

ORIGINAL RESEARCH

Implementation of a community greenhouse in a remote, sub-Arctic First Nations community in Ontario, Canada: a descriptive case study

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ABSTRACT

Introduction: Food insecurity is prevalent in northern communities in Canada and there is a movement to improve food security through both the re-vitalization of traditional harvesting practices as well as through sustainable agriculture initiatives. Gardening in northern communities can be difficult and may be aided by a community greenhouse. The objective of this project was to conduct a descriptive case study of the context and process surrounding the implementation of a community greenhouse in a remote, sub-Arctic First Nations community in Ontario, Canada.

Method: Data sources included semi-directed interviews with a purposive and snowball sample of key informants ($n=14$), direct observations ($n=32$ days), written documentation ($n=107$), and photo-documentation ($n=621$ total). Digital photographs were taken by both a university investigator during community visits and a community investigator throughout the entire project. The case study was carried out over 33 months; from early 2009 until October of 2011. Thematic data analyses were conducted and followed a categorical aggregation approach.

Results: Categories emerging from the data were appointed gardening-related themes: seasons, fertile ground, sustainability, gardeners, ownership, participant growth, and sunshine. Local champions were critical to project success. Uncertainty was expressed by several participants regarding ownership of the greenhouse; the local community members who championed the project had to emphasize, repeatedly, that it was community owned. Positive outcomes included the involvement of many community members, a host of related activities, and that the greenhouse has been a learning opportunity to gain knowledge about



growing plants in a northern greenhouse setting. A strength of the project was that many children participated in greenhouse activities.

Conclusions: Community and school greenhouse projects require local champions to be successful. It is important to establish guidelines around ownership of a greenhouse and suitable procedures for making the building accessible to everyone without compromising security. Implementing a greenhouse project can engage community members, including children, and provide a great learning opportunity for gardeners in a remote, northern community.

Key words: Canada, case study, First Nations, food security, local food systems, sub-Arctic.

Introduction

The prevalence of food insecurity for Aboriginal (First Nations, Métis, and Inuit) households in Canada is considerably higher than that of non-Aboriginal households¹⁻³ with those living in on-reserve First Nations communities and Arctic Inuit communities especially vulnerable⁴⁻⁸. Food insecurity in remote First Nations communities is heightened by many factors: high incidence of poverty^{3,9}; unreliable food supplies; high cost and reduced availability of quality, healthy market food¹⁰⁻¹²; potential environmental contamination of traditional food sources^{13,14}; climate change affecting hunting and fishing practices^{10,15,16}; loss of traditional food practices; and access to land¹¹. The existence of two interactive food systems (traditional and market) makes the food system unique for Aboriginal people, who continue to participate in traditional food procurement and consumption.

Potential strategies to improve food security in remote and northern communities include the revitalization of traditional harvesting practices, the adoption of sustainable agriculture, and local food production^{12,17-19}. Sustainable agriculture can involve agroforestry, community gardens¹⁸, greenhouses, wild berry and fruit tree maintenance, and seed banks¹⁷. For many northern communities, gardening without a greenhouse may be less feasible due to their climactic extremes, inadequate soil (or permafrost), and considerably shorter growing seasons, but this is changing with global warming¹⁸. Even with global warming, greenhouses can be used on their own and/or used to lengthen the growing season.

Probably the most famous northern greenhouse is in Inuvik, Northwest Territories, which has a guaranteed growing season from mid-May to the end of September compared to the variable outdoor growing season in Inuvik, from mid-June to August. A range of positive outcomes has been reported as a result of the greenhouse, including increased community beautification projects and civic pride; enhanced tourism; heightened sense of community by local inhabitants; fostering community development and community outreach (eg a garden club for children); and increased food security²⁰⁻²³. Some local community members even call the Inuvik greenhouse a 'community wellness centre'²¹. In the Arctic of eastern Canada, residents of Iqaluit, Nunavut, were inspired by the success of the Inuvik greenhouse to build their own community greenhouse called Piruqsiavut²². The goal of the Iqaluit greenhouse is to show that it is possible to eat locally and reduce the quantity of greenhouse gas emissions used to ship fresh produce to Iqaluit²⁴. Members of the greenhouse are encouraged to grow vegetables instead of flowers and all of the produce harvested from the greenhouse is weighed to prove how much food the greenhouse produces. As with the Inuvik greenhouse, community outreach is an important component of the project. Recipes, events, and volunteer opportunities are communicated through an online blog maintained by the Iqaluit Community Greenhouse Society²⁵.

There are very few published studies related to gardening initiatives with Aboriginal or Native North American groups^{4,8,19,26,27}. Outcomes of the Manitoba northern healthy foods initiative included a growing number of gardens, gardeners, and greenhouses over a 3-year period of the



program and authors mention the establishment of greenhouse pilot projects in northern schools⁴. These authors suggested local food production as a viable strategy to improve food security. They also stress the importance of community-based action combined with a supportive policy environment for creating conditions for better food access^{4,8}. Isolated studies suggest that gardening in Aboriginal communities, especially when traditional ways are incorporated¹⁹, can benefit knowledge and skills of participants²⁷, social and physical environments²⁷, and ultimately reduce disease²⁶. The grey literature identifies a number of Canadian First Nations communities that have included greenhouses as part of their healthy food initiatives^{8,28-30} and in conjunction with larger Indigenous food system projects where their mission is to encourage food sovereignty¹⁷.

Objectives and research questions

In response to the lack of published studies on the feasibility of greenhouse projects in northern and isolated geographic locations, this research project was designed to provide information on the feasibility, barriers, supports, and lessons learned for local food production in a greenhouse in a northern, sub-Arctic community.

The objective of this case study was to describe the context and process surrounding the implementation of a community greenhouse from the perspectives of community participants in a remote First Nations community. The research questions addressed by this study were: Is it feasible to implement a greenhouse in this setting? What were the barriers and supports for progress on community greenhouse initiatives in this context? What were the benefits and overall outcomes of the greenhouse project? What were the lessons learned?

Context

Because context is so important to the understanding of a case, the following sections of this introduction provide detail about the setting and history surrounding the greenhouse so

that the reader can gain perspective on the case study environment.

Case study location: Fort Albany First Nation (FAFN) is located on the southern shore of the Albany River on the west coast of James Bay in northern Ontario, Canada. The community is geographically remote (52°15'N, 81°35'W), with year-round access by plane, access by boat and barge during the ice-free season, and by a snow/ice road after freeze-up. FAFN is home to approximately 850 Cree people. The languages spoken are English and Cree. There are no data available for FAFN from the 2006 Census and only a small amount of specific information available from the 2011 Census; therefore, data from the 2001 Census are also cited. FAFN has a young population: 33% of the Fort Albany population was younger than 15 years according to 2011 Canadian Census data, nearly double compared to the Ontario population (17%) in the same age range³¹. According to Statistics Canada and the information available from their First Nations Profile³² on FAFN, residents in the community had only a 43% employment rate, 57% of adults had not obtained a high school graduation certificate, and the average total income (of all persons with income) was US\$17 473. The completion of a fibre optic telecommunications network in February of 2010 enabled FAFN to have high-speed internet access, improving their connectivity to the world wide web, information and resources outside of the community. Community members were sustained in the past by a traditional food system of hunting, fishing, and gathering which has been degraded by colonization, climate change, environmental contaminants, and a heavy reliance on the market food system^{18,33,34}.

During the time of this study there was one large grocery store and two convenience stores in the community where food could be purchased. There was one school in the community with students from kindergarten to grade 12. A community-driven school nutrition program had been in existence at the school for nearly two decades^{35,36}. Community members had been organizing a non-profit alternative market, where fresh foods including produce and meat were flown into the community and sold at-cost to



community members³⁷. The market began in 2007 and was initially held every few months and has now grown into a bi-weekly event with external support and recognition^{37,38}.

Spiegelaar and Tsuji explored the historical and modern food systems of FAFN by interviewing eight community members in June 2010¹⁸. Participants reported the introduction of agriculture to FAFN by Christian missionaries in 1930. There was larger scale field production of primarily root crops as well as small gardens for diverse produce and some livestock¹⁸. The Mission also had a greenhouse, which was used to grow tomatoes and to start seedlings that were later transplanted into gardens. Large-scale agriculture ended around 1970 when Indian Affairs (now Aboriginal Affairs and Northern Development Canada) took over and removed the residential school, and the grocery store was opened¹⁸. Spiegelaar and Tsuji¹⁸ noted that FAFN aspires to move towards sustainable food systems and become food secure³⁹, to re-instate the traditional knowledge necessary for a subsistence lifestyle as well as regain connection to the land⁴⁰.

Past community food system projects: Over the past decade, the research team and the community of FAFN have collaborated on a number of nutrition and physical activity health projects including assessing youth behaviours⁴¹⁻⁴³, determining the barriers of and supports for healthy eating³⁹, planning health promotion strategies⁴⁴, measuring the impact of school nutrition programs^{36,45-47}, and examining the prevalence and severity of household food insecurity⁷. In prior studies, FAFN community members identified food insecurity as a constraint to healthy eating in children and youth^{39,44}, there was a very high prevalence of household food insecurity (70%)⁷, and one of the strategies proposed to increase healthy eating was to start up a community or school garden⁴⁴. Building greenhouses was a suggested way for community members in FAFN to more easily obtain healthy food⁴⁸. This project involved collaboration with a community advisory committee of local stakeholders who were chosen because they had a keen interest in food issues and were enthusiastic about improving food security and supporting healthy lifestyle behaviors. The role of the community advisory committee was to make decisions regarding the

planning and implementation of the greenhouse project. The committee consisted of two women and one man. One of the members was an Elder.

History and timeline: In February of 2009, university partners secured one-time seed funding from the Canadian Government for community-based initiatives to support healthy eating in FAFN youth. The distance between the university and FAFN is nearly 1000 km. The community advisory committee identified priorities and decided on a greenhouse. Indeed, this had been on their agenda for many years: the original plans for the new school, which opened in 2001, had included a school greenhouse. Unfortunately the greenhouse had been excluded from the final school building construction due to financial constraints. A timeline depicting the chronological process^{49,50} for this case study over a period of 33 months, from early 2009 until October of 2011, was developed (not shown). In particular, it identified milestones in the community development of the greenhouse, in researcher participation in the project, and a detailed way to describe the progress of the greenhouse from its inception.

It is important to note that, during this case study, two other community gardening pilot projects were initiated: a pilot agroforestry (local-substitution) project¹⁸ and a provincially funded Get Growing community garden initiative⁵¹.

The greenhouse: The 30 m² greenhouse in FAFN is constructed of fivewall polycarbonate. A greenhouse made of this material was chosen for a number of reasons. In comparison to glass or twinwall polycarbonate, a fivewall polycarbonate greenhouse is more energy efficient and better for colder climates, offers built-in shading, is maintenance free, is virtually unbreakable, and is considered a four-season greenhouse. Two heater fans, to be powered by liquid propane, were included with the structure. The cost of the greenhouse and shipping was partially funded by a research grant; additional costs (eg building foundation, shelving, soil, seeds, gardening tools, heating expenses, maintenance) were covered by the community. The greenhouse was built on the south side of the school near the primary wing.



The process of building the greenhouse and the activities that took place in and about the greenhouse after it was built were determined completely by members of the community. There were many decisions to be made including where to put the greenhouse; what type of foundation to use; how to organize the interior; what to plant; and how the school, students and other community members would be involved. The university investigators were on hand to provide support when requested, but otherwise did not participate in greenhouse activities.

Methods

This research project was a descriptive case study. A descriptive case study presents a complete description of a phenomenon within its context⁵². For this study, the 'case', or phenomenon, was a greenhouse and the context that surrounded it, including the people who were involved and the activities and actions that took place during the study period. A case has been described as a 'bounded system'⁵³ and it can be recognized that 'certain features are within the system, within the boundaries, and other features outside'⁵³. Key factors for understanding the case are the boundedness and the behavior patterns of the system⁵³. This study was bounded by time (33 months) and by a single case (the greenhouse project in a community).

Data sources and collection

Multiple sources of evidence were purposively sampled, including semi-directed interviews with key informants, direct observations during community visits, documentation of process including phone conversations and emails, and photo-documentation to facilitate an in-depth understanding of the case⁴⁹, to test for convergence amongst the different avenues of inquiry⁵⁰ and to support the validity of emerging constructs⁵⁰. The greenhouse was the focal point for data collected from each source. For example, the interview discussions revolved around participant's greenhouse involvement and although related activities (eg high school student composting, community gardening) were also

discussed, it was only with respect to their connection to the greenhouse. One member of the University of Waterloo-based research team made four visits to the community during the study period (April and July 2009 and January and October 2011). The purpose of these visits was to communicate in person with the community investigator, collect case study data and to monitor the progress and implementation of greenhouse activities. The university investigator was only able to be in the community periodically. Rigor is enhanced when observations are combined with other methods, so a community investigator who was central to the entire project (JM) assisted in photo-documentation^{54,55}. The community investigator had lived in FAFN for more than three decades and was chosen for her long-term involvement in community activities related to improving the food system as well as for her strong photography skills. Table 1 summarizes the number of sources for each category.

Interviews: In October 2011, after the greenhouse had been assembled and gardening activities had been established, semi-directed, informal interviews were conducted with adult and child key informants by a trained interviewer. Initially, adult participants ($n=5$) were purposively selected based on their connection to the greenhouse: community members who had been involved with either building the structure and the raised beds, planting seedlings and seeds, caring for the greenhouse and plants; and/or teachers who incorporated greenhouse activities into their classroom curriculum. Snowball sampling helped to identify nine more key informants. The interview schedule was flexible, open-ended and based around the theme of the greenhouse. Verbal consent was obtained from adults, and parental consent obtained for children. All interviews were conducted in English, although Cree interpreters were available to translate if they had been requested. Interviews were audiotaped with the consent of the interviewees. Interviews lasted from 15 to 95 minutes; shorter interviews were with children and the longest interviews with local champions leading the greenhouse initiative.



Direct observations: Direct observations were made during each of the four visits made by the university investigator and recorded in detailed field notes and digital photographs. The university investigator kept a daily reflective journal during community visits as well as writing memos during other aspects of the research process^{56,57}. It was recognized that direct observations offer a better understanding and ability of the inquirer to capture the context in which the participants live and interact⁵⁸.

Written documentation: Document types included detailed notes taken during phone conversations, and email messages⁴⁹. Phone conversations and emails occurred throughout the project between the university investigator and community investigator.

Photo-documentation: Photo-documentation occurred throughout the project, even while the university investigators were absent from the community. Digital photographs were taken regularly by the community investigator throughout the study period as well as by the university investigator during community visits.

Data analysis

Audiotaped interviews were transcribed verbatim. Initially, the visual data were analyzed separately to allow the analyst to gain a full grasp of the photo-documentation and to conduct a visual content analysis⁵⁹. The visual content analysis of the data for this study was characterized by the 'identification and counting of events, characteristics, or other phenomena in visual data', which is a more quantitative approach than other forms of visual data analysis⁵⁹. For example, the number of unique individuals in the photographs was counted to quantify the involvement of community members in greenhouse activities. During community visits in 2011, a university investigator and the community investigator reviewed and discussed all of the photographs that were taken and began the initial coding that would be included in the visual content analysis. Analysis of the photographs included a selection of questions posed by Rose⁶⁰ to ask when interpreting visual images. For example, questions were answered regarding production of the images (When was it made? Where was it

made?), and the 'text' of the images (What is being shown? What are the components of the image? Was it one of a series? What do the different components of the image signify?)⁶⁰. In this way, text descriptions were created for each photograph and were analyzed together to create preliminary codes. Following the visual analysis, all data sources (interview transcripts, field notes, documents, and digital photographs) were compiled into one data file and therefore the final data analysis did not distinguish between data sources.

Categorical aggregation was used to identify themes^{49,61}. Commonly used for case studies, this type of analysis is a way of classifying the data into codes and themes. The process involves aggregating instances until something can be said about them as a class⁵⁹. In other words, to search for a collection of instances from the data, aggregate them into categories, and then collapse them into themes⁴⁹.

In many instances, data were verified by more than one source. For example, dates of photographs were confirmed by statements of when activities occurred by interviewed participants. During analysis, the data were aggregated into 26 categories (sub-themes) and then collapsed into seven themes.

Ethics approval

Permission to conduct this study was obtained from FAFN (the locally elected government), Mundo Peetabek Education Authority (the local First Nation administered school board), and the Office of Research Ethics at the University of Waterloo; ethics approval number 16313.

Results

Fourteen key informants participated in the interviews: six men, five women, and three children. Three of the participants were Elders. Photographs ($n=370$) taken by the community investigator began in mid-November 2009 when the greenhouse arrived in the community and spanned nearly every month of the study period until October 2011.



Table 1: Summary of data sources

Source category	Total number of sources/respondents
Interviews	14 key informants
Direct observations	32 days of field notes and digital photographs; 24 journal entries
Written documentation	107 documents (notes from 6 phone conversations; 77 emails)
Photo-documentation	621 digital photographs

Themes

Figure 1 illustrates the categories and themes from the case study. The themes are described in the following section using quotes from the interviews (see Table 2) and photographs (Figures 2–6) to support and illustrate specific themes. To protect the identity of community members, photos identifying individuals' faces have been cropped or not included. The categories that emerged from the data were appointed the following gardening-related themes: seasons, fertile ground, sustainability, gardeners, ownership, participant growth, and sunshine. The themes, categories (subthemes) and supporting quotations are summarized in Table 2.

Seasons: From the chronological timeline, interviews, and date analyses of the photographs, the concept of seasons emerged as a major theme. This included acknowledgement by the interviewees that progress and implementation of the greenhouse took time and occurred over the course of many seasons. The greenhouse arrived in the late fall (autumn) of 2009 and a wood foundation was started. The following summer was spent putting the greenhouse together with one main dedicated volunteer and a few occasional helpers. In the summer of 2011, raised beds were built, seeds and seedlings were planted, and greenhouse gardening activities were maintained until the fall (autumn) when produce was harvested. Figure 2 depicts a sequence of events over time and through many seasons, from the initial construction of the greenhouse foundation in November 2009 to the harvesting of a head of lettuce grown in the greenhouse in October 2011, nearly 2 years later. One person from the

community took on the main leadership role of building the greenhouse and oversaw its construction from start to finish.

Fertile ground: Fertile ground represents resources for the greenhouse, including other local experienced gardeners as sources of knowledge. Figure 3 is an example of one of the gardens grown and maintained by an experienced gardener in FAFN.

Sustainability: Sustainability activities took place during the project and these included those that seemed directly related, such as composting (Fig4) and home gardening (Fig3), and those that seemed indirectly related, such as green technology and re-using/recycling. Preserving and canning were other activities mentioned during the interviews, but this activity was not done with produce grown in the greenhouse. Berry harvesting emerged as a sub-theme as community members mentioned harvesting local low cranberries and the possibility of transplanting wild raspberry canes to their home gardens. A few of the teachers were very excited about using the greenhouse as a starting point to help students discuss different types of green technology as well as teaching students how a greenhouse works. There was also a plan to get some solar panels to be used to heat the greenhouse in early spring and extend the growing season. Numerous home gardens were planted in the community each year during the study. In some instances, the home gardens were seen as a complement to the greenhouse, in which seedlings could be kept safely until they were planted outdoors.



Figure 1: Case study categories and themes.

Gardeners: Many people were involved with the greenhouse over the course of the study period and were labelled as ‘gardeners’. Two main project champions oversaw the planning and implementation of the greenhouse from the time it arrived in the community in November 2009. They continue to be the leaders of the greenhouse initiative at the time of writing this article. One of those champions was the local investigator who took digital photographs for the study. Seventy-seven unique individuals were counted in the photographs: 36 adults and 41 children. Children helped to plant most of the seeds and some of the seedlings and were very keen to help with watering the plants (Fig2e). With the exception of the two project champion gardeners, who carried out daily maintenance activities for the greenhouse during the growing season, most adults were involved when the greenhouse was being built. A few school teachers and students planted seeds in their classrooms, and those seedlings were later transplanted into the greenhouse, but the majority of teachers had not taken their students into the greenhouse.

Ownership: The theme of ownership came up repeatedly during the interviews. Some community members, including children, were not clear about who the greenhouse belonged to. They did not think of it as a communal structure that belonged to everyone. The two project champions both agreed, independently, that ownership of the greenhouse did not belong to them and it should be made more obvious to community members and the school that the greenhouse belonged to everyone. The project champions tried to explain to community members and students that the greenhouse belonged to everyone, the community, the school and the students, and that everyone was welcome to participate in greenhouse activities. One possible reason why community members did not feel that they owned the greenhouse was that the door was normally locked unless one of the two champions was working in the greenhouse. It was observed, during the research visits, that shortly after the door was opened, many people would come into the greenhouse to take a look at the plants and would often ask if they could help with watering.



Table 2: Summary of themes, categories, and supporting quote examples from interviews

Theme	Categories	Excerpts from interviewee responses
Seasons	Time to build the structure Time for plants to grow Time to build up involvement	'We worked at it on the weekends and after school through the month of June. It's a beam foundation on top of gravel. It was kind of hard because we had to level it, we had to make sure the ground was level. We used string and it took a long time. And then it sat there for a long time. We worked on it a little bit over the summer. But then in the fall, my husband put lots of time into it. People saw him working on it and they came and helped. ... Once it was up it sat for the winter. ... All winter long people would say, when are you going to start planting, what are you going to plant ... We just watched it and talked about it and waited for spring.' (Interview 8)
Fertile ground	Other people with gardening experience Books and internet resources Materials (eg soil, seeds)	'I had just seen it at [name omitted] house in this book that the fungus was in that book ... I took the leaf to [name omitted] and she said ... take that leaf away from my garden. I found out it had powdery mildew.' (Interview 11) 'Most of the things that we learn are from reading. Going on the internet and researching. And [name omitted] has a lot of gardening books.' (Interview 8) 'We got some seeds from [name omitted]. And [name omitted] had ordered many, many seeds. She had ordered anticipating the outside gardening.' (Interview 8)
Sustainability	Berry harvesting Composting Re-using/recycling Canning/preserving 'Green' technology Home gardening Seed saving	'I'll teach it 2nd semester to the kids ... Grade 10 and 11. It's called Green Technology. We'll talk about solar and wind energy and stuff like that. They will like it. I got my idea about the Green Technology course from the greenhouse ... my idea came from there.' (Interview 3) 'I got to go into the greenhouse with my science teacher. He talked about the greenhouse effect and how the plants absorb heat.' (Interview 7) 'I know the kids planted in juice cans or milk cartons. Reusing shelf milk cartons. They make great planters. You just need to be resourceful. We reuse large metal cans for watering by punching a bunch of holes in the bottom.' (Interview 8) '... I brought some things from my own garden. And within 3 days my squashes were blooming ... they were dying in my own garden ... and they came alive in the greenhouse. I did a lot of work in the greenhouse for most of July ... we did a lot of work in there.' (Interview 11)
Gardeners	Champions Community members School (e.g., teachers, staff, students)	'I was the one looking after it for the first many weeks. With kids we planted the beans. Oh God, they [the kids] were everywhere! ... they wanted to plant.' (Interview 9) 'One of the main people that helped us was my husband. The teachers, gr. 7 and gr. 8 mostly, there were a few other teachers too, and the phys ed teacher too.' (Interview 8) 'I picked tomatoes in there and I washed them. Then I ate them. Some were sour and some were sweet. Sometimes I work with my mom there. I didn't help when they put the greenhouse up. It was too dangerous. I just played in the park.' (Interview 10)
Ownership	Champions Community members School (e.g., teachers, staff, students)	'Somebody asked me, what do you do with the food from your greenhouse? But we haven't worked that out. Who will decide that? It's a school greenhouse ... I think it should be run by the school. It should be more of an overt ... it belongs to the school. We should have one little bed for each class ... I think we could divide it up. They could be responsible for it. Perhaps the greenhouse is a little small. But for the outside garden we could do it. I've done a lot of planting with the kids over the past year. But that's what I would like to see ... for the school to take ownership. I've learned a lot. Both about how amazing it is and that there are some downsides.' (Interview 11) 'For the greenhouse, it has been a lot of work. And ... uh ... I guess the challenge might be the security of it versus making many people know they are welcome to use it. What is best. From my experience, community people will not think it's theirs to use. If the door is open, they will come in and look.' (Interview 9)



Table 2: cont'd

Theme	Categories	Excerpts from interviewee responses
		<p>'The science camp ... they are the ones who came one day and we gave them some seeds and they planted the seeds in the greenhouse. That's why when we went there today they said 'Those are my carrots!'. They can actually do it themselves or at least see how it is growing. They don't know how things grow. But most kids just see a carrot from the store in a plastic bag with no top on it.' (Interview 8)</p> <p>'We've tried to include all the kids. That's why it doesn't get wrecked. They ask "Is this your greenhouse" And I say "it's yours!"' (Interview 8)</p>
Participant Growth	<ul style="list-style-type: none"> Building and maintaining the greenhouse Involving others Growing plants Watering and ventilation Using space Incorporating into the curriculum 	<p>'In the beginning we were like, it's so big. But once things grew in, it didn't seem as big. That was learning too. How much things grow and how much space it takes up.' (Interview 11)</p> <p>'That was another question too ... how are we going to water. We needed to figure out how to get the water in there. So we asked for a hose and we hook it up to the outside school tap on the side of the building and we run the hose into a huge barrel inside the greenhouse. And the water lasts in there [the barrel] for about a week. And the kids love watering. They know the importance of putting water on plants. They are learning quite a bit.' (Interview 8)</p> <p>'Through the summer, every day we went to water our plants. The kids would be hanging around. As soon as they would see us they would come and they wanted to get wet. Especially when it was hot. They wanted to help. And then they could watch things grow.' (Interview 8)</p> <p>'Even for them to do a group thing. For them to start growing. For those who don't know how to garden ... they could learn together. Whoever wants to do their own.' (Interview 1)</p>
Sunshine	<ul style="list-style-type: none"> Plans for future growth People keen to have home-based greenhouses Described as "fun" Little vandalism 	<p>'There's a lot of people who don't know there are plants in there. They think it's empty. I think it's good. I thought it wouldn't last long. I thought kids would vandalize it, but it's good. Nobody has got in there.' (Interview 2)</p> <p>'Once it was up it sat for the winter. People said uh oh, the kids are going to smash it ... especially if it isn't going to be used. All winter long people would say, when are you going to start planting, what are you going to plant.' (Interview 8)</p> <p>'I thought the greenhouse was connected to the gardening. People are talking about getting their own gardens and even building their own greenhouses. It shows people that you can garden and things can grow in a greenhouse too. I'm surprised to see all the vegetables and all that.' (Interview 1)</p> <p>'Did you see all the plants? Lots eh! It's good.' (Interview 3)</p> <p>'I've seen the greenhouse at the school. I want to have a greenhouse at my house. There is one in this catalogue. I could order it and get it shipped up here. Then I can grow my own food.' (Interview 10)</p> <p>'Kids will come and they want to try the things that we are growing. They love trying all these things. Even some little girls love the radishes ... they have fun trying. It's a fine line between pulling it out with them and them coming and pulling them out themselves. It's fun. It IS fun. I can spend hours in there [greenhouse]. I love being there.' (Interview 9)</p> <p>'Someone called me last night and asked me if we would use the greenhouse over the winter. And I said, I'm reading this book about the winter harvest. We should think about this.' (Interview 11)</p>



Participant knowledge growth: Participant knowledge grew over the course of the project and community members described the greenhouse as presenting many opportunities for learning (Figs 1, 2a,c,d, 6). Most community members had not previously experienced gardening inside a greenhouse and felt there was a lot to learn. The two champions discussed their need to learn about watering, ventilation, and general knowledge about how to grow plants in a greenhouse setting as well as making the best use of the space available. This may have limited some of the yield of the greenhouse in this first growing season.

Sunshine: All of the key informants spoke about the greenhouse with a positive 'sunshine' perspective. The greenhouse seemed to stimulate new interests in food or in gardening. They enjoyed having a greenhouse in which to plant their seeds and appreciated it as a safe meeting place where people could gather.

Discussion

Lessons learned

Despite the long time taken to build the greenhouse and begin gardening activities in it, the positive outcomes of this project indicated that it is feasible to implement a community greenhouse in a remote, sub-Arctic community. Barriers to project implementation and progress included a lack of prior knowledge about gardening in a greenhouse setting and the challenge of making the broader group of community members feel like they had some ownership of the greenhouse.

Supports for project implementation included the drive and positive attitude of project champions and their ability to access and utilize resources to improve the successful growth of plants in the greenhouse. Sustainability activities that branched out from the greenhouse were also positive outcomes of greenhouse implementation. Another strength of the project was so many children participated in greenhouse activities. From the photographs, more children

were recorded as working in and around the greenhouse than adults. There could be many reasons, for example that the greenhouse is situated next to the school where the children spend a lot of their time, or that children were not as reluctant to enter the greenhouse because they didn't feel any issues about ownership.

The concept of ownership arose across many of the interviews because it was unclear to some community members who the greenhouse belonged to. Involving parents and their children together with school-based greenhouse activities and hosting community-wide greenhouse events with an open-door policy might help to dispel the myth about ownership of the greenhouse in FAFN. Other communities initiating school and/or community greenhouse projects may want to establish guidelines around whom, when, and how community members can access the greenhouse, to avoid confusion around ownership.

An important facilitator of the FAFN project was local champions, who were essential for successful implementation of the greenhouse. The success and sustainability of many community health initiatives, Aboriginal and non-Aboriginal, have been correlated with the presence of program champions^{45,62-64}. Identifying existing action-oriented local champions and involving them during initial project planning may be an important way for other communities to begin their own greenhouse and gardening interventions. This study recorded only one growing season and it was expected that the use of the greenhouse would increase and improve in subsequent years. As long as the project champions remained motivated to continue maintaining the greenhouse, the knowledge gained would be valuable for future growing seasons.

Interestingly, uncertainty about ownership, and the critical roles of local project champions, may be divergent findings: community members may not have felt ownership of the FAFN greenhouse because of the perceived status of the project champions.



Figure 2: From construction to harvest. (A) 21 November 2009: Following the arrival of the greenhouse pieces, a few teachers and community members began to construct the foundation for the greenhouse out of wood from the local sawmill. Community members felt it was important to have the foundation initiated and to let it sit over the winter and spring thaw to make sure that it would not shift through the seasons. **(B) 16 June 2010:** Greenhouse construction in progress during the following summer of 2010. **(C) 11 January 2011:** The greenhouse was built and sat under a blanket of snow, waiting for spring to arrive. **(D) 25 June 2011:** Inside the greenhouse, raised garden beds were built out of wood and filled with dirt. **(E) 29 July 2011:** A young girl helped to meticulously plant seeds in one of the raised beds in the greenhouse. **(F) 2 October 2011:** Vegetable plants, even sunflowers, thriving in one of the raised beds inside the greenhouse. Beans, peas, carrots, squash, tomatoes, various types of lettuce and a few flowers were planted and grown in the greenhouse. **(G) 5 October 2011:** Harvesting a head of lettuce to make a salad for dinner.

Although the amount of food able to be grown in the greenhouse would not be able to sustain many people overall, it could be used as a place to germinate seeds and cultivate seedlings to support home-based gardens and to be transplanted outdoors in community gardens. The

greenhouse could be further incorporated into the classroom curriculum to teach students about cultivating plants and the value of producing locally grown produce.



Figure 3: A crate garden, planted and maintained by a local and experienced gardening enthusiast. The owner of this garden was a great resource for gardening knowledge for the local project champions overseeing the greenhouse. (Photo taken 2 August 2011.)



Figure 4: A worm compost maintained by the high school science teacher. Compost was collected in classrooms and the cafeteria and fed to the worms. The worm compost was used as a teaching tool for the high school students. (Photo taken 30 September 2011.)



Figure 5: A colourful sign painted by literacy camp members for the greenhouse. The sign was painted in the summer of 2010. Peetabeck Academy is the name of the school situated next to the greenhouse. (Photo taken 1 October 2011.)



Figure 6: View at the entrance of the greenhouse. Stones from nearby were used to make a sturdy and appealing path through the center of the greenhouse. A tree stump served as a seat to be used while weeding and suckering tomatoes. Tables along the back wall held seedlings, flowers, and pitcher plants that had been retrieved during a student biology excursion. A large blue barrel was used to hold a large quantity of water for watering. (Photo taken 1 October 2011.)

The implementation of the FAFN greenhouse is still in the early stages and it was beyond the scope of this study to examine any substantial long-term outcomes. Initial experiences with children harvesting vegetables from the greenhouse suggested potential impact on willingness to try locally grown produce. Future research regarding the greenhouse in this community could examine some of the outcomes reported by other greenhouse and gardening projects, such as whether the greenhouse contributes to community outreach²⁰⁻²³ and an increase in students' knowledge and skills in nutrition and gardening²⁷. Findings from a study of 14 communities in northern Manitoba by Thompson et al. found a significant positive relationship between food security and gardening, whereas there was not a significant relationship between food security and household hunting and fishing²⁷. The probability of having household food security increased according to how often individuals ate from their garden in communities where there was a country food program but no access by road or public transport⁸. An important future study could examine the impact of the

greenhouse on food security status of community members in FAFN.

Findings may have important relevance for the implementation of community food security projects and initiatives that can have broad community reach and impact, and for future research on programs and policies addressing food security issues.

Conclusions

Results of this study indicate that greenhouse and gardening projects in a northern setting are a possible avenue to initiate and build up local food production; develop skills for agricultural activities at the home and community level; and engage and involve community members, including children, in growing local produce. Identifying local program champions and addressing concerns about ownership should be considered during the planning stages of community or school-based gardening initiatives. It may be important to establish some guidelines around



ownership of a greenhouse and suitable procedures for making the building accessible to everyone without compromising security. Greenhouse projects could be seen as avenues for building individual and community empowerment, whereby program champions and community members are able to take control over initiatives that they feel are worthwhile.

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