Water Security of Arctic Peoples

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Arctic peoples, especially indigenous subsistence hunters, are often overlooked when it comes to the global water crisis. Although some may have been surviving on ice for thousands of years, many communities are still subject to poor infrastructure and are especially affected by global climate change. Solutions to these crises depend strongly on region, with soft-path rainwater harvesting working in some subarctic communities but others requiring hard-path infrastructure such as piped running water.

The Millennium Development Goals of the United Nations (UN) are targets that include the access to clean water for everyone on Earth. For good reason, programs to help in the achievement of these focus on less-developed nations, where the eight Arctic countries are all considered developed due to their expansive southern populations. However, the polar areas of these countries contain marginalized communities with low access to clean water that would not qualify as meeting the UN's targets, the "fourth world".

Many homes in rural Alaska do not have piped water service. Without such service, people there must get water directly from the environment or from stores which charge a high price for the service of transporting it. Thus, these households, on average, only use 5.7 liters per person per day (Hennessy & Bressler, 2016), what the World Health Organization considers "no access" and of "very high" health concern (Howard & Bartram, 2003). Doctors with the Alaskan Centers for Disease Control have noted that Alaskan Native children have some of the world's highest rates of invasive pneumococcal disease, even after introduction of the PCV7 vaccine. The researchers strongly connect this problem to a lack of running water in the homes of these children which limits handwashing (Wenger et al., 2010).

In the Labrador town of Black Tickle, the Inuit residents must retrieve water from shallow wells in town or from a small brook twenty-five kilometers away. Counterintuitively, winter is the easiest season to retrieve water, as traditional Inuit sleds allow for quick and easy travel. In the spring, however, the ground is so wet that inhabitants must carry water on their backs. As a result, nearly every man in the town reports chronic back and shoulder pain and cannot undergo surgery as they are needed daily to procure water. When the relatively new provincial water filtration system broke down in 2012, the community saw an outbreak of gastrointestinal illness. Many older members of the community have said that illness was a normal condition of the town in the past (Hanrahan, Sarkar, & Hudson, 2014).

Indigenous peoples of Siberia have lived there for much longer than those of the New World, but they still suffer from the many problems of all Arctic peoples. Researchers have surveyed the saturation of hot running water to homes within all of Russia's regions. In Eastern Chukotka, the indigenous home of Chukchi people, only 30% of communities across the region had any access to hot water (Hennessy & Bressler, 2016). It should be noted that access to running water, even if hot, is safe for human use. In Arctic and Siberian regions, centralized surface water sources have extreme levels of contamination by both chemicals and biological agents. The study found over 50% of sources had chlorine or magnesium, and nearly 1% of water contained Rotavirus or *Clostridium* spores (Dudarev et al., 2013). The water crisis involves more than just drinking

water. Drastic health impacts result from lack of modern sewerage. The United Nations has noted that only 25-50% of housing in Nenets Autonomous Okrug has sewerage installed (*Russia's Regions: Goals, Challenges, Achievements*, 2007), and this is likely to be far more severe in the rural parts of the federal subject.

Indigenous people of the Arctic are overwhelmingly subsistence hunters, and for the Inuit, hunting is an important coming-of-age milestone. In North America, the melting of sea ice in spring heralds the return of narwhal, whose skin contains the greatest concentration of Vitamin C in the Arctic. Without the narwhal, it's unlikely that the Inuit would have ever survived in much of their territory (Brown, Flowers, Jones, & Stone, 2011).

Climate change is causing Arctic sea ice to melt drastically faster than it had previously. Weakened sea ice prevents hunters from going out as far as in past decades, as the ice can crack underfoot and subject the hunter to a hypothermic plunge (Brown et al., 2011). In 2013, two Inuit communities were forced to cut short their hunting seasons after sea ice melted early and, as a consequence, the Governor of Alaska declared them disaster areas. After the ice melted even earlier the next year, the state government flew in 10,000 pounds of fish to save the communities (Struzik, 2016).

In one Inuit village, hunting means scouring for mussels. Normally impossible with the permanent cover of ice, the community of Kangiqsujuaq breaks into caverns under the sea ice, where the tide varies an incredible twelve meters. There, they scour the exposed ocean floor for mollusks for a half hour until the tide returns (Brown et al., 2011). Rising ocean levels threaten to shorten the gap between sea and land ice, possibly leading to such caverns being permanently submerged. Without mussels, the residents of Kangiqsujuaq will go without a major source of nutrition.

In the northwest Alaskan island of Kivalina, the community shares a single facility with running water for showers, laundry, and toilets. A report by the regional Department of Community Health Services discovered that since 2004, storm surges resulting from lack of ice formation have caused this facility to close frequently for extended periods. The sudden lack of flush toilets has resulted in drastic health impacts, with increases in visits to the community clinic for soft tissue infections (Thomas, Bell, Bruden, Hawley, & Brubaker, 2013).

While those in temperate regions are terrified of their pipes freezing and breaking, those in the Arctic experience the opposite: thaw of permafrost can allow the ground to shift and collapse infrastructure, especially long-distance water piping (see Figure 1). Climate change threatens to exacerbate this damage. As permafrost melts deeper into the Arctic Circle, more hard-path infrastructure will suffer severe damage.

Improving water access amongst Northern communities varies considerably on local environments. Some locations, especially in the subarctic, have enough rainfall or partially thawed lakes to provide some freshwater. In colder and drier parts of the Arctic, it is unlikely that such easy acquisition of water can be reliably obtained.

The Sustainable-Development Working Group (SDWG) in the Arctic Council has been working to discover new ways to sustainably provide in-home water and sanitation to underserved Arctic communities. At the impending 10th Ministerial Meeting of the Arctic Council on May 11, the foreign ministers of Arctic nations are set to discuss the findings of the SDWG's 2016 Conference on Water Innovations for Healthy Arctic Homes (WIHAH).

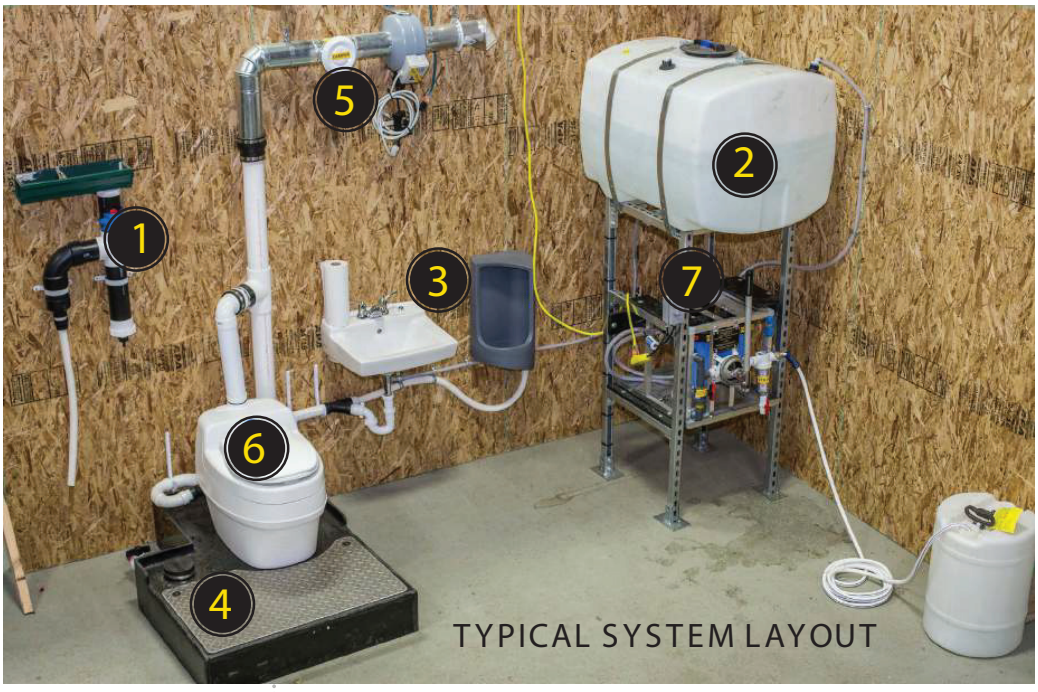
Across the Arctic, soft-path solutions are preferred. All Arctic nations, especially Canada, decentralize their water distribution networks to the community level, creating a great barrier for dispersed communities to access water in the same way as Southern urban areas. Furthermore, some Arctic people are wisely averse to drinking groundwater. Surveyed Inuit communities in Alaska have noted a traditional preference for drinking snowmelt, especially in winter, when it can be caught in buckets (Dotson, 2016). Thus, decentralized water services such as domestic rainwater harvesting and using high-efficiency utilities can manage water effectively.

In the subarctic, rainwater harvesting can be a lucrative supplement to a community's current source of water. In one particular Inuit community, researchers implemented a pilot scheme that returned an average of 19.07 gallons of water weekly. The researchers noted that the rainwater was not potable, and as such, drinking water did not increase; however, the participants in the program testified that they felt healthier (Mercer & Hanrahan, 2017). With improved water filtration, domestic rainwater harvesting can be able to meet drinking water needs as well.

In Black Tickle, Labrador, researchers from the province's university trained two locals to monitor the water sources for sanitation and send regular water samples to Happy Valley-Goose Bay, the nearest large town (Hanrahan et al., 2014). Programs such as this can be extremely useful in preventing disease before

Figure 1: A collapsed service line due to permafrost thaw in Selawik. Reprinted from Brubaker, M. (2011). The Snyder kids are all smiles despite the sagging Arctic pipe that brings water to their home. In M. Brubaker, P. Chavan, J. Berner, M. Black, & J. Warren (Eds.), *Climate change in Selawik, Alaska: Strategies for community health* (p. 1). Alaska Native Tribal Health Consortium. Anchorage: ANTHC Center for Climate and Health. Copyright 2011 by Brubaker

PORTABLEALTERNATIVESANITATIONSYSTEM



1. RAIN CATCHMENT

For an 800-square-foot home with a catchment area of approximately 1,200 square feet, it is possible to recover nearly 3,000 gallons or more of rain each year to supplement the quantity of water hauled to the home.

2. WATER STORAGE TANK

The 100-gallon, gravity-fed tank does not require electricity.

3. LOW-FLOW SINK AND WATERLESS URINAL

The sink and urinal conserves water while providing for hygiene and sanitation needs.

4. GREY WATER TANK

The grey water tank purges into the seepage pit below when full.

5. INTEGRATED VENTILATION

An energy-efficient combined ventilation system dries the waste, reduces odors, and ventilates the home.

6. SEPARATING TOILET

Waste is separated into liquid and solid components where the liquid is disposed of into a seepage pit and dried solids are disposed of in the landfill.

7. WATER TREATMENT SYSTEM

The water treatment system incorporates membranes and chlorination for point-of-use treatment to ensure the water is safe to drink despite its condition upon entering the system.

Figure 2: The Alaska Native Tribal Health Consortium's proposal for the State of Alaska Water & Sewer Challenge Project. Reprinted from Hickel, K., & Heavener, M. (2016). The portable alternative sanitation system (PASS): A water and sanitation pilot project. In *Water innovations for healthy Arctic homes: Addressing the challenges of providing safe and affordable access to household running water and sanitation in in remote Arctic and sub-Arctic communities*, September 18–21, 2016 (pp. 76–77). Anchorage Hilton. Anchorage, p. 86. Copyright 2016 by Hickel and Heavener

outbreaks occur. With so many in Black Tickle and across the Arctic suffering from regular gastrointestinal sickness, it is imperative that programs to monitor water quality are put in place across the region.

The WIHAH conference included coverage of the Alaska Water and Sewer Challenge, a state competition for engineers to design decentralized soft-path solutions to poor sanitation. Currently, the program is in Stage 3 – prototyping and lab testing the grant recipients. Most teams designed a system with reverse-osmosis filtration to accompany waterless urinals, low-flow sinks, and separating toilets (see Figure 2). This drastically reduces water consumption while still allowing residents to consistently use sanitary systems. A team from the University of Alaska successfully designed a treatment system that, when coupled with a dry-flush toilet, took eight weeks before needing to refill the water tank (Dotson, 2016).

With such severe problems in Arctic communities, it's shocking that they exist within developed nations. It is imperative that soft-path solutions be implemented to promote regional health and welfare. Thankfully, the Arctic Council is working toward these goals with research grants and interdisciplinary approaches. Domestic rainwater harvesting and high-efficiency water reuse systems are extremely helpful to improve public water access in the home, and teaching communities how to ensure their own safety is beneficial in both promoting health and promoting indigenous people's self-determination. However, climate change threatens the future stability of Arctic water access. A global solution to climate change is desperately needed to accompany the soft-path solutions within communities.

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