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Flood Risk Communication And Perception In Longyearbyen

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Abstract

The Arctic region, including Svalbard, is experiencing increasing temperatures to a greater extent than the rest of the world, resulting in more extreme and frequent climate risks, such as higher precipitation, avalanches, melting of permafrost, landslides, and flooding. This paper studies the impact of climate change in Longyearbyen, the largest settlement on the Svalbard archipelago. More precisely, the aim of the paper is to investigate the link between flood risk communication by Longyearbyen authorities and the risk perception among members of the population. Data is collected through qualitative document analysis of legislation and publications dealing with flood risk and risk communication. Additionally, semi-structured interviews have been conducted with representatives of the authorities and the population, and a survey incorporating questions addressing both the perception of flood risk communication and the perception of the risk itself was carried out. The study reveals weaknesses in the authorities' risk communication, influencing the population's risk perception.

Keywords: climate change, arctic, flood, risk communication, risk perception

1. Introduction

Svalbard and the rest of the polar regions experience climate change to a greater extent than the rest of the world (NCCS, 2019; Norwegian Polar Institute, 2014). Svalbard has in recent years turned into somewhat of a showcase of a changing Arctic, and Longyearbyen at 78° North has become renowned as the town on the front line of climate change (Meyer, 2022).

The last four decades have been significantly warmer than in the past (IPCC, 2023; World Meteorological Organization (WMO), 2021). The resulting climate risks impact societies at an increasing pace. According to the Norwegian Centre for Climate Services (NCCS)'s "Climate in Svalbard 2100" report, future climate changes expected in Svalbard include increased sea level, increased air temperature, increased annual precipitation, higher frequency and intense rainfall events; increased river flow and the risk of flooding; permafrost melting and thus increased active surface; changes in glacier areas and masses; and increased frequency of avalanches and landslides. Thus, safety of the Longyearbyen community relies heavily on the ability to assess these changes and communicate an updated risk picture to the population.

The aim of this paper is to study the link between the Longyearbyen authorities' flood risk communication and the subsequent risk perception among members of the population.

Data is collected through qualitative document analysis of legislation and publications dealing with flood risk and risk communication, and quantitative document analysis of the government's webpages and social media page. Furthermore, we conducted semi-structured interviews with representatives of the authorities and the population, and, finally, conducted a survey incorporating questions addressing both the perception of flood risk communication and the perception of the risk itself. The survey aimed at gathering quantitative data about the population's thoughts and perceptions, to support and supplement the interviews and the content analyses.

2. Conceptual framework

This chapter addresses the theoretical foundation of the study and clarifies the perspectives that we emphasize concerning risk, communication, risk communication, and risk perception.

2.1. Risk

There exist diverging perspectives within the academic research community concerning the conceptualization of the term "risk." A prevailing paradigm focuses on uncertainty, underscoring that “risk refers to the uncertainty and severity of the consequences (or outcomes) of an activity with respect to something that humans value” (Aven and Renn, 2009, p. 10).

Citizens in Longyearbyen are especially exposed to, what is known as, involuntary risk. Involuntary risks are risks that individuals do not willingly subject themselves to (Rehm et al., 2014). Such risks can, for example, be climate change and natural disasters. Comparatively, voluntary risks are risks that individuals willingly expose themselves to (Rehm et al., 2014). Individuals often tolerate a greater degree of voluntary risks than involuntary risks since they rely on their own judgments and perceive a higher degree of control.

2.2. Communication

According to the Irish playwright, critic, polemicist and political activist, George Bernhard Shaw, “the single biggest problem in communication is the illusion that it has taken place.” People may think that communication has occurred, however, even though a message has been sent, it may not have reached or have not been understood properly by the receiver. Sender and receiver might also think they have a common understanding of the message that was passed between them, even though that is not the case. This illusion of communication may be problematic, especially if the topic at hand is of importance, such as during risk or crisis communication.

“To share” or “to make common” is the core of what it means to communicate (Rosengren, 2000, p. 1). There are many ways to communicate, of which the most common ways being verbal and non-verbal. Communication is a process which takes place between individuals, groups, organizations, social classes, nations, lands, regions, etc. This diversity in how communication takes place makes it a complicated and complex process. In light of this, there are several communication models that illustrate how communication can take place, for instance Berlo’s (1960) Source-Message-Channel-Receiver (SMCR) model:

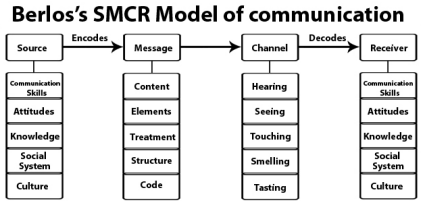

Fig. 1. SMCR Model of Communication (Berlo, 1960).

Berlo’s SMCR model is a general or generic communication model that is also relevant for risk communication.

There are some prerequisites for effective communication that must be met in the proper or adequate proportion, represented by the four central elements of the model. The first element is the ***sender***. The sender is the person or entity transmitting the message. This can be individuals, a group of people, a company, an organization, or similar entities. The sender is responsible for encoding the message in a way that the receiver can understand. The second element is the ***message***. The message is the information communicated from the sender to the receiver. The message can take various forms, including language, verbal or written words, images, sounds, or other types of media. The third element is the ***channel***. The channel is the way the message is delivered from the sender to the receiver. The channel can be a face-to-face conversation, a phone call, email, TV, radio, or similar methods. The last element is the ***receiver***. The receiver is the person or entity receiving the message from the sender. The receiver is responsible for decoding the message so that it is understandable to them.

Regarding Berlo's SMCR communication model, Engen et al. (2021) states that despite the impression that the figure suggests one-way communication, by not including feedback as an element, it can be an example of two-way communication. This is justified by the model assuming that the sender and receiver are on the same level and thus share a common understanding in their communication.

In the model, there are implicit central principles that experts and decision-makers should include in their risk communication. One principle is that the sender and receiver must be on the same level of understanding. This means that the sender must understand how the receiver is likely to interpret and comprehend the message, while the receiver must take the time to decode and understand the message. Another principle emphasizes the importance of the channel being appropriate for the message. In any risk communication, it is crucial for the sender to tailor the message to the receiver and channel. Overall, the SMCR model provides a useful framework for understanding the components of communication and how they interact to effectively convey a message.

2.2.1. Risk communication

Risk communication is utilized as a communication tool in risk-based scenarios, and in order to improve how we communicate about risks (Qiu et al., 2016). Risk communication is essential in closing the gap between the knowledge of risks that the experts have and the risk-perception of the lay people (Engen et al., 2021). This paper bases its understanding of risk communication on this definition: “The act of conveying or transmitting information between interested parties about (a) levels of health or environmental risks; (b) the significance or meaning of health or environmental risks; or (c) decisions, actions, or policies aimed at managing or controlling health or environmental risks” (Covello et al., 1986, p. 172).

Rakow et al. (2015) highlight challenges with risk communication. One of the challenges is to assist individuals in understanding the phenomenology of risk. This includes the type of risk, how it arises, and how it can be managed, involving explaining "what it is, what can cause it [and] what can happen" (Rakow et al., 2015, p. 148).

Another challenge is to present quantitative risk information in the best possible way. Challenges here are related to uncertainty, difficulties in assessing quantitative information, and poor mathematical knowledge among the receivers. Gigerenzer et al. (2005) demonstrate this in their study "A 30% Chance of Rain Tomorrow." The study shows that ordinary individuals believe they understand what it means when the weather station reports a 30% chance of rain tomorrow. Many interpret it as it will rain 30% of the time or in 30% of the area. This is incorrect, and the example illustrates how experts can communicate quantitative numbers that are misunderstood by receivers. Finally, the last challenge is related to people's emotional reactions to risks and its communication. This means that people's feelings about danger or risk are influenced by the information they have received through risk communication. Decision-makers and experts must take these challenges into account in their risk communication.

2.3. Risk perception

Risk perception is often defined as “a person’s subjective judgment or appraisal of risk” (SRA, 2015, p. 8). A broader definition is that “Risk perception [...] includes people’s beliefs, attitudes, judgements and feelings, as well as the wider cultural and social dispositions they adopt towards threats to things that we value” (Pidgeon, 1998, p. 5). On the basis of these definitions, our understanding is that risk perception pertains to how we perceive our physical world and how our subconscious processes, assesses, and filters information regarding uncertainties and risks (Engen et al., 2021), i.e. that risk perception is about opinions (Slovic, 1987), that risk perception is inherently a subjective (Finucane, 2002) feeling influenced by a wide range of factors, in addition to statistical calculations of risk (Cole and Withey, 1981).

Human behaviour is predominantly affected by perception and not facts (Renn, 2008). At least what is known as facts by experts. This means that there is a difference in experts and lay people's perception of risks and dangers. Risk perception is a phenomenon that must be taken into consideration in decisions at the societal and organizational levels. For instance, when decision-makers at this level seek to reduce risk, they must consider how lay people construct their own risk perceptions, both socially and individually (Njå et al., 2020). The social context is a pivotal element: "Risk perception is not so much a product of experience or personal evidence, as it is a result of social communication" (Renn, 2008, p. 99). This underscores the importance of decision-makers and experts being aware of the risk perception of lay people in their risk communication efforts.

There is a substantial amount of literature addressing the factors that influence our risk perception and how risk perception influences human decision-making (see, for example, Engen et al., 2021; Njå et al., 2020; Pidgeon, 1998; Renn, 2008; Slovic, 1987, 1992). Much of this literature focuses on how lay people perceive the seriousness or acceptability of risks, how they assess risks, and how these assessments are influenced by knowledge, values, and emotions (Renn, 2008). Within this context, it is crucial to examine mental models and other psychological mechanisms that individuals process, such as cognitive heuristics, individual factors, and trust. These factors are often internalized through background and social factors, including friends, family, education, and mass media, as well as social media (Renn, 2008).

The public's trust in key societal institutions is vital both for their functionality, but also for people's response (Olsen et al., 2007). The effectiveness of executive authorities in specific domains and their willingness to allocate resources to enhance risk communication are crucial factors in building confidence, and thus for their ability to be seen as trustworthy communicators, and, in the end, for the population's adjustment of behaviour according to the authorities' risk communication. It is fair to assume that there needs to be a feeling of trust in the communicator’s capabilities and intentions adhering to risk communication for the receiver’s willingness to adapt their behaviour according to the message communicated. Fundamentally, trust involves navigating risks and uncertainties. According to Rousseau et al., (1998) trust is a psychological state rooted in the intention to accept vulnerability based on positive expectations of another's intentions or behaviour. Trust, by its nature, involves making a choice in the face of risk. If the receivers of risk communication do not trust the source of the

communication, there is a greater chance of them not trusting the content. Trust is therefore fundamental to be able to convey what is communicated, but also for the message communicated to the result in the required responses by the receivers.

3. Methodology

This study utilized the Mixed Methods Case Study Research (MMCSR) approach. The MMCSR approach, as defined by Cook and Kamalodeen (2021), is a comprehensive and multidimensional strategy that integrates both qualitative and quantitative methods to enhance the overall understanding of a research problem. The central theme of the study required a combination of qualitative and quantitative methods to obtain a comprehensive overview of how communication is conducted, how residents in Longyearbyen engage in this communication, and how they adapt to the risk of flooding.

The study employed various data collection methods, with interviews being the most prevalent. We conducted 12 semi-structured interviews involving 16 informants. The study explicitly distinguished between laypeople and government employees to highlight the communication divide between senders and receivers. Most interviews were conducted in person, with only two held via Microsoft Teams. The interviews provided a platform for in-depth conversations, offering valuable insights into the informants' perspectives on both communication and the actual risk of flooding.

Detailed content analyses were also conducted, encompassing official documentation such as reports and publications, along with posts on official government web pages and Facebook pages. The analysis involved 30 official documents and 86 posts, all containing direct references to flood risk or mentions of it. Both content analyses aimed to capture the narrative within the digital discourse surrounding climate risk and flooding. They provided insights into contextual factors related to the theme and offered an indication of the prevalence and target audience of the communication. Finally, the study administered a survey, incorporating questions addressing both the perception of flood risk communication and the perception of the risk itself. The survey facilitated the acquisition of quantifiable data, offering numerical insights into respondents' sentiments on these aspects. A total of 126 individuals participated in the survey.

By integrating both qualitative and quantitative methods, this study aspires to provide a comprehensive understanding of the complex issues under examination. The triangulation of data from diverse sources not only enhances the reliability and validity of the findings but also contributes to a more robust academic exploration of the interconnected realms of risk communication and risk perception (Denzin, 2017; Merriam and Tisdell, 2015).

4. Findings

This chapter portrays the studies' key findings. The context, Longyearbyen and Svalbard, is first explained, before the chapter explores language dynamics in Longyearbyen, focusing on government risk communication, using the climate risk, flooding, as a case study. The findings reveal insight into how the local population interprets and responds to climate-related risks in the Arctic.

4.1. Longyearbyen, Svalbard

Svalbard, an Arctic archipelago located between 74-81 degrees north latitude and 10-35 degrees east longitude, experiences significant variations in temperature, precipitation, and geological conditions due to its Arctic location (Sokolíčková et al., 2022). The region is influenced by the interaction of warm air from the south and cold air from the north, resulting in strong winds and weather fluctuations (Marchenko, 2015; NCCS, 2019). Notable settlements on Svalbard include Longyearbyen, Barentsburg, and Ny-Ålesund (Governor of Svalbard, 2022).

Longyearbyen, located at 78 degrees north, has around 2,500 residents, representing diverse nationalities and is the biggest settlement on the archipelago (Berg, 2019; Longyearbyen Community Council, 2022; SSB, 2012). The diverse population of Longyearbyen might contribute to the different ways that information is processed and perceived. The absence of an indigenous population on Svalbard results in a consciously chosen population that relocates to Longyearbyen for work, study, or family reasons (Meyer, 2022; St.meld. nr. 22 (2008-2009)). The government in Longyearbyen consists of the Governor of Svalbard at the regional level and the Longyearbyen Community Council on the local level.

There are five rivers in and around Longyearbyen that are especially exposed to flooding (Barr, 2023a; Governor of Svalbard, 2022; Longyearbyen Community Council, 2018; Norwegian Polar Institute, n.d.; Spitsbergen Svalbard, 2019; Stenius, 2016; Węsławski, 2011). These are:

- *Longyearelva*: The river that flows through Longyearbyen, from glaciers like Longyearebreen, Larsbreen and Platåbreen, covering approximately 5 km with a 23 km2 drainage area and it is susceptible to flooding during rapid snow and ice melt.
- *Adventelva*: The river that flows through Adventdalen. It spans about 38 km from the mountains Slottet and Tronfjellet. It is susceptible to flooding during rapid snow and ice melting.
- *Endalselva*: Extending around 12 km with a 36 km2 drainage area, it flows into Isdammen in Adventdalen, serving as Longyearbyen's primary water source. Flooding in Endalselva would impact the city's water supply.
- *Bolterdalselva*: About 8 km long river, flowing through Bolterdalen and emptying into Adventelva, with water primarily sourced from the glacier Scott Turnerbreen.
- *Vannledningsdalen*: Positioned on the east side of Longyearbyen, this area is particularly vulnerable to slush avalanches during conditions of heavy rainfall, warm temperatures, and snowmelt. Its position and exposure to the city lead to the decision, made in 2022, to implement permanent security measures to prevent new slush avalanches.

The complex environmental and demographic dynamics of Svalbard and Longyearbyen underscore the importance of comprehensive planning and risk mitigation in the face of ongoing climate challenges, which furthermore expands the populations demands for risk information from the government.

4.2. Flood as a climate related risk

Floods and inundations are two of the predicted climate changes expected in Svalbard, according to NCCS (2019). Additionally, SvalbardROS (2022-2016) states: *There is an assessed low risk of societal values being affected by flooding in Longyearelva and Larselva, provided that planned protective measures are established and maintained. However, there is some risk that a flood could impact societal values in Adventdalen.* (own translation) (Governor of Svalbard, 2022, p. 4).

Flood risk is also emphasized in one of the risk- and vulnerability analyses by the Local Government. This analysis is published as an attachment to the Local Government's Area Plan, underscoring its focus on flood risk in various areas of Longyearbyen, in accordance with the Area Plan. A flood in the rivers in and around Longyearbyen could result in harm to the population, property, infrastructure, and other societal assets. Despite the Governor assessing the flood risk as low in the evaluations for 2022-2026, it is conceivable that this risk will increase in the coming years. Therefore, it is a relevant risk to study more closely.

Predictions regarding floods are characterized by significant uncertainties since flood volumes are linked to changes in precipitation, snowfall, and glacier melt. A decrease in snowfall will lead to fewer snowmelt floods, while an increase in water flooding is expected due to greater precipitation amounts and frequency (NCCS, 2019). Another type of flood is glacier outburst floods, caused by a significant rise in temperature and the melting of glaciers (NCCS, 2019). This type of flood occurs due to water accumulation at a glacier, and as the glacier melts, this water volume is released as a flood.

In a report published by The Norwegian Water Resources and Energy Directorate (NVE), Stenius (2016) states that snowmelt floods in the area around Longyearbyen are most prevalent in June-July, while floods caused by heavy rainfall and glacier melting occur in August-October. During the winter months, floods are rare as the rivers are frozen. However, these trends can change during periods of intense rainfall in conjunction with mild weather. For example, this occurred in 2015 when 26.5 mm of precipitation was recorded in 24 hours on December 30th, and 77 mm over four days (December 30, 2015, to January 2, 2016), which corresponds to approximately 40% of the normal annual precipitation' at Svalbard Airport (Stenius, 2016, p. 4). Additionally, numerous floods have been recorded in De Geerdalen from the 1990s to the present. De Geerdalen is a valley located further inland in Isfjorden than Longyearbyen. Isfjorden is the body of water into which Adventfjorden flows in the northwest of Longyearbyen (Barr, 2023b). The largest recorded flood in De Geerdalen occurred in July 2000.

4.3. Language in Longyearbyen

Longyearbyen boasts a diverse population, with 2,500 residents from around 50 different countries. The majority come from Norway, Thailand, Sweden, the Philippines, Denmark, and Germany (Berg, 2019; Longyearbyen Community Council, 2022; SSB, 2012). Recognizing this diversity is crucial, as people's varied backgrounds influence how they perceive information and shape their expectations when seeking or receiving information. Additionally, residents tend not to stay for extended periods of time, with a statistical turnover rate of the population every five years (Governor of Svalbard, 2022). This frequent change in population can impact preparedness resources and the overall stability of the Svalbard archipelago (Johannessen, 2022).

While the official language in Longyearbyen is Norwegian, and governmental organizations in the city more or less operate exclusively in Norwegian, a significant portion of the population consists of non-Norwegian

speakers. Consequently, this demographic relies on communication in a language they understand, which is often English.

During the interviews, several informants expressed concerns that risk communication, from the government to residents, is not readily available for those who do not speak Norwegian. Two non-Norwegian informants even reacted with laughter when asked if they had access to information in a language they understood, stating, "Are you really asking me that question?" Another informant noted, "[...] if you are an active participant, you can find it, but if you are passive, perhaps from abroad and not familiar with where to find information, then I think it can be difficult to access."

Some informants mentioned that, aside from the Governor, who provides much of the information in both Norwegian and English, most of the information in town is in Norwegian. Even though the Governor's webpage is available in English, Norwegian, and Russian, their risk and vulnerability analysis for Svalbard is published only in Norwegian. Additionally, there are no community meetings held in English, and all local meetings are conducted in Norwegian. These meetings are typically organized by the Governor or the Local Government. Overall, dissatisfaction with the lack of English risk communication, but also communication in general, was expressed in more than half of the conducted interviews.

Many Norwegian-speaking informants acknowledged that others are dissatisfied with the lack of accommodation for non-Norwegian-speaking residents, recognizing that most of the information is available only in Norwegian. In contrast, non-Norwegian-speaking residents that were interviewed directly expressed their dissatisfaction. In one of these interviews, the conversation delved into the divide between Norwegian-speaking and non-Norwegian-speaking residents in Longyearbyen. It was noted that the absence of information in English exacerbates this divide. Simultaneously, an informant from the Local Government stated, "We are very focused on things being in Norwegian." Conversely, when an informant from the Governor was questioned about the language in which their information is published, they responded, "The general rule is that it should be in Norwegian, English, and Russian. On the website, you should be able to read all the articles in English. Furthermore, the Governor holds community meetings in Norwegian in Longyearbyen and meetings with a Russian interpreter in Barentsburg."

Informants from the Local Government believed they provided sufficient information in English, citing information brochures in multiple languages and crisis communication conveyed in several languages. The Local Government's website also offers a function where Google Translate can translate the webpage into another language e.g. English, French, Russian, or Thai. However, this contrasts with the fact that all community meetings and hearings organized by the Local Government are exclusively conducted in Norwegian. Despite the Local Government informants' belief that they provide enough information in English, residents expressed dissatisfaction with the lack of available information in English.

4.4. Communication in Longyearbyen

The population in Longyearbyen primarily receives information about climate risks from friends and family, Facebook, and SvalbardPosten, the local newspaper.

Facebook is the most widely used communication source among the population. The key source on Facebook is the group "Ros & Info Longyearbyen," boasting over 9000 members. This group serves as a knowledge sharing platform for current and former citizens. Government-run Facebook pages are also members. Pages use the group to share information on various topics to reach a broader audience. Most of the government's posts on Facebook, whether on their official pages or in the group, contain links to their website posts. However, many informants expressed concerns about relying on social media, particularly Facebook, as the primary source for risk communication. These informants highlighted the challenges of communication through this channel, emphasizing the difficulty of reaching people who do not have access to the social media platform. As one informant pointed out, "A significant issue in town is that it relies on Facebook. […] If you didn't see a post, then you miss the information completely".

Even though Facebook is portrayed as a channel meant for two-way communication, the Local Government and the Governor has a policy about not responding to comments that they receive on the social media platform. This usage of the platform, as a one-way-communication channel, contrasts the population's expectations about the channel as a two-way-communication platform. Despite Facebook being the most used information channel, several informants expressed concerns that communication through social media could be problematic. They expressed doubt about whether the government's use of Facebook as a channel for risk communication is as effective as they believe it to be.

All the informants emphasized that a significant portion of risk information in Longyearbyen is communicated through social networks, especially friends and acquaintances. This is supported by the results of the survey. Following, many residents use their own experiences as a source of information. One informant highlighted that they used to live near Longyearelva, and at that time, they were concerned about floods and inundation. Now, residing in Vannledningsdalen, their focus has shifted to mudslides. Others reported that they

rely on their own experiences to alert about new events, potentially overriding information from authorities. This indicates that the informants have greater trust in information from close contacts and personal experiences than the information provided by the authorities. Based on this, it can be concluded that information conveyed through social networks and knowledge gathered from personal experiences plays a significant role in information gathering and risk assessment for the residents of Longyearbyen.

This correlates to the fact that less than half of the respondents on the survey reported utilizing the Governor's and the Local Government's websites in searching for information or attending public meetings. Most of the information regarding climate risks and climate change in Longyearbyen is disseminated through documents and reports on the websites of the Governor and the Local Government. To access this information, there is an expectation that the population will actively seek it out. One informant noted that the COVID-19 pandemic highlighted the lack of readily available information from the authorities, while another informant indicated that the information is available if one actively searches for it. Simultaneously, some informants mentioned that they read documents from the websites of the Governor and the Local Government when it pertains to their housing or job-related matters, whereas others do not use the government websites. At the same time, the public meetings are one of the only channels that is open for feedback from the population. Even though these meetings are primarily held in Norwegian, the non-Norwegian speaking residents are welcome to ask questions in English after the presentations are held.

The government's usage of the local newspaper for risk communication is limited. Nonetheless, the Governor, in an effort to promote information about SvalbardROS, which is the risk and vulnerability analysis for Svalbard, published a summary of the report in SvalbardPosten. This summary was in Norwegian. Furthermore, the survey showed that only 41% of all respondents received information from the government about the dangers concerning climate risk when moving to the city, and of these people only one person received this information from the government. The others received the information from their employer or the University Centre of Svalbard (UNIS).

Even though less than half of the population search for information on climate risks from government sources, and instead rely on social networks and Facebook and only 35% of the respondents feel they have the possibility to give feedback on the government's communication, the residents' expectations for government risk communication are high. The interviews and surveys revealed a consensus among residents that the government bears a significant responsibility for communicating climate risks. This involves informing the population about potential dangers and risks and providing knowledge and tools to handle such situations. There is some disagreement among the population regarding the extent to which the government's expectations for communication with the public are being met. Some residents who have lived in the city for several years believe there has been an improvement, while others disagree with this assessment.

Overall, risk communication about climate risk and flooding in Longyearbyen is spread across several different channels. The most prominent being Facebook, and where the other channels have limited, but some, persistent users. Communication in Longyearbyen is influenced by the town's unique location in the Arctic, with an international, but small, population, all of whom have chosen to settle on the archipelago.

5. Discussion

The aim of this paper is to study the link between the Longyearbyen authorities flood risk communication and the risk perception among members of the population. We start with the risk communication in Longyearbyen, before we move on to the population's risk perception.

5.1 The authorities' risk communication

Risk communication primarily involves the effective communication of risks (Qiu et al., 2016). A key element of risk communication is that it is a communication process focused on two-way communication (Renn, 2008) that is shaping the risk perception of the recipients of the communication.

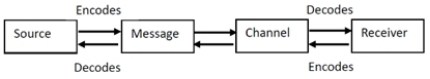

Fig. 2. A modified communication model with two-way communication (feedback loop).

Risk perception is about how individuals perceive and assess risks (SRA, 2015). The way risks are communicated, the means and methods used, and the recipients targeted by the communication are elements that influence risk perception. A shifting climate impact society (Zscheischler et al., 2018) through a variety of

climate risks. Due to climate change, these impacts will occur more frequently and more drastically (Engen et al., 2021). This makes climate risks more unpredictable and harder to prevent, especially relevant in the Arctic where climate change has the most significant impact (NCCS, 2019; Norwegian Polar Institute, 2014).

So, is flood risk "made common" (Rosengren, 2000, p. 1) or communicated in Longyearbyen? This study reveals that risk communication in Longyearbyen deviates from this model in several areas. Firstly, our findings show that climate risk communication is challenging due to the technical and comprehensive nature of the message, or the risk information, which, according to Rakow et al. (2015), complicates communication. Receivers of risk communication may struggle to understand the technical language and grasp the overall content of the reports.

Secondly, conveying risk information to a diverse population, such as in Longyearbyen, considering factors like language, residency and diverse backgrounds is challenging. This is particularly true for those who do not speak Norwegian. This segment of the population will miss out on significant portions of available information. High turnover rate increases this challenge because of knowledge loss, as those who move may not always share their experiences with others.

Thirdly, communication from the Local Government and the Governor is vague, especially on platforms like Facebook and the news sections of their websites. This is because the purpose of the channel Facebook contradicts how it is utilized by the government. It would be beneficial for the Local Government and the Governor to use Facebook to gather feedback from the population, aligning more with Wendling et al.'s (2013) recommendation of utilizing social media as a two-way communication tool. Moreover, almost exclusively, information about the risk of avalanches is published on Facebook, a platform that can make it difficult for the source to know how a message is received and responded to. Furthermore, Facebook has its own algorithms and structures that the Local Government and the Governor cannot control, thus lacking a way to manage the message once it has been posted.

Fourthly, accessibility is a significant challenge. Reports and documents are not easy to find on the websites. Finally, the residents of Longyearbyen believe that they themselves have a responsibility to seek out information about risk. They obtain such information from other residents through "Ros & Info Longyearbyen," friends, and acquaintances. Consequently, a significant amount of risk information and communication occurs horizontally at a grassroots level in the community, among the population. This mode of communication may have emerged due to inadequate vertical communication from the authorities. However, the public's trust in key societal institutions is vital both for their functionality, but also for people's response (Olsen et al., 2007). The effectiveness of executive authorities in specific domains are crucial for the population's perception of them as trustworthy communicators, and thus, how the population adapts according to the authorities' risk communication. If the residents have little trust that they will be informed by the authorities in a timely manner, they look elsewhere for information about climate risk. Thus, a horizontal information network has arisen among the population to fill the gaps in the vertical flow of information from the authorities. The government's communication would benefit from tapping into this type of horizontal communication. Figure 3 illustrates various forms of risk communication in Longyearbyen:

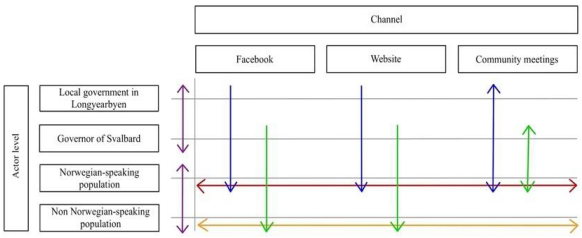

Fig. 3. Risk communication in Longyearbyen.

This less effective risk communication (Qiu et al., 2016) is an indication of a communication breakdown as shown in Figure 4.

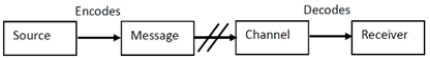

Fig. 4. A simplified communication model with communication breakdown.

Such a communication breakdown may lead to a vacuum in risk communication and sensemaking and thus parts of the population missing out on risk communication, influencing their risk perception since risk perception is heavily influenced by social communication (Renn, 2008).

5.2. The population's risk perception

Human behaviour is driven by perception, not facts (Renn, 2008). The risk perception of the population is shaped by what is communicated to them, how it is communicated, personal experiences, and individual factors (Renn, 2008). The population in Longyearbyen, like other communities, is characterized by differences, including occupation, nationality, previous experiences, and similar factors. Such factors contribute to shaping how individuals perceive risk.

Different individuals experience the same risk in different ways (Renn, 2008). Personal factors, such as individual experiences, mental shortcuts, trust, knowledge, values, and social and background factors, together shape an individual's risk perception (Renn, 2008). This means that factors like workplace, place of residence, age, and gender influence individuals' risk perception, and these are factors that authorities should consider in their risk communication. As a result, various groups in society will perceive the same risk differently. Our research has identified the outlines of a "divided" society in Longyearbyen.

The categorization factors of language and background can be linked to individually influential factors on risk perception. These categorization factors refer to the significant differences within Longyearbyen's population and thus highlight the considerations that should be made to be inclusive of everyone (Renn, 2008). Not communicating in a common language can lead to misunderstandings and misconceptions. Providing information in multiple languages will enhance understanding and awareness of risks among the population. The optimal approach for effective risk communication is therefore to communicate in a language that the entire population can comprehend, in contrast to the Local Government's current practice and the Governor's general practice at town hall meetings in Longyearbyen. However, it is important to note that offering information in multiple languages can be costly and time-consuming. Communicating technical and professional terminology, especially in a non-native language, can also be challenging (Rakow et al., 2015).

Informants' background factors influence how risk is perceived and how risk communication is received (Renn, 2008). These factors mainly involve elements that make it more challenging for individuals to understand the context of potential information, which can weaken their risk perception (Renn, 2008). Therefore, it is crucial for authorities to understand the population's beliefs, attitudes, judgements, and feelings, as well as the wider cultural and social dispositions they adopt towards threats to things that they value (Pidgeon, 1998) and tailor risk communication accordingly. Using codes from different backgrounds in risk communication pose different challenges, such as communicating in a Norwegian context, and these codes cannot be decoded by individuals who do not share the same background. Thus the authorities need to be aware of the receivers' various nationalities and languages to adapt risk communication to the local community.

The Governor publishes risk information in English, Norwegian, and Russian, tailoring the language to the population in Svalbard. However, it is difficult to determine whether the information is translated from Norwegian to the other languages with consideration for the recipient's nationality, or if the information is communicated in a Norwegian context. At the same time, finding a balance between adapting communication and ensuring it is correct and precise can also be challenging. In an ideal world, both the language and social codes in risk communication would be adapted in government risk communication, but this has not yet been achieved in Longyearbyen.

6. Conclusion

So, has risk communication taken place in Longyearbyen, or is it, as George Bernhard Shaw points out, "an illusion that communication has taken place?"

The findings of this paper reveal a lot of risk communication in Longyearbyen, mainly on avalanche risk, but also on flood risk, on a lot of platforms. However, the paper also reveals weaknesses in the authorities' risk communication, leading to several adverse outcomes, and a low flood risk perception among the population. The result is individuals within the community seeking information about risk from alternative sources, in a form of horizontal level of communication among the population.

That said, risk information from the authorities plays a crucial role in shaping the risk perception among parts of the population. However, the communication is mainly a one-way communication, leading to the authorities missing out on the knowledge possessed by parts of the population, and less information about the degree to which their risk communication is received by the receivers. The language barrier is a major obstacle for the authorities' risk communication to a huge part of the population in Longyearbyen. Furthermore, individual and background factors, such as cultural background, trust, mental heuristics, and social groupings, influence the population's risk perception. Recognizing the diversity within Longyearbyen's society, it becomes essential for authorities to consider the individuality of the population in their communication efforts.

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