year round.

Forest owners also indicated that they feel that a change is already underway. For example, several have noted a shifting of the seasons and changed growth in the forests. There is, on the other hand, uncertainty about what is causing these changes and how the effects of climate change should be interpreted. Climate change has also been perceived as a matter for international and domestic politics and markets to deal with. Other comments indicate a more relaxed, “wait and see” attitude and, in some cases, scepticism to climate change actually taking place. The uncertainty experienced is based not only on how scientific evidence should be assessed but on a general reluctance to accept new findings. There seems to be some distrust of climate science that is rooted in individuals’ beliefs and in past experiences of

seeing scientific claims disproven, as during the acidification debate in the 1980s. Such distrust may be difficult to overcome through education. Moreover, several forest owners indicate that they feel there is an element of unpredictability when it comes to political decisions and how these affect conditions in forestry.

It is clear that climate change and climate-related risks are only elements of several challenges to face and deal with in forestry. Urbanisation and a perceived widespread ignorance among the general public and decision makers were regarded by several participants as an obstacle to adapted forestry. This was also the case with conflicts linked to land use and nature conservation policies. The forestry industry’s profitability (particularly the pulp industry), its ability to increase revenues from timber, demand in the market and ownership and holding rights with regard to individuals’ forests were also perceived as problematic.

The focus group discussions also show certain regional differences between southern and northern Sweden. In Kronoberg in the south, there was a clear focus in the group discussions on the storms Gudrun and Per (which affected large parts of Götaland and Svealand in 2005 and 2007) and their consequences for forests and forestry. Gudrun felled a total of 75 million cubic metres of forest and Per approximately 12 million cubic metres<sup>15</sup>. The storms and the risks of future storms and whether these could be linked to climate change were also discussed in Skåne. In Västerbotten in the north, the majority of the forest owners have not been affected by storms to the same extent as in the other counties and here forest owners raised issues concerning the forestry industry and technical developments to a greater extent.

14. <http://www.smhi.se/kunskapsbanken/brandrisker-idag-och-imorgon-1.87501>

15. <http://www.smhi.se/kunskapsbanken/meteorologi/stormar-i-sverige-1.5770>

## CLIMATE CHANGE ADAPTATION WITHIN THE SWEDISH FORESTRY SECTOR

Climate change adaptation can be seen as a process that covers not only an interpretation of the scientific information on anticipated climate change and its effects but which is also a result of the interests, needs, perceptions, values and abilities of forestry stakeholders. Climate change adaptation involves a continuous process of learning. Collective experiences and scientific knowledge are required in order to develop different climate change adaptation options, including with regard to the ability to preserve biological diversity, achieve economic profitability and opportunities for recreation in a changing climate. At the same time, forestry stakeholders differ when it comes to objectives and prerequisites and consequently which adaptation measures they prefer to implement. On a national level, a number of political and administrative factors influence how a country like Sweden and its forestry relate to the issue of climate change adaptation. Since both Sweden as a country and the forest industry as a sector are very internationalised, it is also important to be aware of the risks and opportunities linked to climate change beyond the country's borders.

### Climate change adaptation in public debates and policy processes

In Sweden, the discussion regarding social vulnerability and adaptation to climate-related risk has emerged since the beginning of the 2000s. The question of adaptation has gradually been allowed more scope by researchers, decision makers and practitioners. Contributory reasons include frequent strong torrential rain and flooding, the Stern Report on the economic effects of climate change and the fact that the IPCC (Intergovernmental Panel on Climate Change) had stressed the need for adaptation in combination with limiting emissions to a greater extent. Research into climate change goes somewhat further back than this, as does attention to the issues in the forestry sector.

At the national level, a large number of political activities were initiated and linked to climate change adaptation in connection with the storm Gudrun in 2005. Before 2005, adaptation issues had in principle been

absent from national climate policy. The Swedish Forest Agency produced a climate policy as early as 2003, but it did not contain any clear recommendations on how forest owners could deal with climate change in forestry. Despite the lack of long-term adaptation strategies among the political measures taken in connection with the storms Gudrun and later Per (in early 2007), it is clear that awareness of climate change and the need for adaptation increased in the forestry sector during this time period, partly as a result of external influences, such as political pressure, and partly on the basis of the experiences of the negative effects of the storms.

In 2007, the final report of the Swedish Commission on Climate and Vulnerability<sup>16</sup> proposed a number of policy measures with direct relevance for the forestry sector. The need to further investigate and compile knowledge of how biological diversity can be protected was also identified. The commission formed an important basis for the Swedish Government's Climate and Energy Bill<sup>17</sup> of 2009. The bill laid down, in accordance with the commission's proposal, that responsibility for climate change adaptation should rest with the County Administrative Boards, who were tasked with a coordinating role at the regional and local level, and with the responsible sector authority. As part of its responsibility for coordination, the Swedish Forest Agency received funds to develop a system to disseminate information on climate change and possible adaptation measures to forest owners and other forestry stakeholders. In accordance with the recommendations made by the commission, a decision was also made on funds for research into and monitoring of effects of climate change and a system for early warnings of severe weather conditions.

In summary, the integration of adaptation considerations in the forestry sector has been a slow process and relatively limited in its extent, although there has been an increasing insight over the last few years into the value of adapting to climate change alongside other objectives, such as increased production and biological diversity. An important stage in the adaptation process at the national level and one that later spread to the for-

16. SOU 2007:60

17. Swedish Government Bill 2008/09:162

estry sector was the insight that climate change mitigation and climate change adaptation do not need to conflict with each other or replace each other. This fresh insight has gradually paved the way for a more diversified debate on how Swedish forestry methods should be changed in order to both reap the benefits of opportunities and reduce risks associated with climate change.

Today, adaptation is part of the Swedish Forest Agency's advisory and information activities, partly as a result of the Rural Development Programme<sup>18</sup>. As also shown in a report on adaptation published by SMHI<sup>19</sup>, climate change now takes a more prominent place in advice on planting and forestry conservation from the Forestry Research Institute of Sweden<sup>20</sup> and the forest-owner associations<sup>21</sup>. A new internal driving policy has also been developed within the industry as well as new planting and felling systems<sup>22</sup>.

#### Whether to adapt – different opinions, obstacles and driving forces

The research in Mistra-SWECIA includes studies into how social factors can explain how forest owners in Sweden perceive and act on the basis of climate risks. As previously mentioned, climate change is not generally regarded as an urgent threat to forestry, although there is an increasing awareness within the forestry sector that it could lead to more difficult conditions for forestry in the future. In focus groups comprising of forest owners and forestry officers, it emerges that few of the participants are taking direct action on the basis of anticipated climate change. On the other hand, the issue of climate change adaptation has begun to be discussed, particularly among forestry professionals, who feel that the question has been raised regarding how to plan and create contingency plans for climate change. Many forest owners are also considering management choices pertaining to e.g. tree species, clearing and thinning strategies, drainage and road maintenance and what these activities could involve if the climate changes.

The fact that climate change is not felt to be an urgent threat could be due to its effects lying far in the

future. It also appears that climate change is felt to be a gradual change that there is time and possibility to gradually adapt to. For example, some forest owners see opportunities to adapt their forests in the long term, particularly through the anticipated increase in growth, which means increased flexibility for forestry as a result of it being possible to shorten rotation periods. Nevertheless, few forest owners are prepared to change their management objectives in favour of forest biomass for energy purposes. In a study of more than 800 forest owners in Sweden, Germany and Portugal a majority of the forest owners expressed that they strongly believed in a permanent demand for forest biomass for energy purposes<sup>23</sup>. Despite this, the study shows that they had a negative attitude to changing management objectives for forest holdings that are used today for stemwood production to forest biomass for bio-energy – although this would lead to greater financial profits. Only 10 percent of forest owners reported a positive attitude to reorganising their forestry.

Previous experiences of managing difficulties in forestry and the belief in innovative solutions and the individual's ability to adapt also appear to be important factors that demonstrate the importance of attitudes and cultural aspects. The fact that forest owners manage their forests in different ways is also perceived as enhancing resilience, as the diversity of how the forests are managed spreads the risks while indicating different practical alternatives.

Several forest owners also believe that adaptation to risk is already taking place today even if this is not linked to perceived climate risks per se, but rather to the general increase in awareness of risks in forestry. Being a forest owner means constantly adapting to different weather and climate conditions, trends, technologies and conditions in the market. There are also discussions on how to utilise the expected increase in growth in a more optimal manner. This does not have any direct bearing on climate change per se, but shows how the climate issue is linked to other issues. Climate change adaptation does not, therefore, only occur on the basis of expected

18. See, for example <http://skogensklimatrad.skogsstyrelsen.se/beslutsstodguide/>

19. Andersson et al. 2015

20. See for example <http://www.skogforsk.se/kunskap/kunskapsbanken/2014/Granslos-klimatanpassning/>

21. See for example <http://www.lrf.se/politikochpaverkan/skogspolitik/skog-och-klimat/>

22. See for example [http://www.skogsindustrierna.org/pressrum/nyheter/nyheter-2012/samlad\\_miljopolicy\\_om\\_korskador\\_pa\\_skogsmark](http://www.skogsindustrierna.org/pressrum/nyheter/nyheter-2012/samlad_miljopolicy_om_korskador_pa_skogsmark) and <http://storaensskog.se/rattmetod/>

23. Blennow et al. 2014

climate change but in combination with other perceived and expected experiences and opportunities.

Many forest owners and forest officers believe that what makes the adaptation process particularly complicated is the fact that many decisions, measures and activities lie beyond what forest owners themselves have any control over or can make decisions on. Neighbours' decisions on forest management, restrictions on drainage and knowledge about the tree species that will be in future demand are issues with an influence on the individual forest owner's decisions. The importance of strong demand for wood products is also emphasized. Maintenance and the building of roads are also frequently discussed in the focus groups. Some perceived it to be difficult as it requires coordination with neighbours who can put a stop to their plans, while other forest owners did not feel this was challenging.

Results from the Mistra-SWECIA's survey-based study also show that a considerable number of forest owners are considering taking climate change adaptation measures as an urgent measure and approximately one-fifth feel that they need to take the first steps to adapt their forest to climate change in the near future. Almost half of all forest owners believe that they will need to take risk-reducing measures within the next five years. This shows that there is a growing awareness of climate change adaptation requirements among forest owners and preparedness for adaptation measures.

At the same time, the survey-based study reveals another obstacle to adaptation; forest owners do not necessarily agree on the most effective measures for dealing with climate change. The survey-based study shows, for example, that more than 40 percent of forest owners feel that alternative management methods, such as avoiding clear-cutting, are an effective way of dealing with the effects of climate change. Only 17 percent of the advisers share this opinion. The results also vary when it comes to opinions on measures such as earlier and more intensive felling and thinning. More than 80 percent of the advisers preferred this type of measure

but only half of the forest owners did. These differing opinions on how effective different adaptation measures suggest that there are different perceptions about what constitutes desirable forestry objectives and livelihoods among forest owners. In addition, many forest owners feel that the implementation and maintenance of extensive adaptation measures is beyond their personal capacity. Another obstacle to adaptation that emerges in focus groups and interviews involves trust in climate change research and climate researchers. It appears that there is some distrust of climate research, which is rooted in individuals' convictions and previous experiences that scientific statements have proved incorrect, for example, during the acidification debate of the 1980s. Such mistrust can be difficult to overcome through education and usual scientific communication strategies are not always optimal for promoting the adaptation process among forestry stakeholders. Studies show, however, that climate research can be strengthened by establishing meeting places for close contact between users, researchers, professionals and experts who already have a great deal of trust in the field.

Personal experience of extreme weather events such as storms increases awareness of climate risk and the willingness to implement adaptation measures. In order for extreme events to be a triggering factor for proactive adaptation, forest owners need to interpret them to be a direct result of climate change, which is a tricky point given that, from a scientific perspective, direct attribution of any event is not really possible. Climate change and scientific knowledge are, in other words, accepted when they align with people's own perceptions of weather and the climate.

It is clear that the storms which have affected Sweden over the last few years are awakening a great deal of involvement and a number of questions on future risks and climate-related events, such as: Will storms/storm damages increase in the future? What does this mean for forestry? How should we manage storm risks? Forest owners provided several examples of this, with

some managing well after the storms while their neighbour was hit hard, and vice versa. For some people, this confirms that they are taking the right measures, while others feel greater uncertainty about their forest management. For example, a number of forest owners wonder why they were affected when they feel that they have been managing their forests in accordance with the guidelines and recommendations available. In these cases, there is some dejection, while, at the same time, it emerged during the focus group meetings that they nevertheless have a more or less specific strategy for how they will manage their forests in the future.

The link between forest owners who think they have experienced the effects of climate change and who actually took measures also emerges in another survey-based study based on responses from 845 private forest owners active in different parts of Europe<sup>24</sup>. Since climate is defined in terms of long-term weather patterns, it has been asserted that climate change is not perceived as an imminent risk since it cannot be experienced directly. This study shows that a large number of the respondents feel they have directly experienced climate change. It also is clear that the degree to which the forest owners believe in and say they have experienced local effects of climate change almost always explains and predicts whether they will have adapted their use of the forest to take into account the change in climate. This also indicates the importance of personal factors in explaining forest owners' actual adaptation measures. Overall, the results show that personal belief in and opinions on climate change have a great influence on the preparedness to adapt among those making decisions at a local level.

#### **Indirect climate effects – do they complicate the adaptation process?**

The Swedish forestry industry stands out among the heavy export industries as not particularly dependent on imported input goods, since the absolutely dominating raw material is timber from Swedish forests. This makes it easy to come to the conclusion that the Swedish forestry industry

is relatively unaffected by climate change in other parts of the world, but this conclusion could be a rash one.

First, it is important to not only analyse where the input goods come from but also the main markets for exported wood products. For the Swedish forest industry, the main market is traditionally Europe, but increasing shares are being exported to emerging countries. One region that is more vulnerable to climate change is North Africa and the Middle East, which has emerged as a more and more important market for the Swedish sawmill industry over the last few years. Here, it is important to analyse whether and how climate change could affect the market's conditions in the slightly longer term.

Second, it is important to be aware of more subtle effects associated with the general globalisation of markets for forest products. Swedish sawmills export sawn timber to Japan and China, where they compete to some extent with suppliers from Canada and the USA. The forestry sector in both the latter countries has been badly affected by insect attacks linked to a warmer climate over the past few years.

Third, forest products could generally benefit from global climate change having a negative effect on competing materials. An example of this is cotton, where climate change could create difficulties for production regions that already have a problem today with a supply of water. This could mean long-term competitive advantages for wood-based textiles, a product niche that is still rather small but that has a great deal of potential and where Swedish forest industries have begun to operate.

Overall, it is important to note that markets are becoming more and more global, at the same time as the effects of climate change are becoming more tangible. Thinking broadly and seeing the threats – but also the opportunities – that could arise as a result of climate change will be a key asset in a changing world.

## KNOWLEDGE SHARING AND COMMUNICATION

Forest owners operate in a landscape featuring many stakeholders and interests, which affect management choices and strategies. This section concerns which stakeholders forest owners are primarily in contact with about questions and decisions on forestry and forest management and where they obtain information about climate change. In addition, Mistra-SWECIA's collective experiences of communicating and disseminating knowledge of climate change are discussed.

Understanding with whom forest owners communicate about questions and decisions on forestry is important with regard to what type of information they receive, how it is interpreted and how it is put into practice. By analysing forest owners' social networks, we can get answers to this type of question, which gives us a greater understanding of how effective different channels are for disseminating information.

Mistra-SWECIA's results of a social network analysis of 932 forest owners in Sweden are compiled in Table 1. The table shows which actors forest owners are in con-

tact with and how often they are in contact. It also provides an estimation of how important these stakeholders are perceived to be for the individual's forestry.

According to the network analysis, a number of forest owners communicate with their families and co-owners, neighbours and other forest owners but also with forest-owner associations, forestry companies and the Swedish Forest Agency. The latter offers different forms of advice to forest owners and thus plays an important role in disseminating knowledge and information in forestry. The majority of forest owners have contact with the respective stakeholders annually or less frequently, with the exception of family and co-owners, where contact is more frequent. This group is also seen as the most important with regard to the decisions made in forestry. The actors that forest owners are in contact with more rarely are perceived as less important: for example, authorities and researchers. However, this may be due to the fact that their roles are different when it comes to the individual forest owner's decision-making.

Table 1 Social network analysis of forest owners' contacts (André et al. forthcoming).

With whom do forest owners communicate about forestry and forest management decisions	Percentage of respondents with this alter group in their ego network	Mean frequency of communication <sup>1</sup>	Mean importance when making decisions <sup>2</sup>
Family/co-owners	62	3.1	2.2
Neighbours	51	4.1	3.0
Other forest owners	48	4.2	3.2
Forest owner associations	46	4.2	2.7
Forestry companies	44	4.3	2.8
Swedish Forest Agency	44	4.7	3.0
Service companies	11	4.5	3.8
Contractors	40	4.5	2.8
County Administrative Board	21	4.8	3.5
Environmental Protection Agency	11	4.9	3.8
Federation of Swedish Farmers	21	4.5	3.4
Researchers	8	4.6	3.9
Banks/Insurers	28	4.6	3.1
Other forestry associations or networks	4	4.5	4.2
Other	2	3.1	3.8

1. 1 = Daily; 2 = Weekly; 3 = Monthly; 4 = Annually; 5 = Less frequent than annually

2. 1 = Very important – 5 = Not at all important

The focus group discussions show that forest owners often gather and study scientific knowledge and practical information via different sources. Several organisations have a role to play and good potential for facilitating how scientific knowledge is absorbed in the forestry sector. Many discuss with other forest owners in different contexts and subsequently feel that they can form their own opinion of different management strategies. Neighbours, friends and relatives/family are of importance primarily when it comes to attitudes and values with regard to different management alternatives. The actions of other forest owners in the vicinity may also facilitate change, since they are acting as good examples.

Forest advisers are also important stakeholders in this respect, particularly for the forest owners without a forestry degree. Several mention that their primary contact with research is via advisers, but also via the media and specialist literature. The survey-based study indicates, however, that the primary sources of information associated with climate change are journals, radio and the

daily newspapers, rather than forest owners and advisers. Many forest owners feel that it is difficult to assimilate all the information generated, which is why they feel that the adviser plays an important role in communicating the newest information. Although the majority state that they have confidence in their adviser, the importance of making their own decisions and the fact that it is the landowner who has the ultimate responsibility for how the forest is managed is stressed. Forest owners who have the forest as their full-time employment or who have a background in forestry emphasise that they make decisions themselves but like to confer with others. Other stakeholders regarded as important are contractors and felling operators, for example, with regard to advice on when felling can take place.

An interim study illustrates in greater detail the challenges the scientific community faces when it comes to communicating climate change in a pedagogic and relevant manner to forest owners. The results show that communication between researchers and stakeholders is

### Continuous cooperation between researchers and practitioners

A better understanding of how researchers and practitioners can communicate with regard to climate change adaptation issues has been one of the key themes of Mistra-SWECIA. Communication between climate researchers and forest owners has been – as previously touched on – the focus of research initiatives via both focus group interviews and a large survey-based study. Encouraging increased interaction between researchers and stakeholders has also been a core activity in the programme per se.

It has previously been difficult to combine research into climate change adaptation with support for climate change adaptation. Mistra-SWECIA has, however, made a fresh attempt by prioritising the cooperation between researchers and users so as to make it more on par with the actual research in the programme. In 2011, a working group was established for this purpose. The working group was made up of a number of researchers connected to the programme and representatives for the forestry industry, the forest owner movement and authorities affected at regional and national level. The work-

ing group was tasked with finding common questions of interest to illustrate, discuss and analyse through jointly performed studies and in the form of different events. Seminars, round table talks and forestry excursions have been arranged. This has proved very useful in stimulating open discussions on questions such as how long-term nature conservation is affected by ongoing climate change, how forestry can deal with and manage climate risks and the need for better decision-making support for forestry stakeholders when it comes to climate-related issues.

This form of continuous cooperation between researchers and users has been uncommon up to now in the area of climate change adaptation research. The lessons learned from the work in Mistra-SWECIA are, however, that there is a great deal to gain using this method of working with regard to the continuous sharing of experiences concerning factual matters. The greatest benefit is probably the establishment of mutual trust and an understanding of each other's way of thinking, something that is and will remain extremely important.

often restricted by different language use, different priorities and a lack of time. It is clear from the study that it is difficult to initiate and maintain a good dialogue between researchers and forest stakeholders, between stakeholders from different stakeholder groups and even between researchers from different scientific disciplines. Popular science activities have little research merit and a general lack of time is stated to be an obstacle to a good dialogue between the research community and practitioners. Based on the forest sector's perspective, it is seen as important that this involvement leads to practical information; many people want specific answers to how they should act in specific situations.

Part of the research involves illustrating relevant aspects, including uncertainties and developing tools for handling different perspectives. Decisions on common objectives and the allocation of responsibilities between stakeholders should, however, lie outside the research process. Clarity regarding objectives, expectations, resources and time limitations are required in order for the contact between research and practice to be effective and to be able to contribute to the development of knowledge.

#### **Tips on disseminating information on climate change adaptation**

The dissemination of information and education can be a powerful tool in encouraging adaptation to climate change. Scientific communication has measurable effects on people's views of their own adaptive capacity and can

lead to them deciding to adapt to climate change. Forest owners who took part in the survey-based study have been compared with a group of forest owners who recently took part in one of the Swedish Forest Agency's educational projects on adaptation to climate change. The latter group of forest owners had been informed at seminars, workshops or through private advice of risks associated with climate change and of potential adaptation measures. The comparison between these two groups shows that forest owners who have received information on climate change are more capable of taking on adaptation measures. More than one-third (37 percent) of the forest owners who took part in the Swedish Forest Agency's educational project felt that they had sufficient knowledge to adapt their forestry. A smaller percentage (31 percent) also stated that they needed to take measures soon. Among the forest owners who had not taken part in the educational project, less than one in four (23 percent) responded that they had sufficient knowledge and one in five (20 percent) answered that they needed to take measures within the near future.

Information and knowledge of climate change needs to satisfy three criteria in order to encourage climate change adaptation: *relevance*, *credibility* and *legitimacy*. *Relevance* in the sense that the information and knowledge is regarded by the recipients as linked to their objectives, practical needs and personal knowledge. *Credibility* involves confidence in the information and knowledge and that the individual or organisation



communicating is impartial, objective and factual. *Legitimacy* involves how transparently and democratically information and knowledge are developed, evaluated and used in decision-making.

During the discussions with stakeholders in the forestry sector in Sweden, we have identified a number of tips for communication on climate risk and adaptation measures.

- 1) Those communicating climate science need to use clear language since scientific language tends to confuse people and lead to them feeling incapable of forming their own opinion and taking their own measures. Language is important when it comes to communicating uncertainty. Although it is important to provide information on the inherent uncertainty of climate science, it should be clearly stated what is known with a great deal of probability and what the uncertainty and the different levels of this actually mean.
- 2) Information and knowledge of climate risks should not be communicated in a manner that is perceived as frightening. Alarming messages tend to make people feel powerless or manipulated, which may, in turn, lead to them denying or playing down the risks and the challenges associated with these.
- 3) How successfully the communication initiatives reach the recipients depends on how well knowledge of the effects of climate change adaptation measures match the recipients' practical needs, objectives and ambitions. This illustrates the importance of tailoring the information on the basis of the specific target group's needs, for example, the scale (in time and space), relevant questions and gaining support and linking the information to the target group's own objectives and experiences.
- 4) The dissemination of information about climate change and its effects appears most effective for those who feel that they have noticed climate changes and are thereby considering taking adaptation measures<sup>25</sup>.
- 5) It takes time to disseminate scientific information with a view to developing knowledge and an insight into the need to adapt to climate change. In order to encourage the ability to adapt among the stakeholders using the scientific information, long-term commitment is required at a personal and institutional level.
- 6) Mutual confidence is an essential component in the effective communication of climate science. Our experiences have clearly shown that conveying information and communicating climate information between researchers and users more interactively can help to bridge the obstacles relating to scientific uncertainty, complexity and credibility. Workshops and informal meetings are some examples of forums for facilitating the interaction between representatives of the different target groups, researchers and other experts.

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## About the report

20

This is an extract from the longer synthesis report Klimatanpassat skogsbruk – Drivkrafter, risker och möjligheter [Climate change adaptation in Swedish forestry: Driving forces, risks and opportunities], which is available only in Swedish (see [mistra-swecia.se](http://mistra-swecia.se)). This report, with the same name, focuses on the social science contribution to Mistra-SWECIA, which concerns research on the actual process of adaptation to a climate that is gradually changing. In order to illustrate adaptation processes in a real-world context, the programme has focused on the Swedish forestry sector, with field and literature studies between the years 2010 and 2015. This has

also underpinned the description and conclusions contained in this report on the climate change adaptation landscape and process of adaptation, including roles and the interests of stakeholders (with the focus on individual forest owners and forest officials), as well as which factors drive or prevent climate change adaptation. As a result of Mistra-SWECIA, we now know more about how private forest owners and forestry advisers perceive climate change and risks, different ways of managing the forest and what knowledge they need in order to adapt their forestry to climate change. □

*Read more about Mistra-SWECIA at [www.mistra-swecia.se](http://www.mistra-swecia.se) and [www.mistra.org](http://www.mistra.org)*



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