

This is the authors' version published as:

Rybråten, S., Bjørkan, M., Hovelsrud, G. K. & Kaltenborn, B. P. 2018. Sustainable coasts? Perceptions of change and livelihood vulnerability in Nordland, Norway. *Local Environment*. Published online: 16 Oct 2018.

Notice: Changes introduced as a result of publishing processes such as copy-editing and formatting is not reflected in this document. For a definitive version of this work, please refer to the published source.

<https://doi.org/10.1080/13549839.2018.1533931>

# Sustainable coasts?

## Perceptions of change and livelihood vulnerability in

### Nordland, Norway

Stine Rybråten<sup>1</sup>, Maiken Bjørkan<sup>2</sup>, Grete K. Hovelsrud<sup>3</sup>, Bjørn P. Kaltenborn<sup>1</sup>

<sup>1</sup>*Norwegian Institute of Nature Research, Lillehammer, Norway*

<sup>2</sup>*Nordland Research Institute, Bodø, Norway*

<sup>3</sup>*Faculty of Social Sciences, Nord University, Bodø, Norway*

#### Abstract

Northern coastal regions are facing multiple challenges from accelerating global environmental and socioeconomic changes, such as ecosystem degradation, climate change, intensified resource extraction, land use change and declining populations. Based on interviews with 13 farmers, fishers and aquaculture employees from coastal Nordland, northern Norway, this study demonstrates how the local stakeholders' perceptions of change and experiences of vulnerability are closely linked to their livelihood values and worldviews. What the informants consider a sustainable and meaningful way of coastal living does not coincide with national goals for sustainable, natural resource dependent development of the region. The article demonstrates the importance of attending to local values if policymakers and managers are to ensure successful local mobilisation, reduce vulnerability to ongoing and future processes of change, and ensure legitimacy and consistency in development goals of coastal zone management. Insights from this study are useful for local and regional decision makers with responsibility for natural resource policies and development efforts.

## Key words

Perceptions of change, livelihood values, worldviews, sustainability, coastal regions, Northern Norway.

## 1. Introduction

Northern coastal regions are facing multiple challenges from accelerating global environmental and socioeconomic changes, such as ecosystem degradation, climate change, intensified resource extraction, land use change and declining populations. However, environmental and socioeconomic changes also entail opportunities, and coastal areas are 'hotspots' for blending nature-based practises and economies with new technologies and business opportunities. Within the current 'green growth' discourse, policy makers, corporations, political actors, and NGOs worldwide see possible solutions to environmental and economic challenges, through the markets' capacity to deliver sustainability. In Norway, the 'green growth' discourse is reflected in governmental documents on regional development, emphasising how resources in rural districts provide a basis for industry and regional growth (Meld. St. 18 (2016–2017) Report to the Parliament). Furthermore, the Government explicitly aims for developing Northern Norway as "one of the most creative and sustainable regions of the country" (ibid., 3). A salient question is whether the national 'green growth' discourse is perceived as equally relevant to local stakeholders representing nature-based industries along the northern coast of Norway.

Northern coastal communities are often both directly and indirectly dependent upon natural resources. Subject to globalisation processes and increased mobilisation, these

communities nevertheless face declines in traditional nature-based professions and a demographic trend of centralisation, with people moving from rural areas to larger centres (Amundsen 2012; Kaltenborn et al. 2017). By no way confined to this region of the world, the situation parallels conditions reported, amongst others, from coastal areas of northern Iceland (Kokorsch and Benediktsson 2018) and Coastal Canada (Dolan et al. 2005). In Norway, state-driven structural subsidies are designed to even out some of the costs of living in rural districts, with an objective to maintain the main features of the current settlement pattern (Meld. St. 18 (2016–2017) Report to the Parliament). The geographical specification of this objective has still been reliant on shifting political priorities at the national level (Knudsen 2018), with the current government emphasising economic growth and business development in its regional policy. Meanwhile, migration from rural to urban areas continues to be an ongoing challenge for smaller communities.

The current Norwegian strategy for coastal and, consequently, regional and national development, links the increasing demand for food worldwide and “Norway’s unique position for leading the development of an industrial and sustainable seafood production” (Government’s marine strategy 2017, 27). The Government explicitly aims at developing the potential in the Norwegian maritime industries in line with the UN Sustainable Development Goals (2015), “through sustainable growth where management, industry and technology is developed on premises of the biology” (Government’s Marine Strategy 2017, 48). In this context, the Government highlights the ability for transition, innovation and technological development found to characterise the ocean-based industries through generations (*ibid.*).

The Norwegian government’s view of the maritime industries’ ability to adjust to change corresponds with several research findings of the inherent flexibility of nature-based livelihoods in northern, coastal communities (Hovelsrud et al. 2010; West and Hovelsrud

2010; Amundsen 2012, 2013; Dannevig and Hovelsrud 2016). What some of these studies concurrently highlight, however, is how intersectional effects of various drivers of change, as well as current policy and management strategies, may constrain the potential for sustaining vital livelihood flexibilities (Hovelsrud et al. 2010; Rybråten and Hovelsrud 2010). This, in turn, may lead to increased livelihood vulnerability.

Including different experiences, perspectives and values of people involved in and affected by resource policies is key to avoid conflicts over goals and lack of public trust, and imperative for consensual management of ecosystems and their resources. In the pursuit of sustainable development, a top-down approach to sustainable growth emphasising economic competitiveness and environmental integrity is not enough. Visionary political goals for regional (as well as national and international) economic development are in need of recognising the interrelations of ecosystems and human societies when devising political guidelines for natural resource dependent development. On the regional level, the county council is responsible for, amongst others, sector coordination, adjustments of national policies to regional and local needs, and regional development and growth. Here, the current Government calls for a closer collaboration between national and regional actors, “without infringing the principle of municipal autonomy” (Meld. St. 18 (2016–2017) Report to the Parliament, 15). How these levels of governance may be adequately linked, and what is needed to ensure a local community grounding of the natural resource dependent development goals, still remain empirical questions.

In order to outline how local stakeholders and community members assess outcomes of environmental and socioeconomic change, and what they identify as desirable futures, this study investigates how fishers, farmers and aquaculture employees in a coastal region in northern Norway experience the complexity of change currently influencing their ways of

living. We further highlight the drivers of change the stakeholders are most concerned about, and how they are perceived to influence opportunities, challenges and livelihood vulnerability. The outcome of this study is of relevance to local and regional decision makers with responsibility for resource policies, as it demonstrates how local stakeholders' perceptions of change and experiences of vulnerability are closely linked to their livelihood values and worldviews. Attending to local values and worldviews is essential, we argue, if policymakers and managers are to ensure successful local mobilisation, reduce vulnerability to ongoing and future processes of change, and ensure legitimacy and consistency in development goals of coastal zone management.

## 2. Theoretical framework

### 2.1 Vulnerability, livelihood values and worldviews

Since the late 1990's, research advancing our understanding of how to balance a human desire to increase welfare with a carrying capacity of the environment, has been tightly coupled to the concept of Social-Ecological Systems (SES) (Chapin, Kofinas and Folke 2009; Folke et al. 2010; Anderies et al. 2013; Brown 2016). SES approaches recognise the inextricable link between people and the environment, as human systems are components of, and in turn shape, ecological ones (Folke et al. 2010; Cote and Nightingale 2012; Fabinyi, Evans & Foale 2014). From this perspective, emerging in opposition to mainstream utilitarian views in natural resource management, the feedbacks between social and ecological processes mean that separating the two would be artificial (Fabinyi, Evans & Foale 2014). Despite anthropologists' longstanding critique of the nature-culture divide (Starthern 1980; Cronon 1995), it was not until the idea of a coupled SES emerged in parallel with resilience

thinking (Berkes and Folke 1998) that a combined social-ecological perspective gained ground within several fields of research, including the environmental sciences (Folke 2006; Fabinyi, Evans & Foale 2014).

While representing a cross-disciplinary and holistic perspective on human–environment relations in analysing dynamics of change (Brown 2016), the SES approach is criticized for a lack of attention to social diversity, values and power (Cote and Nightingale 2012; Fabinyi, Evans & Foale 2014). By focusing primarily on system structures, and in particular institutions, emphasis is placed on external forces that influence peoples' behaviours rather than attending to various interests and values, agency and power (Coulthard 2012). In the following, we combine the SES approach with the concept of vulnerability, through a particular focus on livelihood values, place attachment and lack of local stakeholder participation in policymaking. Through this approach, we will underline diversified perspectives and challenges connected to dealing with change at a coastal community level, where identity is strongly linked to place and natural resource dependent livelihoods.

Vulnerability can be defined as “the manner and degree to which an individual, community or industry is susceptible to conditions that directly or indirectly affect their well-being or sustainability. This includes the sensitivity or resilience of the ecosystem of which the community is a part” (Smit et al. 2010, 5). Vulnerability not only regards negative material outcomes associated with change, but also how these outcomes are differentially valued (O'Brien and Wolf 2010). In order to understand decisions made to reduce coastal communities' vulnerability to environmental, socioeconomic or political change, it becomes important to understand the values these decisions are based upon. As stated by Bennett

and colleagues (2016, 442) “people can hold vastly different views on what a good quality of life entails and on which values are most important for human happiness and well-being.”

In vernacular language, the term ‘values’ is used imprecisely to refer to a broad range of concepts, such as interests, preferences, moral obligations, desires, goals, aversions and attractions (Rohan 2000; O’Brien 2009; Horlings 2015). Within the social sciences, ‘value’ represents somewhat different constructs in psychology, sociology and anthropology, but generally denote stable, normative orientations either on an individual level or shared within and/or among social groups (Schwartz 1992; Blake 1999; Buijs 2009). As values are generally considered to be core conceptions of ‘the desirable’ within individuals and society (O’Brien 2009), they serve as standards or criteria to guide not only action but also judgment, choice, attitude and evaluation (ibid.). Furthermore, values are “intertwined, context-determined, culturally varied and connected to how we see our self and how we perceive our environment” (Horlings 2015, 261). In other words, values influence and are influenced by constraints and opportunities of social-ecological systems. In this article, we pay particular attention to livelihood values as shared orientations about factors critical to achieve well-being and a meaningful life, since the values expressed by the stakeholders interviewed appear to be closely linked to their livelihoods and sense of place.

Values are commonly associated with ‘worldviews’, described by Rohan (2000, 267) to denote peoples’ conscious beliefs about the world. Worldviews are also a function of value priorities: Peoples’ views on what constitute a high quality of life is inextricable linked to their value priorities (ibid.). Here, sense of place may form an important element in peoples’ evaluations of what a good life implies. Focusing on how strongly people feel attached to a particular place, the sense of place concept has been used to describe and analyse the values people confer on their surroundings, together with associated



behavioural relationships with place (Lin and Lockwood 2014; Brown, Raymond and Corcoran 2015). Brown, Raymond and Corcoran (2015) emphasise how conceptualisation of place attachment may vary, depending upon different scholars' focus on personal, environmental, and/or social contexts of people-place interactions. The empirical data of this study exemplifies how these three 'contexts' interact and are interchangeably referred to by the stakeholders involved, corresponding to Lin and Lockwood's (2014) emphasis on the joint significance of social and physical dimensions for attachment to place. More specifically, our approach to sense of place covers individual emotional and functional bonds, physical aspects of the geographic area, social connections and community place attachment.

Linking vulnerability, livelihood values and worldviews and applying such an approach to an integrated understanding of SES, helps illuminate how factors such as power, perceptions and competing value systems are integral to how SES are defined and function (Cote and Nightingale 2012). This study adds to the literature integrating human values into assessments of vulnerability (O'Brien and Wolf 2010), and provides insights into connections between local perceptions of change, experiences of vulnerability, and livelihood values related to sense of place, wellbeing and what is considered a sustainable and meaningful way of coastal living.

**Figure 1:** Location of study area.

### 3. Study area and method

#### 3.1 Case Study area

Our fieldwork has taken place in five municipalities along the coast of Nordland County, northern Norway (see figure 1). Nordland covers an area of close to 38.500 km<sup>2</sup> and has a population of approximately 243.000 inhabitants (Statistics Norway 2017a). Recognised by its long coastline and narrow stretch of land bordering Sweden, the region holds mountains, forests and fjords, and a coastline with a large number of islands, generating both opportunities and challenges for its inhabitants. The coastal conditions are excellent for fishing, farming and aquaculture, but the geographic distances between towns and settlements are long, with difficult and expensive logistics. The County's sub-arctic location, with the polar circle in the middle, means yearly temperatures can fluctuate between + 30°C during summer and - 30°C in winter. Post World War II, several industrial strongholds were established in Nordland, because of the region's rich natural resources and abundance of hydro-electrical power.

The primary industries are still of great importance in Nordland. While the employment rate within agriculture and fisheries is decreasing, the earnings are increasing. Today, Nordland has 2600 farms, covering 600.000 acers - or 6% of the total Norwegian farmland. In 2015, agricultural employment amounted to 2644 fulltime equivalents and a production with a first-hand value of 1,7 billions NOK (~ 133 millions USD) (Stornes 2016). There is a strong declining trend in the number of farms, and the farms that remain are increasing their size and productivity (ibid.).

When it comes to fisheries, Nordland County has the highest number both of fishers in Norway (2763 = 25%) and of fishing vessels. In 2016, approximately 1550 vessels were

registered in Nordland County (Directorate of Fisheries 2017). More than 90 % of the fleet are small coastal vessels under 15 metres, targeting North East Atlantic (NEA) cod (*Gadus morhua*), saithe (*Pollachius virens*), haddock (*Melanogrammus aeglefinus*) and Norwegian spring spawning herring (*Clupea harengus*) (ibid.). In 2016, 310.000 tons of fish were landed, primarily NEA cod, haddock and saithe, but also herring and mackerel (*Scomber scombrus*), with a first-hand value of 3,4 billions NOK (~ 400 millions USD).

Nordland County also has the highest aquaculture production of Atlantic salmon (*Salmo salar*) in Norway (Winther et al., 2016). The largest exporters in the area are Nova Sea and Marine Harvest, the latter being the world's largest aquaculture company ([www.marineharvest.com](http://www.marineharvest.com)). The aquaculture production in Nordland is carried out on 114 locations and involves 1247 employees. The 2016-production of salmon and trout in Nordland was 256.000 tons, with a first-hand value of 12 billions NOK (~ 1,6 billions USD) (Winther et al. 2016). While this aquaculture boom has caused new employment opportunities and regional as well as national wealth, recent years have shown increased land-use conflicts and growing concerns regarding the industry's environmental footprint (Sandersen and Kvalvik 2015). In addition to coastal pollution, a main worry has been the industry's (potential) negative impact on the wild Atlantic salmon population, due to spread of sea lice, diseases and escapees from salmon farms (Liu, Olaussen and Skonhoft 2011; Forseth et al. 2017).

According to a report published in 2012 (Olafsen et al. 2012), the growth potential of Norwegian marine nature-based industries (which includes fisheries, aquaculture, new industries and more) is massive. Exploiting this potential is currently an explicit national development target. For the aquaculture industry, the government's goal is for Norway to

become the world's leading seafood nation, with an aquaculture production of 5 million tons in 2050, almost four times the current production (PwC Seafood Barometer 2017).

### 3.2 Methods and data

Data was collected through interviews with 13 farmers, fishers and aquaculture employees from coastal Nordland (see figure 1). Starting out by contacting local organisations of the relevant industries, we used "snowballing" to get in touch with key informants (Biernacki and Waldorf 1981). Rather than striving for statistical representation, the aim of the interviews was to identify a diversity of experiences of change and perceptions of the underlying drivers of these changes, among local stakeholders representing the primary industries. The data collection was conducted in accordance with the Norwegian Data Protection Official's standards, and the names of persons and companies participating in the project have been anonymized.

An interview guide formed the basis for semi-structured interviews carried out during autumn 2016 and spring 2017. Thematically, the interviews addressed the stakeholders' background for being involved in current livelihoods, operations throughout the year, current livelihood situation, changes experienced during the last 5-10 years or during time of active operation, perceptions of drivers of experienced changes, future prospects, identity and sense of place and belonging. Choosing an open approach to the discussions about change, the interviewees were further encouraged to include their own perspectives and concerns not covered in the interviews.

All interviews, lasting from one to two hours, were recorded and transcribed, and subsequently analysed in the Nvivo software programme for qualitative data analysis. In the analysis, we used a grounded, explorative approach, openly coding the interviews based on

emerging themes, identified through repeated reading and categorisation of the interview data (Glaser & Strauss 1967; Strauss and Corbin 1998). Change was the only predefined category in Nvivo prior to the data analysis. The citations selected for inclusion in this article have been translated from Norwegian to English.

In addition to interviews, participatory observation was undertaken onboard a shrimp vessel during fishing (two days, autumn 2016), at a salmon farm during sea lice counting (one day, autumn 2016) and at the Norwegian Reference Fleet annual meeting in 2016 and 2017 (four days).<sup>1</sup> The latter is an arena for fishers where they can voice their experiences, reflections and observations to the management authorities (represented by the Institute of Marine Research). Input from these meetings provides useful, comparative information from fishers along the entire coast of Norway.

## 4. Findings

### 4.1 Environmental change

When interviewing stakeholders along the coast of Nordland about change, a certain preparedness for the unexpected emerges as an integral part of their nature-based livelihoods, in particular with respect to weather. As exemplified by a quote from a salmon manager:

*You can't do anything about the weather, really, so that's something everyone is used to (15.09.2016).*

---

<sup>1</sup> The Norwegian Reference Fleet is organized by the Institute of Marine Research (IMR), which rents vessels (coastal and seagoing) to collect data. The IMR is the advisory body for fisheries management in Norway. See also Bjørkan, 2011.

While seasonal variations, fluctuations and change appear to be an accepted part of these stakeholders' livelihood activities, some changes are still expressed to be of a more comprehensive kind. Among the fishers interviewed, the most significant environmental changes are decreasing shrimp stocks and shifts in various fish species. In Northern Norway, coastal shrimp fishers are especially vocal in public arenas like newspapers and Facebook, about the changes they experience with the decrease in catches. The shrimp fishers articulate the reduced landings as their main livelihood concern:

*There has been periods earlier on with small amounts of shrimp, and periods with large amounts of shrimp, but not to such an extent a lack of shrimp [that we experience now]. And this total disappearance from the shrimp grounds, that has just not happened before (06.07.2016).*

While being used to natural variations in their catches, the current absence of shrimp is perceived by the shrimp fishers to go beyond normal variability.

Fishers targeting other species like cod, saithe and halibut (*Hippoglossus hippoglossus*) express concerns for the decrease in stationary coastal cod stocks. Simultaneously, they have witnessed a major increase in the mackerel stock in recent years, potentially providing new opportunities. However, while mackerel is an important species further south in Norway, there is little tradition for both harvesting and consuming mackerel in the north. As such, the mackerel potential has not been fully utilised.

The farmers are primarily concerned with two kinds of environmental change. On the one hand, they link opportunities to the increased growing season, which has expanded with more than two weeks, as spring arrives earlier and autumn delays as an opportunity (see also Kvalvik et al. 2011, Uleberg et al. 2014). On the other hand, increased heavy rainfall in

spring and autumn is considered a major challenge, because it affects the farmers' access to the fields:

*Operations become more challenging. It is more difficult to get out on the field to spread the manure before the grass is too long. Later on, we may get problems with the harvest because of the wet fields (29.11.2016).*

As the farmers depend on increasingly heavy equipment for farming larger land areas including more rented land plots, to meet the demands for increased productivity, seasonal shifts in temperature and precipitation challenge these farmers' operations. Similar to findings from other parts of northern Norway (Kvalvik et al. 2011; Hovelsrud, West and Dannevig 2015; Dannevig & Hovelsrud 2016), the farmers relate the current environmental challenges to their dependency on increasingly heavy equipment, which damage the soil when it is saturated with water from increased precipitation. While being used to weather fluctuations and variable production years, the farmers emphasise the negative impacts following more frequent heavy rainfalls, hindering daily operations:

*Where I operate, the soil is boggy, and then it is not always that easy to get out on the fields without destroying them (29.11.2016).*

Changes experienced by aquaculture employees along the coast of Nordland include certain changes to the seasonal production window. Linking this change to increased water temperatures, some of the interviewees emphasise the beneficial implications for their overall production:

*Earlier on, releasing smolt midwinter was madness. It is not only that the quality of the smolt has increased and the average weight has increased, but opportunities has opened up as to when to put out the smolt. In this area, the window has traditionally*

*been from the end of April to the end of September. Earlier on, it was really rare to put out smolt in January, but this has increasingly happened over the last couple of years. Then you get the possibility to have fish of harvestable size throughout the year. High [water] temperatures provide very good growth through increased appetite among the fish (15.09.2016).*

The quote illustrates how this aquaculture employee experiences a significant change in the production cycle due to increased ocean temperature, prolonging the seasonal window for releasing smolt from closed tanks into coastal water pens. In addition, the warmer ocean makes the fish consume more feed. Consequently, the growth rate increases and results in a biomass rise, which in turn generates higher financial gains.

The ocean temperature increase is considered both a benefit and a challenge. While some, like the salmon farmer quoted above, perceive this to be a noticeable change that benefit the total production, others are more hesitant as to the positive effects of rising ocean temperatures. While acknowledging the advantage for salmon growth and profit, these salmon farmers simultaneously express a fear that the ocean temperature will rise above an advantageous level:

*We have had quite gentle winters, at least the last couple of years. And that is no drawback, as long as the summer temperatures of the ocean do not turn an awful lot warmer. (...) But then there are other drawbacks that comes with it (16.09.2016).*

Among the disadvantages noted by aquaculture employees in relation to increasing ocean temperatures are the potential for current feed systems to be too small and insufficient for supplying adequate quantities to fish with increased appetite. As the fish only feed in daylight and the midwinter day length along the coast of Nordland amounts to just a few



hours, the available time for additional feeding is limited. In order to satisfy faster growing salmon, the feed systems must have the capacity to provide increasing amounts of feed. One of the salmon farmers, however, finds this challenge solvable through investments in a new feeding system with higher capacity.

**Table 1: Stakeholders' experiences of environmental change**

Aquaculture employees are cautious about singling out one specific driver of the observed changes in ocean temperatures and the experienced changes to their livelihoods resulting from it. While climate change is perceived as a possible cause, they also express a possibility for the change to be driven by natural variability (see table 1), which correlates with findings from other parts of northern Norway (Hovelsrud et al. 2010; West and Hovelsrud 2010). As explained by an operation manager, icing on the pens is no longer a concern like it was when his father was in charge of the company:

*I am thinking that it might be that they [the predecessors] were in a cold period, and that we might be in a warm period. Or that it might come back or that it might not come back (15.09.2016).*

The fishers underline that there are always natural variability in catches (see table 1). In terms of the observed fluctuations in the mackerel stock, they consider natural variability to be an underlying cause, without completely rejecting the possibility of climate change to form a contributing factor. As to the decrease in shrimp stocks, however, the shrimp fishers are fully convinced that this change is caused by increased aquaculture operations in the areas. As one of the shrimp fishers explains:

*They [my dad and my grandfather] earned more money on trawling for shrimp than they did during the entire winter fishery in Lofoten. It is a lot. So I went to the same fjords and got shrimp all the time. There is not a lot of shrimp at any time in each place. (...) But then it was just as if the shrimp did not want to enter there [the fjords] in the spring anymore. (...) We noticed that after they placed the aquaculture pens there, the shrimp stopped coming in (25.05.2017).*

Linking the lack of catch in the traditional shrimp fjords to the establishment of aquaculture farms, this fisher further explains that the decline of shrimp is due to the use of chemicals for sea lice treatment in the salmon farms:

*I was trawling as usual. Then they started de-licing. (...). We got the same amount of shrimp, and maybe more than during the first haul. But the strange thing was that you open the trawl sac and it was just like... No life inside! Not a single shrimp moved. I was in shock! They killed it [the shrimp] while I was trawling (25.05.2017).*

To this fisher, there is a clear and direct relationship between the use of chemicals and the decline in the coastal shrimp.

Another stock of key importance to coastal fishers in the north of Norway is the cod. While the migrating North East Atlantic cod stock is well-managed and the Total Allowable Catch for 2017 was 805 000 tons (IMR 2017), the coastal cod is considered to be threatened. Several fishers explain the decrease in coastal cod to be caused by over-fishing, particularly emphasising the negative effect of the growing marine recreational fisheries. As these fisheries typically take place during summer, outside the NEA cod season, they are found to have an impact on the coastal cod stock (Kleiven et al. 2016).

Unlike the aquaculture employees and fishers, the farmers explicitly link climate change to experienced changes in the growing season as well as in rain patterns and intensity. One of the farmers interviewed further considers climate change to constitute the main challenge to future agricultural operation:

*The fact that it gets wetter and we are facing challenges regarding the operations of the soil and the harvesting... That cattle cannot graze the fields without trodden the ground... I can see a clear change here already (29.11.2016).*

As this section has illustrated, some environmental changes experienced by fishers, farmers and aquaculture representatives along the coast of Nordland are seen as opportunities, while others clearly challenge their livelihood procedures. The perceived drivers of these changes also vary among the various stakeholders, with only farmers explicitly mentioning climate change as an indisputable driver of environmental change. Despite pointing at the potential benefits of a prolonged growing season, the farmers interviewed primarily consider climate change to be a clear challenge for future livelihood sustenance. The environmental changes experienced by fishers, farmers and aquaculture employees described above, vary from fish stock fluctuations via changes in growing season and rain patterns, to increased salmon growth rates. This range of experienced changes is not surprising, as these stakeholders' livelihoods are associated with different ecological systems. As the next section will show, the experiences connected with socioeconomic change are much more consistent.

#### 4.2 Socioeconomic change

While their livelihoods are based on different ecological systems, the fishers, farmers and aquaculture employees operate, more or less, within the same socioeconomic conditions.

This may be illustrated through one experienced change emphasised by all interviewees, unambiguously referring to “the demand for increased productivity and growth” as a risk to maintaining their present operations. While the interviewees do not necessarily refer to particular political documents, official statements on the need for continued growth in the industries abound. These documents include the Government’s Marine Strategy (2017), and the white papers “Predictable and environmentally sustainable growth in Norwegian salmon and trout farming” (Norwegian Ministry of Trade, Industry and Fisheries 2015), and “Change and development: A future-oriented agricultural production” (Ministry of Agriculture and Food 2016). Below we outline how the stakeholders’ experience this external demand for growth as contradictory to their livelihood values, worldviews and their view on sustainability.

On a national level, employment in fisheries and agriculture has steadily declined since the 1940s, with an 88% reduction in the number of Norwegian fishers and an 80% decline in the number of active Norwegian farms by 2016 (Directorate of Fisheries 2017, Statistics Norway 2017b). During the last decade, the number of Nordland fishers has been reduced from 3 662 in 2004 to 2 301 in 2015 (Directorate of Fisheries 2017). Despite a slightly reduced catch volume, the catch value has increased considerably during the last years, due to increased market value of important fish species. Moreover, more efficient fishing vessels and lower fuel costs have strengthened the fisheries’ operating margin (Indeks Nordland 2017). As one of the fishers’ states:

*There is a steady move towards larger vessels, increased amount of quotas and demand for high yields. It becomes harder to stay small (15.09.2016).*

Within the agricultural sector, there has correspondingly been a significant decline in the number of full-time equivalents (FTEs) during the last decade, from roughly 3 800 FTEs in 2004 to 2 644 FTEs in 2015 (Stornes 2016). During the same period, the first-hand value of the agricultural production has increased from 771 million NOK to 819 million NOK (ibid.). As expressed by one of the farmers:

*The farms get larger and larger, and the efficiency increases. We may not earn more, but we produce more (...). And then there are less hands to share the work now than before. Even if we now have more equipment, the job is still to be done (29.11.2016).*

Furthermore, the political incentives for increased productivity and growth make the farmers worry about the future:

*What's happening now, and I've seen it for a long time, it's kind of... With the size of our farm, it is almost three full-time equivalents for one man, and that is already too much, really. Why then should I become twice as big, have twice as many animals, double my acres? That amounts to twice as much manure to spread, twice as much to harvest. I will never get time off. I hardly have time off as it is. Why should I become even bigger? That is insanity (12.10.2016).*

Within the aquaculture industry, recent historical trends differ from that of the fisheries and agricultural sectors. With the emergence of the aquaculture industry in Norway in the 1970s, a growing optimism regarding coastal regional development followed. Small-scale salmon farming along the western and northern Norwegian coastline was in the late 1960s and early 1970s initially considered a means to rebuild the livelihoods of rural fishing communities facing decreasing economies due to declining wild fisheries (Liu, Olaussen and Skonhoft 2011). In a few decades, however, Norway has become the world's largest

producer of farmed salmon, with the 2016 production amounting to approximately 1,2 million tons (Statistics Norway 2017c). Currently, farmed salmon is the country's fourth biggest export commodity, after oil, gas and metal (ibid.).

As described in section 3.1 above, there are several large aquaculture companies in Nordland, but there are also several smaller, locally owned salmon farms, in particular in the region of Helgeland. Among these, the current managers are typically descendants of the salmon farming pioneers of the region, running the business as the second or third owner generation. Some of these managers explicitly emphasise the structural changes experienced within the industry:

*It used to be more like smallholdings. Now it is simply a giga-industry (16.09.2016).*

Referring to the experienced pressure among local aquaculture managers for increased production and development in accordance with the national aim of enlarged aquaculture productivity, they express a fear that the system would favour the larger companies:

*If you become any smaller than what we are today, you are in great danger of being squeezed out. (...) If you keep your fish in all production regions, you can produce a little here and a little there. If you have to reduce the production in one area, you can increase it somewhere else. (...) We cannot do any displacements, because we are stuck exactly where we are (16.09.2016).*

While aquaculture managers of relatively small operations express fear of being outcompeted by larger companies, fishers and farmers share a concern about future decline in population numbers and in recruitment to their primary industries. This is a general worry in Nordland, as young and well-educated people, especially women, are migrating out of the region and the population is ageing. This pattern of outmigration has developed over several

years, and regional policies aim at improving the situation ([www.nfk.no](http://www.nfk.no)). As stated by a fisher:

*The recruitment to the fisheries is non-existent here. These fisheries will die out with us. We are the youngest ones now, and we are approaching our 60s (15.09.2016).*

Farmers express similar concerns:

*We have one milk-farmer that soon will close down. And there is no one to take over the farm. Mainly there has been sheep here, but now there are hardly any sheep left. Or, that's how it will be when the old people quits and no one takes over (16.09.2016).*

While the fisheries and agricultural sector are experiencing a lack of recruitment, this is hardly a concern within the aquaculture industry. Still, among the locally owned companies in the region, managers aim at counteracting the depopulation trend. In order to help maintain a viable local community, they have chosen not to practice shift work, with fly in-fly out employees. As one aquaculture manager explained:

*We want people to live here, bring their partner, have kids, pay taxes to our municipality and be part of the community. (...) That is partly the reason for doing this [aquaculture operation] at all, to maintain a living local community (16.09.2016).*

In this way, attempts are made to impede the mobile workforce and lack of settling newcomers that characterise many coastal communities in Norway and parallel the Icelandic situation described by Kokorsch and Benediktsson (2018). While the aquaculture industry faces an upward trend, with minimal challenges associated with recruitment, they nevertheless form part of a local community in a region affected by rural-urban migration. The responsibility experienced by some of the local salmon farm managers thus expands the

focus beyond increased company profit, as they live and work in their childhood community for which they aspire a vibrant future:

*It is a bit special here, that you feel such a commitment to safeguard the local community. You would not feel the same living in a big city, competing in the free market (16.09.2016).*

As in many sectors in Norway, aquaculture work is horizontally organised. This means that in practice, work tasks circulate and managers partake in practical salmon pen operations, adding versatility, diversified knowledge and social value to their work. As one aquaculture manager says:

*We, as a small company, cannot have a sales office in Korea or a filet line in the US. Where we can be outstanding is in the production of fish, in our work by the pens (15.09.2016).*

Emphasising advantages of being 'small', ensuring local value creation and taking part in a culture of joint efforts for local community development, thus appears to form essential parts of these salmon farmers' identity as managers of locally owned companies.

Sense of place emerges as a common feature across the livelihoods, connected to both physical and personal attachment to place, but also to the societal aspect and to a sense of community. One farmer expresses the value of community and social engagement the following way:

*We manage to keep it going. But you need to take on many, many roles. You have to be active. You cannot afford, like in the cities, that a lot of people just withdraw and sit inside and watch TV. You have to take part in all associations, the sports club, all kinds of affairs and what so ever. In everything (01.04.2017).*



Forming part of what constitute the good life along the coast of Nordland, fishers, farmers and aquaculture employees experience these valued ways of living to be threatened by politically generated top-down growth policies. This does not mean that the stakeholders are against expansion, but they want growth to come from 'within', to be in accordance with the local environmental and social conditions, and to comply with a local sense of place and community attachment. Several informants emphasise how increased efficiency and the ongoing decline in number of livelihood colleagues lead to withering networks, reducing the opportunities for exchanging knowledge, expertise and opinions.

**Table 2: Stakeholders' experiences of socioeconomic change**

The stakeholders link the socioeconomic and political changes to economic growth goals, where an emphasis on increased production, larger units and economic gains are found to challenge the maintenance of livelihoods and local communities as valued by the fishers, farmers and aquaculture employees alike (Table 2). The interviewees consider the environmental and socioeconomical aspects of their livelihoods to be deeply interconnected. This explains why the local stakeholders experience their values and worldviews to be compromised by the growth goals, as these goals signify a detached production increase and economic gain, overlooking locally relevant social-ecological interconnections. Furthermore, by referring to an economic rationale behind the experienced political incentives for centralisation, with continual cuts in the municipalities' budgets and gradual reductions in public services, the stakeholders emphasise a feeling that their way of life "is not wanted" in a regional and national development perspective. Additionally, the interviewees worry about the demographic trends, with people moving from the small communities to the city centres, their continuous fight to keep key public services such as roads, ferries, schools and

hospitals, and their desire to maintain a viable community in line with their values. As one aquaculture manager says:

*Some structural changes must be tolerated. They might lead to progress, right. But structural changes necessarily involves the abandoning of some structures that are already present. That is not always that clever (15.09.2016).*

While the farmers express a concern for growth policies to entail conditions affecting their well-being or sustainability, they simultaneously emphasise a strong attachment to both their livelihoods and local communities. “Being a farmer is a way of living,” one farmer says, and continues:

*I like it. You are tied, but still you have a lot of freedom. For those of us who keep on, it is because it is rewarding. That is why you proceed, even though the profitability might not be very high (29.11.2016).*

The livelihood values represent a shared worldview through linking the best possible way of living to a sustainable way of life. However, the stakeholders experience the lack of inclusion in decision-making processes and policy development to compromise their values and worldviews. A farmer summed it up illustratively:

*Here we touch upon the issue of development: Who is given room to bring forth their opinions, their views and their understanding of what is right (25.04.2016).*

## 5. Concluding discussion

This study on perceptions of change among primary industry stakeholders in coastal Nordland provides insights into local livelihood values. The stakeholders’ livelihood practices are associated with different ecological systems. Nevertheless, they experience congruent

threats to their shared values. These values are associated with the ability to make what the interviewees consider a sustainable living, which may not necessarily coincide with national policies for regional development. Rather than experiencing the national focus on economic growth as a pathway for increased prosperity and development, the stakeholders view this as a threat to their preferred way of life and what they consider sustainable community-oriented local livelihoods. The sample of fishers, farmers and aquaculture employees included in this study clearly consider socioeconomic and environmental processes to be interlinked. They utilise the natural renewable resources and environmental conditions of the coastal landscape; handle seasonal variations, rough weather and recurrent centralisation challenges, but also emphasise the maintenance of community involvement and solidarity.

While always in flux, the values connected with living a good and meaningful life, include, as expressed by the interviewees, issues of freedom, flexibility and community solidarity. Of further significance is utilising – not overexploiting – local resources, a sense of place and belonging to the coastal landscape, as well as a strong sense of community. Working in the primary industries requires much effort, long working days and the ability to handle the unexpected. However, in line with these stakeholders' worldviews, these issues are manageable and even appreciated aspects of the livelihoods, as long as a certain flexibility exists in the social-ecological systems. Here, the politically driven national growth goal is emphasised as having disturbing effects, increasing the vulnerability and stress of all three primary industry groups. As such, our findings bear resemblance to Brox (1966; 2006) and his critique of Norway's centrally drawn economic development plan for Northern Norway after World War II. Here, Brox emphasised how overall goals of industrialisation and large-scale operations for regional development ignored local conditions, including

livelihood subsistence practices outside the economic realm that still contributed significantly to the livelihoods of people living in the North (Abram 2018).

The results of our study revealed three sets of drivers affecting vulnerability. First, the necessary and highly valued flexibility of the local livelihoods is found to be reduced. This is linked to increased size and weight of agriculture machinery, larger fishing vessels to be purchased or new regulations found to favour larger, geographically dispersed aquaculture companies. Consequently, several stakeholders experience reduced flexibility to adjust to the social-ecological situations that arise and to operate in accordance with their own sustainability convictions. Second, the informants find that their values and worldviews are compromised through the experienced obstacles against their preferred ways of life. Third, the interviewees experience a lack of influence on national policy frameworks for primary industry development that are directly affecting their livelihoods. Combined, these aspects lead to increased vulnerability within the different primary industries, and they exacerbate the level of conflict between the industries' practitioners, in particular between fishers and aquaculture employees. Furthermore, the ongoing demographic trend of rural outmigration contributes to the deterioration of social networks, negatively influencing livelihood knowledge exchange and cooperation. The centralisation trend and the drivers of change identified to negatively influence the viability of the local livelihoods, make the coastal communities to which they belong more vulnerable as well.

Many of the recurring problems in natural resource use and management stem from the lack of recognition that ecosystems and social systems are inextricably linked and interdependent (Folke et al. 2010). As illustrated by this study, such interconnections are highly visible and evident at the local level, reflecting peoples' experiences of the close connections between the social and the ecological in their everyday livelihoods. In national

and international policy and management, on the other hand, merging this divide between the natural and social systems may prove challenging. Despite growing recognition of how society and the environment are linked in multiple and complex ways, there is still a way to go to achieve governance systems that truly embody local values, worldviews and concerns. Reaching this kind of policy integration will require improved cooperation across sectors, as well as between the local, regional and national levels, and rely upon a recognition of different value systems.

Currently, the Nordland county council participates in the European Union's Smart Specialization Platform for regional development. According to the Nordland Smart Specialization Strategy, the region should focus on value creation in the three sectors of seafood production, the process industry and tourism (Mariussen et al. 2013). Despite the ongoing reorganisation of the county structure, the county council's role as regional development agency and the regional actors' knowledge of place specific conditions, could potentially give room for a greater inclusion of local opinions and concerns. A feasible way to start would be for the municipalities to play a more active role in facilitating venues for different stakeholders to meet and establish social networks, within and across occupational affiliations. Such processes have the potential to reduce local vulnerability to change, as they may increase the awareness of values upon which perceptions of challenges and opportunities are based, enable further knowledge development and enhance the local capacity to handle future processes of change. Furthermore, this kind of institutional arrangement may improve local mobilisation and community cohesion, and strengthen the local level of management. Including local stakeholders and livelihood values in decision-making processes, through a more active municipal organization, is not only a question of legitimacy, democracy and of involving those who are directly affected by the decisions

taken. It also provides an opportunity to increase the knowledge about locally valued ways of life and sustainability goals. Additionally, such inclusion may facilitate a legitimate and locally supported process of regional development, which resonates with local values and is perceived as capable of dealing adequately with social, economic and environmental change.

In a vulnerability context, understanding the values that underlie decisions made to reduce coastal communities' vulnerability to environmental, socioeconomic or political change, becomes important (see also O'Brien and Wolf 2010). Based on examples from the coast of Nordland, this paper has illustrated a tension between national goals for sustainable, natural resource dependent development, emphasising economic competitiveness and environmental integrity, and local sustainability perspectives, which place greater emphasis on localised social-ecological interconnections. As these diverging evaluations are founded upon different values, awareness and clarification of how the values differ becomes a necessity if a shared goal is to be realised. Attention to local values thus becomes a prerequisite in order for policymakers and managers to work successfully towards local mobilisation and social capacity building, to reduce local vulnerability to ongoing and future processes of change and to achieve consistency in development goals of coastal zone management.

### **Acknowledgements:**

The authors would like to thank those who contributed to the study through participation in interviews. This work was supported by the Research Council of Norway, grant number 255783.

**Disclosure statement:**

No potential conflict of interest was reported by the authors.

## 6. References

- Abram, S. 2018. Likhhet Is Not Equality: Discussing Norway in English and Norwegian. In Bendixsen, S., Bringslid, M. B., & Vike, H. (Eds.) *Egalitarianism in Scandinavia: Historical and Contemporary Perspectives*. Cham: Springer Nature, 87-108.
- Amundsen, H. 2012. "Illusions of resilience? An analysis of community responses to change in northern Norway." *Ecology and Society* 17 (4): 46. <http://dx.doi.org/10.5751/ES-05142-170446>
- Amundsen, H. 2013. "Place attachment as a driver of adaptation in coastal communities in Northern Norway." *Local Environment* 20 (3): 257-276.  
<http://dx.doi.org/10.1080/13549839.2013.838751>
- Anderies, J. M., Folke, C., Walker, B. & Ostrom, E. 2013. "Aligning key concepts for global change policy: robustness, resilience, and sustainability." *Ecology and Society* 18(2): 8.  
[http:// dx.doi.org/10.5751/ES-05178-180208](http://dx.doi.org/10.5751/ES-05178-180208)
- Bennett, E. M., Solan, M., Biggs, R., McPhearson, T., Norström, A. V., Olsson, P., Pereira, L. et al. 2016. "Bright spots: seeds of a good Anthropocene." *Frontiers in Ecology and the Environment* 14 (8): 441–448, DOI:10.1002/fee.1309
- Berkes, F. & Folke, C. 1998. *Linking social and ecological systems: management practices and social mechanisms for building resilience*. Cambridge: Cambridge University Press.

- Biernacki, P. & Waldorf, B. 1981. "Snowball Sampling: Problems and Techniques of Chain Referral Sampling." *Sociological Methods and Research* 10 (2): 141-163.
- Bjørkan, Maiken, 2011. "Fishing for Advice: The Case of the Norwegian Reference Fleet." PhD thesis. Faculty of Biology, Fisheries and Economy, Norwegian College of Fisheries Science, University of Tromsø, Norway.
- Blake, J. 1999. "Overcoming the 'Value-Action Gap' in Environmental Policy: tensions between national policy and local experience." *Local Environment* 4 (3): 257-278.
- Brown, G., Raymond, C. M., Corcoran, J. 2015. "Mapping and measuring place attachment." *Applied Geography* 57 (Supplement C): 42-53.
- Brown, K. 2016. *Resilience, development and global change*. London: Routledge.
- Brox, O. 1966. *Hva skjer i Nord-Norge?* Oslo: Pax.
- Brox, O. 2006. *The Political Economy of Rural Development: Modernisation without Centralisation?* Delft: Eburon Academic Publishers.
- Buijs, A. E. 2009. Lay People's Images of Nature: Comprehensive Frameworks of Values, Beliefs, and Value Orientations. *Society and Natural Resources* 22 (5): 417-432.  
<https://doi.org/10.1080/08941920801901335>
- Chapin, III, F.S., Kofinas, G.P. and Folke, C. (eds.) 2009. *Principles of ecosystem stewardship: resilience-based natural resource management in a changing world*. New York, NY: Springer.
- Cote, M. & Nightingale, A.J. 2012. "Resilience thinking meets social theory: Situating social change in socio-ecological systems (SES) research". *Progress in Human Geography*, 36 (4): 475-489.



- Coulthard, S. 2012. "Can we be both resilient and well, and what choices do people have? Incorporating agency into the resilience debate from a fisheries perspective." *Ecology and Society* 17 (1): 4. <http://dx.doi.org/10.5751/ES-04483-170104>
- Cronon, W. (ed.) 1995: *Uncommon Ground: Rethinking the Human Place in Nature*. New York: W. W. Norton & Co.
- Dannevig, H. & Hovelsrud, G. K. 2016. "Understanding the need for adaptation in a natural resource dependent community in Northern Norway: issue salience, knowledge and values." *Climatic Change* 135: 261-275.
- Directorate of Fisheries 2017. <https://www.fiskeridir.no/Yrkesfiske/Statistikk-yrkesfiske>, accessed 04.08.2017.
- Dolan, A. H., Taylor, M., Neis, B., Ommer, R., Eyles, J., Schneider, D., & Montevecchi., B. 2005. Restructuring and Health in Canadian Coastal Communities. *EcoHealth* 2: 195–208 <https://doi.org/10.1007/s10393-005-6333-7>
- Fabinyi, M., L. Evans, and S. J. Foale. 2014. "Social-ecological systems, social diversity, and power: insights from anthropology and political ecology." *Ecology and Society* 19 (4): 28. <http://dx.doi.org/10.5751/ES-07029-190428>
- Folke, C. 2006. "Resilience: the emergence of a perspective for social–ecological systems analyses." *Global Environmental Change* 16: 253-267.
- Folke, C., Carpenter, S. R., Walker, B., Scheffer, M., Chapin, T. & Rockström, J. 2010. "Resilience thinking: integrating resilience, adaptability and transformability." *Ecology and Society* 15 (4): 20. <http://www.ecologyandsociety.org/vol15/iss4/art20>

Forseth, T., Barlaup, B. T., Finstad, B., Fiske, P., Gjøsæter, H., Falkegård, M., Hindar, A. et al. 2017. "The major threats to Atlantic salmon in Norway." *ICES Journal of Marine Science* 74 (6): 1496–1513. <https://doi.org/10.1093/icesjms/fsx020>

Glaser, B., Strauss, A. 1967. *The Discovery of Grounded Theory*. Hawthorne, NY: Aldine Publishing Company.

Government's Marine Strategy 2017. Nærings- og fiskeridepartementet, Olje- og energidepartementet 2017. Ny vekst, stolt historie: Regjeringens havstrategi. [https://www.regjeringen.no/contentassets/1ed01965de3249f689f1938ad3c0b672/nfd\\_havstrategi\\_webfil.pdf](https://www.regjeringen.no/contentassets/1ed01965de3249f689f1938ad3c0b672/nfd_havstrategi_webfil.pdf)

Horlings, L. G. 2015. "Values in place: A value-oriented approach toward sustainable place-shaping". *Regional Studies, Regional Science* 2(1): 257-274.

Hovelsrud, G. K., Dannevig, H., West, J. & Amundsen, H. 2010. "Adaptation in fisheries and municipalities: three communities in northern Norway." In G. K. Hovelsrud and B. Smith (eds.) *Community Adaptation and Vulnerability in Arctic Regions*. Dordrecht: Springer, 23-62.

Hovelsrud, G.K., West, J. and H. Dannevig 2015. "Exploring vulnerability and adaptation narratives among fishers, farmers and municipal planners in Northern Norway." In O'Brien, K. & Elin Selboe, E. (eds.) *The Adaptive Challenge of Climate Change*. Cambridge: Cambridge University Press, 194-212.

IMR 2017: Quota advice 2017.

[https://www.hi.no/radgivning/kvoterad/kvoterad\\_for\\_2017/ices-rad\\_for\\_de\\_arktiske\\_bestandene/nb-no](https://www.hi.no/radgivning/kvoterad/kvoterad_for_2017/ices-rad_for_de_arktiske_bestandene/nb-no), accessed 02.01.2018.

Indeks Nordland 2017. En rapport om utviklingen gjennom 2016 og utsiktene for 2017.

<http://indeksnordland.no/06-vekst-og-verdiskaping/>, accessed 04.08.2017.

Kaltenborn, B. P., Linnell, J. D. C., Gómez-Baggethun, E., Lindhjem, H., Thomassen, J., Chan, K. M. 2017. "Ecosystem Services and Cultural Values as Building Blocks for 'The Good life'. A Case Study in the Community of Røst, Lofoten Islands, Norway." *Ecological Economics* 140: 166–176. <http://dx.doi.org/10.1016/j.ecolecon.2017.05.003>

Kleiven, A. R., Fernandez-Chacon, A., Nordahl, J.-H., Moland, E., Espeland, S. H., Knutsen, H., Olsen, E. M. 2016. «Correction: Harvest pressure on coastal Atlantic cod (*Gadus morhua*) from recreational fishing relative to commercial fishing assessed from tag-recovery data." *PLoS ONE* 11 (7). DOI: 10.1371/journal.pone.0159220

Knudsen, J. P. 2018. Vicarious habitation - reinterpreting the role of peripheral living in a Nordic context. *European Planning Studies* 26(2): 279-296.

<https://doi.org/10.1080/09654313.2017.1361589>

Kokorsch, M. & Benediktsson, K. 2018. Where have all the people gone? The limits of resilience in coastal communities, *Norsk Geografisk Tidsskrift – Norwegian Journal of Geography*, 72 (2): 97-114. DOI: 10.1080/00291951.2018.1450289

Kvalvik I., Dalmannsdottir, S., Dannevig, H., Hovelsrud, G., Rønning, L. Uleberg, E. 2011. "Climate change vulnerability and adaptive capacity in the agricultural sector in Northern Norway." *Acta Agricultura Scandinavica. Section B – Soil and Plant Science*, Supplement 61: 1 27-37.

Lin, C.-C. & M. Lockwood 2014. "Forms and sources of place attachment: Evidence from two protected areas." *Geoforum* 53(Supplement C): 74-81.

Liu, Y., Olaussen, J. O. & Skonhoft, A. 2011. "Wild and farmed salmon in Norway—A review." *Marine Policy* 35: 413-418.

Mariussen, Å., Knudsen, J. P., Gjertsen, A., Løvland, J. & Lindeløv, B. 2013. Smart 4H. Forslag til smart spesialisering for Nordland. Bodø: Nordlandsforskning.

Meld. St. 18 (2016–2017) Report to the Parliament (white paper): Urban sustainability and rural strength – in brief.

<https://www.regjeringen.no/contentassets/d15e0f19e7d9439ea5c1b08ba888bdd1/engb/pdfs/stm201620170018000engpdfs.pdf>, accessed 03.08.2017

Norwegian Ministry of Agriculture and Food 2016. Change and development: A future-oriented agricultural production (White paper).

Norwegian Ministry of Trade, Industry and Fisheries 2015. Predictable and environmentally sustainable growth in Norwegian salmon and trout farming (White paper).

O'Brien, K. L., Wolf, J. 2010. "A values-based approach to vulnerability and adaptation to climate change." *Wiley Interdisciplinary Reviews: Climate Change* 1: 232-242.

<http://onlinelibrary.wiley.com/doi/10.1002/wcc.30/full>

O'Brien, K. 2009. "Do values subjectively define the limits to climate change adaptation?" In Adger, W. N., Lorenzoni, I. O'Brien, K. (eds.) *Adapting to Climate Change: Thresholds, Values, Governance*. Cambridge: Cambridge University Press, 164-180.

Olafsen, T., Winther, U., Olsen, Y., Skjermo, J. 2012. Verdiskaping basert på produktive hav i 2050. På oppdrag fra NTVA og DKNVS. Rapport fra en arbeidsgruppe oppnevnt av Det Kongelige Norske Videnskabers Selskab (DKNVS) og Norges Tekniske Vitenskapsakademi (NTVA).

PwC Seafood Barometer 2017: <https://www.pwc.no/no/publikasjoner/PwC-Seafood%20Barometer.pdf>, accessed 21.12.2017.

Rohan, M. J. 2000. "A rose by any name? The values construct." *Personality and Social Psychology Review* 4: 255-277.

Rybråten, S. & Hovelsrud, G. K. 2010. «Local effects of global climate change: Differential experiences of sheep farmers and reindeer herders in Unjárga/Nesseby, a coastal Sámi community in Northern Norway." In G. K. Hovelsrud and B. Smith (eds.) *Community Adaptation and Vulnerability in Arctic Regions*. Dordrecht: Springer Publishers, 313 – 334.

Sandersen, H. T. & Kvalvik, I. 2015. "Access to aquaculture sites: A wicked problem in Norwegian aquaculture development." *Maritime Studies* 14 (1): 10.

<https://doi.org/10.1186/s40152-015-0027-8>

Schwartz, S.H. 1992. "Universals in the Content and Structure of Values: Theoretical Advances and Empirical Tests in 20 Countries." *Advances in Experimental Social Psychology* 25: 1-65.

Smit, B., Hovelsrud, G. K., Wandel, J. & Andrachuk, M. 2010: Chapter 1: Introduction to the CAVIAR Project and Framework. In Hovelsrud, G. K. & Smit, B. (eds.) *Community Adaptation and Vulnerability in Arctic Regions*. Dordrecht: Springer Publishers, 1-22.

Statistics Norway 2017a. Nordland Population in urban and rural areas. County: Nordland.

<https://www.ssb.no/befolkning/statistikker/beftett>, accessed 21.12.2017

Statistics Norway 2017b. Land, forest, hunting and fishing: Agriculture.

<https://www.ssb.no/jord-skog-jakt-og-fiskeri?de=Jordbruk>, accessed 05.08.2017.

Statistics Norway 2017c. External economy. <https://www.ssb.no/utenriksokonomi>, accessed 21.12.2017.

Stornes, O. K. 2016. Verdiskaping og sysselsetting av jordbruket i Nordland. NIBIO Rapport 2(83).

Strathern, M. 1980. "No nature, no culture: the Hagen case." In MacCormack, C.C & Strathern, M. (eds.) *Nature, culture and gender*. Cambridge: Cambridge University Press.

Strauss, A., Corbin, J. 1998. *Basics of Qualitative Research: Grounded Theory Procedures and Technique*. 2<sup>nd</sup> Edition. London: Sage.

Uleberg E., Hanssen-Bauer I., van Oort B., Dalmannsdottir S. 2014. "Impact of climate change on agriculture in northern Norway and potential strategies for adaptation." *Climatic Change* 122: 27-39.

UN Sustainable Development Goals 2015.

<http://www.un.org/sustainabledevelopment/sustainable-development-goals/>, accessed 29.12.2017

West, J. & Hovelsrud, G. K. 2010: "Cross-scale adaptation challenges in the coastal fisheries: findings from Lebesby, Northern Norway." *Arctic* 63 (3): 338–354

Winther, U., Richardsen, R., Ratvik, I., Bull-Berg, H., Vik, L., Grindvoll, I. L. T., Løvland, J. 2016.

Ringvirknings- og varestrømsanalyse av fiskeri og havbruksnæringen i Nordland.

Nordlandsforskning. [http://docplayer.me/40400100-Rapport-ringvirknings-og-](http://docplayer.me/40400100-Rapport-ringvirknings-og-varestromsanalyse-av-fiskeri-og-havbruksnaeringen-i-nordland.html)

[varestromsanalyse-av-fiskeri-og-havbruksnaeringen-i-nordland.html](http://docplayer.me/40400100-Rapport-ringvirknings-og-varestromsanalyse-av-fiskeri-og-havbruksnaeringen-i-nordland.html)

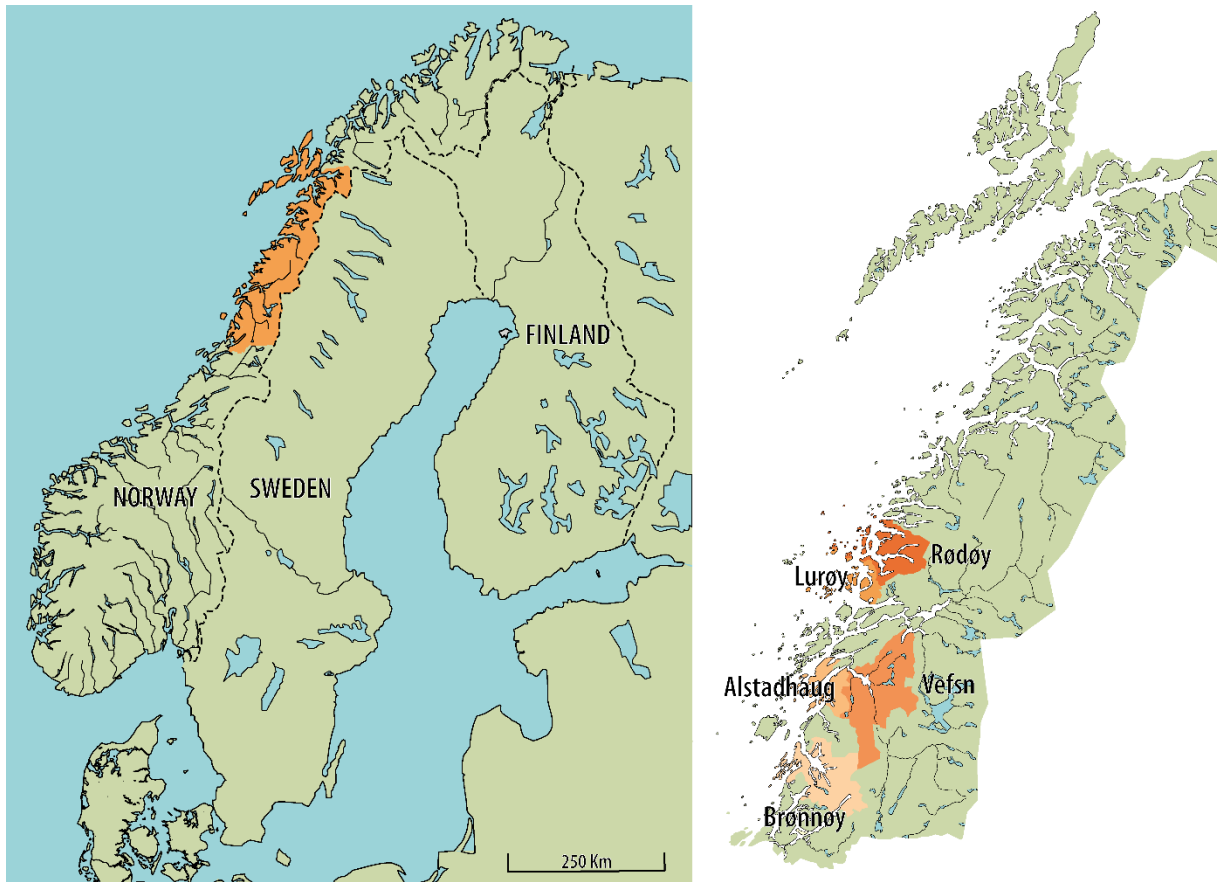


Figure 1: Location of study area.

Table 1: Stakeholders' experiences of environmental change

Stakeholders	Experiences of environmental change	Change perceived as opportunity or challenge	Perceived drivers of environmental change
Fishers	Variation in catches	Both opportunity and challenge	Primarily natural variations, but also use of chemicals by the aquaculture industry (shrimp) and overfishing (coastal cod)
Farmers	Longer growing season (2 weeks +) More rain and heavier rainfalls	Opportunity  Challenge	Climate change
Aquaculture employees	Increasing ocean temperatures	Both opportunity and challenge	Maybe climate change, maybe natural variability

**Table 2: Stakeholders' experiences of socio-economic change**

<b>Stakeholders</b>	<b>Experiences of socio-economic change</b>	<b>Change perceived as opportunity or challenge</b>	<b>Perceived drivers of socio-economic change</b>
Fishers	Demand for higher production Lack of recruitment Centralisation	Challenge	Political growth incentives through increased efficiency in the fishing fleet <sup>2</sup> Demographic changes Sociocultural change
Farmers	Demand for higher production Lack of recruitment Centralisation	Challenge	Political growth incentives emphasising increased efficiency and competitiveness <sup>3</sup> Demographic changes Sociocultural change
Aquaculture employees	Demand for higher production	Challenge	Political growth incentives for "predictable and environmentally sustainable growth in Norwegian salmon and trout farming" <sup>4</sup>

<sup>2</sup> Government's Marine Strategy (2017).

<sup>3</sup> Norwegian Ministry of Agriculture and Food (2016).

<sup>4</sup> Norwegian Ministry of Trade, Industry and Fisheries (2015: 9).