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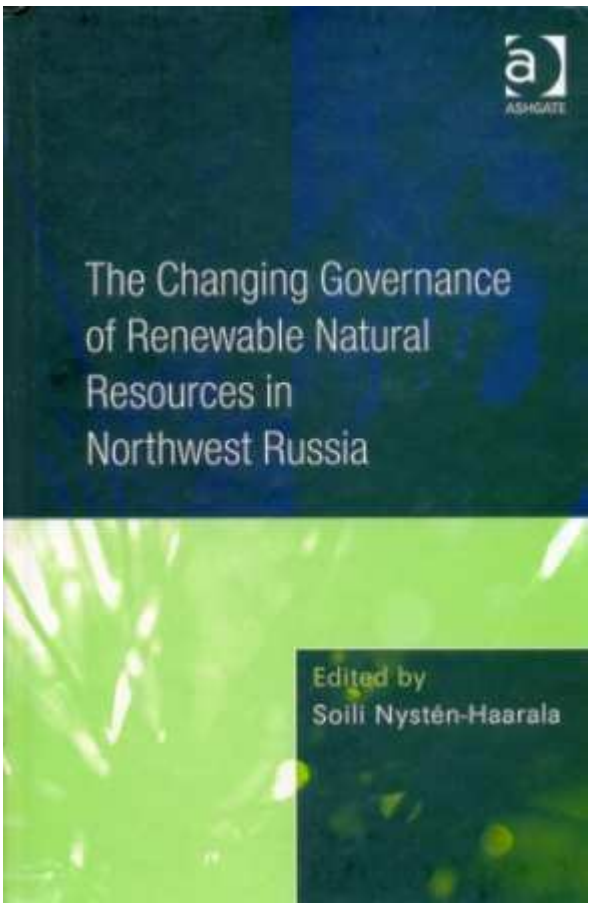

Chapter 11

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Local Adaptation to Climate Change in Fishing Villages and Forest Settlements in Northwest Russia

Introduction and Theoretical Framework

Climate change will have a large impact on community level. As the emissions causing climate change are unlikely to be halted entirely in the near future, local areas and resource users may expect to have to adapt their ongoing land use to some extent (Ford and Smit 2004). Climate change is projected to lead to a more temperate climate in northernmost Europe, resulting in a delayed autumn and milder winters with increased precipitation. This change in climate, and adaptation to it, will cause an additional stress on resource users. The winter season will be shortened by perhaps a month (Hogda et al. 2001; ACIA 2004) and the ice on rivers and lakes will break up earlier and freeze later (IPCC 2001).

This in turn will impact the spring flood and the seasonality of the flood may change (Hogda et al. 2001; IPCC 2001). In summer, plants may suffer from heat stress and soil moisture deficit due to the longer growing season and changing precipitation patterns and be exposed to invading pests, pathogens and herbivores. On the other hand, growth conditions may improve as a result of warmer temperatures and the ground being snow-free longer (Krankina et al. 1997; Saelthun 1995; Watson et al. 1998; cf. Maracchi et al. 2005; ACIA 2004).

Such changes could be expected to have the earliest effect on those parts of communities who are most directly dependent on the environment. The concepts of vulnerability and adaptive capacity have been used in research on both hazards and climate change to describe a community's susceptibility to change and possibilities to adapt to it. Vulnerability has been broadly defined as the 'capacity to be wounded' (Kates et al. 1985: 17).

It is a measure of the exposure sensitivity (that is, how much a stress like climate change is expected to affect an area, given the exposure to the stress and the sensitivity of systems to it), less the adaptive capacity of socioeconomic, political and environmental systems to cope with or respond to this stress (Smit et al. 2000). Adaptive capacity can be defined as the potential for coping and adjustment in a societal system that allows for particular adaptations (Smit and Wandel 2006). In recent literature, vulnerability has been seen as largely targeting social vulnerability, that is, a focus on that it is the existing resource situation and to a large extent the adaptive capacity that determines the extent to which a community or other socio-economic or political unit is impacted by or can respond to change (Adger 2006).

Social vulnerability thus argues that the access to resources such as political, economic, and social entitlements and resource rights play a large role in determining vulnerability and adaptive capacity at large, in response to whatever exposure to hazard may occur (Adger 2006). The concept of adaptive capacity also highlights that different communities even in the same area may be impacted differently by a stress, depending on the extent to which they can cope with or adapt to it (Smit et al. 2000; Srait and Skinner 2002).

The degree of adaptive capacity can be seen as defined by a number of general determinants that may interact to different extents depending on the particular characteristics of the case and localities being studied (cf. Eakin and Leraos 2006; Smit and Pilifosova 2001; Moench and Dixit 2004; Cutter et al. 2003). These include economic wealth, technology, information and skills, as well as infrastructure, which embraces the availability of and access to resources by decision makers, institutions for, among other things, the distribution of resource rights, and the equity of resource distribution (Smit and Pilifosova 2001).

In this chapter, vulnerability will be applied as an overarching concept denoting the existing resource use and access situation in a community given existing stresses, thus focusing on social vulnerability, while climate change will be seen as a specific exposure-sensitivity or stress that affects and may add to that vulnerability (cf. O'Brien and Leicbenko 2000). Adaptive capacity is seen as the capacity for coping with and adapting to stresses within an area, community or sector determined by broad community and societal characteristics.

What is relevant here is to assess the degree to which the general socioeconomic and political capacities to deal with stresses are available to communities at the local level, as well as to define the level of governance — understood as the decision-making network of both public and private actors - on which adaptive capacities are determined (cf. Keskitalo 2008). A focal concern is whether actors are able to adapt locally within a community, or whether adaptive capacity mainly resides with the state or other frameworks. Such a distinction is important as the changes that require access to, for instance, legislative or other system changes would be dependent on access to external actors rather than undertaken directly on community level, with potential impacts on adaptive capacity and vulnerability.

Specifically, the study addresses the following questions:

• What is the current socioeconomic situation and in what ways, and to what extent, will climate change as described in the impacts and scenario literature have an effect on communities?

• What are the determinants that are most important for adaptive capacity in the case study, and at what levels are adaptive capacity situated?

The study aims to describe the effects of change and the capacity to adapt to combined stresses as seen through the eyes of focal people, i. e. as narratives of

perceived vulnerability in a current situation and the capacity to adapt to both existing stresses and climate change. Wide-ranging change can be expected to have the most detrimental effects on those who have the least resources and are least able to draw upon economic and political networks for support or adaptation within a market or legislative framework (O'Brien and Leichenko 2000).

The study targets the case of fishing villages in the Arkhangel'sk coastal area and forest settlements in the Arkhangel'sk Region. The choice of case study area and sectors is based on the fact that renewable resource industries and users are the most directly impacted by climate change, as climate change may increase natural variability and make resource availability less predictable. The local communities studied are to a large extent dependent both economically and - given the structure of social organization in Russia - socially on fishing cooperatives on logging enterprises.

Local communities also depend on the use of other renewable natural resources - gathering berries and mushrooms, hunting, fishing, and using firewood for heat and wood for building. These factors as well as the peripheral location of many of the settlements in relation to regional and national decision-making could be expected to cause a heightened vulnerability to changes in both governance and resource rights distribution.

Methodology and Case Study Areas

The forest industry traditionally plays a large role in the Arkhangel'sk Region (oblast') in Northwest Russia. Most of the rural settlements in the region are forest settlements. The fishing industry and fishing cooperatives (kolkhozes] also have considerable importance in the region, especially socially and culturally, as they support coastal villages with the traditional Pomor culture, which is connected with fishing. This study mainly utilizes semi-structured interviews with stakeholders in local communities that are part of the fishing kolkhozes and logging enterprises (lespromkhozy). The former are located on the White Sea coast near Arkhangel'sk and in the Onega and Primorsk districts on the Onega Isthmus, and include the kolkhozes Red Banner (Krasnoe Znamya), Forty years of October (40 Let Oktyabrya), In Lenin's Name (Imeni Lenina), and Magus on the White Sea Coast (Belomor); the latter operate in the Arkhangel'sk Region and the Onega, Kargopol and Plesetsk districts (the logging enterprises Onegales, Kargopol'les, Yarnemales) (see the map at the beginning of the book). The study thus centres on conditions for fishing, logging and subsistence in rural areas. The qualitative and open-ended design centres on semi-structured interviews is intended to ascertain the understanding of large-scale change through the interviewees' rather than outsiders' eyes (Keskitalo 2008).

The aim is to provide an assessment of the perceived changes and stresses that impact social vulnerability, as well as an understanding of the extent to which

climate or environmental change impacts renewable resource and subsistence users and what determines their adaptive capacities. The interviews were mainly undertaken during the period 2005-2006 and include in total about 55 persons between the ages of 30 to 86 working in fish kolkhozes, logging enterprises and local branches of state forest agencies (leskhozy), pensioners, representatives from local administration, hunters and fishers, as well as people who were registered as unemployed and who make their living from individual subsistence farms. Within the collective farm system described above, interviewees were mainly selected from among people who had worked for a long time - as much as a generation, or most of their lives - in the areas. This means that the stakeholders interviewed have lived through and can describe changes in the economic, organizational/ political and natural environment over time.

The issue of climate change was mainly discussed by presenting the interviewees with statements on broad climate change impacts phrased in lay terms, the aim being to focus on stakeholders' understandings of change rather than on the uncertainties inherent in determining levels of climate change. Thus, questions were phrased not to include the term 'climate change' but to ask about changes in the weather and nature instead. The interviews were structured as follows. Firstly, interviewees were asked to describe the structure of their work or livelihood in broad terms, how changes they have seen in their livelihood have impacted them and what they considered to be their main problems and prospects.

They were also asked to describe their possibilities to adapt to these changes and, where these existed, the means available to them for doing so. These questions were posed in order to view general social vulnerability to changes at large, aside from climate as a focal stress. Secondly, stakeholders were asked if they had perceived changes in the environment, and if so, which, as well as were asked a number of questions regarding potential or actual impacts of changes that could become recurrent with climate change. These questions were expressed in a lay format (for instance, 'How would it affect you if spring came earlier?'), and derived from a survey of climate scenario and impacts literature regarding general impacts predicted for the region (IPCC 2001; Hogda et al. 2001; Krankina et al. 1997; Watson et al. 1998; Maracchi et al. 2005; ACIA 2004; Saelthun 1995).

Specific questions regarding climate change impacts and adaptation thus concerned what changes, if any, the interviewees had seen in the weather and nature during their life, and how it would affect them if there were warmer winters with more snow and thaws, autumn came later, or spring came earlier with thawing and re-freezing and the time of the spring floods changed. Interviewees were also asked how it would impact them if summers were warmer and drier, forest growth increased, there were more pests or forest fires, and the weather were less predictable, with more storms. Interviewees were also asked what they could do to adapt if these changes were to take place.

The sections below describe, firstly, the social vulnerability of areas with reference to their resource access and organization. The section after describes the added impacts of climate change given this situation, and the final section discusses the main determinants of adaptive capacity in the focal case.

Socioeconomic Situation and Resource Access: Social Vulnerability

The socioeconomic conditions and resources of the fishing villages and forest settlements are important in evaluating their potential for adaptation to social and climatic modifications. Social vulnerability can be seen as a result of the historical development and infrastructure in the fishing villages and forest settlements, as well as access to fishing, forest and subsistence resources.

Historical Development and Infrastructure in Fishing Villages and Forest Settlements

Historically, fishing kolkhozy were organized as part of Soviet state policy in the 1930s as a cooperative form of village economy and were reorganized in the 1950s to include several neighbouring villages. Kolkhozy were thus based on traditional, often Pomor, settlements and local decision making. Kolkhozy were also inherently connected with the social organization of the villages, with their infrastructure organized by the kolkhoz and funded by profits from fishing. This made it possible for remote villages to maintain collective-farm agriculture and infrastructure that, among other things, provided them with milk and meat. The kolkhoz was thus responsible for social services in the areas. The fishing kolkhoz was unique in Soviet times in working as a cooperative society which itself planned its own activities and use of profits rather than following state plans. Kolkhozy had a state plan specifying the amount of fish they had to give to the state annually, but they could meet this requirement as they saw fit. As a result of this independence, kolkhozy were generally not liquidated or incorporated into larger units following the fall of the Soviet Union; rather, they maintained their identity as local cooperative societies (see Chapter 10 of this volume).

In contrast to the fishing kolkhozy, Soviet state logging enterprises (lespromkhozy) appeared, for the most part between the 1930s and the 1950s, in locations that were convenient for logging, often where settlements did not previously exist; they followed state-determined logging plans and took responsibility for social services in the settlements that were established. The lespromkhozy were often made up of in-migrants from a number of places, including the southern republics of the Soviet Union. During the reforms following the fall of the Soviet Union in the 1990s, the lespromkhozy were converted into joint-stock companies, most of which finally became part of larger forest holding companies. Thus, unlike the fishing kolkhozy, the lespromkhozy, lost some of their connection to the local context in the 1990s; they may also have a more limited basis of

traditional local knowledge that can support adaptation to socioeconomic and environmental changes (Kulyasova and Pchelkina 2004; Kulyasova and Kulyasov 2005; Kulyasova et al. 2005). Employment in forest settlements has also been severely reduced. The fishing kolkhozy haves generally attempted to maintain the social infrastructure of the villages, but at the cost of making it more difficult for the enterprise to rationalize its activities and compete on the economic market, In the case of forest settlements, however, enterprises have generally limited their investment in social life and infrastructure, although retained some role in relation to the corporate social responsibility of the holding company as a whole.

In both cases, the loss of social responsibility and infrastructure has had severe impacts on the local community and on access to electricity, telephone and mobile communication connections, as well as railway and automobile lines. In most of the fishing villages and in some forest settlements there today exists no connection to public electricity lines, but only mini power stations that run on oil. As a result of the high cost of oil and oil delivery, one kilowatt-hour produced by a local mini power station may cost as much as 10-20 times what it does when supplied on the general network in the countryside. In addition, the capacity of mini power stations is low and restricts electricity use to night time, when it is needed the most, effectively making day-time use of electrical household appliances and computers impossible. Thus, local logging enterprises cannot for example use electrical saw equipment, and fishing kolkhozes cannot use industrial refrigerators for fish storage. As a result, fish is stored outside in the winter, making storage reliant on below-freezing weather and subject to damage in warm winters or winters with frequent thaws. Telephone service exists between the majority of fishing villages and forest settlements but is slow and frequently hampered by weather conditions (high winds, rain, and breaking wires). In practice, there are no mobile communication connections; satellite communication connections are very expensive and essentially only available to managers of enterprises; access to the Internet is lacking.

Where transportation is concerned, most forest settlements have road or railway connections, but the roads are in poor condition and become worse especially in rainy periods. Fishing villages are in a particularly complicated situation, as most of them are only accessible by winter roads. During other times they use waterways or airplanes, which are very expensive and make it difficult to organize the transport of products economically. As a result, any shortening of the period during which there is stable below-freezing weather and winter roads are accessible will have an effect on the economic situation of kolkhozes and the related communities. The absence of infrastructure, in both fishing villages and forest settlements, thus decreases socioeconomic adaptability and results in a major dependence on weather conditions. The conditions in the remote villages also result in a relatively large outflow of youth to the cities in search of work.

Access to Fishing Resources

The existence of enterprises depends on access to resources. Fishing kolkhozy undertake quota-based marine fishing from large trawlers and also utilize subsistence ice-fishing close to the shoreline (cf. chapter 10) during the period with thick ice; this has regularly been November to April, but in the last five years the season has been limited to the period from December to March or even January and February. The kolkhozy pay a fixed fee to the state for this use of bioresources; the fee can be reduced if the kolkhoz can prove that it is the main enterprise supplying the community with social services. Fish harvested within quota-based fishing is most often sold for export, for instance, to Norway or other European states or to Asia, as export prices are higher than those on the domestic market. The fishing quotas are decided in the Norwegian-Russian Fishing Commission, with each state then distributing its national quota. Units such as the collective farms are awarded a certain quantity free of charge and to catch for their own consumption, but since 2001 have had to compete for additional quotas in auctions where the quota goes to the highest bidder. This in effect decreases the resources available to small-scale collective farms with limited economic resources, and the quota available to each collective farm may now be half of what it was prior to the auction system. Kolkhozy estimate that they require 1,000 tons per kolkhoz, while a trawler can readily catch 2,000 tons. There are also minimum limits on ship-specific quotas whereby a trawler must have at least a 600-ton quota to be allowed to fish. Thus, kolkhozy have considerable problems in acquiring rights to marine fish resources. Because of limited economic resources, the collective farms are not able to get bank loans to support competition with companies for quotas, and are thus not able to gain access to resources that would enable them to subsist economically. As one interviewee expressed it: "*[It] turns out that if you have economically effective facilities, it means that your application will be considered and if this is not the case, then it will not. And the dizel' station in our community is unprofitable, agriculture is unprofitable, and they [the banks] say that 'you won't be able to pay us back'. Therefore banks generally refuse us credit. They see that we have only 300 tons, they say that 'with these 300 tons we cannot give you a permit'... we are always turned down, and the reason is 'you are not solvent'. We say that we survive in difficult conditions, support the population, pay attention to our social importance [as well as] production efficiency. We try to show that we are not efficient not because we are... not able to work, but because we work under difficult conditions in the north*".

As an economic adaptation, kolkhozes have united in associations in order to pool quotas and trawlers, as well as the financial resources for purchasing quotas at auctions. Many kolkhozy have received offers from large fishing enterprises to join joint-stock companies or holding companies, but have most often rejected these offers, as it would mean a loss of independence for the collective and a

change in the role of the kolkhoz in the local community (cf. Chapters 5 and 10). As a result of these problems of resource access, some kolkhozes have also investigated the possibility of claiming indigenous rights based on Pomor traditions. Indigenous peoples are according to Russian legislation accorded larger resource rights than purely local groups, and if Pomor were to be recognized as an indigenous group, local users who could claim this background would be able to gain larger fish quota rights.

Access to Forest Resources

In the Soviet period, forest settlements were constructed in places where there were significant stocks of wood, exhausting much of the timber reserves in Northwest Russia; in Arkhangel'sk, however, there are still regions with old-growth forest, protected by international and Russian environmental organizations (cf. Chapter 9). While there exist major forest-covered territories in these areas, many of them are not accessible on account of the limited road network, and in certain areas long transport distances to consumers make logging unprofitable. Most logging also utilizes winter roads, which are roads that are only possible to use during the period when the ground is frozen. This situation means that any shortening of winter would impact logging negatively given the current infrastructure.

The competition for wood resources has also increased in the areas since the mid-1990s, when it became possible to lease forest plots from the state for logging following regional competitions or auctions. While the state owns all land, forest companies are thus able to lease plots for time periods ranging from a few years to several decades, with the result that only those who are able to compete at auctions are able to lease land. The price of roundwood at the end of the 1990s and in the 2000s was also comparatively low and resulted in that many logging enterprises operated at zero profit and could not pay wages and taxes or invest in new machinery. As a result, during this period many enterprises became parts of larger holding companies which included more profitable sawmills or pulp and paper mills. The redistribution of profits within the holding structure allowed for investments in logging enterprises and the stable payment of wages and taxes; however, these changes led to a dominance of large holding structures on the local level.

In the Arkhangel'sk Region, the general scheme of management for the enterprises in the holding company PLO Onegales has helped the enterprises pay stable wages and taxes and become more efficient by acquiring new technology such as harvesters and forwarders. However, under the new Forest Code adopted in 2006 all forest plots for logging in the Russian Northwest will be distributed by auction under relatively tough competition, where large-scale forest holding companies may win out on account of larger resources. This may have effects on communities should leaseholders log areas surrounding communities. To some

extent, however, may community use of forests be supported by the fact that all settlements in the case study are situated near FSC-certified territories (see more on the Forest Stewardship Council, FSC, in other chapters in this volume; Kulyasova and Kulyasov 2005; Kulyasova, Kulyasov and Pchelkina 2005). Certification - the opportunity to label wood as certified when harvested according to certain environmental and social criteria - is seen by holding companies as a market requirement and is part of their policy in the area, among other things resulting in the holding companies paying for certification of their constituent enterprises. Certification has economic benefits for the company in that it gains access to the stable European market; the certification process also prompts companies to internalize environmental values and requires a certain level of corporate social responsibility such as retaining forest areas for local use and provision of firewood.

While financial resources in fishing villages are largely dependent on fishing quotas and collective farm arrangements, regular day-to-day life in the villages is dependent to a large extent on subsistence resources, including forest and coastal resources. In forest settlements, daily life is dependent on forest, river and lake resources, as well as on subsistence farming. Fishing villages are especially reliant on local subsistence resources given the limited transport possibilities and low incomes in the kolkhozy. Many of the villages have small-scale agriculture maintained by the kolkhoz: they grow potatoes and vegetables and raise horses and cattle for milk and meat, primarily for subsistence use but sometimes for sale as well. The villages also harvest hay for animal fodder. The number of both privately owned and kolkhoz-owned horses has increased since the 1990s; the animals are used in agricultural work and for transportation, as petrol and spare parts for tractors are expensive and delivery times may be long and uncertain. Some villages also hunt seals and cultivate seaweed, although any prospects of increasing seaweed production are limited by the areas not having access to export networks for the resource.

In both fishing villages and forest settlements people also gather berries and mushrooms. Many people dry or preserve berries (cowberry, bilberry, cloudberry, cranberry) and mushrooms, which are used for subsistence or sale. The gathering of mushrooms and berries is common in Russia; it forms the basis of the budget of many families - especially those who are unemployed - and may be essential even for those who have other incomes. In all communities in this case study, the gathering of berries and mushrooms for sale at a storage point is a large-scale activity. The storage of berries is organized in villages and settlements, where local inhabitants are employed by corporations who purchase berries and transport them to larger storage facilities or cities. For families who engaged in berry picking during the entire season, the earnings from berries were comparable with the income from work at the logging enterprise; in many fishing villages, however,

large-scale berry picking and sale was difficult due to lack of transportation. Hunting is also important, both as a source of meat and as a social practice. Hare, elk and forest birds are hunted to provide both fresh meat and salted meat for winter. Declining amounts of game and game diversity due to non-local hunters and ecological changes are, however, reducing the importance of hunting. Some villagers also own small boats (typically around six metres in length) for small-scale coastal fishing; however, most commonly villagers catch fish for food by ice-fishing. In total, any changes in the environment, weather or climate that affect the large-scale harvesting of berries or wildlife distribution will thus substantially affect the economic security of the inhabitants of forest settlements and fishing villages.

Local forests are also important for villages as a result of the use of local wood for heating and as building material. In fishing villages this need is partly met by the kolkhozes, which log and saw a small amount of wood, with the work being done partly by the residents themselves. In forest settlements, as a rale, the logging enterprises sell logs, often substandard logs that cannot be used for saw or pulp and paper mills, to communities as firewood. However, as logging technology improves there is less and less such surplus wood available for stove heating purposes; the distance from the cutting plot to the settlements has also increased with increased logging, which raises the price of firewood. In some cases the logging enterprises give permission to local people to log for their own needs on the leased territory. Both fishing kolkhozy and logging enterprises try to provide local social institutions (schools, libraries, houses of culture, medical offices and kindergartens) with wood for free or at low prices. However, the timely supply of wood for heating, building and repairing remains a problem. As stoves are used for not only heating but cooking as well, warmer temperatures (due, for instance, to climate change) will not necessarily significantly reduce the amount of wood needed in homes. Continued access to wood resources is also becoming more restricted, as the system by which the state sells resource rights to the highest bidder may encourage logging companies taking out as high amounts of wood as possible from forests, in order to gain returns to their investment.

Impacts of Climate Change

Given the extensive reliance on the environment for subsistence in the region studied, climate change may exacerbate the current situation in that it impacts resource access by shifting the times when resources are accessible, as well as the quality and quantity of resources and services such as winter storage and travel. Interviewees generally viewed projected climate change impacts as mirroring the changes seen in recent years, which suggests that climate change may already be ongoing. Villagers were thus able to point out the effects of existing or experienced situations, and to a large extent described existing responses. Overall, the

changes they noted indicate that weather is becoming more unpredictable, affecting for instance the timing of different activities (such as transport or fishing dependent on ice conditions, or sowing crops). The longer period of open water will lead to a longer navigation period, meaning that water routes for transport will function longer in the winter; however, for villagers, having access to winter roads for travel by car was preferable to having ice-free waterways for transport by ship or boat.

Temperature Change and Seasonality

The interviewees generally stated that it has become warmer over time. Winter has started later, been milder and included thawing periods, and spring has also come earlier. This has made the weather less predictable. For instance, one interviewee noted: "*The weather for the last 10 years has become unstable. Earlier, if it was summer, it was summer. If it was winter, it was winter. And now [this winter] the snow already has melted three times*".

A beneficial impact of the temperature change in winter is that somewhat less wood is used for heating purposes only if the weather is warmer. On the other hand, there are negative impacts on the accessibility of places that are only reachable by winter road, or by ferry or plane in the summer. For areas that are dependent on access by roads across frozen sea and river ice, access by frozen marshes is similarly limited, as the rivers, marshes and the sea all freeze later and thaw earlier.

A shorter period when waterways and the ground are frozen also has a strong impact on the local populations of fishing villages, for whom ice-fishing provides an important source of protein in winter. The varying and warmer weather both shortens the period for secure ice fishing and makes it more difficult to store fish and other foodstuffs over winter, as the villages and forest settlements that cannot rely on access to electricity use the outdoors as their freezer. Fish or other perishables are ruined if the thaws last long enough: "*Winter [comes] later and later every year. Earlier we caught fish for November seventh, for the holidays, and the sea was frozen. And now, look, every year it [is] later and later... [If] the ice is not present, also fish [are] not present; we do not catch them... without ice... And winters [are] warmer. In the winter when you catch fish, suddenly [there is] a thaw*". In order to adapt to thawing in winter, the collective farm Forty Years of October recently purchased its first freezer for the villages; a freezer is beneficial in that, unlike in a refrigerator, food does not have the time to thaw during breaks in the electricity supply.

Changes in temperature have also been seen in summer. Summers have sometimes become hotter with less rain. Many interviewees also observed that summers have become drier, with the risk of water levels in rivers falling, causing trees to dry up and limiting fish spawning and the amount of river fish.

Impacts on Fishing

For fishing activities, warming of the seawater has resulted in a somewhat different distribution offish. One stakeholder with access to scientific data on temperature measurements and fish distribution noted: "*In the last three years fishers have noticed... a change of average annual temperature of the water. The thing is that the fish very much react to it, even a change on the extent of a degree, on a tenth of a degree. And it is true, we have noticed, that in recent years the distribution, in particular, of cod, has extended, and already in those northern areas where it never occurred, now it can be seen*".

Because of this non-conventional distribution offish and the fact that the ice has receded to the north, the last three years have brought benefits to the fishing yield among trawlers. However, such changes in fish distribution may mean that coastal fishing, which uses smaller boats that are not allowed to transgress the 12-mile coastal limit for fishing, may not be able to access their target species. "*Previously, the migration routes were stable; now this is not the case. The fish move go to colder waters, to the north - the cod, haddock, the basic species of fish that we catch. For us, for trawlers, this is not of great importance, but [for] the coastal fishery [it is]*".

For instance, the head of one fishing collective noted that as quotas are defined for the different fish species (such as cod, haddock, halibut, or herring) and the vessels only cany equipment to catch certain of these, any change in the distribution of species could have a large impact. Interviewees also observe that storms and strong wind may become more frequent, further impacting small boats in particular. The navigation period may, however, be extended, as winter, which brings snow and freezing temperatures, will start later.

Additionally, the lack of ice was seen as impacting the possibilities for seal hunting, with seals potentially moving towards Norway, for instance, where they will not be accessible to local hunters. This is something that fishers worried may reduce fish resources further in the long run, as increased numbers of seals, not diminished through hunting, may consume more of the fish resources.

Impacts on Forestry

For forestry-related activities and for logging enterprises the shorter winter will have a large limiting impact on the access to logging areas through frozen winter forest roads. An increase in timber growth has been observed, one trend possibly related to warming. The major concern however, is that given the limited road network, logging enterprises and smaller collective farms will only be able to carry out logging during the period when winter roads are available, which in some years has lasted only from December to March, rather than, as earlier, from October to April. Some plots can be logged only when the ground is frozen, because rnarsh soil, moist soil, and weak soil are very susceptible to damage during

logging under other conditions. Unpredictability around the length of the frozen period could also impact the possibilities for wood storage. If logs are harvested and placed by a winter road to be picked up for transport, they may be destroyed by insects and pests if there occurs a thaw that hinders transport. Machines such as tractors that attempt to transport wood may sink in marshland areas or bogs, potentially getting stuck and destroying the root system of trees. A warm winter would mean that many of the logging enterprises either could not operate on winter plots or would cause substantial ecological damage to the forest soil if operations were not ceased. A more unpredictable and shorter winter period would thus impact the possibilities for logging, transport and wood storage.

It was also noted that changes in temperature could have a large impact on the risk of forest fires. Interviewees noted that the risk of forest fires differ with conditions from year to year: "*If June is damp, there are few fires. If it is dry, even if cold and dry, there are a lot of fires. Everything depends on the first month - May or June*". However, fires may have a lesser effect in undersized forests with relatively few cubic metres of wood per hectare than in other, denser forests.

Impacts from variation in temperature have also been observed on the main rivers in Northwest Russia, which are used during the spring flood for transporting logs. In the last few years, the spring flood has been extremely low because of the small amount of snow, and the logs that were prepared for water transportation were not floated down the river. On the other hand, interviewees noted that an unpredictably high spring flood could destroy logs stored on the bank. These varying observations are consistent with climate change impacts and projections literature that has noted variable levels of snowfall, snowmelt and spring floods (1PCC 2001). Bogs were also seen as having increased, possibly due to higher logging rates and greater snowmelt as well. At the same time, the number of dry areas at somewhat higher elevations has increased. An increase in the number of bogs was seen as further disrupting the possibility for communications between settlements. However, the formation of bogs may prevent problems with flooding, as marshes may absorb excess water.

Impacts on Subsistence and Invasive Species

Another result of warmer temperatures is that the timing for sowing crops in spring has been impacted. While earlier sowing would be beneficial for crop yields, then is a risk that recurring frosts might damage the crop and make it difficult to take advantage of a longer growing period: "*It is usual that snow melts in the middle of May and potatoes can be put into the ground. Now I put the potatoes in the ground already in May - the first or the second - but the thing is that there can be frosts at the end of May or beginning of-June; [there may be] temperatures such as [those] now [in winter] and in July it is again hot, warm; by September there is a downturn of temperature; in the first half of September, zero*

degrees, temperatures below freezing, frosts, and then sharp warming". In 2006 there were unusual frosts during the whole summer: "*...there were frosts in the beginning of June, in the middle and the end of June, and in the beginning and the middle of July; the potatoes, squashes, pumpkins were partly frozen*". There was also an unusual period of warmer temperatures in early spring and a long period of frost after and also a different pattern of rain in the warmer season (three to four weeks of rains and three to four weeks of sunny weather without precipitation instead of mixed weather). Such occurrences may make berry flowers freeze, impacting the crucial berry crops and also limiting mushroom harvests.

In addition, species not prevalent in the area earlier have been observed, such as vipers, which may be dangerous as people are unprepared for them. As one interviewee noted: 'snakes are thermophilic, they should [need to] keep warm... they never came here before'. Changes have also been seen in the behaviour of migratory birds such as swans and geese (which may however relate to losses of earlier migration sites and agricultural patterns of sowing), in the prevalence of ticks and in the occurrence of Colorado beetles and other crop pests not seen previously in the region. Cow-parsnip (Sosnovskogo), a very poisonous plant which causes skin rashes when touched, has appeared in several parts of the Arkhangel'sk and the Karelia Regions. The plant is an invasive species originating from the Caucasus and very aggressive, spreading very fast and replacing endemic species. Bees, previously rather rare in the Arkhangel'sk area, have also been seen more frequently, and one interviewee described how her cherry tree had suddenly started bearing fruit during a long, unusually warm summer that occurred in the last few years. In general, as one interviewee noted on the new species: 'These are kinds of animals and insects which lived in the south of our area, that is, somewhere 500-600 kilometres to the south; now they have moved here'. With regard to these changes, interviewees state that one problem in finding adaptive measures lies in the fact that there exist no traditional ways of responding to the problems: "*In the south people have already adapted for a long time.... but here nobody knows how to combat these setbacks [ticks, potato and crop pests]*".

Conclusion: Possibilities for Adaptation?

In general, many of the problems for the villagers can be defined as relating to the possibilities for maintaining an economy in the peripheral northern regions. The existence of a system where resource access beyond a certain level is distributed through a market (auction) system has a high impact on local enterprises and units, who are not able to compete as a result of their small size as well as of bearing much of the social costs of communities, as well as the costs of investing in new technology. This Catch 22-situation can be seen as leading to unemployment in many settlements. As a result, the governance or decision-making framework for access to resources (both natural resources and the terms for social services

provision) that is set by the state and gives preference to larger-scale actors is a main determinant of social vulnerability and adaptive capacity (Smit and Pilifosova 2001; O'Brien and Leichenkko 2000). The main resource problems thus reside in establishing rights to supply of resources, rather than in demand for products given that sales networks and business connections exist. The general social vulnerability thus limits the possibilities for local adaptation overall and to climate change in particular.

An illustrative example of this pattern in the present case is fishing, which can be seen as highly vulnerable because of the economic requirement of supporting social services, which limits resources for adaptation. In fishing, large problems was seen to be the limited resources available to the communities, one being the lack of capital available to collective farms, which cannot obtain loans and thus lack sufficient resources to purchase quotas that would enable them to get access to electricity or improve the infrastructure. What could be defined as globalizing factors are thereby of considerable importance for adaptation (O'Brien and Leichenko 2000). To increase their profit margin and thereby adapt economically, collective farms sell their products for export at higher prices but are limited by internal resource conflicts and a regulative system that favours larger market actors. Legislation that restricts coastal fishing to within a 12-mile limit was also seen by interviewees as decreasing coastal fishing possibilities. The possibilities actors saw for potentially increasing their adaptive capacity over time mainly consisted of contesting the distribution of rights by claiming indigenous peoples' rights for Pomors. Any further combination of quotas or joining together into larger units may be difficult given existing problems and the market- rather than socially-oriented attitude in potential business partners. Many of the perceived problems and the adaptations suggested for dealing with these thus also here hinge on the regulative framework on the state level, which determines resource rights and thereby also economic opportunities (for instance, for bank loans in order to compete economically within the system). This impact of extra-local frameworks is consistent with patterns found in other research in northern areas (Keskitalo 2008), indicating that much of the adaptive capacity for localities are situated at and require actions at higher levels, thereby limiting the degree of adaptation that can be undertaken in the community.

The case of forestry and fishing communities in Northwest Russia further illustrates the higher vulnerability to climate change among local communities that are dependent on subsistence resources (cf. Ford and Smit 2004) compared to those where technology and well-developed physical and social infrastructures can be used to limit direct dependency on the environment. For the communities studied here, potential adaptation strategies such as technological change that may be available in more wealthy fishing communities as a response to climate change were not available. Examples of these may include, for instance, by cold storage,

central heating, or focusing on technologies such as fish farming that would lessen dependency on fish stock fluctuations which have been seen in communities in northernmost Norway (Keskitalo 2008). Climate change may possibly exacerbate existing resource problems by limiting access to areas, thereby further increasing the reliance on electricity for cold storage and impacting local natural resource use (harvest and subsistence agriculture). In many cases, impacts such as those that could be expected with continuing climate change have already been perceived, such as changes in seasonality and the in-migration of invasive species. Adaptations to climatic changes may be less demanding when they relate to conditions in which variations have been seen for a long time and for which strategies exist, or in cases where they can be undertaken through individual-based adaptations, such as changes in crop patterns due to limited seasonal predictability. In some cases, adaptations may be able to include modifications to accommodate changes to unfamiliar conditions, such as those brought on by new species and for which adaptive or coping strategies do not yet exist. However, this adaptive range is limited by the institutional framework; more far-ranging adaptation on the local level would require changes on the level of state regulation involving resource access and infrastructure and other support.

References

ACIA [Arctic Climate Impact Assessment] (2004), Impacts of a Warming Arctic - Arctic Climate Impact Assessment. (Cambridge: Cambridge University Press).

Adger, W.N. (2006), 'Vulnerability', Global Environmental Change 16, 268-281.

Cutter, S.L., Boruff, B. J. and Shirley, W. L. (2003), 'Social Vulnerability to Environmental Hazards', Social Science Quarterly 84:2, June 2003, 242-261.

Eakin, H. and Lemos, M.C. (2006), 'Adaptation and the State: Latin America and theChallenge of Capacity-Building under Globalization', Global Environmental Change 16, 7-18.

Ford, J.D. and Smit, B. (2004), 'A Framework for Assessing the Vulnerability of Communities in the Canadian Arctic to Risks Associated with Climate Change', A relic 57:4, Dec. 2004, 389-400.

Guisan, A., Holten, J. L, Spichiger, R. and Tessier, L. (eds) (1995), Potential Ecological Impacts of Climate Change in the Alps and Fennoscandian Mountains. An Annex to the Intergovernmental Panel on Climate Change (IPCC) Second Assessment Report, Working Group II-C (Impacts of Climate Change on Mountain Regions) (Geneve: Conservatorie et Jardin Botaniques de Geneve).

Hogda, K.A., Karlsen, S.R. and Solheim, I. (2001), 'Climatic Change Impact On Growing Season in Fennoscandia Studied by a Time Series of NOAA AVHRR NDVI Data', Proceedings of IGARSS. 9-13 July 2001, Sydney, Australia.

IPCC [J.J. McCarthy, O.F. Canziani, N.A. Leary, D.J. Dokken and K.S. White, eds] (2001), Climate Change 2001: Mitigation. Contribution of Working Group

III to the Third Assessment Report of the Intergovernmental Panel on Climate Change (Cambridge: Cambridge University Press).
Kates, R.W., Ausubel, J.H. and Berberian, M. (eds) (1985), Climate Impact Assessment: Studies of the Impact of Climate and Society (Chichester, UK: John Wiley and Sons).
Keskitalo, E.C.H. (2008), Climate Change and Globalization In the Arctic. An Integrated Approach to Vulnerability Assessment. (London: Earthscan).
Krankina, O.N., Dixon, R.K., Kirilenko, A.P. and Kobak, K.I. (1997), 'Global Climate Change Adaptation: Examples from Russian Boreal Forests', Climatic Changed: 197-216.
Kulyasova, A.A. and Pchelkina, S.S. (2004), 'Global Processes in Local Scale: Malashuika Case Study', Spectrum 3. (in Russian).
Kulyasova, A.A. and Kulyasov, I.P. (2005), 'Russian National Voluntary Forest Certification (Vozhegales Case Study)', Spectrum 1. (in Russian).
Kulyasova, A.A., Kulyasov, I.P. and Pchelkina, S.S. (2005), 'Regional Aspects of the Global Forest Certification Process', Region: Economy and Sociology 4. (in Russian) Maracchi, G., Sirotenko, O. and Bindi, M. (2005), 'Impacts of Present and Future Climate Variability on Agriculture and Forestry in the Temperate Regions: Europe', Climatic Change 70, 117-135.
Moench, M. and Dixit, A. (eds) (2004), Adaptive Capacity and Livelihood Resilience. Adaptive Strategies for Responding to Floods and Draught in South Asia. The Institute for Social and Environmental Transition, International, Boulder, Colorado, USA and the Institute for Social and Environmental Transition, Nepal.
O'Brien, K.L., and Leichenko, R.M. (2000), 'Double Exposure: Assessing the Impacts of Climate Change within the Context of Economic Globalization', Global Environmental Change 10, 221-232.
Saelthun, N.R. (1995), 'Climate Change Impact on Hydrology and Cryology', 45-49 in Guisan, A., Holten, J.I., Spichiger, R. and Tessier, L. (eds).
Smit, B., Burton, L, Klein, R. J.T. and Wandel, J. (2000), 'An Anatomy of Adaptation to Climate Change and Variability', Climatic Change 45: 223-251.
Smit, B. and Pilifosova, O. (2001), 'Adaptation to Climate Change in the Context of Sustainable Development and Equity', 877-912 in IPCC [J.J. McCarthy, O.F. Canziani, N.A. Leary, D.J. Dokken and K.S. White, eds].
Smit, B. and Skinner, M.V. (2002), 'Adaptation Options in Agriculture to Climate Change: ATypology', Mitigation and Adaptation Strategies for Global Change 7, 85-114.
Smit, B. and Wandel, J. (2006), 'Adaptation, Adaptive Capacity and Vulnerability', Global Environmental Change 16, 282-292.
Watson, R.T., Zinyowera, M.C., Moss, R.H. (eds) (1998), The Regional Impacts of Climate Change: An Assessment of Vulnerability (Cambridge: Cambridge University Press).