Climate Change Effects on Alpine Ski Areas in Sogn og Fjordane[1]

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Abstract

Climate change is a potential modifier on tourist flows to destinations, especially those highly based on natural resources. Alpine skiing market is not the least of such vulnerable tourism sectors, as existence of snow is a vital factor for its operations. Here we present the progress with our research on the issue of climate change adaptation and winter sports tourism in Norway. The research pursues a dual and sequential approach where physical and human elements of the interaction are dealt separately while the latter is partly built up on the results of the physical analysis. The paper summarizes the methodology behind the initial empirical phase and presents examples of past and future snow-reliability analyses carried out individually for each alpine ski area in the Sogn og Fjordane county of Fjord Norway region. Finally, we discuss the human phase of the research with reference to the preliminary results that point out diverse cases with both opportunities and threats, and with an emphasis on possible adaptation measures and the consequences of such measures.
Keywords: Climate Change, Winter Tourism, Ski Area, Snow-reliability, Adaptation, Fjord Norway.

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Introduction

Climate change is a potential modifier on tourist flows to destinations, especially those highly based on natural resources. Alpine skiing market is not the least of such vulnerable tourism sectors, as existence of snow is a vital factor for its operations. As the extent of snow cover and duration retreats in line with the rising surface temperatures (Lemke et al 2007), even many large ski resorts, but also those low-lying areas that cater a lot especially for the local demand, including but not limited to the popular Alps, are facing or to face large snow deficits that jeopardize continuation of winter sports activities and tourism and are thus keen to engage in different types of specific adaptation strategies, such as some that even requires huge investments in snowmaking or relocation of existing facilities (Simpson et al 2008), most of which may have their own significant climatic consequences as tertiary effects that should be further studied (Aall 2005, 2010).

Methodology

The poster presents the progress with our research on the issue of climate change adaptation and winter sports tourism in Norway. This requires a dual and sequential approach where physical and human elements of the interaction are dealt separately while the latter is partly built up on the results of the physical analysis. However, here we focus just on the initial empirical phase by an analysis of the isolated effect of present and future snow-reliability for existing alpine skiing areas in Sogn og Fjordane County. First, we have taken a census of all the areas in the county and its surrounding region, Fjord/Western Norway. Then in order to check their snow-reliability, which can be defined as "a viability requirement of minimum 30 cm snow depth for 100 days in at least 7 out of 10 seasons" (Witmer 1986), we have first identified their past situation for the 1971-2000 period on a one square kilometer resolution. Secondly, we tried to figure out the future snow-reliability through data on freezing levels, which, in the case of Sogn og Fjordane, only existed exclusively for Stryn Summer Ski Area (Snow-forecast.com ltd 2012a) but is also available for 40 other ski resorts across the country (Snow-forecast.com ltd 2012b). Finally we calculated future freezing levels for our case, with the assistance of key figures on rising temperature and snowline scenarios obtained from Hanssen-Bauer et al (2009a, 2009b). Although freezing levels (0°C isotherms) do not necessarily stand for the snowlines, they can imply the dry bulb temperature requirement of snowfall and the ablation possibility of the present snow cover. Moreover, they can also be used to determine "technical snow-reliability", since the "snowmaking line" can be detected by moving along the altitude, according to the environmental lapse rates and humidity characteristics of the specific ski area and specifications of the snowmaking equipment (Demiroglu 2010). In this sense, the method enables the research with customization and an opportunity to include the vital snowmaking module. On the other hand, it has some drawbacks associated with database, since records do not mostly go earlier than 2008, and those available are the archives of forecasts, rather than logs of actual observations.

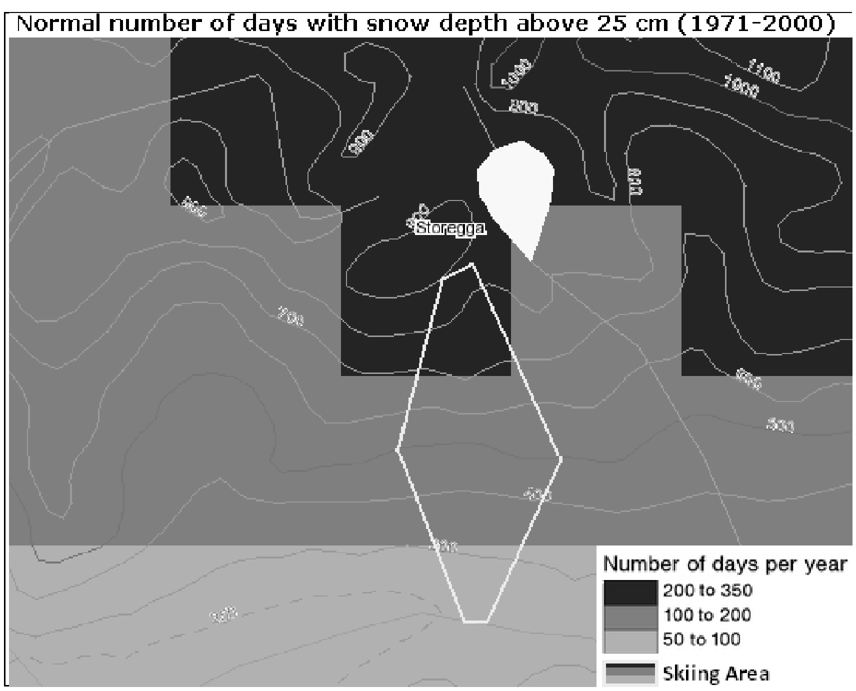
Preliminary Results

During the 2010-2011 ski season in Norway, there were 6 million visits to the ca 215 alpine ski areas, which had total lift sales worth 885 million NOKs. There are 633 lifts to all the areas, almost 3 lifts per area (Alpinanleggenes Landsforening 2012b, 2012c, 2012d), indicating that the Norwegian ski areas are mostly SMEs. As seen on the census results below, Fjord Norway, with 43 areas, constitutes 20% of the country's alpine skiing tourism supply, while our study field, the county of Sogn og Fjordane, contains 13 of these areas. Most areas have a little number of lifts and slopes, depicting the very SME characteristic, and very few could be attributed as "ski resorts" due to lack of extended accommodation facilities and alike. Overall, Fjord Norway has a lot of potential to be utilized for winter sports tourism but is nonetheless not as much developed as Eastern Norway or other major winter sports destinations abroad. Even the largest resorts of the West are not comparable with the giants of the East, such as Trysil (31 lifts and 66 slopes) and Hemsedal (24 lifts and 48 slopes) (Alpinanleggenes Landsforening 2012a).

Table 1: A Census of Alpine Ski Areas in Fjord/Western Norway

County	*Ski Area*	*Slopes*	*Lifts*	*County*	*Ski Area*	*Slopes*	*Lifts*
Møre og Romsdal	Strandafjellet	18	8	Sogn og Fjordane (cont'd)	Vik	3	1
	Sunnmørsalpane	18	5		Vangen	2	1
	Tusten	14	3		Saurdal	1	1
	Bjorli	11	6		Kleppa	1	1
	Stordal	5	4	Hordaland	Myrkdalen	15	6
	Ørsta	5	4		Voss	14	12
	Ørskogfjell	4	2		Eikedalen	13	8
	Volda	3	2		Røldal	13	6
	Rauma	3	1		Furedalen/Kvam	7	3
	Surnadal	3	1		Aktiven	5	4
	Sunndal	2	2		Stordalen	4	2
	Freikollheisen	2	1		Folgefonn	3	2
	Spjelkavikheis	1	1		Fjellhaugen	2	1
Sogn og Fjordane	Stryn Sommerski	10	2		Oppheimsheisen	2	1
	Harpefossen	9	5		Finse	1	1
	Breimsbygda	5	4		Haugsåsen	1	1
	Stryn	5	4	Rogaland	Sauda	11	5
	Sogn	5	3		Stavtjørn	5	4
	Sogndal	5	2		Gilja	3	1
	Jølster	4	4		Gullingen	3	1
	Sunnfjord	4	2		Egersund	1	1
	Siplo	3	2	Note that Bjorli and Egersund are in the bordering counties			

Source: Alpinanleggenes Landsforening 2012a, Zpin Media 2012a, Skiinfo AS 2012, Fjord Norge AS 2012, Skiresort Service International GmbH 2012.



Source: Snow cover layer from NVE et al 2012, Ski area layer from Zpin Media 2012b.

Fig. 1: Past Snow Reliability of Harpefossen Ski Center

Results from a physical analysis on exposure sensitivity of the ski areas in Sogn og Fjordane, based on the snow cover maps of seNorge.no, provide us with some visual representations of the past climate in and around the ski areas. With such data available, it is possible to utilize the "100 days rule" of snow-reliability explained above, but hereby setting the snow depth threshold to 25 cm due to data availability. An example to such visualizations is supplied on Figure 1. Here we see that Harpefossen Ski Center, the largest winter skiing area in the county, has mostly been snow-reliable during the normal climatic period of 1971-2000, with only its lowest elevations below 300 masl having the required snow depth for less than 100 days.

As for the analysis of future snow-reliability of ski areas in Sogn og Fjordane, we have taken three times daily means of the freezing levels for Stryn Summer Ski Center (ski area with the most slopes in the county) for its unique season from May 20 to July 8. Then we have raised these levels by 217 m for the year 2050 and 383 m for 2100, as Hanssen-Bauer et al anticipates a 500 m rise in snowline for a 3°C temperature increase (166.7m/°C) (2009a: 104), and 1.3°C and 2.3°C summer temperature rises for the years 2050 and 2100 in Western Norway (2009b). The final picture displays that the skiing area of Stryn Summer Ski Center falls below the freezing levels during most of its 6-7 weeks summer season, with a lot warmer conditions from late June, according to the data from last three seasons. In fact the last season of summer 2011 has been recorded as wettest summer in the last 74 years and Stryn Summer Ski Center had to shut down in late June due to heavy rainfall (Stryn Sommerski AS 2011). If the scenarios for 2050 and 2100 hold true, such a shutdown could become permanent, since the present skiing areas will remain warmer well below the freezing levels already by the year 2050, while some terrain towards the summit of the mountain (Kvitlenova) will still be developable for higher skiing areas. Another option to adapt Stryn to climate change could be to shift its operations to colder months and thus even benefit from the possible business loss of other winter ski areas due to warming. However, such an adaptation would also require a restoration of the area's notorious winter accessibility.

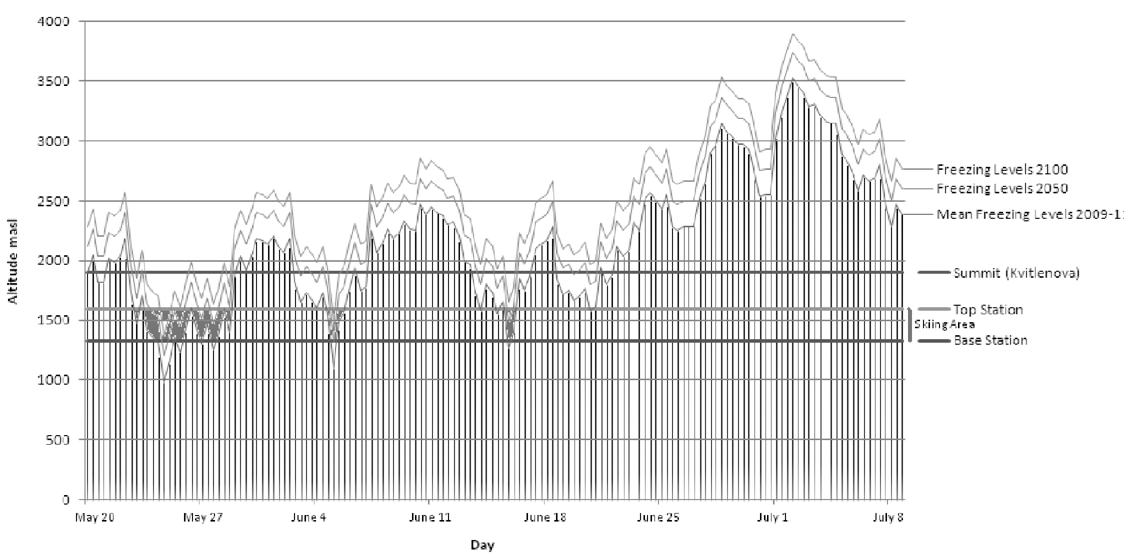


Fig. 2: Future Snow Reliability of Stryn Summer Ski Center

Conclusion, Implications, and Suggestions

So far we have partly come to an understanding on the physical effects of climate change with regards to alpine ski areas in Sogn og Fjordane. Next, we aim to seek for more data sources that could fill in the gap for the last decade's snow-reliability as well as the future technical snow reliability. Ski areas' own records, if any, would be a good example to such databases. We will then complete the physical research for all areas in Fjord Norway and move on to discover the "impacts", focusing on the vulnerability of the society and the businesses involved with winter tourism in the region.

Once the analysis of climate effects on ski areas is completed, we shall deliver our output as an input to our prospective investigations with the stakeholders of the sector such as the tourists within and to Fjord Norway on the demand side (Gössling et al 2012), and the public and private industry players on the supply side, in an attempt to synthesize a "transdisciplinary approach" (Pröbstl & Unbehaun 2006) that could disclose the adaptive capacity of our cases individually and as a whole. This second phase of research will again pursue a two stage sequential method, by first an analysis of what means have been taken and are decided to be taken which can reduce the economic vulnerability of possible negative changes in snow conditions in the future, and secondly an analysis of how and to what extent these means, namely the adaptation strategies, can lead to an increase in GHG emissions, as well as other environmental effects such as the water consumption pressure or chemical additive usage of snowmaking practices and the likewise effects and impacts of the emerging examples of new investments in destination management, such as relocation of the physical infrastructure, as in the case of Jølster Ski Resort (Vestlandsforsking 2010). Here we expect that the improved approach towards carbon accounting for the climate change adaptation of winter tourism will work as a different perspective and contribution to the literature.

Finally, we should stress that our research is limited by alpine skiing tourism in Fjord Norway. Delivering similar studies nationwide or even into a wider geography could benefit the literature in terms of comparison and benchmarking. For instance, a comparison of Eastern and Western Norway could become a major determinant for the direction of future investments in the country. As for the second limitation, it is advised to include other winter sports activities in the research since alpine skiing, although quite popular, would not suffice to give the big picture of winter tourism. Besides, other snow sports such as cross-country skiing, which is a classical and common form of winter sports in Nordic countries, or off-piste skiing, which follows a serious upward trend especially in Fjord Norway, may require different snow-reliability thresholds as in terms of desired snow depth or even quality.

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