

Climate Change in the Arctic: Perspectives on Adaptation

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Abstract

The consequences of climate change are felt earlier and more intensely in the Arctic region than in the rest of the world. Climate change causes melting of the Arctic Ocean sea ice, which has profound implications for the Arctic ecosystem and the geopolitical position of the Arctic region. In this new situation, understanding of the interplay between environmental change and human activities is more important than perhaps ever before. This presentation is based on my doctoral dissertation, which remains to be finalized. The aim is to add perspectives on adaptation and environmental change to this discussion from a historical point of view. In my doctoral dissertation, I investigate how two Northern societies have responded to challenges caused by the interplay between environmental, political, and/ or socio-economic change throughout their history. In this presentation I have chosen to describe some perspectives on adaptation in the history of Greenland.

1. Introduction: Background of the Study and Present Challenges of the Arctic Region

In my doctoral dissertation I investigate how two northern societies, Greenland and the Faroe Islands, have responded to challenges caused by the interplay of environmental, political, and/ or socio-economic change throughout their history. I examine the strategies that people have developed in order to adapt from a long-term perspective. In my dissertation, I also explore the spatial outcomes of adaptation, which in practice means settlement pattern development.

The main goal of the dissertation has been to show what kind of adaptation strategies people have developed or applied, and *if* or *how* these adaptation strategies are related to the development of settlement patterns in the two case study regions. To do this, I have created two narratives about human adaptation in two environmentally marginalized, northern regions. For this publication, I bring out some perspectives regarding adaptation in Greenland. My aim is to reflect past development upon present challenges caused by climate change in Greenland.

A topical example of the interplay of environmental, political, and socio-economic change and human activities is climate change, which has become a part of the global political agenda. According to the Intergovernmental Panel on Climate Change, IPCC (2007: 3), there exists “a very high confidence” that global warming is caused by human activities. A great

number of indications of climate change, such as changes in Arctic temperatures and ice, precipitation, ocean salinity, and wind patterns, have been observed throughout the global ecosystem (IPCC 2007:). Climate change also has a great impact on human lives. It represents a worldwide challenge as “the greatest and widest-ranging market failure ever seen” (The Stern Review on the Economics of Climate Change 2007). For these reasons, understanding the interplay of environmental change and human response is now more important than perhaps ever before. An investigation on how environmental change interacts with political and socio-economic factors, and an assessment of how they may affect human societies, is very important (Dugmore et al. 2007).

The consequences of climate change are felt earlier and more intensely in the Arctic region than in the rest of the world (ACIA 2004). Climate change causes melting of the Arctic Ocean sea ice, which has profound implications on the Arctic ecosystem and the geopolitical position of the Arctic region.

Currently, the Arctic region is in the spotlight of global media because of climate change. Climate change causes melting of sea ice of the Arctic Sea, and the whole Arctic region is warming up faster than the rest of the world. The loss of the sea ice has been so rapid, that it has surprised even scholars. Recently, scholars have suggested that the very first ice-free Arctic summer will be experienced already in 2013 (<http://news.bbc.co.uk/2/hi/science/nature/7139797.stm>).

The geopolitical position of the Arctic has changed. There are a number of reasons for this. Firstly, the subsoil of the Arctic Sea is assumed to contain remarkable oil and gas reserves, which are likely to become attainable in the future. The U.S. Geological Survey estimates that the region has 90 billion barrels of oil, 1,670 trillion cubic feet of natural gas, and 44 billion barrels of natural gas liquids in 25 geologically defined areas (<http://energy.usgs.gov/arctic/>). In practice this amount is equal to one fifth of the global undiscovered oil and gas reserves, corresponding to three years’ global demand for oil.

Secondly, the melting sea ice is likely to reveal new fishing waters. The Arctic Sea is one of the richest fishing grounds in the world. It is attractive, because fish stocks are large in size, yet the number of fish species is not considerably high. The domination of relatively small number of fish species is favourable, because that reduces the amount of wasted bycatch.

Thirdly, the melting sea ice will clear Arctic sea routes. The Northwest Passage opened up in summer 2007 for the first time as sea ice of the Arctic Sea retreated. At the same time the ice cover of the Northern Sea Route through the Russian Arctic has diminished. The

Trans-Arctic sea route through the Arctic Ocean may also open up in the future. The passage rights of the Arctic waters will most probably have great importance in the future because the sea routes shorten the absolute and temporary distance between the Atlantic and the Pacific Oceans. The use of the Arctic sea routes will have economic benefits because use of them would enable cargo vessels to avoid the bottlenecks of Suez and Panama canals. The present breadth of the canals also limits the size of ships. The use of the Arctic sea routes would enable the use of larger cargo ships.

The Arctic ecosystem is altering because of the melting ice and warmer temperatures. For example, southern animal and plant species extend northwards while the survival of existing ice-dependent Arctic species is challenged by the retreating ice (CBMP, 2006). Humans, who depend on harvesting/ the harvest of Arctic animal species, will also be affected by climate change. Climate change challenges the entire livelihoods and cultures of the Arctic indigenous peoples, who still base their subsistence economy on renewable resource harvesting (Ford et al. 2006). For this reason, I provide in my presentation some examples of how people in a Northern society such as Greenland, have previously adapted. The development of past societies is not directly applicable to the development of modern societies. For example, adaptation is made easier today because of new technologies, medicines, and greater knowledge (Diamond 2005). My aim is to show that some past forms of adaptation can guide us to confront and understand the complexity of the present challenges.

2. Adaptation – Historical Perspectives from Greenland

Although the new economic opportunities are very topical in terms of future development in the Arctic, their effect – in addition to other consequences of climate change – on the Arctic environment and the Arctic communities is perhaps an even more pressing issue at this very moment. The Arctic communities need to adapt to the new reality.

I wish to argue that adaptation to climate change in the Arctic region should *not* be seen in a simplistic way, for example as the replacement of one economic activity by another, but rather as a complex process. To understand features of the multi-dimensional character of adaptation, I present some perspectives from a historical case study regarding Greenland.

I have chosen a long-term perspective for the case study because I agree with Dugmore et al. (2007) who suggest that understanding of the interplay between environmental, political, and socio-economic change requires the establishment of entire trajectories of

different climatic episodes and cultural changes. My aim is to provide long-term narratives on how people have responded to such changes throughout history.

The issue of adaptation to climate change in the Arctic communities has been studied by, for example, Berkes & Jolly (2002), who have investigated climate change and adaptation in a case study on a Western Canadian Arctic society called Sachs Harbour. For the Inuit who live in the community Climate change has posed challenges because environmental conditions have become more varying and therefore less predictable. The Inuit who live in Sachs Harbour have coped with the challenges through the adjustment and modification of their subsistence activity patterns. For example, they have changed when, where and how they hunt or fish. Berkes and Jolly also point out that the inhabitants of the studied community use adaptive strategies such as flexible resource use, local environmental knowledge and skills, sharing through social networks, and intercommunity trade to respond to the changing environmental conditions.

My point of departure in this case study was to look at the connections between environmental, political, and/ or socio-economic change and development of settlement patterns in the Arctic. I wanted to investigate and clarify how these factors interplay with each other concretely and how they affect the spatial organization of people. I used the concept of adaptation to link the interplaying factors and their consequences with the settlement patterns and their changes.

In general, I want to suggest that people who have settled in the Northern societies adapted their livelihoods and settlements due to environmental settings such as topography and climatic conditions. But I also want to point out that soon factors such as demographic change (population growth) and market conditions began to influence development. Several factors interplayed with one another and interacted synergistically.

The early history of Greenland is an account of people who arrived at the island, occupied it, and declined in population or moved away according to environmental variations and changes that affected prey abundance (Diamond 2005). Survival of people and their culture depended on flexible utilization of the available resources and relocation (Rasmussen & Hamilton 2001). Greenland has been inhabited throughout the past 4,000-5,000 years. The Inuit initially lived as nomads. There were times when the whole of West Greenland coast was settled, and others when only a few stretches were inhabited. Occasionally people were entirely absent from the islands (Petersen 1991).

The Inuit, who were descendants of the Thule culture, adapted their livelihoods in the Greenlandic natural environment and its fluctuations. From the point of view of adaptation, I

choose to introduce some adaptive strategies from the history of the Greenlandic Inuit that helped their survival. Such strategies were: flexible and highly developed hunting techniques and technologies on land, sea, and ice; the use of a large and varying renewable resource base and diversified subsistence activities; familiarity with environmental variations; societal flexibility, mobility and flexible settlements; and well-defined rules and practices.

The Inuit used highly developed hunting techniques and technologies, which enabled their survival in the marginal environment. Their subsistence activities were based on a strategy to utilize all renewable resources that were available on the island. The Inuit emphasised the hunting of sea mammals, especially seals, which provided them with all the necessities: food, oil for lamps, and skins for clothing, boats, and shelters. Hunting took place on land, sea, and on the sea ice. Moreover, Greenlanders fished and gathered mussels, seaweed, plants and berries (Rasmussen 2000). Seasonal and annual variations in animal stocks occurred continuously in the Arctic. It was possible that some of the hunted animals simply disappeared. The Inuit survived despite these variations due to a great deal of familiarity with the nature (Dahl 1999).

According to Hammer et al (1921), the hunting techniques, equipment, and the hunted animals were divided into Arctic and the Sub-Arctic hunting, which overlapped with one another. The Arctic hunting took place in regions where the sea was covered by ice in winters. For instance, dog sleds and ice hunting were highly developed in these regions. The main prey animals were ringed seals and walrus.

As an example of the Arctic hunting technique, hunting of ringed seals was highly specialized. Ringed seals wintered outside Greenland's coasts under the ice shelf. The Inuit opened breathing holes through the ice. They covered the holes with a cone of snow. A hunter would stand near the cone until a seal arrived to breath and harpooned it through the cone. When the seal swam off, the harpoon head detached from the shaft but remained attached to a rope, which the hunter pulled until the seal became exhausted and could be pulled over the ice (Diamond 2005). When the climate started to cool, the ice-hunting of ringed seals became more common along the coastline of West Greenland.

The Inuit adapted their hunting to the Sub-Arctic conditions of southern Greenland as they migrated along the South Coast of Greenland. Despite climatic cooling caused by the Little Ice Age, the climate of Southern Greenland was relatively mild for the Inuit. In the new and more southern regions, water was open from ice during the whole year. Sub-Arctic hunting techniques were developed for open water hunting. For example, kayaks (in Greenlandic *qajaq*), water-proof costumes made from seal skin, harpoons, and *umiaks*,

“women’s boats”, were developed. Dog sleds lost their importance as means of transportation (Viemose 1976). The ingenious feature of the equipment was that they were light and they were built from available materials (Lidegaard 1999). The qajaq, which was made of seal skin, was elementary (essential?) for the Inuit because it enabled seal hunting in open water. Qajaqs were greatest in number and most highly developed in Southern Greenland, where they could be used throughout the year (Hammer et al. 1921; Petersen 1991). The principal prey animals were pelagic seals, which migrated along the coast during the summers because they could not live under the permanent ice cover (Hammer et al. 1921).

The Inuit used umiaqs for hunting whales and for transportation on sea. Umiaqs were bigger skin boats, where several people could be transported. In the most southern regions women only rowed while men steered. The importance of umiaqs was especially pronounced because dog sleds could not be used in the most southern parts of Greenland. An umiaq was thus the only means of transport that women and children could use when they wanted to move (Hammer et al. 1921). In addition, whaling took place from the umiaqs with harpoons as the main hunting apparatus. The hunters rowed their umiaq so close to the whale that they could throw a harpoon at it (Larsen 1960b). For hunting on land, the Inuit used bows and arrows (Diamond 2005).

The Inuit also developed a flexible societal structure. Their settlements generally consisted of extended family groups that relocated according to favourable hunting opportunities (Skjelbo 1995). The basis of existence for the group was the presence of one or several great hunters who supplied the whole settlement group with food (Skjelbo 1995). Division of labor was generally based on a kin-ordered and sexually defined system. The Inuit had well-defined rules and practices that they followed. For example, sharing was important. When large marine mammals were caught, the Inuit shared meat between all the members of the group according to well-defined rules and practices (Marquardt & Caulfield 1996; Rasmussen 2000). An unwritten but strictly maintained rule was also that a man should be taught to hunt and he had to hunt as long as it was physically possible for him to do so. Moreover, laziness was considered a crime (Oldendow 1936). The complex system of sharing meat, exchanging meat presents, and dividing up labor increased security in the Inuit society. The survival of the group was enhanced by the fact that the group was constantly changing its composition, moving between summer and winter settlements, and was always present in locations where hunting opportunities were the best (Dahl 1999).

I consider mobility as the most important adaptive strategy that the Inuit had developed. My view is supported by, for example, Lidegaard (1999). Since sea mammals

were the most important prey animals, the Inuit followed them during summers. Their summer settlements consisted of tents, which could be moved more easily from one place to another. In the autumn reindeer hunting and trout catching took place in the inland areas. In the winters, the Inuit lived more sedentarily by the coast and hunted seals on ice (Bro 1993).

The summer tents were made of skin and were held on the ground by big stones. They were light to transport and it was easy to pack them and to continue to a new settlement site if hunting and catching was not successful (Rosing & Gynther 1999). In the winter season, houses were built from stones and covered and isolated with turf. The entrance was usually low, long and narrow in order to isolate coldness and snow from the house. Thus, people had to crawl in the house. Light came into the house through a pane made of gut. Warmth and light were provided by a big soapstone lamp. The walls were covered by skins (Oldendow 1936; Rosing & Gynther 1999).

The Inuit adapted their settlements according to the resource base. In the most thinly populated parts of the land, i.e. the sealing districts, turf houses were small. They had room for one or two families. In the more densely populated areas in southern Greenland and the Ammassalik district, where hunting of bigger sea mammals required more people, another kind of settlement strategy was used. Large houses for extended families were built because several men were needed to hunt whales (Hammer et al. 1921: 76). Large houses also saved heating energy. The quantity and quality of natural resources and the daily action radius of the hunters determined the size of the houses and their spatial dispersion.

Contacts between the Inuit groups in different parts of the land existed. In addition to goods, knowledge, experiences, and legends were also exchanged. Trading sites emerged in locations where settlement groups met each other (Bro 1993). In the central sites along the coast there were summer appointments called *Aassivik* (Lidegaard 1999). Meetings between settlement groups helped supply food storages and hunting equipment. They also increased the spread of knowledge about locations of prey animals and hunting techniques.

Although the Inuit mastered a life in a marginalized environment with specialized techniques, diversified subsistence activities, highly developed hunting equipment, flexible social organization, and flexible living places, life in Greenland was precarious. Starvation and accidents were a part of every-day life.

3. Conclusions

I have made some observations about the factors that influence adaptation, especially in connection with the development of settlement patterns, in my doctoral dissertation. The factors, according to the case studies, are related to environmental change (most often climatic cooling or warming), geography/ topography (initial settlement choices), demographic change (population growth), market conditions (market demand of export products), societies' resource management skills and economic activities, and the availability and quality of the main resource base. I want to point out that the interplaying factors seldom occur alone.

I found some adaptive strategies from the case study of Greenland, which looked at the adaptation of the Inuit before the 1900s. Adaptations can be categorized as flexible and highly developed hunting techniques and technologies in land, sea, and ice, the use of a large and varying renewable resource base and diverse subsistence activities, familiarity with environmental variations, societal flexibility, mobility and flexible settlements, and well-defined rules and practices. I wish to point out some similarities between the findings of Berkes and Jolly and those of my own study on Greenland's Inuit's past adaptation strategies. For instance, flexibility in resource use, sharing, and inter-community trade have been, and still are, common adaptive strategies for the Inuit. This suggests that there are similarities between present and past adaptation strategies.

I wish to point out that adaptation, at least in the case study of the history of Greenland, is a very complex process. It is not merely a question of finding a "technological fix", finding new technological skills or the replacement of one resource by another. The shift from one resource to another has been accompanied by major socio-economic and political changes, including changes in the development of settlement patterns. I would suggest that this trend will continue also in the future.

Flexibility and seizing of new opportunities have also been important for the adaptation of the Inuit in Greenland. I anticipate that climate change will create new economic opportunities for these societies. I therefore consider flexibility in terms of economic activities and resource use as a central element also in the future. The future development of the settlement patterns will depend much on economic activities and adaptation. If the economic basis of the settlements is diversified, they will have a greater range of options to adapt and protect themselves from outside influences, such as consequences of climate change.

I want to underline the importance of the availability of renewable resources for Arctic societies, which has been shown very clearly in the history of Greenland. People have faced,

and they will continue to face, new challenges that hit them harder than many other regions in the world. Therefore, I find it very important that context-dependent case studies will be conducted in the future. It is important to identify in each case which factors might interplay with one another, and how they may affect the societies. For such studies, monitoring environmental changes and the resource base plays a key role. Because of context-dependency, generalizations on adaptation and its direction will be difficult to make. The interplaying factors seem to vary from one region to another. Some Arctic locations may experience great changes while the others will be able to maintain the present situation.

I wanted to show in my presentation, that the Greenland Inuit have throughout their history been challenged by environmental change and they have had to adapt. They have been good at adaptation. This is a success story of adaptation, in a sense that the Inuit were able to survive. But I want to point out that adaptation has required very much flexibility and that adaptation has been a process that has affected the society on multiple levels, causing changes from a household level to the entire national economy.

Now in this new situation – with human activities with the new economic opportunities and the related environmental threats, and climate change with its effects on the Arctic environment – the Arctic communities face great challenges in terms of adaptation. This is especially true, because they are so dependent on renewable resources.

It is important to learn lessons from the past, but also to understand that climate change will cause entirely new situations to adapt to. Great flexibility, as well as close monitoring of changes in the environment, and the resource base, will be required. In addition, it is important to understand that adaptation will require as much effort as it has in the past. So, although new economic opportunities will change the situation, I want to suggest in the end that environmental change will play a key role in future development, especially for those who rely on renewable resources.

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