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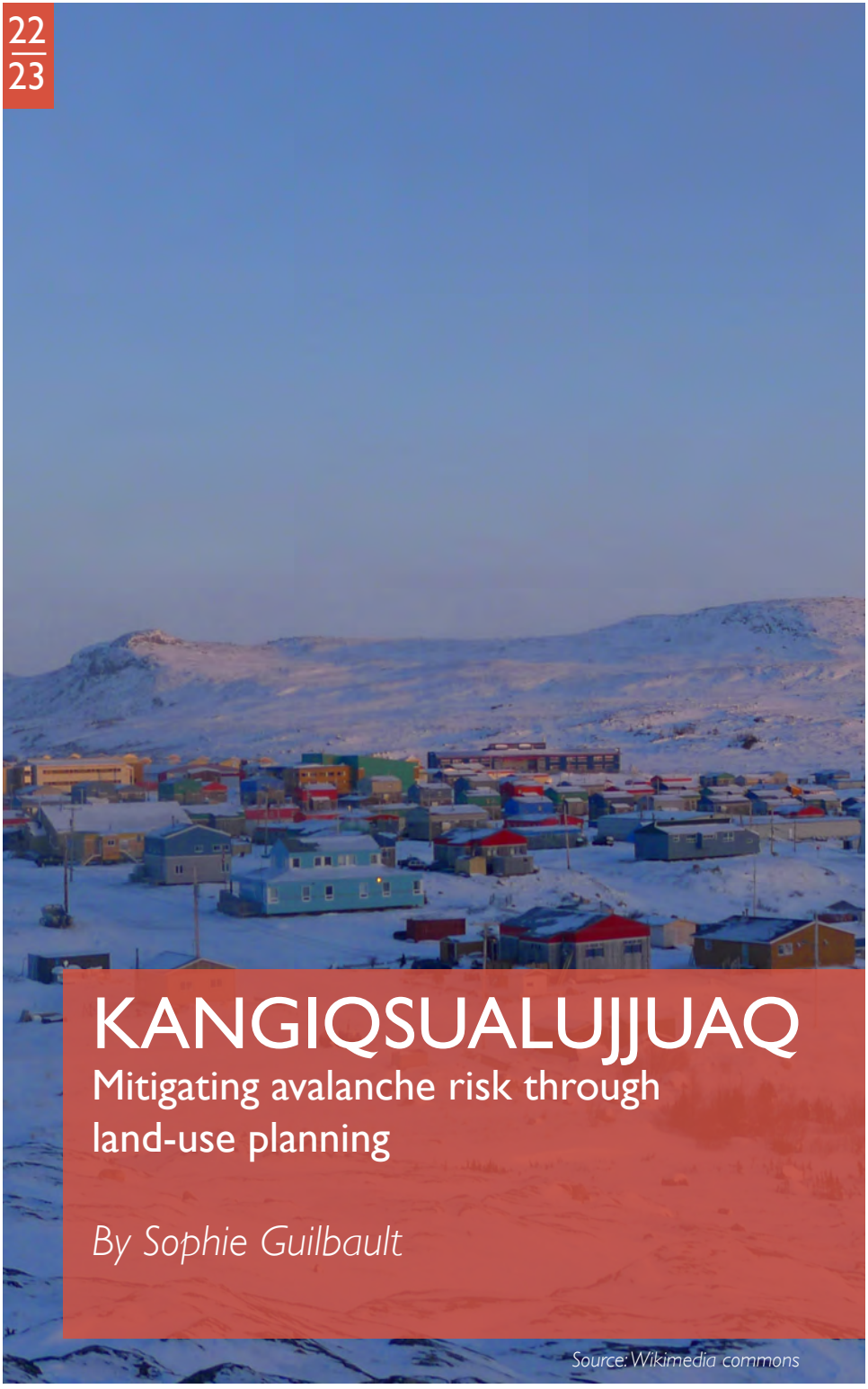

KANGIQSUALUJJUAQ

Mitigating avalanche risk through land-use planning

By Sophie Guilbault

Source: Wikimedia commons

THE SCIENCE

Snow avalanches happen when a mass of snow loses its attachment to an inclined surface, such as a hill or mountainside. While there are several thousand snow avalanches in Canada every year, only a very small percentage occur near communities, transportation routes, or recreational areas. When avalanches happen in areas where there is human activity, they can cause various levels of damage depending on their type, mass, path length, and impact pressure. Snow avalanches can be triggered by a variety of factors including wind, rain, warming temperatures, skiers, snowmobiles, etc.

In Canada, avalanches are mostly known to happen in the mountains of British Columbia, Alberta, and the Yukon. However, some happen in other areas of the country, such as northern Quebec. In this remote region, the majority of avalanche incidents have happened on short and steep slopes (minimum of 30° incline) with a poorly vegetated plain surface at the top. These specific conditions are known to be favourable to snow drifting and the formation of overhanging edges of snow.

THE TRIGGER

One of the deadliest avalanches in Canadian history affected Kangiqsualujjuaq, a small Inuit community located in Quebec, on the east shore of the Ungava Bay. The village of Kangiqsualujjuaq was established in 1959 in a valley surrounded by a small mountain ridge. Given its northern location, the community is particularly isolated and can only be accessed by air transportation. Travelling in and out of the community in the winter months is particularly challenging, as flights to and from the village are highly dependant on weather conditions.

During the early hours of January 1st, 1999, between 400 and 500 residents of Kangiqsualujjuaq were gathered in the gymnasium of the village's school to welcome the New Year. Shortly before 2 AM, a dry slab avalanche rapidly slid down the hill located behind the school. The gymnasium was instantly buried and one of its walls collapsed under the immense pressure, leaving several people covered by two metres of snow. While some were able to escape, others were unfortunately not rescued in time. Nine individuals lost their lives in this tragedy and 25 were injured.

THE APPROACH

Following the avalanche, an investigation took place mandated by the Quebec Ministry of Public Safety. The Coroner's report indicated that several factors contributed to the fatal outcome of the avalanche that affected Kangiqsualujjuaq. First, it appears that negligence related to the construction and renovation of the school over the course of 25 years was to blame for the way the building sustained the impact of the avalanche. Second, the lack of hazard zoning in the village also

Figure 6: *In Canada, avalanches are mostly known to happen in the mountains of British Columbia, Alberta and the Yukon. However, some happen in other areas of the country, such as northern Quebec. (Source: Adobe Stock Photo)*

contributed to the devastating outcome. Finally, poor risk management of snow avalanches in the area also contributed to the consequences of the January 1999 avalanche in the village of Kangiqsualujjuaq.

Following the Coroner's investigation, recommendations were made to reduce risks associated with snow avalanches in Quebec. In addition, Quebec's Public Safety requested that the Norwegian Geotechnical Institute (NGI) assess snow avalanche hazards and possible mitigation measures for villages located in Nunavik and on the Lower North Shore of the St. Lawrence River. Experts from NGI partnered with the Quebec Ministries of Public Safety and Natural Resources and visited 14 communities in the pre-identified areas to evaluate the risk of snow avalanches faced by these communities and to delimit the run-out distance of avalanches with a return period of 1:100 years.

In an effort to assist the Inuit community of Kangiqsualujjuaq, the Government of Quebec invested $30 million (1999 dollars) to introduce three different assistance programs. The first program was focused on emergency measures, including the provision of temporary shelters and clothing, the repair of damaged snowmobiles and sledges, and the reimbursement of the expenses covered by the organizations that helped the victims of the avalanche. The second program was developed to repair the infrastructure and equipment damaged during the event. The third and final program helped with the relocation of local businesses that were in high-risk areas. In the spring of 1999, the Ministers of Public Safety and Aboriginal Affairs signed a five-year agreement (1999-2004) with the Kativik Regional Government. The $700,000 agreement was used to set up a regional organization and municipal civil security organizations for 14 northern villages to mitigate future risks faced by these communities.

THE OUTCOME

Following the Kangiqsualujjuaq avalanche and the recommendations that came out of the coroner's report, several actions were taken by Quebec's Ministry of Public Safety to reduce the future risk of injuries and fatalities due to snow avalanches. For instance, the day after the avalanche, the Ministry recommended the establishment of an exclusion zone of 75 metres to municipal authorities that would cover the area between the bottom of a hill or mountain and the closest street. Later on, the recommended exclusion zone was increased to 100 metres. Not only did this prevent future construction in the exclusion zone, but the Quebec government also decided to relocate the exposed buildings outside of the hazard zone. Homeowners that had to relocate outside of the risk area were presented with three different options. If their house was considered safe from an engineering perspective, the building could be moved to a different area of the village. Homeowners could also choose to build a new property or buy an existing home in a safer area of the community. Finally, they were also given the possibility to receive a fixed amount of compensation, based on the value of their house, to vacate the hazardous area. Given the high number of homes that had to be relocated, the Government of Quebec funded the relocation program over several years until all buildings were relocated outside of the avalanche risk area, or removed.

A WORD FROM KANGIQSUALUJJUAQ

Following the Kangiqsualujjuaq avalanche, Quebec's Ministry of Public Safety led the recovery operations that took place in the village. At the time, François Morneau worked as a Scientific Coordinator and Risk Management Specialist for the Ministry and was involved in the recovery and rebuilding operations that took place in the community. When asked about his thoughts on the decisions that were made in the rebuilding of Kangiqsualujjuaq, Mr. Morneau said that "When it comes to risk management, it is important to show leadership and not be afraid to make hard decisions that could positively impact the long-term future of a community. In Kangiqsualujjuaq, the Ministry decided to rely on the expertise of NGI because of their familiarity with the type of landscape that is found in Northern Quebec. Their expertise allowed us to establish an adequate exclusion zone for the community, and for other villages in Northern Quebec. The decision to relocate buildings outside of this exclusion zone in Kangiqsualujjuaq was extremely important as it contributed to keep the population from harms way and reduce the risk of future losses from avalanche."