



HOW CAN GOVERNMENTS SUPPORT ADAPTATION TO CLIMATE CHANGE BY SMALL-SCALE FARMERS?

A case study from the Canadian
Maritime provinces

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WORKING PAPER

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Abstract: This paper uses a case study from the Canadian Maritime provinces (New Brunswick, Nova Scotia, and Prince Edward Island) to consider agricultural adaptation strategies developed by small-scale vegetable farmers, focusing on their interactions with government support initiatives. Farmers (n=40) were interviewed in-situ, in addition to participant observation practices, and interviews were qualitatively analyzed according to grounded theory methodology. Results show that small-scale farmers have developed a range of on- and off-farm adaptation and resilience-building strategies, but that very few of them are connected to government initiatives due to a culture of mistrust between the agricultural and governance communities. I argue that, in order to adequately support ground-level farmer adaptation initiatives, governments need to reframe farmer interventions as expert interventions, and agricultural adaptation as polycentric and multi-level. Allowing farmers to experiment, communicate, collaborate, and be supported according to their needs and constraints is suggested as more effective than a top-down, centralized approach.

Keywords: Canada; agriculture; adaptive capacity; climate governance; knowledge integration

1. Introduction

How can institutions best support climate change adaptation for farmers and for the food system? It is well-established that small-scale farmers and food producers maintain an inherent capacity to adapt to some changes and shocks, regardless of whether they acknowledge the urgency of the problem of climate change (Abdul-Razak and Kruse, 2017; Armitage et al., 2008; Cockburn, 2015; Takahashi et al., 2016). Yet adaptation efforts by farmers, will likely not be enough to successfully adapt to the challenge of a new and increasingly erratic climate regime worldwide. Food production is only one link in a global food system which includes distribution, storage, consumption, waste management, and the governance structures which hold them together; compounded shocks will likely overwhelm smallholders without systemic support. (Ericksen et al., 2009; Ingram et al., 2010).

While altering farming production practices is an essential part of agricultural adaptation to climate change, the adaptation literature increasingly recognizes the importance of non-production strategies which help farmers build adaptive capacity. Smit and Skinner (2002) describe four typological areas in which agricultural adaptation exists: government programmes and insurance; technological developments; farm production practices; and farm financial management. The best strategies for adaptation increase the adaptive capacity of producers by removing drivers of negative or constraining impacts, and maintaining or increasing the potential number of future management options (Fazey et al., 2010; Kent and Sherren, 2017; Smit and Wandel, 2006). Programmes which do not require behavioural change on behalf of farmers, on the other hand, have been criticized as potentially reducing resilience to future change (Adger et al., 2014; Kent and Sherren, 2017). Within adaptation literature, there is a growing consensus that multi-scalar and multi-stakeholder governance models are essential to creating

successful adaptation planning (Adger et al., 2014; Ostrom, 2014, 2010; Sherren et al., 2016). It is only when initiatives put forward by governance institutions and initiatives in place by farmers and other food system actors meet in a mutually beneficial and supportive capacity that adaptation policy can be truly successful, rather than undermining one objectives or the other.

The Maritime provinces of Canada—New Brunswick, Nova Scotia, and Prince Edward Island, hereafter referred to as “the Maritimes”—form an interesting case study for the interaction of climate change adaptation, farmer adaptation, and government support. The region has experienced and will continue to experience the effects of global climate change on production agriculture (Campbell et al., 2014; Daigle, 2012; Jellett, 2013; Richards and Daigle, 2011; Savard et al., 2016). Its topographic and biological diversity makes it difficult to categorize and model as one geographic region for the purposes of climate adaptation planning (Savard et al., 2016). Moreover, a recent upsurge in small-scale vegetable farms in one of the provinces has countered a national trend of farm agglomeration (StatsCan, 2017). Critics have suggested that current government structures have made it difficult to adequately design adaptation strategies for climate change due to a disconnect between government, scientists, and farmers (Wade and Robichaud, 2011). Yet individual farmers will continue adaptation initiatives so long as there are changes to adapt to (Kent and Sherren, 2017; Niles and Mueller, 2016; Sumane et al., 2017). It would be useful, if only for the sake of building adequate adaptation policy, to understand the interactions between farmer adaptations and those government-based adaptation strategies which purport to aid them in adapting.

This paper responds to a perceived gap in the literature by describing current climate adaptation practices employed by farmers across the Maritimes, both in terms of production techniques and business practices. It also aims to clarify the

relationship between government-mandated adaptation support and small-scale farmer decisions, and the ways in which institutional support is variously accepted and rejected within the Maritime agricultural community. I use interviews with 40 small-scale vegetable farmers in the Maritimes about the techniques and strategies they used to increase resilience and adaptive capacity on their farm, among their networks, and in their business practices.

2. Methods

Between May and August 2016, I interviewed 40 small-scale vegetable farmers across New Brunswick, Nova Scotia, and Prince Edward Island about their practices, the changes in weather and climate which they had experienced, and their relationship with other food system institutions.

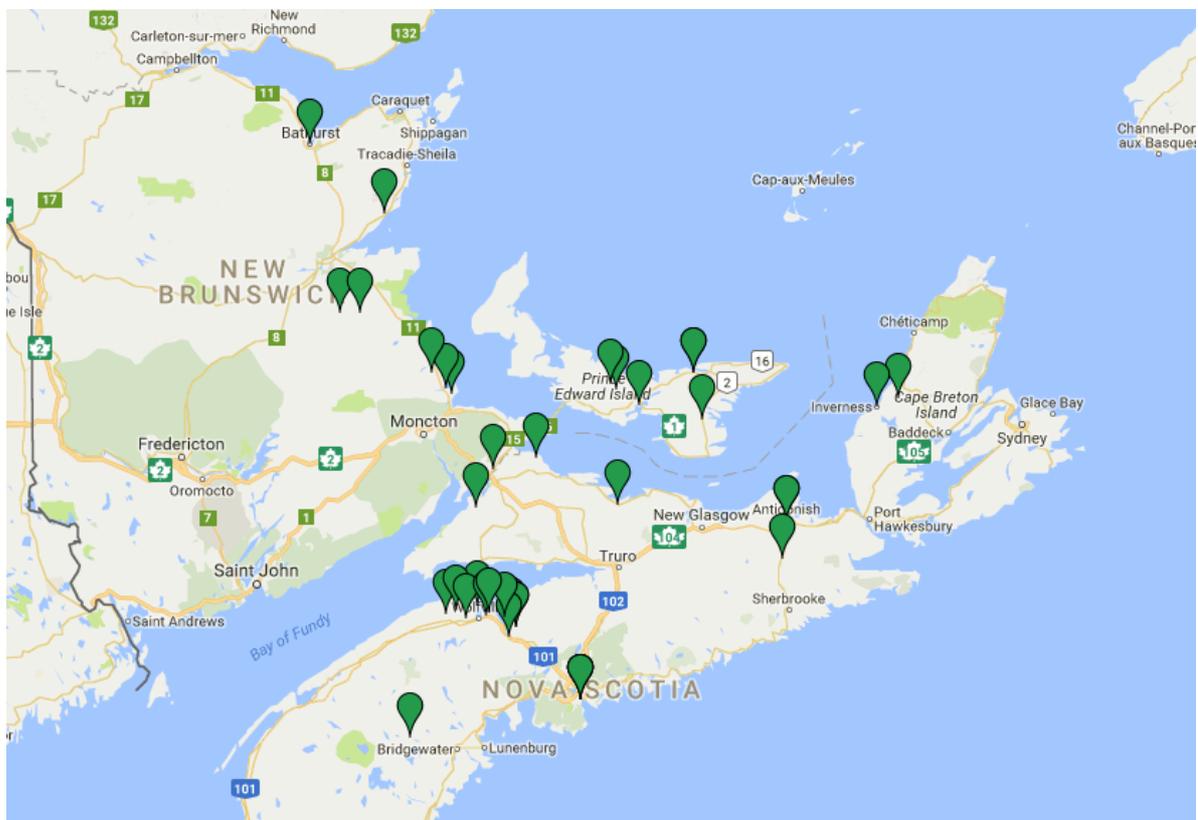


Fig. 1: Interview locations, May-August 2016 (Google Maps, 2017)

Participants were chosen from an emic knowledge of the small-scale farming community in the region. Having worked as a farming apprentice in Nova Scotia and New Brunswick between 2013 and 2015, I was able to target contacts who were likely to be interested, and used snowball sampling techniques to find further participants. Snowballing proved effective for making connections that would otherwise require significant social capital in the community, and in helping potential interviewees find a personal reason to participate (Tansey, 2007). Additional participants were contacted via advertisements in online newsletters from regional farming organizations such as the Atlantic Canada Organic Regional Network, with links that led to an online Google form which could be filled out to indicate interest.

Interviews took place across the Maritimes, from Northern New Brunswick to the South Shore of Nova Scotia (Figure 1). In order to obtain a true geographical cross-section of impacts, it would have been preferable to interview farmers outside the coastal regions. Timing and funding constraints made it difficult or impossible to perform interviews in western New Brunswick, Northern Cape Breton, and the Southern Shore of Nova Scotia. The area covered by interviews, however, represents the dominant region for small-scale vegetable growing in the Maritime provinces.

Farmers were informed that they would be asked about changes in weather and climate; about changes they had made in their farming or business practices; and about any other topics which they might wish to raise or discuss. Most of the interviews took place during visits to farms; those that did not were done by telephone. Interviews were semi-structured: they followed a set of questions within an initial questionnaire, but quickly moved towards topics and concerns that farmers were keen to discuss.

The interviews were conducted in French, English, or Chiac, all of which I speak fluently; many of the Acadian farmers preferred to speak French or Chiac¹. Appreciating and responding to the linguistic diversity of the region led to a deeper understanding of adaptation options; had the study been conducted entirely in English, many French-speaking farmers would likely have been discouraged from participating in the research project. During or after the interviews, I would often reciprocate by giving farmers a few hours' worth of skilled labour. It was understood that, given the timing of the interview process (high production season), it would have been unacceptable not to compensate farmers in some form for the lost time. Part of my identity as a researcher in this study stems from the fact that I have worked as a farm manager and labourer in the region. Much of my access is predicated on the fact that the agricultural community knows me as a member of that community first, and as an academic second. This study remains committed to honouring the relational accountability and mutual reciprocity which is essential in participatory research (Wilson (2008)).

Other data were collected through follow-up calls, which were recorded, and through participant observation while visiting farms. In addition to the interview process, this research project was initially meant to complete a strategic planning scenarios exercise, the methodology for which is explained in Vervoort (2013). Farmers were invited into a collaborative planning session, which due to poor turnout was unable to build a collaborative adaptation plan: a significant snow storm hit Moncton on the evening of the scheduled exercise, leading many farmers

¹ The Maritimes is a bilingual region. New Brunswick has two official languages, English and French, and Nova Scotia and Prince Edward Island each contain French-speaking populations. Many of these French-speaking citizens are Acadians. Acadie (or the Acadian region) covers much of New Brunswick, as well as parts of Nova Scotia, Prince Edward Island, and Maine; it is the historical territory of the French-speaking peoples of Eastern Canada. Today, Chiac refers to the vernacular Acadian French which combines French, English, and Aboriginal languages.

to remain at home to tend to buildings or livestock. Despite being cowed by the forces of Maritime weather, ten farmers did attend; I also accumulated notes in the form of data-rich memos (Birks and Mills, 2015), many of which were used in forming theory during subsequent rounds of interview analysis.

Transcribed interviews were coded using *NVivo 11* (QSR International, 2016). Coding was inductive and iterative: codes were generated at a line level, then categorized into more general theoretical categories. The multiple iterations of coding ensured consistency within theoretical codes. An initial analysis was performed by exploring the themes which inductively emerged in coding (e.g., season extension; government support for adaptation; etc.). The Results section below highlights specific transcript sections, which allows me to present farmers' insights as expert interventions (Sumane et al., 2017).

Finally, I conducted a systematic qualitative analysis of adaptation options described by farmers across the Maritimes through the lens of the adaptation framework described above, considering adaptations which took place on the farm and in business or marketing practices. In particular, I paid attention to the ways in which adaptation options fit within a framework of drivers or indicators of adaptive capacity, as well as whether they were supported by other institutions than the farmers themselves (Nelson et al., 2007).

3. Results

The results are organized around the major thematic nodes which emerged during coding, including water management, soil management, season extension, marketing, government support, and financial resilience. I begin with on-farm adaptation techniques and initiatives, then consider off-farm adaptations.

3.1 On-farm adaptation techniques

3.1.1. Water management

For many of the farms which were included in the study, the effects of wind and increased temperature mean that water management for crops has become a significant issue, leading farmers to develop more rigorous irrigation plans.

Basically, my mentality is if you can't water it you shouldn't put it in the ground. Because you put in all that effort, all that expense, all that environmental impact, if you need to water once or twice to bring it through then that's what you should do. (NS-012)

To try to grow vegetables now without irrigation is almost unthinkable. (NS-016)

Techniques for irrigation depend on the nature and size of farms. Many farms have chosen to dig additional wells or ponds to be able to access water across the farm, which amounts to a significant investment both in terms of finances and in terms of infrastructure, given the landscape changes required for a pond to be dug on a small farm. Once water sources have been secured, irrigation methods differ.

Sur un petit acrage, t'as pas le choix que d'irriguer. Pis moi je dis que les systèmes les plus économiques, c'est du goutte-à-goutte. Je creuse des puits, j'irrigue à partir des puits--c'est pas des ponds, c'est des puits. (NB-002)²

(On a small acreage, you have no choice but to irrigate. I tell you that the most economical system is drip irrigation. I dig wells, I irrigate from wells—not ponds, wells.)

There is a general understanding with farmers across the Maritimes that irrigation acts as a buffer against the increasingly unpredictable nature of precipitation. If rains come, the irrigation infrastructure is unnecessary for field crops, but allows for

² To respect the importance of Acadian culture and language in agricultural practice, I present quotes in their original language, then provide translation below.

watering inside season extension structures; on the other hand, in periods of drought, irrigation provides vital watering to transplants and recently seeded crops.

3.1.2. Soil management

In order to mitigate irrigation risks, as well as to hold nutrients for crops, many farmers describe shifting their soil management practices towards one which promoted strong soil health and high biological activity, which promotes fertility, adequate moisture retention, and strong soil structure.

Ideally, at some point, the fertility could be managed more through the soil. [...] Fewer inputs, yeah. We would build the soil health to a degree where there are more loops [in the nutrient cycle] within the soil that we are not constantly impeding. (NS-006)

While many farmers consider it a normal part of practice to buy in soil inputs such as compost or minerals from off-farm, several suggest that part of their plan for building the farm's overall resilience includes weaning off external inputs, allowing the farm system to be largely self-sustaining and focusing on building topsoil which could drain well, but retain moisture when needed. These practices include reducing or eliminating soil tillage from cultivation plans in order to promote microbial and mycorrhizal activity in soils, both of which prevent nutrient loss; reducing or eliminating the use of fertilizers and pesticides and using cover crops and tarps to cover beds and build soil organic matter. Farmers observe that the result of increased soil health is a lower requirement for soil and crop management; several spoke of the soil "doing the growing for them".

I want the soil to be the thing doing the growing [...] in commercial production, it tends to be the soil is just holding the crop there and different components are thrown at the crop to make it grow. We put a seed in the ground and with our good soil management the soil does the work for us. We have pretty good moisture-holding capability on our farm, with our heavier clay-loam soils and the

amount of organic matter we've managed to get into our soils. (NS-013)

Healthy soil acts as a buffer against weather-related shocks by holding moisture, allowing for richer microorganism life to improve the nutrient cycle, increasing innate soil fertility, and requiring less intensive cultivation before planting. One farmer mentioned that the indicators for soil health are unclear at present, and that it would be useful to have better indicators of soil health in order to understand which nutrients are available to plants.

3.1.3 Diversification in crops

Farmers who were asked about building resilience in a farm system often spoke of the importance of diversification in crop planning. By planning multiple varieties of one same crop, and many different crop types, farms are able to withstand crop losses, low yields, disease, or market failures of individual varieties without necessarily losing a significant part of their income.

As far as resilience goes, to change, definitely a very diverse operation like this is much better able to ride the waves than some of these guys. We've got neighbours up here that grows onions, that's it, just onions. So if you have a bad year for onions, they're in trouble, they have a horrible year. With us, you know we watch our income and our profits and it steady, every year. (NS-012)

A diverse array of crops acts as a physical buffer against potential shocks from weather and climate by reducing systemic damage to the farm, but also acts as a buffer against economic shocks. One farmer expands on the economic advantages of diversification:

De un, côté économique, ça nous aide à pouvoir augmenter le nombre d'argent que chaque client--développer un partenariat avec des clients, alors on peut vendre plus de produits à ces gens-là [...]. Ça fait qu'on peut dormir la nuit quand même parce qu'on peut retomber sur plusieurs autres affaires. Je pense aussi [que] ça

devient plus intéressant niveau... avoir plus de sortes de légumes. On est comme des fermiers de famille, on farm pour des familles de gens. (NB-001-2)

(One, on the economic side of things, it helps us raise the amount of income per customer—developing a partnership with customers, so that we can sell them more product [...]. It means we can sleep at night because we can fall back on other stuff. I also think it becomes more interesting with regards to having different kinds of vegetables. We're family farmers, we farm for whole families.)

3.1.4 Season extension infrastructure

The most direct adaptation to changing weather and climate discussed by farmers was the use of season extension infrastructure: indoor or sheltered growing areas which allowed for crops to be planted and harvested beyond normal seasonal parameters. In the Maritimes, these can take the form of greenhouses, which are rigid, heated, plastic-covered structures; polytunnels, which are unheated greenhouses; or hoophouses, which are flexible, unheated structures characterized by their rapid installation capacity.

Season extension techniques have proliferated, with many farmers adopting hoophouses or greenhouses as essential infrastructure to lengthen the production season.

Je veux faire d'autres tunnels de trois baies, parce que les cultures sont trois semaines en avance des producteurs du sud-est. Ça demande de la gestion, pis des fois ça réussit pas pire. [...] Ça m'arrange au printemps, ça m'arrange à l'automne. Avec une saison courte, même si on a eu dix jours de pluie, on a pu travailler dans les tunnels. (NB-002)

(I want to build more three-bay tunnels, because the crops in there come three weeks earlier than other producers in the South-East. It needs managing, but it works out pretty well. [...] It helps me out in spring, it helps me out in the fall. With a short season, even if you get ten days of rain, you can still work in the tunnels.)

By building season extension structures, farmers protect crops from disruptive wind events and rain-borne fungi such as late tomato blight. Crops receive a much higher air and soil temperature, allowing farmers to grow crops which would normally be impossible to grow in the current climate or to plant earlier and later than they normally would without having to fear for frost. Some farmers have begun experimenting heavily with winter production, which enables farmers to go to market almost throughout the entire winter.

Season extension infrastructure, however, is as much a vector for vulnerability as it is an opportunity for adaptation. Farmers point out that the increasing windiness in the region has made them think very carefully about the way in which they set up infrastructure.

Sometimes we think about our tunnels in terms of climate change, as like a tool but also as a potential detriment, because of storms and stuff.

Q: Is it because of wind, or--

A1: Yeah. Or snow load.

A2: Getting destroyed. We see them both as a benefit and as a downfall in terms of climate change management on the farm. I know sometimes people think of it as just a benefit, but we definitely can see both sides. (NS-006)

Some farmers are experimenting with hoophouse and greenhouse structures in order to mitigate potential damages. While these investments are costly, they are considered necessary to adapting traditional structures to new environments and weather conditions:

We've changed the way we are doing hoophouses to make them more wind-resistant; we're putting a purlin in now. A wooden purlin [transveral structural bar], and we have wooden cross bars. [...] I'm trying to dial in a 20-foot-wide hoophouse that works. You know that gothic shape that just sheds snow—20-foot-wide is just so much more efficient than a low-profile 17 [feet], where your two

edge beds might as well be outside all summer because the plastic rolls up and the rain falls on them. So with the 24-foot-wide, you can do four big beds that are sheltered from the rain so they don't get disease. (NS-002)

Q: what are you doing to mitigate [damage to hoophouses]?

A: Buying the strongest structures. Like the one we just did. [...] Thicker steel, closest spacing on the ribs. Fortunately, there are other farmers and engineers who are smarter than us and can figure out how to make it a stronger structure. So when they come up with new designs and they say that they're better suited for handling wind or being able to withstand snow load on top of it, we invest in those structures and replace the old ones. [PEI-004]

Farmers' approaches to innovation differs. While some are content to experiment by themselves and invest in new structures, others rely on the knowledge networks available to them to hear about how other farmers are doing with their innovations, and purchasing or adapting designs in reaction to others' experiences.

3.2 Business and financial adaptation techniques

Beyond the immediate adaptations which they can make to their production techniques or farm infrastructure, farmers in the Maritime provinces overwhelmingly associate the resilience of their farm with a financial resilience. As a result, many have adapted their business plans to become more flexible, to distribute risk, and to stabilize income, all of which can be considered financial adaptation techniques.

3.2.1 Defining financial resilience

Farmers were quick to point out that climate resilience is dependent on financial resilience.

I think economics is number 1. [...] Stop talking about sustainability until we talk about economic sustainability. Because if it's not economically sustainable, I don't want to have a discussion with you.[...]. Economic sustainability comes from having better control over your expenses. (NS-011)

A resilient farm system is one that is able to stay in business and stay productive in the face of all these problems that, to some extent are already here, and that are expected to get worse. [...] Part of resilience for a farm means having a certain amount of economic independence. (NS-026)

A mentality which privileges financial resilience is essential to many farmers' business models, making them inherently risk-averse in terms of investments. On small farms, an efficient investment is one which can perform multiple tasks and remain flexible.

[To be resilient,] build a building that'll do a whole bunch of jobs for you, not just one. And equipment-wise, a truck that would do more than just one dedicated job. A tractor sizing so that it will do many different-sized jobs. We run this farm with two tractors, 150 acres, we manage very well, we've got an 85 horse-power and a 40 horse-power tractor. Things like that. (NS-013)

3.2.2 Diversifying markets

Some farmers extend their definitions of diversification to market opportunities. By selling at multiple markets, or by setting up different streams of revenue such as community supported agriculture schemes alongside market sales, it becomes easier for farmers to move product with speed and flexibility, which keeps revenue stable.

Si c'est plus divers, c'est plus facile à vendre. Un produit, un acheteur, c'est ta pire situation, parce que s'il en veut pas... si t'es diversifié, avec 6-7 kioskes [...] ça va bien. (NB-002)
(If it's more diverse, it's easier to sell. One product, one buyer,

that's your worst nightmare, because if the buyer doesn't want it... if you're diversified, with six or seven avenues, you're okay.)

The diversity of markets means that if something goes under, something goes wrong, kablooey, whatever, then you have other markets to fall back on. (NB-005)

Overall, having more options for growing or for sale is considered to help a farm's systemic resilience, allowing it to maintain control over inputs and outputs without necessarily becoming dependent on any one source.

Q: D'un côté la diversification ça aide un peu avec le système de la ferme en général.

A: Absolument. On n'est pas obligés de faire rentrer des implants. On est un peu comme un circuit fermé. On a pas mal tout ce qu'on a besoin proche d'ici. (NB-001-1)

(Q: So you could say that diversification aids with the farm system in general.

A: Absolutely. We don't have to bring in inputs. We're like a closed loop. We have pretty much all we need close by.)

3.2.3 Marketing adaptation through co-operative enterprise

Farmers across the Maritimes who are members of cooperatives speak very highly of their capacity to mitigate risk and increase financial resilience.

Two forms of co-operatives are described. The first is an (often informal) arrangement between farmers to pool produce and share a single point of sale at market, rotating selling duties each week. The second is a formal, incorporated organization owned by farmers, to which they sell vegetables based on orders, and which stockpiled produce, negotiated contracts with institutions, and distributed products to buyers and consumers.

Farmer marketing co-operatives in the Maritimes identify and exploit new niches in the market, which allows small-scale agricultural enterprises to avoid competition with some of the larger distributors while maintaining market share.

We had a co-op going. [...] Alison was our broker and manager. And so, she dealt with [large grocery store] Sobeys and she did a really, really good job. [...]

Q: So, you weren't directly brokering with them?

A: No. Alison, basically, sold a lot of our stuff at the time to restaurants and stuff. She took the orders. We supplied it and she took a commission and that worked great. (NS-005)

Ordinarily, farms would negotiate contacts with distributors, restaurants, or other buyers individually. This has the disadvantage of extra work for the distributor, which must manage a significant number of orders from multiple farmers in order to buy locally. Farmers describe their attempts to sell to hospitals and schools as previously unsuccessful because no one farmer could provide enough for a kitchen serving hundreds. By selling into a co-op, however, farmers in south-eastern New Brunswick are able to sell to multiple institutions that would otherwise be inaccessible:

En plus de mes 85 paniers, je fournis--notre groupe, La Récolte de chez nous, fait aussi des paniers approvisionnés par les producteurs. [...] on a un entrepôt où il y a deux personnes qui travaillent à cocagne, pis on livre du produit là qu'eux-autres font les boîtes avec. Pis il y a aussi des cafétérias d'école qu'on approvisionne de produits de notre groupe. (NB-002)

(In addition to my 85 baskets, I've got—our group, *La Récolte de chez nous* [Really Local Harvest Co-Op], does baskets with vegetables from its producers. We have a warehouse with two employees in Cocagne, and we deliver produce there for them to make up the boxes. And we sell to school cafeterias with produce from the co-op.)

Selling to institutions like schools and hospitals allows co-ops to take advantage of a previously unexploited niche in the market, thus moving produce without increasing competition with other farmers. Moreover, since farmers are selling to the cooperative as an institution, they receive payment immediately, rather than after sale to the consumer.

For many farmers, participating in a co-op creates a new revenue stream above and beyond their normal revenue, increasing their annual income:

L'année passée, à Dieppe, on aurait juste amené des fraises. [...] On aurait fait 1200 [dollars] l'an passé. Mais là qu'on a décidé d'apporter des légumes pis tout, pis on a officiellement intégré cette coopération-là en s'incorporant en coopérative avec trois autres fermes, et ça nous a ramené quoi? 5000\$ de légumes plus le 1200, 1300 de fraises. C'est quand même un bond substantiel pour une première année. Et ça s'est fait sans même qu'on le planifie. (NB-001-1)

(Last year in [the market at] Dieppe, we would have just brought strawberries. We would have made \$1200 last year. But then we decided to bring vegetables and everything, and we officially integrated that cooperation by incorporating as a co-op with three other farms, that brought us, what? \$5000 in vegetables, plus the \$1200, \$1300 from the strawberries. That's a substantial increase for a first year. And it happened without our planning it.)

[The co-op] just works so well. We thought that our sales would go down into the second year because we only have the priority every second week, but our sales actually went up. Both of our sales went up. And the thing was, we had a better stocked table. We had a longer selling season. It just made such a difference. And so then we said, ok, this is a good thing. (NB-005)

For many farmers in an informal co-op, selling at market as a co-op allows for a greater diversity of produce at the table. This has the double advantage of taking pressure of some of the crop planning, as none of the co-op members needs to

grow quite as diverse a span of crops; and of making the table more attractive at market, which keeps customers interested and loyal. Regardless of whether the co-op is officially registered and incorporated or not, farmers report that the financial benefits of such an arrangement have been significant.

Finally, farmers who had formed a co-operative report that the arrangement creates a support network between farmers, one which facilitates knowledge exchange and mutual aid. While these arrangements are often informal, co-operation in one aspect of the business facilitates co-operation with others:

This is one of the beauties of the co-op, its resilience. When you have more people working together, and it's going back to what I was saying before about how the strength is going to come out of grassroots initiatives. The Co-op is that, is us getting together and helping each other. [...] we want to create businesses, viable businesses, and we want to have fun. You know all of these things! Generally, working together is how we're going to manage it. (NB-005)

3.3 Government support for adaptation projects

Beyond direct financial self-sufficiency, however, farmers in the Maritimes have also explored opportunities for support from government institutions. Farmers are aware that there are certain government programmes which can aid in financing adaptation or business projects such as setting up season extension. These programmes may take different names and forms, but most are loan- or grant-based funding which can be applied for to fulfill a specific project.

3.3.1 Government framing of adaptation

Adaptation strategy in the Canadian Maritimes, especially as it relates to climate change and food systems, has historically been understood as risk-management

strategies rather than aiming to increase adaptive capacity (Milne, K, pers.comm.³). Notions of building adaptive capacity are more centered on finding, isolating, and responding to specific risks which might affect the Maritimes—notably sea level rise and coastal erosion (Lieske et al., 2015; Richards and Daigle, 2011)—than they were on identifying current drivers of adaptive capacity.

Across the adaptation literature publicly available from provincial governments, climate change is primarily understood as potentially beneficial to agriculture in the Maritime provinces due to shifting climate bands making it possible to grow crops in more northern regions (Campbell et al., 2014; IPCC, 2014a). Agriculture is not considered vulnerable within the adaptation framework of most governance institutions in the Maritimes (NB Govt, 2013; NS Govt, 2009; PEI Govt, 2008), despite most climate change projections and literature suggesting that the Maritimes are intensely vulnerable to the impacts of climate change (Campbell et al., 2014; Hewitt, 2016; IPCC, 2014b; Jellett, 2013; Lieske et al., 2015; Savard et al., 2016). As a result of this approach to adaptation, government support for agricultural adaptation is primarily framed as support for farmers' improvement of their business, and maintaining market share.

3.3.2 Farmer reaction to government support

While most participants know of government financial support for activities which might help to bolster adaptive capacity or resilience on the farm (such as installing season extension infrastructure), very few actually admitted to receiving or even seeking out direct government help. Those who did primarily accessed business-development grants, which are more numerous than direct adaptation opportunities. Farmers who discussed government support generally held the

³ Nova Scotia Department of Environment, pers. comm., July 2016.

opinion that the support *would* be helpful *if* it were presented differently, or was tailored for small farmers rather than large-scale farms. The negative feedback received in interviews can be broken down into three categories.:

Firstly, support from governing institutions is inadequate because farmers feel too overwhelmed with current activities to deal with current bureaucracy. Farmers spoke of not wanting to apply for financial support out because they quite simply have better, or more essential, things to do with their time.

La paperasse parfois, ça vaut pas la peine. Je vais faire ce que j'ai besoin, c'est tout. (NB-002)

(Sometimes the paperwork just isn't worth it. I'm going to do what I have to, that's it.)

Q: A lot of people have just said, I keep getting approached by people or people keep pointing out the [government support] exists but, I am so busy and I have so little time for the bullshit of bureaucracy that, why would I spend six hours applying for something when I could just be working?

A: That's exactly me. That's exactly where I am. (NS-011)

Part of this sense of feeling overwhelmed comes from the nature of the timing of government programme applications, many of which are due during high production season, a time which they cannot afford to take off in order to deal with the bureaucratic burden of applications.

It's kind of hard because, for this year, we sent out our application in April, but we still haven't heard back if it's approved or not [to the Homegrown Success program, through NS Dept. of Agriculture]. When we hear whether we've been approved for different projects or not, often we hear back when we start to get really busy. We usually try to plan to a degree, but usually project have to be completed before March of the next year. And for many projects, the winter isn't really good time to do that. (NS-006)

Secondly, support from governing institutions is inadequate because small farms are not perceived as being important to government. Many small farmers expressed the feeling that they are overlooked by institutions in comparison to large farms, mentioning that they feel entities like the Nova Scotia Federation of Agriculture primarily represent large-scale farms in the region:

To have the government support in terms of local food and farmers markets has been beneficial, but it's been harmful to have that kind of regulation where large-scale and small-scale are being treated like basically the same kind of production. (NS-001)

There is very little communication in actual fact between the department and farmers. I almost never hear from them. (NS-019)

Extension agents were widely lauded as excellent go-betweens between governments and farmers across the Maritime region. By acting as knowledge bridges between farmers and other institutions and as liaisons with government, extension agents respond to specific requests from farmers to run crop variety trials, to obtain information about pests and diseases, or to organize exchanges with farmers from other provinces to cross-pollinate knowledge. Yet these positions are typically understaffed, to the point where extension agents are unable to support small farms.

I kind of feel like [our extension agent] is useful in spite of the system that he works in, not because of it. I feel like he's kind of battling the system all the time, so they are trying to bury him in paperwork and he is trying to get out and see farmers and talk to farmers and help farmers. [...] I don't feel like the New Brunswick government is that supportive of agriculture. (NB-005)

Thirdly, support from governing institutions is inadequate because it does not respond to the needs of farmers. Much of the financial support offered by governments is considered impractical by participants because it considers specific projects rather than general objectives for adaptation, the former of which are often

incompatible with the aims of smaller farms.

I haven't had much to do with the government programs in the last few years because they seem to have narrowed it up so much toward just environmental things. We don't use pesticides, so we don't need to go looking for money for pesticide storages. (NS-013)

Furthermore, those projects which were accessed by farmers are not flexible enough to allow farmers adequate cash flow during the work. Farmers perceive the opportunity cost of dealing with reimbursement forms and poorly-timed project timelines to be too high to properly take advantage of the financial support.

We've done a few research projects under the Growing Forward Innovation funding. And honestly, I think that's a terrible program. [...] It's not farmer friendly. First of all, you spend your own money and then they reimburse you. And most small to medium-sized farms have cash flow issues. It's money that you've got to spend that could be better spent on other things. (NS-026)

It has been a challenge to make [funding schemes] fit in our production plan in them in some ways. [...] If we're putting up the greenhouse... [...] you actually have to finish putting it up before you get that money back, but on other projects you just have to buy it and then have it before they give you the money back. [...] And the winter wouldn't be a good time to do it. So that is a challenge. (NS-006)

French-speaking participants also highlighted the fact that government support and education do not exist in French anywhere in the Maritime provinces, which makes knowledge acquisition and networking more difficult for non-bilingual farmers:

C'est comme si l'agriculture était pour les Anglais par ici. [...] Je vais me retrouver à plus fouiller au Québec que dans les affaires atlantiques. C'est de valeur [...] je comprends l'anglais, mais je le comprends moins. C'est pas ma langue. (NB-001-1)
(It's as though agriculture were for English people round here. I find myself looking more into the resources in [French-speaking]Quebec

more than in Atlantic resources. It's too bad [...] I understand English, but I don't understand it as well. It's not my language.

In general, participants did not express a high confidence that government can be a useful source of support in concerted efforts towards adaptation to climate change or building adaptive capacity on farms, due to government efforts fundamentally misunderstanding the needs of small-scale farmers.

4. Discussion

I set out to understand the changes farmers are making, on and off the farm, to mitigate the negative impacts of climate change and to build adaptive capacity into both their production systems and their businesses. This was done by performing a series of interviews and participant observation sessions with farmers across New Brunswick, Nova Scotia, and Prince Edward Island. An inductive approach to analysis was both appropriate and necessary due to the lack of climate adaptation research in the Maritimes, combined with the present lack of official public policy on agricultural climate adaptation. This discussion responds to this gap by describing the mismatch between farmer strategies and available support structure for farmers.

Before beginning, it is worth noting that few of the actions described by farmers have emerged exclusively in direct reaction to climate change. Many farmers have argued that it is in the nature of farming to adapt to changing conditions, not only in terms of identifying and mitigating immediate risks, but in enhancing the way in which their farm systems work such that they can build their capacity to adapt. As such, this discussion does not pretend to identify any specific strategies that should be reproduced across the Maritimes, but rather to explore the ways in which participants have built adaptive capacity and the bearing of these strategies on current policy.

This discussion focuses on the interactions between farmers' individual adaptation initiatives and those larger collaborative or governance-based initiatives which have emerged in recent years in the Maritimes. Current techniques and strategies for building farmer adaptive capacity may be successful on a local level, but provincial adaptation and support initiatives suffer from a significant lack of trust between farmers and governing institutions. Considering a polycentric, multi-level framework for adaptation support may be a way forward in building programmes which not only provide funding to farmers for their own adaptation initiatives, but respect the constraints of scale and timing in which they operate.

4.1 Climate resilience is financial resilience

For farmers in New Brunswick, Nova Scotia, and Prince Edward Island, climate resilience and adaptive capacity are intimately tied to financial resilience. Many farmers draw direct links between future resilience to climate change and the ability for their business to remain financially viable. This takes the form of distributing risk and building adaptive capacity in the system, neither of which is a necessarily separate project. On-farm adaptations such as building season-extension infrastructure help mitigate storm risk and distribute the growing season over a longer period, while simultaneously expanding the possibilities for growing, and thus income. Similarly, engaging in co-operative marketing opens new market niches for farmers, creating additional revenue streams, while simultaneously crafting a network of support in the form of other co-operative members.

Farmers' techniques for distributing financial risk and building adaptive capacity can be understood as essential to mitigating impacts of climate change, despite not necessarily directly addressing weather or climate impacts on production. For many farmers, there is no hard and fast line between the sustainable development of a

farm, its capacity to stay in business, and its capacity to adapt to and remain flexible in the face of future shocks, whether related to climate or to the market. As such, building adaptive capacity and resilience is simply seen as a facet of sustainable business practices—which, of course, includes the development of social and economic capital (Adger, 2003; Adger et al., 2014; van Bers et al., 2016). As Wynne-Jones points out, "economic motivations cannot be conceptualised in simplistic or isolated terms. Rather they need to be understood as part of a more holistic form of decision-making which include social and temporal dimensions, and whether actions enable resilience in more systematic terms" (2017, p. 261).

4.2 Supporting adaptation, reclaiming trust

Across the Maritimes, farmers are cognisant of and reacting to changes in weather and climate by building systems to mitigate risk and build flexibility on their farm and in their business. While government initiatives have been put in place to support farmers, there appears to be a climate of mistrust and poor communication between farmers and governance institutions which have been hampering potential support or collaborative opportunities across scales. This feeling corresponds strongly with some of the criticism which has been leveled at provincial climate change governance over the years over a management structure which has failed to successfully create a flexible and multi-scalar risk management structure (ACASA, 2016; Lieske et al., 2013; Wade and Robichaud, 2011).

Among adaptive strategies, season extension stands out as a clear example of miscommunication between funders and farmers. Most of the farmers interviewed are experimenting with, if not heavily invested in, season extension infrastructure which could provide advantages in both growing and building adaptive capacity. Farmers know that government grants have been made available, yet none of the forty farmers I interviewed had received granting from governments.

Why was such a programme available, but not taken up? Farmers expressed frustration with a mistimed application process that came in the middle of production; with lack of communication with the department, apart from through overworked extension agents; and with a general mistrust of government subsidies. As Nelson et al. note, adaptive capacity can be represented by the set of physical and nonphysical available, including economic capital, social capital, information and knowledge networks, institutions, technology, and infrastructure (2007). If grants or support are offered as a way to build adaptive capacity, but the opportunity cost of acquiring them impedes another driver of adaptive capacity—if, for example, it isn't worth a farmer's fieldwork time to submit paperwork—then external support is impeding farmers' current adaptation strategies.

If successful adaptation is the goal of both provincial governments and individual farms in the Maritimes there is a clear need to recognize farmer innovation as important and expert innovation. This brings to mind Tompkins and Adger's framework for successful adaptation, which considers resilience-building and adaptive capacity as essential aspects of sustainable development, and which argues that "the capacity of an individual, group or institution (at any scale) to learn and modify its response is important in generating sustainable outcomes" (2014, p. 563); that is, outcomes which allow not only for the simple survival of a system but rather continued positive development. Wynne-Jones has also highlighted that "the importance of conceptualising benefits as interwoven, rather than singularly defined (as economic or environmental or social), is evidenced with many emergent and unexpected outcomes serving to support and buffer the group when some desired outcomes were not realised" (2017, p. 267). In the case of Maritime farmers, this study sheds light on the multiple ways in which financial resilience, biological resilience, and social resilience are facets of adaptive capacity as well as simply

good, sustainable business sense.

Renegotiating climate adaptation in Maritime agriculture as a polycentric and multi-scalar process may provide one way forward to rebuilding trust and supportive networks between farms and other institutions. Here, I draw on Ostrom (2014, 2010, 2009)'s understanding of dealing with climate change from a polycentric standpoint. Though Ostrom's approach is global in nature, the principle stands that an overarching framework which seeks to control adaptation at all levels will be less efficient than a multi-level adaptation strategy where individual, local, and regional scales can provide local oversight. This research demonstrates that adaptation initiatives are already taking place on individual farms as well as between farmers. Parallels can be drawn between agriculture and other sectors in the Maritimes: for example, municipal flood risk management plans tailored to specific area, yet united in a space for information exchange, as proposed by the Atlantic Climate Adaptation Solutions Association. Building a polycentric governance approach to climate change adaptation in Maritime agriculture would encourage experimentation at multiple levels and confer a level of authority and responsibility over successful approaches. The relationship between farmers and the provincial government, then, could be reframed as one where support is given in the form required, whether this be information, community, or financial support. This relationship, in turn, may lead to the development of support strategies that accurately reflect the social structures and adaptation expertise of the agricultural community (Ostrom, 2014; Sumane et al., 2017).

4.3 Recommendations for current governance initiatives

Based on the results and discussion above, it is clear that opportunities exist for supporting the multiple forms of adaptation developed by farmers across the

Maritimes. I highlight three:

4.3.1. Reframe relationships with farmers under a polycentric lens. Agricultural adaptation in the Maritime provinces should be understood as a multi-level and multi-scalar strategy. If current difficulties with government support of adaptation on farms stems from a culture of misunderstanding between government and farmers, one strong avenue forward would be to reframe governance relationships with the agricultural community such that farmers are included as experts, and their adaptation strategies viable projects to be supported (Kent and Sherren, 2017).

4.3.2. Provide financial support based on overall objectives rather than simply projects. Current financial support for adaptation is project-based; this has resulted in farmers' relationships with funding agencies to become strained. Yet all small farms have their own systems, their own timings, and their own specific needs in terms of support, whether in terms of finance or information. It would appear more appropriate to establish basic objectives for an adaptive food system, and to review applications based on these objectives, rather than to impose a restrictive scope of pre-defined projects.

Other modifications to financial support would include modifying the timing of applications so that they fall within an appropriate time for farmers to submit an application, receive funds, and begin building; and removing restrictions for farmers to put their own capital in before being reimbursed, which currently discriminates against farms with smaller profit margins, such as relatively new entrants to agriculture.

4.3.3. Increase opportunities for the creation or bolstering of knowledge networks. Individual agents such as extension agents, or larger organizations such as

marketing co-ops, were discussed of as extremely useful because they allowed farmers to garner information or ask about experiments or external sources which they would not normally have the time to access. Increasing formal or informal co-operation in farming has long held a history of increasing relative political and economic power, providing neighbourly mutual aid, and fostering resilience against uncertainty by creating information hubs (Friedmann, 1995; Wynne-Jones, 2017). Creating more spaces for farmers to dialogue, promoting co-operative ventures, and allowing farmers to self-organize are all potential avenues for the government mandate to promote and support adaptation to climate change. More simply, hiring more extension agents to fill a palpable void would probably aid with regional knowledge exchange and, in turn, adaptive capacity.

5. Conclusion

This paper describes, based on interviews, the adaptation techniques currently utilized by small-scale vegetable farmers across the Maritime region to build adaptive capacity and mitigate risk in the face of climate change. It then examines them in the light of provincial government adaptation support provided, considering farmers' reactions and adoption of this support.

The benefits of climate adaptation strategies are entwined with the benefits of sustainable agricultural development for small farmers. Study results indicate that, while on-farm adaptation is taking place in reaction to changes in weather, climate resilience is, in the experience of small farmers, largely predicated on financial resilience. Farmers enact adaptation strategies by investing in on-farm strategies such as season extension, sustainable soil management, irrigation infrastructure, and diversification of crops. They also do so by building financial resilience, whether it be by reducing the need for external inputs and maximizing sales, or by

participating in co-operative enterprises to identify market niches, mitigate financial risk, and build strong support networks.

The study pinpoints current government initiatives with limited utility for small-scale farmers: while significant financial and nonfinancial support is available, neither meets the current needs of small farmers. Grants are mistimed, or otherwise focused on projects which do not adequately reflect the practices of small farms in the region. Extension agents are extremely useful in transferring information and providing a liaison with government, but are drastically underfunded.

If building adaptive capacity is a goal of agricultural adaptation, then understanding the context of current farmer efforts in the shared projects of climate resilience and business sustainability is an essential part of supporting those efforts. Unless adaptation support is remolded from its current top-down, normative approach towards a collaborative project which respects the expertise of all actors, government initiatives may remain stymied.

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