TESTING DOMESTIC RAINWATER HARVESTING AS A MEASURE TO IMPROVE DRINKING WATER ACCESS IN A REMOTE WATER-INSECURE COMMUNITY: A CASE STUDY OF BLACK TICKLE-DOMINO, LABRADOR

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Testing Domestic Rainwater Harvesting as a Measure to Improve Drinking Water Access in a Remote Water-Insecure Community: A Case Study of Black Tickle – Domino, Labrador

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GLOSSARY AND ACRONYMS

DRWH: domestic rainwater harvesting

LSD: local service district, an unincorporated municipality in the province of Newfoundland and Labrador

NCC: NunatuKavut Community Council, the political organization of the Southern Inuit; Black Tickle-Domino is a member community

PWDU: potable water dispensing unit

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1. Introduction

This report presents findings from a study that investigated domestic rainwater harvesting [DRWH] as a measure to improve water-access in a remote water-insecure Indigenous community, Black Tickle – Domino, on the southern coast of Labrador. Water security refers to the capacity of a population to safeguard sustainable access to adequate qualities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development (UN Water, 2014). DRWH, or harvesting rainwater for general purpose or drinking water, has been promoted by previous researchers as way to improve water security in areas with restricted access, especially in Africa (Helmreich & Horn, 2009).

1.1: Rationale

Black Tickle-Domino is one of many subarctic Indigenous communities without piped water, a situation that negatively impacts economic development and threatens community health. Without a likely large-scale solution coming to fruition, we decided to take a materialist approach following our water security research projects in the community (Hanrahan, Sarkar, and Hudson, 2014; Hanrahan, Sarkar, and Hudson 2015; Sarkar, Hanrahan, and Hudson 2015). This project was the first of its kind to test DRWH in the subarctic. Our goal was to assess the effectiveness of DRWH, an appropriately-scaled innovation, as a partial solution to water insecurity. h.

1.1.1: Water Insecurity in Black Tickle, Labrador

There is a pattern of water access and quality problems in Indigenous communities in subarctic Labrador (Sarkar et al., 2015; Goldhar, Bell and Wolf, 2013). Water insecurity circumstances in the Southern Inuit community of Black Tickle are particularly dire as the community lacks piped water, the potable water drinking unit (PWDU) is inconveniently located and expensive to access, and residents often rely on unmonitored water sources (wells, ponds, springs, ice, etc.) (Hanrahan, 2003) **(Figure 4)**. On a per-capita basis, drinking water consumption in Black Tickle is less than one-third of the Canadian national average **(**Hanrahan et al., 2014; Hanrahan, 2003), severely compromising personal hygiene and water in-take.

Figure 1: Example of Unmonitored Shallow Pond Used for General Purpose

The PWDU is located between one and two kilometers from local homes, necessitating transportation costs (user fees, gas, lube, etc.) which make water affordability and accessibility a significant issue, especially for a low-income community. Bottled water is expensive and often not available so unmonitored wells are sometimes utilized. Animal fecal contamination and the presence of disinfection by-products are the major quality issues affecting unmonitored drinking water sources (Sarkar et al., 2015); thus, PWDU use is preferable, as residents have indicated, and should be better facilitated through appropriate scaling, technical assistance, training, an improved location, and consistent funding.

Because water insecurity can result in multidimensional consequences including adverse health, economic, social and cultural impacts, a regular supply of affordable safe drinking water would have far-reaching benefits for the community (Sarkar et al. , 2015, p.5). The pilot project aimed to have a positive impact on water security by increasing peoples' access to and consumption of drinking water from the PDWU; we also aimed to generate lessons for other remote communities in NL and beyond.

1.1.2: Community Economic Development

We understand community economic development in a broad sense to include paid work, unpaid work, such as family care, household empowerment, and support for community health. Previous research in Black Tickle identified barriers to community economic development (Hanrahan et al 2014).

Residents currently dedicate significant financial and personal resources (i.e.: time, equipment, opportunity costs) to water retrieval, spending up to three hours each day collecting general use and drinking water. One of our questions was whether DRWH could free up resources for other economic activities, such as berry harvesting. DRWH permits access to at least some level of general purpose water, allowing household members to save time and prioritize efforts on the retrieval of drinking water. Therefore, we hypothesized that DRWH may result in direct financial savings/benefits in terms of decreased fuel consumption, less wear and tear on vehicles and equipment (ATVs, snowmobiles, *komatiks*), and increased hours available for other economic activities. Even small financial savings per household have the ability to significantly advance community development, with money redirected to other necessities such as food security and heating costs, which are negatively impacted because of water retrieval costs (Hanrahan et al., 2014).

The pilot project was expected to have broader regional development impacts as NunatuKavut Community Council (NCC), a key partner, plans to identify other remote water-insecure communities that may benefit from insights gained from this project.

1.1.3: Drinking Water and Health

Mental stress has previously been identified as significant health issue resulting from water insecurity in Black Tickle (Hanrahan et al., 2014). Community members worry about whether

their households have enough water and about the physical health impacts of strenuous water retrieval efforts (e.g. in a gender-stratified community, men's muscular-skeletal health problems resulting from the physical demands of retrieving water daily). Parents also worry about being forced to give their children unhealthy drinks such as soda pop as a cheaper and more accessible alternative to PWDU water (Sarkar et al., 2015). Finally, those with chronic health conditions experience additional stress due to drinking water insecurity; for instance, people with Type 2 diabetes cannot follow medical advice to drink plenty of water and are forced to restrict their water intake against medical advice (Sarkar et al., 2015).

By improving access to and increasing people's consumption of safe drinking water, we hoped that participants would experience less stress and worry about water, and that there would be decreased physical demands on people's bodies due to decreased water retrieval efforts.

1.2: Objective(s)

This was a small-scale project, although we had ambitious goals. The primary objectives of the mixed-methods research project were as follows:

- To increase drinking water access through the provision and installation of 14 domestic rainwater harvesting (DRWH) systems in order for households to collect "general use" water, thus allowing householders to concentrate their water PWDU retrieval efforts on drinking water and accrue other benefits
- Working with residents, to measure changes in the consumption of drinking water as a result of DRWH and to measure financial and economic savings/benefits in terms of reduced water retrieval efforts; this would enable us to assess the feasibility and usefulness of DWRH in the subarctic
- Working with residents, to provide analysis and offer recommendations for the improvement of water security through DRWH

2. Study Area: The Community of Black Tickle Domino, Labrador

The study took place in the Southern Inuit community of Black Tickle-Domino which is located on Island of Ponds off the South Coast of Labrador at 53°28′12″N 055°47′15″W in the Canadian province of Newfoundland and Labrador. Black Tickle-Domino is of NunatuKavut ("our ancient land" in Inuktitut) and is a member community of the Southern Inuit political organization NunatuKavut Community Council (NCC). NCC's comprehensive land claim, filed in 1992, includes Black Tickle but has not yet been accepted for negotiation by the federal government.

The people of Black Tickle-Domino and their ancestors practiced seasonal transhumance for hundreds of years, following Inuit culture established in Labrador approximately 1000 CE. They wintered in wooded areas in Porcupine Bay and Reeds Pond and traveled to the coast to fish in spring and summer with Island of Ponds as their main summer station. The Southern Inuit of Black Tickle-Domino were settled on Island of Ponds year round in the late 1960s, at the urging of the Roman Catholic Church and the government of Newfoundland, which wanted to end Indigenous people's seasonal movements for the stated purpose of service delivery, especially schooling. The site of Island of Ponds, on rich cod-fishing grounds, was chosen for them, not

with them, in keeping with the top-down decision-making processes at the time.

Despite its name, there is no potable water available on Island of Ponds; there are only shallow ponds containing still water. Extremely glaciated, the island is composed of subarctic tundra with low-lying vegetation and very little soil cover on igneous rock. Fog is common and winds are high as is snowfall and rainfall. This portion of the Labrador coast receives an average of 189 inches of snow and 209 inches of rain annually, with early summer being the rainiest season (Southern Labrador, 2010). The weather is highly changeable and is heavily influenced by the cold ocean waters of the Labrador Current. Transportation to the island is by plane, although there have been no commercial flights in recent years, coastal boat in summer and fall, and snowmobile or dog team during the long winter. The island is iced-in for approximately six months of the year, from December to June.

The people of Black Tickle-Domino are predominantly the descendants of Inuit women and British men who came to Labrador to engage in fishing and trapping. Because of the climate and geophysical environment, the people have always used the social, cultural and economic adaptations of their Inuit, rather than British, ancestors. The Inuktitut language has virtually died out in the community, replaced by English, although some nouns, mainly related to food, survive. The population of Black Tickle-Domino is currently 140 in 40 households, some of them multi-generational, with a larger seasonal population. The population has declined in recent years with the 2013 closure of the local crab processing plant; it was about 250 people when the plant was in operation. Residents combine government transfer payments with seasonal work outside the community to generate household incomes, which are low. Hunting and fishing remain important food sources; as part of their food acquisition efforts, residents pick blackberries and ‘bakeapples’ (cloudberries), they hunt ringed and harp seals and Canada geese, and they fish for cod and salmon. In keeping with Inuit cultural values, food sharing is extremely common. Many families have small cabins inland where they spend time in winter, accessing fur-bearing animals and water from brooks, echoing the community pattern until permanent settlement.

There is an all-grade school with an enrolment of 19 students in 2015-2016 in the community; enrolment will increase since the pre-school population was 12 in the summer of 2016. Black Tickle-Domino has a medical clinic, staffed by a registered nurse-practitioner and a licensed personal care attendant; the clinic is open four and a half days a week. In cases of emergency, residents are air-lifted to Goose Bay, the main Labrador service centre, if weather permits. The nearest community, Cartwright, home to approximately 700 Southern Inuit, is about 62 miles away as the crow flies (although it is not possible to travel there so directly); people from Black Tickle-Domino travel to Cartwright via snowmobile in winter and boat in summer. (Cartwright itself is on a gravel road that is a five-hour drive from Goose Bay.) Thus, Black Tickle-Domino is one of the most remote communities in Newfoundland and Labrador, which is Canada’s most remote province.

3: Research Methodology and Approach

3.1: Methods

The research project was designed and conducted in collaboration with two community partners: NunatuKavut Community Council (NCC), based in Goose Bay, and the Black Tickle-Domino Local Service District (LSD). NCC is the political organization which represents the Southern Inuit people of Labrador. The LSD is a volunteer local government in the case study community; as per provincial legislation, it does not have the status of a municipality but it is responsible for water provision. Research was conducted in English as all community members are fluent in this language.

With the support of the Harris Centre-RBC Water Research and Outreach Fund, we purchased, shipped, and installed fourteen stand-alone DRWH units in the community **(Figure 2)**. The DRWH units consisted of a 26.4 gallon storage tank, a 59 inch diameter rain saucer attached to the top of the hard rubber storage tank, a basic debris filter, and a small spout. To this we added wooden pallets and bungee cords to secure the units to the ground, given typically high winds in the area **(Figure 2)**. We hired two local research assistants, both high school students, to assist with installation and data collection for the six-week project. A graduate student worked full-time on the project for 14 weeks (**Figure 3)**.

Figure 2: Example of DRWH Unit Installed in the Community

Figure 3: DRWH Units Secured on Wooden Pallets

3.1.1: Research Participants

The LSD recruited participants, having had long experience with dividing scare resources in culturally appropriate ways. The LSD recruited seven households, which included 21 individuals; each household received two DRWH units. Inclusion criteria included (1) year-round community residency and (2) direct or indirect participation in water-retrieval efforts, chosen to help capture water-retrieval experiences in different parts of the community. Reflecting the Inuit values of social inequality and inclusion, the LSD selected households that were highly water-insecure.

3.1.2: Data Collection

We used a mixed-methods approach consisting of (1) self-administered surveys and (2) focus group discussions. The self-administered pre-project survey posed ‘baseline questions’ which allowed us to gather information on household hours dedicated to water collection, water collection costs (direct fees, fuel, maintenance, wear and tear on vehicles, etc.), and household water consumption (both general purpose and drinking water) prior to the pilot project. Working with the graduate student and the local research assistants, household participants updated their surveys weekly throughout the pilot project and recorded the amount of rainwater harvested.

We held focus group discussions at the beginning and conclusion of the pilot project, which was six weeks duration. The introductory focus group discussion (n = 5) contained open-ended questions relating to current household water consumption, water retrieval efforts, barriers to water access, and pilot project expectations. The concluding focus group discussion (n = 5) contained open-ended questions relating to pilot project results, DRWH unit effectiveness, and general feedback. The questions allowed probing on project impacts. Due to the small sample size, we organized focus group discussions to collect qualitative data related to the quantitative survey data.

3.1.3: Data Analysis:

We used basic descriptive statistics in the quantitative surveys. We used Excel Version 15.13.1 software to organize, manage, and analyze the survey data. For qualitative data, we used content analysis, applied to focus group transcripts, which were transcribed by a professional academic service (Hsieh & Shannon, 2005). We read the transcripts and inductively built an initial codebook. We reviewed all of the transcripts to ensure that the codes comprehensively encompassed key themes. We then used NIVO Version 11.1.1 qualitative analytic software to organize, manage, and analyze the qualitative data. To enhance the credibility of the project (Kowal, Jardine, & Bubela, 2015), we prepared a 'preliminary findings' document for our community partners and project participants, which allowed for feedback. This document later became the basis of project results analysis.

3.1.4: Clearances

This research project received ethical approval from both the Grenfell Campus Research Ethics Board, as well as the NunatuKavut Community Council Research Advisory Committee. These were obtained prior to data collection.

4. Results and Discussion

4.1 Self-Reported Data

Table 1 provides an overview of the data collected relating to water retrieval and consumption, Baseline estimates are also reported.

Weekly attributes:	**Pre-Project (Baseline)**	**Pilot Project Results**	**Percentage Change**
Household hours spent collecting water	6.06	3.58	-40.92%
Household dollars spent collecting water	$30.42	$17.72	-41.75%
Household general purpose water consumption	214.9 gal	251.65 gal	17.10%
Household drinking water consumption	27.6 gal	26. 12 gal	-5.36%
Amount of rainwater harvested	N/A	19.07 gal	N/A

Table 1: Impacts of DRWH on Water Access and Water Consumption

4.2: Positive Impacts of the Project

4.2.1: Effectiveness of DRWH Units

This project successfully tested DRWH in the subarctic. DRWH has been utilized in developing countries, especially on the African continent where it has been favourably viewed as a response to water access difficulties (Ishaku, Majid, & Johar, 2012; Cowden, Michelcic, & Watkins, 2008; Kahinda, Taigbenu, & Boroto, 2007). Until now, DRWH has been tested only in warm to hot climates and not in a climate as harsh as that of subarctic Canada. Climate–especially snow storms, severe cold, and precipitation causing damage to unpaved roads–is a barrier to water access in Black Tickle-Domino.

In Black Tickle, people retrieve drinking water and general purpose water, the latter for personal hygiene, cleaning clothes and dishes, and household cleanliness. Both are compromised given the extent of water insecurity in the community.

Our results demonstrate that DRWH can be an effective method for increasing water access in water insecure communities in the Canadian subarctic in the spring and summer, about five months of the year. On average, household participants reported harvesting 19.07 gal of rainwater per week (Table 1), or 8.9% of baseline general purpose water consumption. The project was received well in the community; as one participant said, “the project itself was amazing, I found that my system collected water really well.”

As discussed with participants, only small-scale DRWH units were utilized because of budget constraints; units with larger surface areas (such as rooftop rainwater harvesting) would be capable of harvesting greater volumes (Canadian Mortgage and Housing Corporation, 2012). Research suggests that 1cm of rain on 100m² of roof yields 10,000 l (2641.7 gal) of water (United Nations Environment Programme, n.d.). Average historical monthly rainfall in Black Tickle-Domino from June - October is 7.18cm (World Weather Online, 2012), suggesting that a 100m² rooftop would yield approximately 19,000 gal of rainwater monthly; this is significant considering current monthly general purpose water consumption is only 930.52 gal in the community. Possibilities associated with other methods of DRWH, such as rooftop rainwater harvesting or the use of larger rain saucers, may be pursued by the community and NCC.

4.2.2: Increased General Purpose Water Consumption – Increased Personal Hygiene

Participants were able to increase their general purpose water consumption. Baseline household consumption was 214.9 gal/week and increased to 251.65 gal/week throughout the project, an increase of 17.10% (Table 1). Because water consumption is so restricted in the community, participants saw this increase as significant. According to a participant “you have that much more water you can use [as a result of DRWH], because it is perfect water for general use.” As Black Tickle-Domino residents are aware, restricted water access compromises personal hygiene and poor personal hygiene has adverse health effects (Prüss, Kay, Fewtrell, & Bartram, 2002). Participants reported that, because there was an increase in supply, DRWH made them feel more

comfortable using water for personal hygiene and general cleanliness. In addition, they favoured rainwater over PDWU general use water because of rainwater's aesthetic appeal; PDWU general use water is frequently discoloured, partially the result of high iron content, with a "yellowish cast" which is a disincentive to use it for personal hygiene and household cleaning **(Figure 5)**. As stated by a participant "(a main benefit of DRWH) was washing your dishes and your clothes; (the water) was really clean and it smelled good, before (PDWU water) smelled like apple juice… at least we can (now) wash a good shirt and it comes out white." Another participant added "(a main benefit of DRWH) was your own general washing purposes. Better than the old scuzzy (PDWU) water".

Figure 5: Rainwater (Left) Versus PDWU Water (Right)

4.2.3: Financial Savings

As Table 1 demonstrates, in some cases, participants accrued substantial financial savings. Pre-project, participating households reported spending $30.42 CDN weekly on water retrieval efforts. Throughout the pilot project, participating households reported spending $17.72 CDN weekly on average, suggesting weekly savings of $12.70 CDN as a result of the project. The average yearly-income in the community is $11,068 CDN and water-retrieval is a severe strain on household financial resources (Hanrahan, 2014; Sakar et al., 2014); the costs of water retrieval are part of a web linking poverty, water security, and food security. Therefore, even small financial savings may have wide-ranging social and economic benefits, increasing purchasing power and allowing people to purchase more food, for instance. Individual and community empowerment have to be considered as well, as we discuss below.

Financial savings resulted from decreased water retrieval efforts; fewer dollars spent paying others in the community to collect water, fewer dollars spent in direct fees at the PDWU, and fewer dollars spent on fuel for and wear and tear on vehicles used to retrieve water. As one participant stated "instead of paying somebody twice a week to get water, I was only paying once a week – so [over the six-week pilot project] I saved $120." Another participant stated "(every rainwater barrel harvested) was one less trip I had to go way in there (to the PDWU).

The wear and tear savings were more than the actual money (fees at the PDWU), because you have to go all the way in across bedrock and bumps, then all the way back".

4.2.4: Decreased Water Retrieval Efforts

DRWH is a good tool for decreasing physically strenuous water-retrieval efforts (Kahinda et al., 2007). Black Tickle-Domino is a gender-stratified community but, unlike as in many developing countries, water retrieval is a male chore here. Due to the physical demands of water retrieval followed by carrying water into houses, virtually every man in Black Tickle-Domino has chronic pain due to muscular-skeletal injuries (Sakar et al., 2014). Some men in the community feel they cannot leave the island for treatment as their families are dependent on them for food acquisition and water retrieval; therefore, they live with frequent injuries and constant pain. The pilot project suggests that DRWH is a viable method to decrease water retrieval efforts in water insecure communities; weekly household water retrieval hours decreased from 6.06 hours to 3.58 hours, a decrease of 40.92% (Table 1). Participants explained that by harvesting general purpose water from their DRWH units, they were able to limit the number of weekly trips to the PDWU, which meant less lifting and carrying of heavy water and, potentially, fewer injuries.

4.2.5: Decline in Psychological Stress – Optimism Related to the Project

Although this was a small-scale project, one of our most significant findings was its impact on mental health in Black Tickle-Domino, identified as a pressing issue in previous research [18]. Water insecurity is extremely labour-intensive in the community and is associated with high levels of psychological stress (Sakar et al., 2014); in Black Tickle Domino, water access is the central cause of water insecurity-related stress — for instance, during winter storms when people are confined to their homes and cannot retrieve water or when the shallow wells dry up, as they do on occasion.

Most participants in this study reported declines in psychological stress related to water insecurity. One participant said, "(before the project) I have been down in my house for two and three days sometimes with no water at all," later adding "(DRWH) it is security." Another participant added "(due to DRWH) you do not have to be so conservative (with your water)". Thus, participants were able to rely less on the traditional coping mechanisms of extreme water conservation, water hoarding, and doing without water. Even a small degree of improved access was linked to a stated decline in participants' stress levels. General feelings of 'optimism' contribute to positive mental health outcomes (Conversano et al., 2010; Carver et al., 1993). Participants expressed optimism and positive emotional benefits as a result of the project, which may contribute to further improvements in mental health. As stated by one participant "I like the look of it (their unit). I am a really proud (pilot project) participant, I love it". Another participant added "Thank you for trying it (DRWH) and opening our eyes… it makes you as a person explore different options (for water security)". Thus, DRWH was associated with a renewed sense of empowerment regarding a problem that has long been viewed as intractable.

4.3: Project Limitations

4.3.1: No Increases in Drinking Water Consumption

An objective of the pilot project was to increase household drinking water consumption; we expected that participants would have more available general purpose water which would allow them to increase their efforts to retrieve drinking water. As explained to participants, the water harvested from the DRWH units was untreated, unmonitored and unsuitable for ingestion; however, by providing some general purpose water, we hoped that participating households could re-direct some of their water-retrieval efforts to retrieving drinking water. However, without proper treatment and filtration, DRWH did not appear to have a positive impact on drinking water consumption. Baseline household drinking water consumption was reported as 27.6 gal per week; this figure remained stable throughout the project (Table 1). As stated by a participant "it [DRWH] would not change the water consumed, because you could not drink it". Participants chose to take "a break" from water retrieval rather than redirect their efforts. This speaks to the strenuous efforts necessary for water retrieval and the deep need for relief.

4.3.2: Difficulty Retrieving Water from Units

Participants reported it was difficult and physically strenuous to harvest water collected in the DRWH unit, using the spout and buckets: "I could not get the bucket under the nozzle"; "I think it [removing water from the DRWH] would be more work than actually going up to the water treatment plant (PDWU)." Participants enthusiastically identified potential improvements to the technology we used; these included inexpensive garden hoses that could bring water directly into houses, and better placement of the units to make pouring easier.

4.3.3: Wind a Factor in System Placement

Occasionally, strong wind speeds, totaling 3-4 days during the project, posed DRWH challenges. Units tipped over or came apart due to high winds and water was lost. As stated by one participant ". . . the wind we get around here, it (the rain saucer) blew off a couple times." Most participants suggested that over the course of the six-week pilot project, the wind was a limitation but not an insurmountable challenge. Units needed to be sheltered from winds so that they were secure. We used bungee cords to tie them to wooden pallets fixed to the ground but, at times, this was not sufficient. The key to remedying this is strategic unit placement based on local experience and knowledge of weather conditions and related factors as well as some good luck.

4.4: Additional Impacts of Water Insecurity

An unexpected positive result was that the pilot project built on existing literature on water insecurity in Black Tickle-Domino and elsewhere by identifying additional dimensions of water insecurity, mainly through the focus group discussions. These are discussed below.

4.4.1: Decreases in Recreational Activity and Leisure

Recreational activity and leisure have positive implications for physical, emotional, social, and cognitive health (Caldwell, 2005; Trenberth & Dewe, 2002; Coleman & Iso-Ahola, 1993). . In Black Tickle-Domino, strenuous water retrieval efforts and its impacts on the community's infrastructure, specifically its unpaved road, appear to contribute to decreases in recreational activity and leisure which may have adverse health implications **(Figure 3)**. As stated by a participant "Every evening a few years ago, when the road (used for water-retrieval)was not as bad, my husband and I would go out in the evening and go for a(n) (all-terrain vehicle) ride; but you cannot do that now. There is no joy in joyriding." Another participant added "(DRWH) could give people a break. They would not have to do so much (water-retrieval), they are older people, so they would be able to stay home and relax more." Because of their lived experience, the links between water insecurity, mental health, and recreation as a remedy were well-understood by participants. Repeatedly participants expressed a desire for some relief from the relentless difficulties of life in a water-insecure community.

Figure 5: Road Conditions Impacted by Water Retrieval

4.4.2: Impacts for Food Security

Water insecurity strains households, forcing people to knowingly make cheaper, unhealthy food choices (Sakar et al., 2014). In Black Tickle-Domino, parents cope with this by consuming junk food and giving it to their children because they could not afford healthier food choices; this happens with knowledge and regret and is seen as an undesirable but forced decision (Sakar et al., 2014). Participants in this project and in previous research projects readily identified the

connections between water and food security (Sakar et al., 2014). With reference to food and water security, a DRWH project participant stated, “one does not come without the other.

This project identified another negative food-related impact: a disincentive to try vegetable gardening, which would require substantial amounts of water. Root crops, such as potatoes and carrots, are incorporated into the local diet, especially during the enduring Sunday dinner ritual. These have to be purchased, however, and are expensive and in poor condition due to transportation over long distances. Despite limited soil (the island is mainly glaciated igneous rock), residents would like to include home-grown vegetables as part of their food acquisition strategies but water access limits this possibility.

4.4.3: Social ‘Inequality’ Based on Water Access

Social inequality leads to adverse health impacts such as feelings of hopelessness (Subramanian & Kawachi, 2004; Raphael, 2000) and runs counter to Inuit values. In Black Tickle-Domino, different household levels of water access contribute to feelings of ‘inequality’ or social stratification, which may have adverse psychological health outcomes. A small number of community members have working artesian wells, some have vehicles to help with water-retrieval, and some use long outdoor-hoses to run water to their homes, while others lack these amenities and are more water-insecure as a result. As one participant stated, “I take care of two seniors, and they got hoses running up the road (to a water source), so they (essentially) have running water.” Another participant immediately added, “I wish I had running water,” followed by another who stated, “me too.” The pervasive sense of social inequality adds to people’s stress levels. The choice of the LSD to recruit extremely water insecure householders to the project reflects both awareness of and concern for this inequality and its impacts.

4.4.4: Feelings of Fear: Water Retrieval and Wildlife

General fear and anxiety have adverse implications for mental health (Dore et al., 2016; Steimer, 2002). A significant source of fear and anxiety in Black Tickle-Domino is the threat of wildlife (particularly polar bears) during water-retrieval efforts. Participants report that, in recent years, there has been an increase in polar bears appearances in and around the community, possibly due to climate change. One researcher witnessed three bears in Black Tickle-Domino in the spring of 2013, which necessitated gun-carrying as polar bears are dangerous animals. Children are kept indoors during this time and anyone venturing outdoors must be protected by someone skilled in shooting; in a gendered community, this restricts the movement of women. Women also worry about their male family members who are responsible for traveling to the PDWU or elsewhere to collect water:

> “When we have polar bears every evening, lingering around, I do not let my husband go (retrieve water) by himself, because of the danger. He could be bending over doing something, and they (polar bears) can come right around. You almost need somebody to watch your back, somebody to go with you. So that danger is right there and lurking.”

DRWH can partly alleviate this problem as it is associated with fewer water retrieval trips and people can retrieve water from units near their homes, which offer shelter in case polar bears appear.

5. Recommendations for Policy and Future Research

We make the following recommendations:

Given the extreme water insecurity in Black Tickle and its severe impacts, water security enhancements for Black Tickle-Domino should be a priority for the provincial government, the Combined Councils of Labrador (the Labrador-wide organization representing local government), and NunatuKavut Community Council;

Improvements to DRWH efforts, such as funding for rooftop harvesting, and further pilot projects should be pursued by the LSD and supporting organizations listed above;

Other water-insecure remote communities in the subarctic should consider DRWH as a partial remedy to water insecurity.

6. Conclusion

Urgent action is required for the many remote Indigenous communities in Canada that experience persistent water insecurity; access to safe drinking water is a human right and a major health issue. Support for safe water provision is inadequate with the result that water insecurity is acute in remote communities such as Black Tickle which lacks piped water. Water insecurity impacts are wide-ranging and interrelated including financial, social and health impacts.

In Black Tickle, DRWH on a small-scale led to increased general purpose water consumption, perceived improvements in psychological health, decreased water retrieval efforts, and household savings. Although DRWH is limited to the spring and summer seasons and cannot meet drinking water needs, DRWH can be a useful supplemental water source for general purpose water. Its limitations can be mitigated through measures such as altering unit placement (in response to winds).

Recognizing the small-scale of this pilot project in subarctic Labrador, DRWH emerges as a potential partial remedy, one that is appropriately-scaled and inexpensive. This is particularly true if DRWH was combined with other water access methods and enhancements were used; these might be small-scale, such as inexpensive garden hoses, or more elaborate, enabling rooftop water collection, for instance. We encourage further research across the subarctic.

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