Innovation shared is Resilience built: farmer-to-farmer knowledge sharing and adapting to climatic change

by

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B.A, University of Victoria, 2005

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Abstract

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Does digitally-mediated farmer-to-farmer learning facilitate farm-level adaptation to climate change? Utilizing semi-structured interviews with small-scale organic farmers in the Cascadia Bioregion, I document how farmers perceive climate change and in what ways they are responding and/or adapting to these changes. Such small-scale farms have limited economic capacity to adapt to climate change. Access to innovative, low-cost but locally relevant solutions will require novel knowledge-dissemination mechanisms. A modern option is "participatory media" - a social network based approach, linking farmers to farmers through internet-exchange of photos and video. This project engages in a "bottom-up" approach to the development and sharing of knowledge. In collaboration with local farmers, I explored the efficacy of a participatory media method in moving towards improving farmers' perception of and adaptation to climate change, as well as overall farm-level resilience.

Key Words: adaptive strategies, participatory video, farmer to farmer learning, resilience

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And finally, to the farmers who work so hard to provide us with our daily sustenance, steward our lands, and willingly share their bountiful knowledge. Thank-you, for all that you do.

Chapter 1: Introduction

Small-scale farms practicing organic, agroecological methods have, in recent years, been lauded as the path forward towards a more sustainable food system (Altieri, 2008; Altieri & Farrell, 1995; De Schutter, 2011; Gliessman, 2007). There is much evidence that small-farms play a crucial role in food security, rural economies and land stewardship, and these multiple functions, as well as their potential to be more productive than large-scale farms, has been recognized for some time (Rosset, 2000).

The evidence for climate change has been said to be "unequivocal" and is being observed with varying intensity around the world (IPCC, 2007) with considerable effects being felt in agriculture. Farmers depend on a variety of climatic conditions in order to produce crops and support their livelihood, and climate change has the potential to usher in both positive and negative responses in agroecosystems. Small-scale organic farmers have been shown to have the potential to be more resilient to climatic changes due to their employment of techniques shown to buffer the effects of change. However, small-scale organic farmers also tend to be more financially vulnerable, which can make adaptation challenging in some cases. Whether the climatic changes experienced in the present or projected for the future are positive or negative, farmers will need to be prepared to adapt to these changes, and adaptation is directly linked to increasing resilience.

Rolling and Wagemakers (1998) regard *learning* as the key action for change in agriculture; farmers need to be constantly learning how to engage with their environment, and adapt to the new conditions or scenarios as they occur. In the past, farmers in British Columbia have relied on their local community for information, as well as agricultural extension services that were employed by the government. Increasingly busy lifestyles as well as funding cuts have seen a reduction in community knowledge-sharing and extension services, therefore making it difficult to obtain locally-relevant information that is directly applicable to farming operations. Bioregional knowledge is important for farmers to be able to engage successfully with their agroecosystems, and prepare for and adapt to climatic change.

I approach this project not only as a researcher, but also as a small-scale organic grower. Having apprenticed and worked with a variety of growers and permaculturalists from around the world, I am aware of the complexities involved in managing an agroecosystem. I also have first-hand understanding of the challenges and barriers that exist for new growers. The conviction of passion that I have for growing food belies the

The objective of this research is to examine if and how participatory methods engaging farmer-to-farmer learning facilitates adaptation strategies to climate change. Within this broad objective are two specific foci:

1. Documenting how small-scale organic farmers in the Pacific Northwest (Vancouver Island, the Gulf Islands and the San Juan Islands) perceive climate change and what adaptive strategies they are using in the context of changing environmental conditions.
2. Examining the effectiveness of using participatory media (photo/video) techniques in learning and knowledge-transfer of adaptations farmer-to-farmer.

In Chapter 2, I outline the context within which this research is situated, concisely detailing the current state of small-scale organic farms, climate change, and the importance of farmers' networks in Canada. I also outline participatory media tools as they have been used in agricultural research. Chapter 3 presents the methodology and framework used to conduct this study, and considers their limitations. Chapter 4 presents the findings gleaned from semi-structured interviews, a questionnaire, and other feedback from farmers regarding the participatory videos. Chapter 5 is the Discussion chapter where the themes gathered from research findings are further examined and placed in a broader context. Chapter 6 is the concluding chapter, where the overall limitations and potential of the research and findings are discussed.

Altieri, M. A. (2008). Small farms as a planetary ecological asset: five key reasons why we should support the revitalisation of small farms in the global south. Third World network (TWN). Retrieved from http://www.twnside.org.sg/title/end/pdf/end07.pdf

Altieri, M. A., & Farrell, J. G. (1995). Agroecology: the science of sustainable agriculture (Vol. 2). Westview Press Boulder.

De Schutter, O. (2011). Agroecology, a Tool for the Realization of the Right to Food. Agroecology and Strategies for Climate Change, 1–16.

Gliessman, S. R. (2007). Agroecology: the ecology of sustainable food systems. CRC.

IPCC. (2007). Intergovernmental Panel on Climate Change. Chapter 14: Agriculture, forestry and fisheries. Fourth Assessment Report: Climate Change. Retrieved from http://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch14s14-2-4.html

Rosset, P. (2000). The multiple functions and benefits of small farm agriculture in the context of global trade negotiations. Development, 43(2), 77–82.

Chapter 2: Context

Small-scale, organic farms and agroecological approaches

Attempts to describe small-scale organic farms yield broad-brush strokes that hide the enormous socio-cultural, ecological, and economic factors found farm to farm. Even defining the parameters of "small-scale" can be challenging. The British Columbia Ministry of Agriculture, Food and Fisheries (BCMAFF)[1] defines small-lot farms as those that are under 10 acres, and small-scale farms as those that earn $50,000 or less in average yearly income; there are of course exceptions to this. For example, in this study there are farmers on 2 acres earning more than $50,000 in one year. For the purposes of this study, "small-scale farms" are defined as those that are either under 10 acres or make less than $50,000.

Research has shown that farms that are labeled "small-scale" may be more resilient to climate change than large-scale farms due to myriad interconnected elements, such as greater crop diversity and dependence on off-farm income (Antle, 2009; Borron, 2006; Kotschi & Müller-Sämann, 2004; Milestad & Darnhofer, 2003). Small-scale farms and sustainable agriculture are linked to practices that are useful risk adaptation strategies for climate change (Altieri, 2009; Altieri & Koohafkan, 2008; E. Wall & Smit, 2005). Large-scale farms which tend to be more specialized (i.e. grow only a single or a few crops) run a greater risk in encountering climate-related losses due to direct impacts on their crop, yet typically have greater access to crop insurance and have more financial sources to aid them in recovery.

Small-scale farms have always represented a high proportion of the farms in BC (Statistics Canada, 2009), and small-scale organic farms appear to be a growing industry in this part of the world. In 2011 there was an increase of nearly 500 more farms under 10 acres since 2006, and a total of 67% of farms in the province of BC were under 70 acres (Statistics Canada, 2011). While certified organic operations still only account for

[1] The BCMAFF is now the British Columbia Ministry of Agriculture (BCMA)

2.9%[2] of all farms in the province of BC, their numbers have grown in Canada by 66.5% since 2001 (Statistics Canada, 2011). Overall, small-scale organic farms appear to be a growing industry.

Many small-scale, organic farmers view their farms as a whole agroecosystem, which encompasses much more than just the many crops they are growing. The agroecological approach links ecology, culture, economics and society to sustainable food production, healthy ecologies and farming communities (Gliessman, 2007)[3].

While small-scale, organic farms may be in some ways more resilient than their industrial-scale counter-parts, transition to organic production can be costly and challenging. All farmers are going to be affected by climate change, and the exposure and sensitivity to the change will differ, as will their adaptive capacity.

Climate change in Canada

Global climate change affects every element, process and interaction in food production, and will preoccupy all food production decisions and policy in the future (IPCC, 2007; Lang & Heasman, 2004). Agriculture is among the most vulnerable sectors to climate change as its performance is directly related to weather conditions, which are a function of climate (Smit & Skinner, 2002). The higher frequency of variable and extreme weather has increased the vulnerability of the agricultural sector overall, while at the same time precipitating more immediate effects for producers, causing concerns over the capacity to adapt, not only in the future, but also in the present. There have been considerable attempts to model the dynamics of adaptation to forecasted climate change; however the sensitivity of agriculture to these changes, not to mention the adaptive capabilities of producers and the food system at large, remain largely unclear (Tol, 2002).

Adaptation in agriculture should not be relegated to the field of policy response by government, and may benefit from involvement of farm-level decision makers (Smit & Skinner, 2002). Interactions of Canadian producers with institutional and political factors,

[2] This number also includes farms that are transitioning to organic status.
[3] Other definitions of agroecology include "the application of ecology to the design and management of sustainable agroecosystems" an "a whole-systems approach to agriculture and food systems of development based on traditional knowledge, alternative agriculture, and local food system experiences." (source: http://www.agroecology.org/)

such as crop insurance and agricultural consultants, diminish farm-level risks stemming from climatic variability but may well increase the long-term vulnerability of Canadian agriculture (Bryant *et al.*, 2000).

Adapting to variable weather patterns is an integral part of farming; it very nearly defines it. Nevertheless, climate projections will require that farmers adapt to considerably greater change and variation than ever before experienced (Motha & Baier, 2005). Seemingly minute fluctuations in temperature and/or precipitation affect flowering and germination phenologies; fluctuations that take the form of a few millimeters or degrees, can determine the success or failure of a whole crop, or series of crops. The projected changes in seasonal air temperature and precipitation for coastal British Columbia are listed in Table 1.

Table 1: Changes in seasonal air temperature and precipitation by 2050 for the coastal region of British Columbia, Canada

Region	***Temperature***				
	Winter*	Spring*	Summer*	Fall*	Annual Mean
Southern Coast	+1.5	+1.3	+1.7	+1.6	+1.5
Northern Coast	+1.9	+1.6	+1.4	+1.5	+1.4

Region	***Precipitation***				
	Winter*	Spring*	Summer*	Fall*	Annual Mean
Southern Coast	+6%	+7%	-13%	+9%	+6%
Northern Coast	+6%	+7%	-8%	+9%	+6%

*Winter=Dec/Jan/Feb, Spring=Mar/Apr/May, Summer=Jun/Jul/Aug, Fall=Sept/Oct/Nov. Adapted from (Pike *et al.*, 2008)

Research into climate change mitigation shifted to a focus on climate change adaptation in the early 1990's (Smit, 1993). Wall *et al.* (2007) developed key insights on agricultural climate change adaptation in Canada, and distinguished three different types of approaches to climate research in agriculture: a) Impact-Based Approach, b) Context-Based Approach, and c) Process-Based Approach. The most commonly used have been the impact-based and context-based approaches, with the process-based approach only

recently being applied in climate adaptation and agriculture research (Wall, Smit, & Wandel, 2007).

The impact-based approach is considered a "top-down" approach, usually based on General Circulation Models (GCM's) under a disturbance (e.g. higher greenhouse gases). From this model, a macro-climate model can be drawn, where climate change is shown to occur periodically over decades, or slowly and incrementally (Wall *et al.* 2007). The impact-based approach can provide useful projections of possible climate scenarios that can be used to plan future adaptations. However, inherent in the impact-based approach is that a) farmers will engage completely in adaptive behavior, b) in response to a steady state of change (Arthur & Van Kooten, 1992; Sauchyn, 2007). There have been climate change models that have demonstrated overall gains in agriculture, yet these make the grand assumption that farmers will adapt without taking into account the myriad reasons why this may or not be the case (Antle, 2009; Wall *et al.*, 2007). This approach runs the risk of ignoring sociocultural or economic factors that may prove to be barriers to adaptation, and weather factors such as variability and extremes, that are real causes for concern for certain crops (Brklacich & Smit, 1992; Bryant *et al.*, 2000).

The context-based approach differs from the impact-based approach in that it recognizes that multiple socioeconomic and political, not only climatic, factors are at play when examining farmer decision-making and adaptive capacities. Consequently, this approach focuses on climate adaptation in the context of existing adaptation strategies undertaken by farmers, from farmer participation in institutional programs to the development of new farming techniques (Brklacich & Smit, 1992; Bryant *et al.*, 2000). It differs from the process-based approach in that it situates its starting point in the broader-scale analysis of sociocultural, political and economic dynamics within which the farms exist, rather than starting analysis at the farm level and working outwards (Bradshaw, 2007; Wall *et al.*, 2007).

The final approach is the process-based approach, which is mainly concerned with understanding the process of adaptation through the lens of community. The focus is to understand the climatic conditions that are most important to the producers, how these conditions affect the farmscape, as well as exploring what the challenges are to adapting in the future (Wall *et al.*, 2007). The approach employed in this research most closely

follows the process-based approach and will be discussed more thoroughly in the methodology section.

Broad-scale models and scenarios can yield useful data to help plan on wide scale, yet can be difficult to apply when trying to understand the finer scale of community response, recovery and adaptation to climate stress (Dolan & Walker, 2006). Previous Canadian research in agricultural adaptation to climate change has asked farmers to indicate what changes they would make, subsequent to suggested climate change scenarios (Brklacich *et al.*, 1997). Though this approach can elucidate some of the possible adaptations that the farmers may employ, it is limited by the fact that they are "imaginary" scenarios, and the scenarios are also based on annual averages, while farmers are typically more concerned with variation from the averages (variability and extremes) (Bryant *et al.*, 2000). Though the process-based approach is fairly new to research in agricultural climate adaptation, it has been employed in research in British Columbia, and in other areas of Canada (Belliveau *et al.*, 2007; Brklacich *et al.*, 1997; Reid *et al.*, 2007).

There is some evidence that climate change may be of some benefit to agriculturalists in mid- and high-latitude ranges (Wall *et al.*, 2007) as an overall general warming of temperatures may help crops grow, as will an increase of CO2 in the atmosphere (Rosenzweig & Parry, 1994; Sauerbeck, 2001). Yet the assumption inherent in this is that growers will make use of the forecasted changes by, for example, growing crops that flourish in warmer weather, and abandoning those crops that are on the margins of the current climate conditions.

Farmer Networks

In the UN's special report on Agroecology and the Right to Food (Altieri, 2009; Altieri & Koohafkan, 2008; Wall & Smit, 2005) the importance of agroecological[4] farming methods were highlighted to be of paramount importance, especially in the

[4] In this thesis, the term "agroecology" is used somewhat interchangeably with sustainable-, ecological, or organic-farming. Distinctions are made where necessary. Though they have similarities and differences, all are focused on a whole-systems approach to agriculture, considering the agricultural landscape as an ecosystem, that involves human actors among the flora and fauna.

context of a changing climate (de Schutter, 2011). Yet the greatest limiting factor to a food secure future was identified in the UN report as *time*: *"In moving towards more sustainable farming systems, time is the greatest limiting factor. Whether or not we will succeed will depend on our ability to learn faster from recent innovations and to disseminate works more widely"* – (de Schutter, 2011, p.6)

If a sustainable agriculture is the goal, there is an urgent need to rapidly familiarize and gain proficiency in agroecological approaches. Critical to the learning process in agriculture is the ability to disseminate knowledge effectively (De Schutter, 2011; Kroma, 2006; Warner, 2007). Agroecosystem management is not only dependent on ecological innovations, but also a corresponding set of social arrangements. It is well-recognized, that farmer networks are composed of farmers whom are well-equipped with practical knowledge and innovations derived from accumulated experiences (Kroma, 2006). Agroecosystems involve social actors who develop inter-subjective practices, values and concepts, all based on a mode of learning that is grounded in participatory processes (Kroma, 2006). These farmer-networks are not only important for information transfer, because as they disperse knowledge there is the simultaneous creation of trust and mutual understanding (Cohen & Prusak, 2001).

For these types of farms (organic, small-scale, ecological), new techniques are more readily adopted when learning occurs through observations, trials and dialogue with information being transferred farmer-to-farmer. Farmer networks are "conduits for the flow of useful climate knowledge" which aid farmers to reduce climate-related risk (Meinke *et al.*, 2006). Recent research from the Resilience Institute at Western Washington University has found that farmers are aware of the importance of investing time in social networking and accumulation of information, as it is embodied in knowledge networks (Berardi, *et al.* 2011). The horizontal dissemination of agricultural research, knowledge and/or experience transforms the nature of that knowledge, allowing it to become the product of a network (Warner, 2007), thereby strengthening community ties that are developed through knowledge-sharing.

3.1 Farmer-to-Farmer Knowledge Exchange in the Canadian Context

The type of information required to adapt to variable weather is not readily available to small-scale, organic farms in Canada, but it is also possible that it is just not

being accessed by producers (Pearce, 2009; Tarnoczi & Berkes, 2010). According to McNamara (2011), the minimal amount of information derived from British Columbia (BC) based sources available has equally modest usage, so clearly dissemination is an issue. The popular U.S. based ATTRA National Sustainable Agriculture Website, a virtual hub of agricultural information accessed by innumerable farmers since 1987, was cut from the 2011 budget by the US Congress on April 15th, signifying the loss of a very significant hub within the knowledge network of US farmers. In Washington State, there are 7 organic extension agents, while in BC, funding for organic extension agents was terminated in 2010 and it is now one of only two provinces in Canada without insufficient organic extension services (COABC, 2011). Currently, only one extension agent is responsible to provide information across the whole province of BC, to both conventional and certified organic producers. In addition, intergenerational knowledge transfer is threatened due to a rapidly aging farmer population. This poses concerns for those who are aiming to either farm organically, or use agroecological approaches, as these practices are more commonly practiced by an earlier generation of farmers. In the face of an ever more variable climate the importance of locally-relevant, place-based, small-scale and sustainable farming techniques has never been greater - yet the means to do so are rapidly being lost.

The two biggest barriers that small-farmers in BC face in adapting to climate change are financial vulnerability and lack of information (McNamara, 2011). Two policy recommendations by McNamara are as follows: 1) *Extension for Small Farms*: to supply targeted extension to small-scale farms, allowing them access to relevant information, 2) *Small Farm Lens*: to ensure that government enacts programs that specifically focus on small-scale farm needs. McNamara (2011) concludes that small farms will adapt to climate change if they are given resources to do so, and adaptation depends on making information available.

A recent study undertaken in the Canadian Prairies focused on what sources of information were actually available to the farmers to help them adapt to climate change (Tarnoczi & Berkes, 2010), as successful adaptation requires appropriate information. Information typically came from a variety of sources, and that the producers were more inclined to adopt new practices when there was learning through observations, trials and

two-way dialogue, with social-sources (other farmers) and personal experience being the most widely used source of information. Media in the form of publications were another source of information, but were considered most useful if regionally or provincially specific. Furthermore, if information was clearly observable it was considered more significant in the adoption of new practices (Tarnoczi & Berkes, 2010).

Participatory Media

This research project explored the effectiveness of farmer-to-farmer learning through a participatory video methodology. It is anticipated that participatory video will be useful in transferring knowledge not only farmer-to-farmer, but also has the potential to transfer knowledge from farmers to decision makers involved in agricultural policy. It is also anticipated that this will be a useful means of transferring knowledge to aspiring young farmers, particularly in the Canadian context, where huge spatial dispersion and a rapidly aging farmer population[5] that have few outlets to share their in-depth agricultural knowledge, are major challenges.

Participatory Video in Agriculture Research

A review of agriculture-related projects worldwide suggests successful knowledge generation, application and transfer dictates the success of an agricultural development (World Bank, 2007). Implicit in this is the assumption that those whom generate the knowledge will therefore dictate how agricultural development will proceed. The facilitation of knowledge transfer between actors who possess locally-specific knowledge, from crop growth patterns to types of crops that are popularly consumed in a region, has proved to be essential for successful adaptation during increasing climate variability (McNamara, 2011; Pearce, 2009; World Bank, 2007).

Participatory video involves groups or communities identifying their own concerns, communicating their ideas and needs to each other, other groups and/or communities, as well as other decision-makers (White, 2003). Conducting research using participatory-video allows for effective engagement of research participants in a research

[5] The 2011 Census of Agriculture showed that farmers over the age of 55 represented the largest share of total operators, up from 32.1% in 1991 to 48.3% (Statistics Canada, 2011).

theme that interests and applies to them, therefore creating opportunities for the implementation of unique forms of development that are particularly tailored to local needs (Lunch & Lunch, 2006).

Participatory video has proven to be a useful method to promote local innovation and endogenous development, and has been effective in transferring knowledge both horizontally and vertically in a number of agricultural contexts (Ballantyne, 2009; C. Lunch, 2004). Research involving participatory-video to facilitate agricultural knowledge transfer has so far been applied with a predominantly locally-based focus; however, the borderless nature of the internet facilitates long distance transfer, and according to Van Mele *et al.* (2010), this method has also proved to be effective in sharing knowledge between farmers of different countries.

Though a relatively new approach (White, 2003), participatory video has shown benefit in a variety of agricultural scenarios, such as: fostering local rice processing innovations (Zossou, *et al.* 2010) improving the ability of women farmers to apply and experiment with seed technologies (Chowdhury & Hauser, 2010), increasing the distribution of new knowledge and skills between farmers (Chowdhury, *et al.* 2011) dissemination of novel integrated pest management strategies (Chowdhury, *et al.* 2010), as well as increasing agricultural knowledge transfer across communities (Lunch and Lunch, 2006).

Agricultural extension has often been criticized for following an unsuccessful technology-transfer model, where the participants frequently reject the new technology or only use it for a short period of time, usually because they have little input into the creation of the technology, which results in lower usage, and finally abandonment (Altieri & Farrell, 1995; Pretty, 2002). Participatory-video allows for the opportunity for farmers can be collaborators in the creation of knowledge, the technology and learning processes. With low governmental support for agricultural extension services in BC, and the historical significance of farmer-networks and farmer-to-farmer knowledge sharing, participatory-video has potential as a novel approach to engage farmers in the distribution of innovative, low-cost and locally-relevant adaptive strategies. As such, participatory video approaches may be a valuable dissemination tool in the context of a changing climate, when farmers will need to explore different techniques in order to survive.

Conclusion

There are a significant number of small-scale farms in BC, and both small-scale and organic farming operations are on the rise. All farms will be affected by climatic change, though small-scale organic farms may be more resilient to changes than others. The coastal region of BC is projected to experience rising air temperatures and both an increase and decrease of seasonal precipitation.

Farmers' networks can be seen as an important element of an agroecosystem. Farmer networks may be useful for sharing climate knowledge, and therefore ways to adapt. Farmer-to-farmer learning in Canada has been limited by the lack of agricultural extension services. Studies have shown that small farms will adapt to climate change if they are given resources to do so, and adaptation depends on having access to appropriate information. Participatory-media methods have been used in agriculture as a way to share knowledge and information that is directly from farmers, and therefore may be more likely to be of use to other farmers.

Altieri, M. A. (2008). Small farms as a planetary ecological asset: five key reasons why we should support the revitalisation of small farms in the global south. Third World network (TWN). Retrieved from http://www.twnside.org.sg/title/end/pdf/end07.pdf

Altieri, M. A. (2009). Agroecology, small farms, and food sovereignty. Monthly Review, 61(3), 102–113.

Altieri, M. A., & Farrell, J. G. (1995). Agroecology: the science of sustainable agriculture (Vol. 2). Westview Press Boulder.

Altieri, M. A., & Koohafkan, P. (2008). Enduring farms: Climate change, smallholders and traditional farming communities. Third World Network (TWN). Retrieved from http://www.indiaenvironmentportal.org.in/files/Enduring_Farms.pdf

Antle, J. M. (2009). Agriculture and the Food System. Washington, DC: Resources for the Future. Retrieved from http://www.climatefruitandwine.co.za/download/RFF-US.Based.Agric.and.Adaptation-Antle.2009.pdf

Arthur, L. M., & Van Kooten, G. C. (1992). Climate Change Impacts on Agribusiness Sectors of a Prairie Economy. Prairie Forum (Vol. 17, pp. 97–109). Retrieved from http://www.citeulike.org/group/13619/article/7672546

Ballantyne, P. (2009). Accessing, sharing and communicating agricultural information for development: Emerging trends and issues. Information Development, 25(4), 260–271.

BCMAFF. BC Ministry of Agriculture, Food and Fisheries. (2000). Small-scale Farming in the South Cowichan Valley. Retrieved from http://www.agf.gov.bc.ca/resmgt/sf/publications/Small_Scale_Farming_in_South_Cowichan_Valley.pdf

Belliveau, S., Bradshaw, B., Smit, B., Wall, E., Wandel, J., & others. (2007). Comparing apples and grapes: farm-level vulnerability to climate variability and change. Farming in a changing climate: Agricultural adaptation in Canada, 157–172.

Berardi, G., Green, R., & Hammond, B. (2011). Stability, sustainability, and catastrophe: Applying resilience thinking to U. S. agriculture. Human Ecology Review, 18(2), 115.

Borron, S. (2006). Building resilience for an unpredictable future: how organic agriculture can help farmers adapt to climate change. Food and Agriculture Organization of the United Nations, Rome.

Bradshaw, B. (2007). Climate change adaptation in a wider context: Conceptualizing multiple risks in primary agriculture. Farming in a changing climate: Agricultural adaptation in Canada, 103–114.

Brklacich, M., McNabb, D., Bryant, C., Dumanski, J., Ilbery, B., Chiotti, Q., Rickard, T. (1997). Adaptability of agricultural systems to global climate change: a Renfrew County, Ontario, Canada Pilot Study. Agricultural restructuring and sustainability: a geographical perspective. (pp. 185–200). Retrieved from http://www.cabdirect.org/abstracts/19971807064.html

Brklacich, M., & Smit, B. (1992). Implications of changes in climatic averages and variability on food production opportunities in Ontario, Canada. Climatic Change, 20(1), 1–21.

Bryant, C. R., Smit, B., Brklacich, M., Johnston, T. R., Smithers, J., Chjotti, Q., & Singh, B. (2000). Adaptation in Canadian agriculture to climatic variability and change. Climatic Change, 45(1), 181–201.

Chambers, R. (2002). Relaxed and Participatory Appraisal: notes on practical approaches and methods for participants in PRA/PLA-related familiarisation workshops. Participation Group, Institute of Development Studies, Brighton, UK.

Chowdhury, A. H., & Hauser, M. (2010, July 28). The Potential of Moving Pictures, Does Participatory Video Enable Learning For Local Innovation? Presented at: Innovation and Sustainable Development, Montpelier, France.

Chowdhury, A. H., Mele, P. V., & Hauser, M. (2010, September 14). Learning Through Moving Pictures: Farmer-to-Farmer video to stimulate farmers' innovation about botanical and alternative pest management practices in Bangladesh. unpublished. Presented at The World Food System Conference: A Contribution from Europe.

Chowdhury, A. H., Van Mele, P., & Hauser, M. (2011). Contribution of farmer-to-farmer video to capital assets building: Evidence from Bangladesh. Journal of Sustainable Agriculture, 35(4), 408–435.

Cohen, D. & Prusak, L. (2001). In Good Company. How Social Capital Makes Organiaztions Work. Massachusetts: Harvard Business School Press.

De Schutter, O. (2011). Agroecology, a Tool for the Realization of the Right to Food. Agroecology and Strategies for Climate Change, 1–16.

Dolan, A. H., & Walker, I. J. (2006). Understanding vulnerability of coastal communities to climate change related risks. Journal of Coastal Research, 1316–1323.

Downing, T., Butterfield, R., Cohen, S., Huq, S., Moss, R., Rahman, A., Sokona, Y. (2001). Climate Change Vulnerability: Linking Impacts and Adaptation. Report to the Governing Council of the United Nations Environment Programme. Environmental Change Institute. Oxford, UK.

Gliessman, S. R. (2007). Agroecology: the ecology of sustainable food systems. CRC.

IPCC. (2007). Intergovernmental Panel on Climate Change. Chapter 14: Agriculture, forestry and fisheries. Fourth Assessment Report: Climate Change. Retrieved from http://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch14s14-2-4.html

Kelly, P. M., & Adger, W. N. (2000). Theory and practice in assessing vulnerability to climate change andFacilitating adaptation. Climatic Change, 47(4), 325–352.

Kotschi, J., & Müller-Sämann, K. (2004). The role of organic agriculture in mitigating climate change. International Federation of Organic Agriculture Movements (IFOAM), Bonn.

Kroma, M. M. (2006). Organic farmer networks: facilitating learning and innovation for sustainable agriculture. Journal of Sustainable Agriculture, 28(4), 5–28.

Lang, T., & Heasman, M. (2004). Food wars: the global battle for mouths, minds and markets. Earthscan/James & James.

Lunch, C. (2004). Participatory Video: Rural People Document their Knowledge and Innovations. IK Notes, World Bank., No. 71. Retrieved from www.worldbank.org/afr/ik/iknotes.htm

Lunch, N., & Lunch, C. (2006). Insights into participatory video: A handbook for the field. InsightShare.

McNamara, K. (2011). Small Farms and Climate Change Adaptation in British Columbia. Masters Thesis, School of Public Policy. Simon Fraser University.

Meinke, H., Nelson, R., Kokic, P., Stone, R., Selvaraju, R., & Baethgen, W. (2006). Actionable climate knowledge: from analysis to synthesis. Climate Research, 33(1), 101.

Milestad, R., & Darnhofer, I. (2003). Building farm resilience: the prospects and challenges of organic farming. Journal of Sustainable Agriculture, 22(3), 81–97.

Motha, R. P., & Baier, W. (2005). Impacts of present and future climate change and climate variability on agriculture in the temperate regions: North America. Climatic Change, 70(1), 137–164.

Pearce, K. T. (2009, March). Living With Climate Change: How Prarie Farmers Deal with Increasing Weather Variability. Natural Resource Institute. University of Manitoba.

Pike, R. G., Spittlehouse, D. ., Bennett, K. E., Egginton, V. N., Tschaplinski, P. J., Murdock, T. Q., & Werner, A. T. (2008, Spring). Climate Change and Watershed Hydrology: Part 1 - Recent and Projected Changes in British Columbia. Streamline, Watershed Management Bulletin, 11(2).

Pretty, J. N. (1995). Participatory learning for sustainable agriculture. World development, 23(8), 1247–1263.

Pretty, J. N. (2002). Agri-culture: reconnecting people, land and nature. Earthscan/James & James.

Pretty, J. N., & Vodouhê, S. D. (n.d.). Using rapid or participatory rural appraisal. Improving Agricultural Extension, 47–55.

Pretty, J. N., Vodouhê, S. D., Swanson, B., Bentz, R., & Sofranko, A. (1997). Using rapid or participatory rural appraisal. Improving Agricultural Extension, 47–55.

Reid, S., Smit, B., Caldwell, W., & Belliveau, S. (2007). Vulnerability and adaptation to climate risks in Ontario agriculture. Mitigation and Adaptation Strategies for Global Change, 12(4), 609–637.

Roling, N. G., & Jiggins, J. (1998). The ecological knowledge system. Facilitating sustainable agriculture: participatory learning and adaptive management in times

of environmental uncertainty. Cambridge University Press, Cambridge, UK, 283–311.

Rosenzweig, C., & Parry, M. L. (1994). Potential impact of climate change on world food supply. Nature, 367(6459), 133–138.

Rosset, P. (2000). The multiple functions and benefits of small farm agriculture in the context of global trade negotiations. Development, 43(2), 77–82.

Sauchyn, D. (2007). Climate Change Impacts on Agriculture in the Prairies Region. Farming in a Changing Climate: Agricultural Adaptation in Canada, 67–80.

Sauerbeck, D. R. (2001). CO2 emissions and C sequestration by agriculture – perspectives and limitations. Nutrient Cycling in Agroecosystems, 60(1), 253–266. doi:10.1023/A:1012617516477

Smit, B. (1993). Adaptation to Climatic Variability and Change: Report of the Task Force on Climate Adaptation, The Canadian Climate Program. Dept. of Geography, University of Guelph, Canada.

Smit, B., & Skinner, M. W. (2002a). Adaptation options in agriculture to climate change: a typology. Mitigation and adaptation strategies for global change, 7(1), 85–114.

Smit, B., & Skinner, M. W. (2002b). Adaptation options in agriculture to climate change: a typology. Mitigation and adaptation strategies for global change, 7(1), 85–114.

Smit, B., & Wandel, J. (2006). Adaptation, adaptive capacity and vulnerability. Global environmental change, 16(3), 282–292.

Statistics Canada. (2011). 2011 Census of Agriculture. Retrieved July 12, 2012, from http://www.statcan.gc.ca/ca-ra2011/index-eng.htm

Statistics Canada, A. C. (2009). Agricultural perspectives from seven censuses, Canada and provinces: census years 1976 to 2006. Retrieved July 12, 2012, from http://www.statcan.gc.ca/pub/95-632-x/2007000/t/4129741-eng.htm#59

Tarnoczi, T. J., & Berkes, F. (2010). Sources of information for farmers' adaptation practices in Canada's Prairie agro-ecosystem. Climatic change, 98(1), 299–305.

Tol, R. S. J. (2002). Estimates of the damage costs of climate change. Part 1: Benchmark estimates. Environmental and Resource Economics, 21(1), 47–73.

Van Mele, P., Wanvoeke, J., Akakpo, C., Dacko, R. M., Ceesay, M., Béavogui, L., Soumah, M. (2010). Videos bridging Asia and Africa: Overcoming cultural and

institutional barriers in technology-mediated rural learning. Journal of Agricultural Education and Extension, 16(1), 75–87.

Wall, E., & Smit, B. (2005). Climate Change Adaptation in Light of Sustainable Agriculture. Journal of Sustainable Agriculture, 27(1), 113. doi:10.1300/J064v27n01_07

Wall, S. E., Smit, B., & Wandel, J. (2007). Farming in a changing climate: agricultural adaptation in Canada. Univ of British Columbia Pr.

Warner, K. (2007). Agroecology in action: Extending alternative agriculture through social networks. The MIT Press.

White, S. A. (2003). Participatory video: Images that transform and empower. Sage Publications Pvt. Ltd.

World Bank. (2007). Enhancing agricultural innovation: How to go beyond the strengthening of research systems. Retrieved from DC. http://siteresources.worldbank.org/INTARD/Resources/EnhancingAgInnovationebook.pdf

Zossou, E., Van Mele, P., Vodouhe, D. S., & Lebailly, P. (2010, November 8). Strengthening local innovations in rice processing through video in Benin. Presented at the 28th International Rice Research Conference.

Chapter 3: Methodology and Framework

Introduction

There are two parts to this research project. In the first part I conduct semi-structured interviews were conducted to explore how small-scale organic farmers were perceiving and experiencing climate change, and what adaptive strategies they were using in the face of these changes. The challenges to, as well as the drivers of, the adaptive capacity of farmers was also assessed.

In the second part of this research, building upon the data gathered through the interview data, a pilot project employing video-mediated knowledge transfer was initiated with the intent to share adaptive strategies, farmer-to-farmer. The videos were recorded and edited in consultation with the participants, after which they were uploaded to a website for public viewing. A questionnaire was included on the website for participants to provide comments and feedback regarding the utility of this approach for sharing farmer-to-farmer knowledge, and for aiding in adaptation.

Adaptive Capacity and Climate Change: Process-Based Approach

Adaptive capacity can be defined as the ability to respond to a stress or suite of stresses (Wall *et al.*, 2007), is context-specific and varies due to a myriad of factors such as access to financial, managerial, educational and political forces at the local level, but the scales of adaptive capacity are not discrete (Smit & Wandel, 2006). It can be difficult to account for all of the elements in a system that influence adaptive capacity due to this multi-scalar nature, and in this research the focus is on the practices of farmers at farm-level. Learning how farmers make decisions in response to ecological challenges, and recording actual adaptive behavior in response to perceived climate change hints at their future adaptive capacity to manage risks and opportunities associated with climate change. This follows very closely the *process-based approach*, in which the emphasis is on exploring how the community of interest perceives the changing conditions and how

they are able to initiate adaptive measures. In agricultural research (and in this case), the focus would be on actual adaptive behavior of agricultural producers, mainly at the farm-level (Wall *et al.*, 2007). This approach begins with understanding how the farm system is a) exposed to hazards, b) how it is vulnerable, and c) how adaptation decisions are made (Wall *et al.*, 2007).

This is a fairly new approach in climate change and agriculture research, as past approaches have typically followed the *impacts-based approach* or the *context-based approach*. The process-based approach is closely related to "vulnerability assessment" used in agricultural adaptation research (Luo & Lin, 1999) as well as in climate change research (Downing *et al*., 2001; Kelly & Adger, 2000). These assessments take into account the sensitivity and/or exposure to an unfavourable stimulus, coupled with the ability to adapt, in order to gain greater insight into a system's vulnerability.

It is important to recognize that total vulnerability does not consist solely of the sum of the present risk and ability to adapt. The future risk (socioeconomic and climatic) and future ability to adapt must be included in the analysis for total vulnerability, as the present risks may be exacerbated and/or the farmer may not be able to continue to adapt in the future. While past approaches focused more on the overarching social context or the physical effects of climatic change, the process-based approach allows for a deeper understanding of the ability of farmers in a particular region to adapt, their willingness to adapt, and how these play in concert with the particularities of their farming system. This may be a more appropriate approach in climate change and agriculture research as there are a myriad of vastly different and nuanced "types" of agriculture, all responding in a diversity of ways to climatic change. The process-based approach focuses on the practical applications and processes of adaptation which can help to improve adaptive capacity in a particular region or community (Wall *et al.*, 2007). This particular approach was employed in this research with the hope that it would result in research findings that were directly applicable to the community being studied.

Participatory Approach

The field research was conducted using a participatory framework which involved asking the interviewees to define their local challenges, and emphasized the importance of local knowledge in dealing with these challenges (Chambers, 2002). On-farm labour was exchanged for the time farmers spent completing interviews. This was intended as a form of reciprocity, and as suggested by Pretty (*et al.* 1997), working within the focal community was intended to facilitate greater understanding of local perspectives and reduce researcher bias

The participatory approach can take many forms which can be conceptualized though the following typology:

1. *Manipulative participation*: participation is just a pretense.
2. *Participation by consultation*: participation is by people being consulted or by answering questions; professionals are under no obligation to accept public comment and act on it
3. *Functional participation*: participation is seen by external agencies as a means to achieve project goals, especially reduced costs; objectives have been pre- determined.
4. *Interactive participation*: people participate in joint analysis and development of action plans, with much group decision making.
5. *Self-mobilization*: people participate by taking initiatives independently of external institutions; they develop contact with external institutions for resources and technical advice, but retain control of the process and results.

(Pretty, 1995)

Participation by consultation best describes this research, as the project was conceptualized, proposed and initiated solely by the researcher. However, there were many attempts to create a more collaborative project overall. Some engagement can also be described as *interactive participation*, as most of the interviewees were the ones who decided what topic would be covered in the practical/technical videos. Interviewees and the researcher also collaborated on co-editing of the videos. And finally, all interview transcripts were sent to participants for review. Participants maintained the right to change anything if they deemed it to be necessary, in both the videos or written transcriptions of the interviews.

Field Study Overview

Qualitative data was gathered for this research through an extensive literature review, in-depth interviews, direct observation of and participation in farming activities, as well as participatory media techniques. Semi-structured, video-taped interviews were conducted with 14 participants on 11 farms, and the data gathered was further analyzed using thematic analysis. A questionnaire was also used to gather data regarding the website, and an analytics program connected to the website gathered data such as number of site visits and regional site distributions (see Appendix 4.0). The details of the field study are reviewed in more detail in the following sections.

Assumptions

A synthesis of research from several countries by Rolling and Jiggins' (1998) was undertaken in order to develop a theory that explains the two dominant knowledge systems found in agriculture. In the Conventional Knowledge System (CKS), farmers are viewed as "receivers of knowledge" from external sources, and the innovations produced as simple "add-ons" rather than integrated methods. In the Ecological Knowledge System (EKS), the farmer is viewed as an expert on their particular farm, where they are able to anticipate future needs and events, as well as make decisions based on their informed inferences garnered from in-depth observation and analysis (Roling & Jiggins, 1998). The assumptions inherent in this thesis follow that of the EKS, in that farmers are able to explicitly state their ecological knowledge based on their lived experiences in their particular landscape.

Another assumption inherent in this research is that there will be farmers who have access to high speed internet in order to be able to watch the final videos. The differences that exist in the learning styles of different individuals also highlights another assumption; as there are a myriad of ways that individuals learn, this method may only appeal to a certain segment of the population.

Study Region

The study region is on the Pacific Northwest Coast, which is referred to as the Cascadia Bioregion. Participants interviewed were located on southern Vancouver Island and Salt Spring Island in Canada, and Orcas Island in the United States.

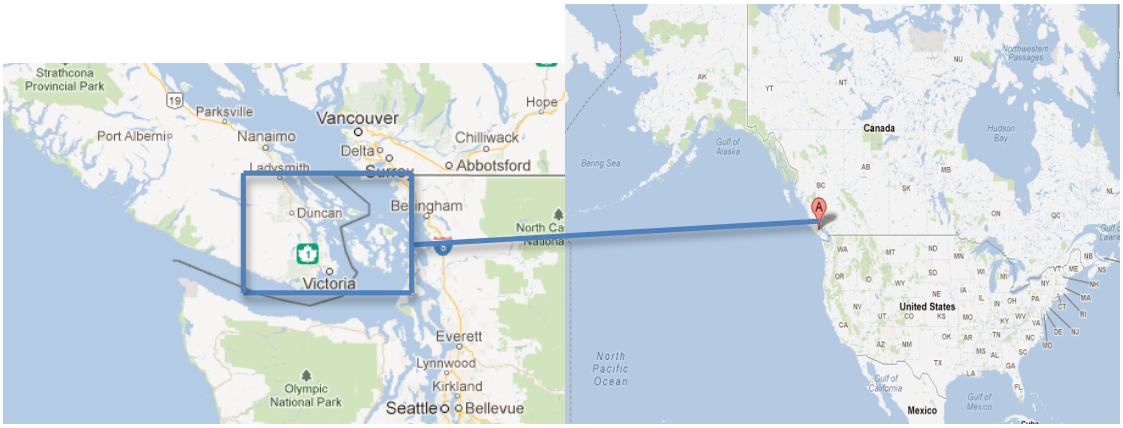

Figure 1 Map of Study Region

Participants

As I had been involved in small-scale farming in the study region as well as a frequent visitor to the farmer's markets, I was aware of the small but vibrant community of small-farmers. In order to create a focus for the study, I decided to create sets of criteria that I could use while searching for research participants. It is important to note that there was no possible way of preserving the anonymity of these participants, due to the visual nature of the research, and the tight-knit community of organic farmers in this study area. The criteria for each group are as follows:

Farmer-experts (11 participants):

1) Organic methods are used on their farm. This does not mean that the farm needs to be *certified* organic, but that the farmers are demonstrably engaging in organic practices.
2) The organic farms are small-scale. According to BC Ministry of Agriculture, Food and Fisheries (which is now known as the BC Ministry of Agriculture and Lands), "small-scale" is defined as having annual sales of less than $50,000, and "small-lot" is defined as lots under 10 acres (BCMAFF. BC Ministry of

Agriculture, Food and Fisheries, 2000) [6]. This research combines these two, thereby defining "small-scale farms" as those being either having annual sales of less than $50,000 and/or being under 10 acres.

3) The items produced on the farm for sale are marketed locally, and are not intended for export.
4) The farm is not a "hobby farm". The income received from farming activities is the primary income for the farmer, or that the farmer is attempting to make farming their primary source of income.
5) The farmers have been farming for at least five years continuously.

New, Aspiring Farmers (3 participants):

1) They have been farming for less than five years.
2) They intend to make farming their profession, or are engaged in it in some way that they are gaining an income from their activities.
3) They have participated or are planning to participate in a farming apprenticeship.

Using the above criteria allowed for the exclusion of many farms in the study region, yet still allowed for some variation between farms. After selecting these criteria, I used my previous experiences as a farmer in the region to identify various interview participants. Continued interviewee selection occurred through snowball sampling, initiated by the discussions that I had with various farmers or food-activists in Victoria. There were a couple of cases that were unique to this sampling method: in one case I met the participant at a conference, and in the other case the participant was a well-known farmer in the region who I contacted by email to request an interview.

Characteristics of Participants

All participants signed consent forms that were approved by the Tricouncil Ethics Board of the University of Victoria. All participants had the opportunity to withdraw specific contributions and/or withdraw completely from the study at any time.

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[6] In the US, small farms are recognized as those farms that are earning $250,000 or less in annual sales, and/or as a farm that is 50 acres or less. There is clearly a wide range as to what can be considered small-scale - it proved to be very difficult to find a concise definition, and it is seemingly a fluctuating conversation in the Canadian community.

Table 2 Characteristics of Research Participants

Interview	Names	Farm Name	Location	No. of years farming	Acres	Product	Organic	Small-scale[7]
1	John Wilcox and Sue Earle	Duck Creek Farm	Salt Spring Island	50+ years (John) 5+ years (Sue)	12	Vegetable Chickens	certified	Yes
2	Chrystal Bryson Ilya Amrhein	Square Root Farm	Saanichton	7	2	Vegetables	certified	Yes
3	Heather Stretch	Northbrook Farm	Saanichton	12	8	Vegetables Chickens Berries Fruit	certified	Yes
4	Ian Vantreight	Vantreight Farm	Saanich Penninsula	50+ years	60 (veg	Vegetables Flowers	transition	No
5	Robin Tunnicliffe	Fiesty Fields	Prospect Lake	10	5	Vegetables Chickens	certified	Yes
6	Lisa Willott	Saanich Organics, Seed Division	Saanichton	5 off and on	1	Seeds	certified land	Yes
7	Dave Boenlhein	Bullocks Permaculture Homestead	Orcas Island	5	10	Permaculture everything	method	Yes
8	Rachel Fisher	Three Oaks Farms	Brentwood Bay	15	5	Vegetables Chickens Berries	certified	Yes
9	Bob Liptrot	Tugwell Creek	Sooke	50	5	Vegetables Berries Honey	method	Yes
10	Kim Watt	Compost Education Center	Downtown Victoria	4	0.5	Vegetables Berries	method	Yes
11	John Mardlin Jill Dalton	Northbrook Farms	Saanichton	2	4	Vegetables	certified land	Yes

Interviews

Semi-structured Interviews

Interviews were conducted in a semi-structured format. For interview questions see Appendix 1.0. Though interview questions followed a framework of chosen themes, a semi-structured format allowed other emergent themes to be incorporated during the interview. Quite often the question was answered before it was asked, as topics easily flowed together. The questions asked to the farmers focused on: 1) the ecological

challenges they faced, 2) how they dealt with these challenges, 3) the adaptations/innovations being employed to deal with these challenges, 4) the barriers to dealing with these challenges, 5) what could help them in the future, 6) where they retrieved information to help them solve challenges/problems/issues, and 7) how they preferred to learn about farming. Most of the interviews proceeded as casual conversations, and many other topics were touched upon.

Interviews were held on-farm, and usually lasted between 1hr-2.5hrs. All interviews were both video (Canon G12) and audio recorded (H2 Zoom recorder), and notes were recorded throughout. The interview began with the above-mentioned questions, and then proceeded to the demonstration of the practical technique. The farmer was asked to choose an innovative technique or practice that they employed when dealing with a particular weather-related challenge, one that they would like to share with their farming community and/or new aspiring farmers. The farmer was then filmed demonstrating the technique. The farmers were given the option to do the filming themselves, but all declined. If this specific practice that the farmer would like to share was not demonstrable at that particular time, they described the technique and the footage was obtained at a later date.

Transcription

All interview data and field notes were transcribed. Additional notes regarding the interview were usually recorded immediately after interviews. Transcriptions were done using Express Scribe (v 5.26 Intel; NCH Software). All completed transcriptions were sent by email back to participants for their review. This allowed participants a chance to edit or remove data from the study. Due to the fact that there is no anonymity in this project, it was important to let the participants know that they would have full control of their contributions.

Analysis of Interview Data: Transcription and Video Coding

The transcribed interview data was analyzed when nearly all interviews were completed. Each transcript was reviewed extensively while searching for and coding for pertinent themes. Interviews were coded extensively in the initial stages, as an attempt to highlight any and all pertinent themes or important details. Videos of the interviews were also reviewed extensively and repetitively, and these provided added depth to the

analysis, as facial expressions and verbal emphasis were much more apparent. After meticulously reviewing five interview transcripts and coding extensively, a pattern began to emerge, and it was at this point that I found my codes to be "saturated", which allowed for the development of a thematic template by which the other interviews could be considered. These initial codes were quite extensive, but relationships did emerge, and it became clearer which codes were extraneous to the research. The codes yielded similar themes in the different interviews, and these were entered into charts and diagrammed (see Figure 1. chapter 4) in order to facilitate organization and to allow for their widely interconnected nature to be considered. Each interview transcript was reviewed repeatedly to explore the possibility for parallel themes or coherence in the collective experience of the interviewees. Interviewees were asked for further feedback after interviews were transcribed, and in some cases this provided additional insight into the developing themes. At times it was challenging to "pull apart" the interconnected elements of an agricultural system, and engaging in continued discussions with farmers helped to refine the themes.

Examining transcripts and interview videos yielded the following consistent themes: a) Perceiving Change, b) Changes and Challenges: short-term, long-term and cascading c) Adaptive Strategies: barriers and supports d) Persistence Through Community, and e) Farmer-to-Farmer Learning.

Video

The video component of this research was introduced as a pilot study to examine its utility in sharing adaptive strategies from farmer-to-farmer, and was launched in response to the reported lack of knowledge transfer tools available to farmers. All videos were shot on a Canon G12 camera and tripod, sometimes incorporating an H2 Zoom recorder.

Co-Editing

Raw video was edited to a total length of between 2-10 minutes before being sent to the participants for review. Video editing was done using Final Cut Express Pro (Version

10). The videos were uploaded to a private youtube channel where each video was assigned a private URL code. The URL code for each video was shared with the corresponding farmer-participant who then had the opportunity to guide and direct any further edits.

Online Information-Sharing Platform

Once the participants were satisfied with their videos and editing was completed, the videos were ready to be posted on a blog, The Farmer's Filmanac (www.farmersfilmanac.com) that was created specifically for this project. This blog was created using free Wordpress software, and had a brief description of the research context and research goals. This was a publically accessible blog, and the web address was shared with participants, through listserves, word of mouth, and through other social media outlets.

Online Questionnaire

In order to gauge the efficacy of the website, a questionnaire was made available online in order to gain feedback regarding the utility of the site in farmer-to-farmer knowledge transfer. See Appendix 2.0 for copy of Questionnaire.

Limitations

There were several limitations that presented themselves before and during the undertaking of this research. The process-based approach was chosen due to the seemingly greater potential to provide research that was directly applicable to a community of study, yet it can also prove to be not as easy to extrapolate the results due to this somewhat specified nature. Also, due to the relatively recent emergence of this approach, there are few studies with which to compare this research.

The snowball sampling methods that was used to recruit participants has limitations in that it may have yielded only those from a particular network within the city of Victoria. Another limitation was that participant interviews were conducted during the summer to fall seasons, which was not ideal considering that this is the busiest time for farmers, and this may have made it less appealing for farmers to participate.

Ideally there would have been more interviews conducted with more participants over a larger distance in order to access a wider breadth of data, but it was proving quite challenging to find participants to work with during these busy planting times.

There was also very little I could offer by way of anonymity due to the video component of the project. Other limitations lay around the intellectual property challenges surrounding the sharing of innovative techniques through a publically viewable platform by way of an online blog. This may have deterred potential participants, and at least one potential participant declined to partake in the project due to this public-sharing of information, as they wanted to maintain ownership/secrecy around their farming techniques.

Other challenges with regards to the technological components of this research are the considerable data storage requirements when dealing with large video files, the extensive time required when engaging in video editing, and the necessity for high internet speeds for viewing the completed videos once they have been uploaded.

Altieri, M. A. (2008). Small farms as a planetary ecological asset: five key reasons why we should support the revitalisation of small farms in the global south. Third World network (TWN). Retrieved from http://www.twnside.org.sg/title/end/pdf/end07.pdf

Altieri, M. A. (2009). Agroecology, small farms, and food sovereignty. Monthly Review, 61(3), 102–113.

Altieri, M. A., & Farrell, J. G. (1995). Agroecology: the science of sustainable agriculture (Vol. 2). Westview Press Boulder.

Altieri, M. A., & Koohafkan, P. (2008). Enduring farms: Climate change, smallholders and traditional farming communities. Third World Network (TWN). Retrieved from http://www.indiaenvironmentportal.org.in/files/Enduring_Farms.pdf

Antle, J. M. (2009). Agriculture and the Food System. Washington, DC: Resources for the Future. Retrieved from http://www.climatefruitandwine.co.za/download/RFF-US.Based.Agric.and.Adaptation-Antle.2009.pdf

Arthur, L. M., & Van Kooten, G. C. (1992). Climate Change Impacts on Agribusiness Sectors of a Prairie Economy. Prairie Forum (Vol. 17, pp. 97–109). Retrieved from http://www.citeulike.org/group/13619/article/7672546

Ballantyne, P. (2009). Accessing, sharing and communicating agricultural information for development: Emerging trends and issues. Information Development, 25(4), 260–271.

BCMAFF. BC Ministry of Agriculture, Food and Fisheries. (2000). Small-scale Farming in the South Cowichan Valley. Retrieved from http://www.agf.gov.bc.ca/resmgt/sf/publications/Small_Scale_Farming_in_South_Cowichan_Valley.pdf

Belliveau, S., Bradshaw, B., Smit, B., Wall, E., Wandel, J., & others. (2007). Comparing apples and grapes: farm-level vulnerability to climate variability and change. Farming in a changing climate: Agricultural adaptation in Canada, 157–172.

Berardi, G., Green, R., & Hammond, B. (2011). Stability, sustainability, and catastrophe: Applying resilience thinking to U. S. agriculture. Human Ecology Review, 18(2), 115.

Borron, S. (2006). Building resilience for an unpredictable future: how organic agriculture can help farmers adapt to climate change. Food and Agriculture Organization of the United Nations, Rome.

Bradshaw, B. (2007). Climate change adaptation in a wider context: Conceptualizing multiple risks in primary agriculture. Farming in a changing climate: Agricultural adaptation in Canada, 103–114.

Brklacich, M., McNabb, D., Bryant, C., Dumanski, J., Ilbery, B., Chiotti, Q., Rickard, T. (1997). Adaptability of agricultural systems to global climate change: a Renfrew County, Ontario, Canada Pilot Study. Agricultural restructuring and sustainability: a geographical perspective. (pp. 185–200). Retrieved from http://www.cabdirect.org/abstracts/19971807064.html

Brklacich, M., & Smit, B. (1992). Implications of changes in climatic averages and variability on food production opportunities in Ontario, Canada. Climatic Change, 20(1), 1–21.

Bryant, C. R., Smit, B., Brklacich, M., Johnston, T. R., Smithers, J., Chjotti, Q., & Singh, B. (2000). Adaptation in Canadian agriculture to climatic variability and change. Climatic Change, 45(1), 181–201.

Chambers, R. (2002). Relaxed and Participatory Appraisal: notes on practical approaches and methods for participants in PRA/PLA-related familiarisation workshops. Participation Group, Institute of Development Studies, Brighton, UK.

Chowdhury, A. H., & Hauser, M. (2010, July 28). The Potential of Moving Pictures, Does Participatory Video Enable Learning For Local Innovation? Presented at: Innovation and Sustainable Development, Montpelier, France.

Chowdhury, A. H., Mele, P. V., & Hauser, M. (2010, September 14). Learning Through Moving Pictures: Farmer-to-Farmer video to stimulate farmers' innovation about botanical and alternative pest management practices in Bangladesh. unpublished. Presented at The World Food System Conference: A Contribution from Europe.

Chowdhury, A. H., Van Mele, P., & Hauser, M. (2011). Contribution of farmer-to-farmer video to capital assets building: Evidence from Bangladesh. Journal of Sustainable Agriculture, 35(4), 408–435.

Cohen, D. & Prusak, L. (2001). In Good Company. How Social Capital Makes Organiaztions Work. Massachusetts: Harvard Business School Press.

De Schutter, O. (2011). Agroecology, a Tool for the Realization of the Right to Food. Agroecology and Strategies for Climate Change, 1–16.

Dolan, A. H., & Walker, I. J. (2006). Understanding vulnerability of coastal communities to climate change related risks. Journal of Coastal Research, 1316–1323.

Downing, T., Butterfield, R., Cohen, S., Huq, S., Moss, R., Rahman, A., Sokona, Y. (2001). Climate Change Vulnerability: Linking Impacts and Adaptation. Report to the Governing Council of the United Nations Environment Programme. Environmental Change Institute. Oxford, UK.

Gliessman, S. R. (2007). Agroecology: the ecology of sustainable food systems. CRC.

IPCC. (2007). Intergovernmental Panel on Climate Change. Chapter 14: Agriculture, forestry and fisheries. Fourth Assessment Report: Climate Change. Retrieved from http://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch14s14-2-4.html

Kelly, P. M., & Adger, W. N. (2000). Theory and practice in assessing vulnerability to climate change andFacilitating adaptation. Climatic Change, 47(4), 325–352.

Kotschi, J., & Müller-Sämann, K. (2004). The role of organic agriculture in mitigating climate change. International Federation of Organic Agriculture Movements (IFOAM), Bonn.

Kroma, M. M. (2006). Organic farmer networks: facilitating learning and innovation for sustainable agriculture. Journal of Sustainable Agriculture, 28(4), 5–28.

Lang, T., & Heasman, M. (2004). Food wars: the global battle for mouths, minds and markets. Earthscan/James & James.

Lunch, C. (2004). Participatory Video: Rural People Document their Knowledge and Innovations. IK Notes, World Bank., No. 71. Retrieved from www.worldbank.org/afr/ik/iknotes.htm

Lunch, N., & Lunch, C. (2006). Insights into participatory video: A handbook for the field. InsightShare.

McNamara, K. (2011). Small Farms and Climate Change Adaptation in British Columbia. Masters Thesis, School of Public Policy. Simon Fraser University.

Meinke, H., Nelson, R., Kokic, P., Stone, R., Selvaraju, R., & Baethgen, W. (2006). Actionable climate knowledge: from analysis to synthesis. Climate Research, 33(1), 101.

Milestad, R., & Darnhofer, I. (2003). Building farm resilience: the prospects and challenges of organic farming. Journal of Sustainable Agriculture, 22(3), 81–97.

Motha, R. P., & Baier, W. (2005). Impacts of present and future climate change and climate variability on agriculture in the temperate regions: North America. Climatic Change, 70(1), 137–164.

Pearce, K. T. (2009, March). Living With Climate Change: How Prarie Farmers Deal with Increasing Weather Variability. Natural Resource Institute. University of Manitoba.

Pike, R. G., Spittlehouse, D. ., Bennett, K. E., Egginton, V. N., Tschaplinski, P. J., Murdock, T. Q., & Werner, A. T. (2008, Spring). Climate Change and Watershed Hydrology: Part ! - Recent and Projected Changes in British Columbia. Streamline, Watershed Management Bulletin, 11(2).

Pretty, J. N. (1995). Participatory learning for sustainable agriculture. World development, 23(8), 1247–1263.

Pretty, J. N. (2002). Agri-culture: reconnecting people, land and nature. Earthscan/James & James.

Pretty, J. N., & Vodouhê, S. D. (n.d.). Using rapid or participatory rural appraisal. Improving Agricultural Extension, 47–55.

Pretty, J. N., Vodouhê, S. D., Swanson, B., Bentz, R., & Sofranko, A. (1997). Using rapid or participatory rural appraisal. Improving Agricultural Extension, 47–55.

Reid, S., Smit, B., Caldwell, W., & Belliveau, S. (2007). Vulnerability and adaptation to climate risks in Ontario agriculture. Mitigation and Adaptation Strategies for Global Change, 12(4), 609–637.

Roling, N. G., & Jiggins, J. (1998). The ecological knowledge system. Facilitating sustainable agriculture: participatory learning and adaptive management in times of environmental uncertainty. Cambridge University Press, Cambridge, UK, 283–311.

Rosenzweig, C., & Parry, M. L. (1994). Potential impact of climate change on world food supply. Nature, 367(6459), 133–138.

Rosset, P. (2000). The multiple functions and benefits of small farm agriculture in the context of global trade negotiations. Development, 43(2), 77–82.

Sauchyn, D. (2007). Climate Change Impacts on Agriculture in the Prairies Region. Farming in a Changing Climate: Agricultural Adaptation in Canada, 67–80.

Sauerbeck, D. R. (2001). CO2 emissions and C sequestration by agriculture – perspectives and limitations. Nutrient Cycling in Agroecosystems, 60(1), 253–266. doi:10.1023/A:1012617516477

Smit, B. (1993). Adaptation to Climatic Variability and Change: Report of the Task Force on Climate Adaptation, The Canadian Climate Program. Dept. of Geography, University of Guelph, Canada.

Smit, B., & Skinner, M. W. (2002a). Adaptation options in agriculture to climate change: a typology. Mitigation and adaptation strategies for global change, 7(1), 85–114.

Smit, B., & Skinner, M. W. (2002b). Adaptation options in agriculture to climate change: a typology. Mitigation and adaptation strategies for global change, 7(1), 85–114.

Smit, B., & Wandel, J. (2006). Adaptation, adaptive capacity and vulnerability. Global environmental change, 16(3), 282–292.

Statistics Canada. (2011). 2011 Census of Agriculture. Retrieved July 12, 2012, from http://www.statcan.gc.ca/ca-ra2011/index-eng.htm

Statistics Canada, A. C. (2009). Agricultural perspectives from seven censuses, Canada and provinces: census years 1976 to 2006. Retrieved July 12, 2012, from http://www.statcan.gc.ca/pub/95-632-x/2007000/t/4129741-eng.htm#59

Tarnoczi, T. J., & Berkes, F. (2010). Sources of information for farmers' adaptation practices in Canada's Prairie agro-ecosystem. Climatic change, 98(1), 299–305.

Tol, R. S. J. (2002). Estimates of the damage costs of climate change. Part 1: Benchmark estimates. Environmental and Resource Economics, 21(1), 47–73.

Van Mele, P., Wanvoeke, J., Akakpo, C., Dacko, R. M., Ceesay, M., Béavogui, L., Soumah, M. (2010). Videos bridging Asia and Africa: Overcoming cultural and institutional barriers in technology-mediated rural learning. Journal of Agricultural Education and Extension, 16(1), 75–87.

Wall, E., & Smit, B. (2005). Climate Change Adaptation in Light of Sustainable Agriculture. Journal of Sustainable Agriculture, 27(1), 113. doi:10.1300/J064v27n01_07

Wall, S. E., Smit, B., & Wandel, J. (2007). Farming in a changing climate: agricultural adaptation in Canada. Univ of British Columbia Pr.

Warner, K. (2007). Agroecology in action: Extending alternative agriculture through social networks. The MIT Press.

White, S. A. (2003). Participatory video: Images that transform and empower. Sage Publications Pvt. Ltd.

World Bank. (2007). Enhancing agricultural innovation: How to go beyond the strengthening of research systems. Retrieved from DC. http://siteresources.worldbank.org/INTARD/Resources/EnhancingAgInnovationebook.pdf

Zossou, E., Van Mele, P., Vodouhe, D. S., & Lebailly, P. (2010, November 8). Strengthening local innovations in rice processing through video in Benin. Presented at the 28th International Rice Research Conference.

Chapter 4: Findings

Introduction

In this chapter the findings from the semi-structured interviews as well as the video pilot project are presented. The findings were derived directly from the words of 14 farmers from 10 farms on Vancouver Island, Salt Spring Island and Orcas Island. The following themes and subthemes presented were chosen by collating the most commonly discussed topics. I used the *process-based* approach as described by Wall *et al.* (2007) to guide my inquiry and analysis, where the focus was placed on the experiences of the farmer:

> *"Experience and knowledge of community members are used to characterize pertinent conditions, community sensitivities, adaptive strategies, and decision-making processes related to adaptive capacity or resilience".* (Wall *et al.*, 2007)

All farmers interviewed noticed recent environmental changes that were impacting their agroecosystems; these changes encompassed impacts to their ecological, social and economic systems. All farmers were aware of climate change, but many were unsure if the changes they were experiencing were a result of climate change specifically. Farmers identified and spoke in detail to the range of related challenges related to the changing environmental conditions, which all led to cascading changes in their systems. Several farmers also identified different opportunities for adaptation and learning. Farmers also discussed the major barriers and supports when adapting to variable and extreme weather. The ability to exchange knowledge farmer-to-farmer, and to access to useful information in general, was highlighted as a key element of succeeding as a farmer in the study region. Overall, there were significant parallels in the responses from all of the farmers interviewed.

Perceptions of Climate Change

> *BL: …[My perspective is] a perspective that comes from fifty years of observation of beekeeping, and seeing what happens to the dynamics of bee populations in a beehive. Where do they go? They thrive if they have resource, they thrive if they have the good climate to*

work in, and they perish if they don't have the resources or the climate turns against them. And that's life. That's how it goes.

During interviews, farmers were asked if there had been any significant "ecological" or "environmental" change(s) that they had noticed or experienced during their time farming. While I used the terms "ecological" or "environmental" change, most farmers were quick to introduce the term "climate change" into the discussion. This indicates that farmers were aware of climate change, or were contemplating the effects of actual climate change.

BL: they're saying a shift of two-degrees one way or the other is going to spell a lot of stress for the planet, lots of organisms, including ourselves, are on the planet. And I tend to believe them, just watching incremental, miniscule shifts in our own climate here on a very micro level….So yeah, from one or two degree rise in temperature or one or two degree drop in temperature, yeah, scary thing, to be candid.

RT: The cold wet springs we've had – maybe we haven't been farming long enough, maybe it's one of those cycles – but then again, maybe not, maybe it's climate change and we are in for a lot of diversity [of weather] and we won't really be able to predict much based on the past. I don't know.

BL: Since fifty years ago there have been a lot of environmental changes particularly noticeable in bee industry because we focus on minutia. When it comes to bees we look at things in great details…So when we are observing the bees at the hives coming and going with or without honey and pollen, we start to wonder why. And more often than not it's climate related. Not always…But a lot of times climate does drive it"

While it was clear that farmers were indeed aware of the concept of climate change, and also concerned about the risks that it may pose, they seemed hesitant to attribute the ecological changes they were experiencing directly to climate change. Most felt that they did not have enough knowledge or information to specifically name the source of the change.

RF: Yeah… there are other fluctuations that are hard to tell whether it's just natural thing that would have happened at any stage or something you could ascribe to climate change.

Sometimes there is just, you know, so much rain that you can't cultivate or early frost takes away all your squash that you haven't yet brought off the field or something but you know those kinds of things have always happened to farmers so, I don't know.

HS: Weather patterns and climate have changed in the past ten years but it's hard to say what's climate and what's a blip…the curse for the climate scientists, hey? [Maybe it's] just this year, just this year…

Although farmers were asked to reflect on changes that they had observed during their time farming, most farmers focused on changes that had been affecting them primarily over the past two years. This would typically be referred to as changes in "weather". Regardless of whether the changing weather patterns are referred to as climate change or a "blip", there were observable and significant changes in the farming systems as a result. It became clear that the important issue at hand was that farmers are experiencing changing weather patterns that were noticeable and challenging. These changes were significant enough to stimulate interest and action towards finding a solution to the resultant challenges that these changes have brought about.

HS: I think that I need to keep on trying to figure out what is going on. Like the specific things, such as slugs, yeah, big concern, big problem. We've got to keep working on solutions for that. Early bolting of crops in the spring, possibly weather related…what am I going to do about that? I haven't figured that one out yet.

DB: I would say that climate change looks like a pretty serious issue…You know all this talk about whether it's actually happening or not. That's not the question. The question is - is there a potential that it's happening? If the answer is yes - and we have seen what the impact of that might be - then you should do something about it.

Exposure to Changes: Weather Extremes and Unpredictability

All of the farmers interviewed reported a noticeable change in weather conditions. Interestingly, all farmers focused on more or less the same set of changes which can be placed in two main categories: temperature and precipitation extremes mostly in the form of cooler and wetter springs, and atypical seasonal trends, resulting in unpredictable

events and circumstances, or overall variability, in the farming system. None of the changes were posited as opportunities; they were all framed as challenges.

The categories of weather extremes and unpredictability are intertwined, even overlapping at times, and each created cascading consequences within the farming system. These categories of extremes and unpredictability are further detailed in the following sections.

Temperature and Precipitation Extremes

According to farmers, cooler and wetter springs have been more common in recent years, which have caused a host of challenges. A couple of farmers also mentioned the recent occurrence of uncharacteristic "cold spikes" during the winter months.

> *HS: The last two years slug populations have been much, much higher. The last two years, springs have been longer, cooler, wetter and slug populations have been higher.*

> *RF: It has been challenging…not being able to cultivate as early as we used to…Usually there is dry spell that I count on in February. So when we don't get that dry spell I feel like we are already set back.*

> *SE: it's been a really cold year this year. Everything is a month late. And it was late last year. We get flooding in the winter.*
> *JW: Way more than normal.*
> *Sue: Way more than normal. And it's been colder and windier.*

> *JW:...what's happened the last couple of years for instance is that our squash is just about failing. It's too late, the starts aren't big enough to transplant, and then half of them die - it's just not warm enough.*

Unpredictability

All farmers depend on seasonal shifts that allow them to make use of particular conditions that make it more or less ideal for growing different crops. Much of agroecosystem management depends on a sequenced pattern of events. The small-scale organic farmers in this study depended heavily on this sequence in order to maintain naturally occurring nutrient cycles and to mitigate the potential for diseases and pests. For example, farmers strongly correlated wetter and cooler springs with more disease and

pest infestations. The varying weather extremes and seasonal shifts have been presenting unpredictable challenges such as pests and disease, to crop losses, to overwintering crops dying, to "late starts" on the growing season, all of which create cascading "unknoweables" in the rest of their system.

> *RT: You know, each farming year is so different, but I do know that the planting dates that I got from my mentors [have changed]… So it's hard to know if we're just in a wet cold cycle right now, but it has been really, really hard in the spring, we've lost all of our transplants, we just haven't been able to work the ground early enough. I think that planting calendars can't be as dependable as they used to be.*

> *CB: Everything has been pushed back for us for about a month…This means that it messes up our planting schedule, and the plants are just all growing a lot slower this year… Everything is off kilter! Everything's condensed. It's not like everything gets pushed, like oh it's a month later and everything's a lot later, [what really happens is] everything just gets condensed.*
> *IA: Yes, definitely!*

> *BL: Even in the last ten or fifteen years since we've moved to the island we've noticed a bit of a change in the climate.... It used to be that we would have our bees out by mid-May to June by the latest to take advantage of the various plants that are in bloom out there. Now we are moving more toward June to mid-June. So it's a couple of weeks difference there.*

The two overarching categories of unpredictable seasons and weather extremes resulted in a variety of overlapping challenges for the farmers. These challenges are evidenced in the above quotes, but are further detailed in the next section.

From Changes to Challenges

HS: "…so many variables, so many variables."

Farmers were asked what these changes meant for them and their agroecosystems (see Appendix 1.0 for interview questions). Without reservation, the changes experienced were discussed as "challenges" or "risks" that were born as a result of these environmental changes. The changes described in the above section can be quite easily

connected to challenges (i.e. increasing cool and wet conditions increases pests and disease which decreases crop yield, quality and resilience), yet some of them are hard to foresee on the surface. While Table 3 displays a summary of the changes in weather and seasons, and the corresponding changes in the farm system and landscape, it does not capture the detailed interactions at play.

Table 3 Summary of Changes in Weather and Corresponding Changes in Landscape

	Weather Stimulus	**Results**
Weather Extremes	General	• Temperature extremes are stressful to the plants • Plant stress can cause bolting (early seeding) and generally "weak" plants, making them susceptible to other problems
	Higher Precipitation	• Increased slug populations • Diseases are more prevalent (molds) • Root rot
	Cold Spikes in Winter	• Crops that have overwintered in the past have been killed by frost
	Windier	• Drying, plants lose water quickly, stress plants
Unpredictability	Cooler Springs	• Slower growing crops, slower germination
	Wetter Springs	• Much higher slug populations • Diseases are more prevalent (molds) • Root rot
Cascading Effects		
	Irregular drainage patterns	• Flooding in uncharacteristic areas, upset crop planning
	Truncated Growing Season	• Less time to produce a crop • Unreliable seeding and planting dates • Smaller yields, in size and quantity of crop • Inability to really organize the crop plantings as they have in the past

Many farmers conceive of and experience their farms as a whole system, and it was difficult to extricate one risk or challenge from the next, as each seemingly minute change can cause cascading changes throughout the whole system. Also, different conditions mean different things for different plants – some crops are more resilient than others. The interconnectedness of the risk posed by these changes is displayed in figure 2. This figure could be expanded considerably and will change depending on the conditions of individual farms. The most commonly discussed risks and vulnerabilities that these unpredictable seasons and weather extremes are causing for the farmers are discussed in the next section.

Figure 2 Cascading changes and challenges

Ecological: Overwintering Crops

Overwintering crops are crops that are planted in the late summer and can be harvested all winter long, and these yield a significant source of income for the farmers. If the winter temperatures drop too low, these crops can freeze and then will rot. Some of the overwintering crops are biennial, such as those of the *Brassica sp.*, which means they also provide an early spring crop. These early spring crops provide a source of income during the "gap" time between winter crops and the summer harvest. If it gets too cold, the farmers can lose a significant source of income in both the winter and the early spring. In the interviews, several farmers clearly noted that overwinter crops were struggling to thrive, if not out-right failing.

> *HS: Chard used to overwinter much better than it does now. My chard has almost completely all died over the winter the last 2-4 years. It used to consistently survive the winter. Yeah, so some of the overwintering crops don't survive as well as they used to...Yeah, and the crops that used to overwinter [that are now] dying, I'm assuming that that's because although the winters haven't been colder in general, there's been colder snaps.*

> *RT: It used to be that certain thing would overwinter in the ground, carrots and beets, for example. In the last couple of winter, we've had this cold spell, you know, minus ten degrees for a week, which is pretty unusually for this area. They froze and died. So I just think that certain things you used to be able to count on, like those things overwintering, you can't necessarily count on any more.*

Ecological: Premature Bolting in Spring Crops

Bolting is the process where a plant goes "to seed", or begins to develop its seed pods earlier than it would in a typical life-cycle – the plant literally "bolts" to a seed stage before it has reach maturity. This can change the flavor and shape of the crop, and the crop is generally considered unfit for sale at this point. Several farmers clearly noted that there were early spring crops that were bolting prematurely.

> *HS: And this spring we had a lot of premature bolting in the spring. It's funny because it was a cool spring so I thought that the early brassica's would have done well, but I'm wondering if there's not this sort of, hmm….spring and summers have been cooler but with the odd spike of warm, and then winters possibly getting a little bit warmer on average but*

then some really significant spikes of cold, and those variations are obviously really hard on the plants.

CB: There's been a lot more bolting happening this spring too.

Ecological: Tilling, Soil Compaction

In the spring months, the farmers are all eager to get on the soil, especially after the winter when income derived from the farm is low to none. In any given year there is urgency to break ground, but the farmers reported that since weather patterns seemed to have shifted, a characteristic dry spell that used to occur in February is no longer occurring. This short dry spell allowed the ground to dry out a bit, enabling the farmers to till the soil and get a start on the growing season. If the farmers till the soil before it is dry enough, it may cause compaction. This can be damaging for the soil, reduce crop quality, disrupt the planting schedule, and at worst, render an area unusable for at least one season.

RF: We got desperate in April when we used to be able to be out there in full force. And I had labor lined-up, you know, three people ready to go, but the land wasn't right. So you know, we took it on a little early, and did some tilling and planting before it was quite dry enough…we had some success, but that ground was quite compact and the crops didn't do as well as they should have. They were in the ground a lot longer because they grew slower and you know, we did it anyway, because we are starting to feel desperate about getting crops in and… But it wasn't the best thing for the soil, and perhaps not the best thing for the crops in the end because it took so long and they weren't as hardy.

CB: In our first five years we were able to get an early till in February, there was always a two week really warm, dry spell, and that was something that we'd noticed from before [we started farming]. But for the last few years that hasn't happened, especially this year, like not being able to get on the land at that time to start breaking up the cover crop meant that when the rain started happening again in march, things weren't able to dry out as quickly as they were in the past and so everything got pushed back.

Ecological: Flowering Times Disrupted

It is important to recognize that the unpredictability in the seasons also affects insects, and not just the pests such as slugs, but the bees necessary for pollinating some crops. Beekeepers on the island have been experiencing significant challenges due to this unpredictability, as well as to the weather extremes.

> *BL: If the winter continues too long and we get cold, damp condition in early spring or what is supposed to be the early spring, the plants won't be producing nectar. A lot of plants require a particular temperature and particular climatic conditions to produce flower, nectar, and pollen to attract pollinators like bees. Without that key temperature and environmental gradient that they rely on, bees essentially starve, or have less diverse habitat...If the weather is too cold bees won't fly until it gets to about thirteen degrees Celsius. If we have extended cold periods, even if the plants are in bloom and are producing nectar, the bees won't come out to visit them. This spring was particularly bad for that.*

Social: Crop Planning, Disorganization

Organic certification in Canada is a long and lengthy process, requiring three years of meticulously kept records of overall management practices, including records of seeds purchased, seeds planted, amendments added, crops harvested, and crops sold, along with times, dates, receipts and amounts associated with all of these items. If there are ambiguities within the records or sequence of plantings by the farmer, there can be some complications through the certification process and the farmer may be put on probation until the next year. Unpredictable or extreme weather can necessitate changes in the planting plans, bringing in confusion and disorganization that can lead to ambiguities that appear during the audits.

> *RT: So what's happening is, we can't get the summer planting in on time because the spring planting is late, so the planting gets screwed up. And for our crop rotation we want our crops in blocks of families, so we have our brassica family, and then our beet family, then our carrot family, so sometimes beds are free in a different area, so if I have broccoli that happens to be early and I need to plant beets (pause) - well it's really tempting to plant those beets in the broccoli area because you need to get those beets in and you need to get that crop happening. So it creates all this chaos and disorganization on the farm, which comes back to haunt you because you want your plants in distinct areas on the rotation*

otherwise you get pest and nutrient problems later on. It's just a lot of…. planning isn't as linear as it used to be.

Financial Impacts

The weather extremes and season truncation described by farmers in interviews sometimes resulted in crop losses, or lower quality crops, which is turn has financial repercussions. When discussing the risks that climate change/ecological change poses to farmers, all farmers presented the financial challenges associated with these changes. It was certainly noted that variability was to be expected – but it was only manageable to a certain degree.

Overall, all of the farmers noted that the challenges resulting from the environmental change have the potential to set them on a financially ruinous course, if not put them out of them out of business overnight. But it was not only environmental challenges that threatened their finances, as is evidenced in the below quotes:

RT: I think that climate change means a lot more crop losses, a lot more insecurity, and I don't think that prices are going to reflect that…like carrots this year should have been three times the cost because I had to plant them four different times before they worked out.

BL: …If you have a weak year in honey yield like this year, you are working for free. That's farming, as they say.

While the environmental challenges were posing considerable challenges, it was clear that the farmers were already in a precarious financial position. The environmental challenges appeared to be exacerbating an already existing economic problem.

CB: Yeah, [variability is] a big concern, but it's something that is expected as well. It is something that you can't prepare for necessarily, you just have to be stubborn and persistent and go on with it…until it breaks you! [laughter]. Yeah but I mean, another spring, another few springs like this would really challenging, it would really hurt us. Theoretically, having like a sale from $1000 to $200 comparatively from last year to this year, and having that over a significant period of time...(for) small scale farming, that's a huge amount.

HS: Yeah, there's more [variability] than I anticipated, but that's not necessarily a bad thing, but really what worries me more sort of in the long term is actually the financial viability, is like prices. I feel like I could face those growing challenges [if there was more financial stability]. It would be unreasonable for me to think, the weather should always be consistent...it's the business end and the growing end..Make at least one side of that equation easy, I almost feel like I'd have more patience for the other one (either side) being challenging or unpredictable.

RT: So it's hard to say what would be the breaking point, and whether the breaking point will come without climate change, it could not be climate change driven, it could just be me being sick of leasing land and not having any savings. I think, yeah, if farming gets any harder, I don't think I'll be here until the bitter end.

The farmers all recognized that there were direct and indirect harmful consequences of weather-related risks, and these all appeared to be felt most acutely in economic terms. After farmers outlined the challenges they were experiencing as a result of these risks, they were asked to discuss how they dealt with these challenges, and how they may, or may not, be adapting to them.

Adaptations

The farmers explained that changes were always occurring in their agroecosystems, as that was the nature of farming – to expect the unexpected, because every year was a bit different. There is so much uncertainty and so many variables in an agroecosystem; the need for problem-solving moment-to-moment seemed an inevitability to the farmers, even under "perfect" conditions.

IA: I think we change a little bit here and there every year. Changing the plants and what we grow and adapting, like using different sorts of mulches to make things warmer, or things wet or planting things a bit farther apart, to get more air circulation. So I guess we're adapting here and there.

Adaptation: Present

The farmers were actively engaging in management practices and techniques that were in place to manage specific weather-related risks. While some of these were adaptations that were directly or indirectly related to weather risks, some may also be

considered to be management practices that have been adopted simply to increase the overall resilience, or adaptive capacity, of a system. These management practices create a "buffer" against other risks that may be introduced (such as climate). This difference varied from farm to farm, and farmer to farmer. Also, it should be noted that these management practices were undertaken to increase not only the ecological resilience, but also the economic resilience of the system; for example, a diversity of crops meant more ecological resilience, but it also meant more market opportunities. The financial and ecological resilience of a farmscape were shown to be very closely intertwined.

HS: …every year, increasingly every year, I'm glad that I grow forty different crops.

RF: …in our community of farmers, you know there is disappointment when you lose a crop, but there are thirty or twenty five more that you can rely on for your income and your production. We are just buffering against those changes that way. We also just love growing everything. So that's part of diversity… it really helps to mitigate the impact of climate change to have a large number of crops.

DB: This year is a perfect example actually we had a fairy lousy year for most of the more conventional or traditional fruit crops… but we had trees that actually bent over and touched the ground because they loaded so heavily with fruits. So, by simply having that diversity [of unique crops]…we were able to do really well for ourselves.

One farmer in particular was reflective regarding the concept of noticeable environmental change. While climate change is of significant concern to him, his perspective is that the agroecosystem is a dynamic system that is ever-changing, just like any ecosystem; therefore constant changes to the system are expected, along with uncertainty in what those changes will bring. This same farmer was exploring very unique adaptations on the land that he grew food on collaboratively with a group of people. The farmers were experimenting with crops on either end of the climate spectrum, planting crops that would do better either in colder or warmer conditions. These farmers were also adapting agricultural techniques that were used in ancient Mexico to the Pacific Northwest, techniques that were specifically useful for growing in marginal, flooded environments. They were also experimenting with apple varieties in

order to discover the variety that was most resistant to a disease that is common west of the Cascade Mountains, as they were not satisfied with the level of research surrounding this topic.

> *DB: Heir-twenty is a variety of apple that was developed in Saskatchewan, or some place in Canada where it gets real cold, and that's an apple that would produce in those condition. So the fact that we have the heir-twenty apple in our landscape, not tons of them, but there are some of them, means if it gets colder, we have something that's going to continue to produce. We also at the other end of the spectrum have planted quite a few loquats in various spots throughout the property. Those are sub-tropicals, and they will only fruit if we get mild February, which hasn't been traditionally what happens here. However, last spring we had mild February and we had the first loquat fruits in twenty-five years. So looking at planting towards the edges of our climate range will help to buffer the climate change.*

Besides ecological adaptations, some farmers were also experimenting with financial adaptations. One group of farmers had developed a cooperative marketing strategy that allowed the farmers wider access to consumers, due to the greater diversity and quantity of crops offered as a group. This strategy allowed them to be, to some degree, competitive with other larger growers. Also, there were obvious social benefits to this strategy, as the farmers could share information and provide support to each other.

Another important financial factor that was described was the important of a diversity of markets. This allowed for greater opportunities for the farmers to market their produce to a variety of tastes and interests.

> *RF: there is the importance of the diversity of markets, particularly our situation as a small-scale farmer because one crop may not sell to restaurants, but it can go on a box program, or maybe targeted for the farmers' markets. So we do plan our farms with that in mind, in terms of what's going to probably sell to what customer.*

In many cases, an adaptation can be as a result of many broad categories of stimulus. For example, the building a greenhouse may be initiated by the combination of increasingly cold and wet weather, as well as a good return in market sales that provides funding to make a greenhouse a reality. Overall, the various combinations of these stimuli would dictate a variety of adaptive responses from the farmers.

Adaptation: Supports and Barriers

RF: I do tend to get habitual but being a small-scale organic farmer just means almost by definition that you are innovating all the time.

During interviews, farmers explained how they could be better supported to adapt and innovate in light of the ecological changes they were experiencing. The farmers also discussed their process of learning, as understanding the process of learning is essential when trying to uncover how farmers adapt to changes and employ new techniques.

Supports to Adaptation: Community Learning, Knowledge-sharing, Experimentation

This section reviews the farmers' process of learning, process of adaptation, and the supports that allow for adaptation to happen. Nearly all of the farmers referred to their local community as being the biggest source for gaining new information and learning adaptive strategies and/or innovative practices. All farmers also mentioned the importance of experimentation, or a "learning by doing" approach, which precipitated innovative practices on their farms.

CB: Community. Absolutely. I mean, talking to other farmers and seeing what they're doing, for sure.

HS: community is probably the single biggest one, both on the farm and then just communicating with the broader farming community around here. I get really re-inspired, which is not an insignificant part of it, I get re-inspired by meeting other farmers wherever I go...All my innovation comes from other [farmers].

BL: Just getting together and chatting with people from our industry, helps us keep ahead of the curve and learn a few ideas.

IA: Sometimes things pop into our head and we think, is this crazy? And then we look to see if anybody else does it…but often it is really just winging it too.

These two ways of learning - sharing knowledge farmer-to-farmer and experimenting – were undoubtedly the most common and important approaches for

farmers when faced with the need to adapt. However, it was also shown in interviews that finances often also play a prominent role in the ability to *risk* experimentation, or afford different types of adaptive technologies.

All farmers described using books and the internet to learn and adapt, but all expressed dissatisfaction with the amount of locally-relevant information that was available. All the farmers stressed the importance of local ecological knowledge that could assist them to deal with changing conditions.

> RT: "*sometimes you think, oh well, that is just the farmer down the road and he's doing the same thing that I'm doing - but just seeing little ways that he or she has solved problems, actually really helps".*

For many farmers, a priority was placed on farming knowledge that was of a more practical nature. Several farmers referred to the "loss of farming knowledge" in light of an aging farming population and a shift in focus towards more industrial farming. Farmers expressed a desire to learn more "traditional" agricultural practices such as animal husbandry, food storage and seed saving; this would allow them a greater "base" of farming knowledge, allowing them to diagnose and solve problems more effectively. All farmers felt strongly about the need to share knowledge with each other, with new aspiring farmers and, in some cases, with the rest of the community at large. It was frequently expressed that the interchange of knowledge farmer-to-farmer is an *essential* part of small-scale organic farming. This ethic of farmer-to-farmer knowledge sharing is further expanded through the transfer of knowledge to the newer generations of farmers, either through official apprenticeship programs or through more informal arrangements.

> *RF: Yeah, it's [sharing knowledge] always been a strong value, because that's how I learned. I think that the mentors in our community, the farmers we learned from, are very into sharing knowledge and encouraging new farmers to get into it. We just adopt the same strategy. We know the value of growing the community that way…I think most people who come to work aren't from farming backgrounds. So there really is a lot to learn.*

Most farmers also expressed that new farmers or apprentices are a significant source of innovative ideas, and while the more experienced farmers are in mentor roles,

they frequently changed elements or practices in their agroecosystems through suggestions from new farmers or apprentices.

> *BL: they [new farmers] should be the one who should step forward and start giving some more modern advice - instead of the old farts who are still stuck in the past.*

> *HS: But I know that it's [the apprentices are] a really really valuable part of the farm...the labour that the apprentices bring, the new energy, and the fact that they make me adapt.*

Several farmers also reflected that being "adaptable" was also a matter of personality or disposition, and one farmer acknowledged that she would be a better farmer if she were more comfortable with change. Several farmers expressed the desire to learn from farmers who were a little bit further than their directly-local community but still within the bioregion, in order to keep new information and ideas circulating. Several of the farmers also expressed interest in learning practices from conventional growers, practices that did not conflict with organic practices, such as irrigation techniques.
In the past, one way of sharing local ecological knowledge was through an organic extension agent. Many farmers regretted the loss of funding in the fall of 2010 that effectively ended the position of this extension service, which had run for a three-year period. The organic extension service facilitated learning between different farm-types (though all organic) in different regions of the province. The extension agent was also a liaison between farmers and agricultural researchers, sharing new research, experiences and concerns between them.

> *HS: …the vast majority of the resources that I look at [on the internet] are American University extension services…I'm glad that it's there, but it just may not be at all applicable! It's a long way away, different ecology, different climate…When there was an organic extension agent she was hugely helpful because she was that great 'bridge'…the organic extension agent sort of knew what was going on in most of BC… She was enormously valuable.*

> *RT: …you know, often times we'll get an idea off a website, like there's the UC Davis AG extension service, and they will do research, but I don't think I've ever really gotten a*

practical idea off of the website… Yeah, but I don't think I've read very many tips that have been useful.

Overall, it was evident that the most important elements for farmers to learn and to adapt to the changes in their environment were the sharing of knowledge farmer-to-farmer, experimentation, and locally relevant knowledge. Also important was internet-research and books, as long as they could find sources of locally applicable techniques and practices, which they reported as somewhat lacking. Many farmers were disappointed at the loss of the organic extension agent for British Columbia and felt that greater governmental support was required in this area.

Barriers to Adaptation: Lack of Time, Financial Challenges, Ineffective Policies and Research

While the farmers I interviewed were quite tenacious in the face of the ecological changes that they outlined, there were undoubtedly barriers or challenges to adaptation. On of these barriers was expressed as *lack of time*, and this was a consistent theme throughout the interview process. While farmers spoke keenly of wanting to share knowledge farmer-to-farmer, they simultaneously expressed frustration or straight acknowledgement that they did not have enough time to visit with farmers or discuss projects or problems with them. While farmer-to-farmer exchanges were favored over all other knowledge transfer, the instances were they occurred were usually brief and haphazard.

Some of the farmers that I interviewed marketed co-operatively, and therefore had more interaction and chance for knowledge-sharing. One of the farmers who was part of this co-operative acknowledged that having this much time to spend with other farmers in your community was quite rare, and she felt that this was distinctively unique compared to other situations. Several of the farmers from this group also commented on the potential for re-circulating information that was not necessarily useful, or even maladaptive, since the group was so small.

HS: I get a lot of really really good information from my immediate neighbourhood, but at some point we need some innovation, we need to bring some new ideas into that tiny little pool or we just end up circulating the same information.

When discussing knowledge-sharing through the use of videos, most farmers agreed that this could be a useful way to share information, but all emphasized that they would preferably be short in length in order to capture the attention of a busy farmer.

While the recurring theme of "lack of time" was agreed upon by all of the farmers, it was frequently paired by the theme of "financial struggle". The financial challenges surrounding small-scale organic farming are vast. There are some seemingly "simple", well-established adaptive technologies and practices that are still considered expensive by small-scale organic growers.

> *IA: We're having a bad year right now and it's kind of killing us, and like we want to be able to have a bad year and it not be like the worst thing in the world where we're in danger of going out of business.*

> *CB: …it kinda feels like when you start to get on that downward spiral…I mean, we've got nothing under us to hold us up.*

> *BL: …If you have a weak year in honey yield like this year, you are working for free. That's farming, as they say.*

> *RT: Research also seems to have the base assumption that everyone has access to remay cloth, irrigation, which are kind of our luxury items in farming. What if you don't have those things, do you just not grow that crop?... how do we do without all that stuff? Researchers often assume, or they have presuppositions that everybody is farming in a semi-industrial manner.*

While distinct financial barriers existed, another important element of introducing a new or adaptive strategy is *knowledge of* or *learning about* that new strategy. Many farmers mentioned the desire to gain more knowledge surrounding "traditional" ways of farming where the focus is on learning skilled practices rather than purchasing material items. Several farmers critiqued what they considered "typical" farm-research approaches and offerings, which were considered not directly useful to farmers, as they did not reflect a true understanding of small-scale farming. Most of the farmers critiqued the government's agriculture experts, programs, policies, researchers and/or funding

strategies, explaining that they reflected a lack of understanding of the specific needs of small-scale organic farmers, which are different than other types of farms. Overall, the farmers interviewed suggested there was a gap in governmental understanding, knowledge and support, and the support that *is* being offered was considered not very useful to small-scale organic farmers.

> *HS: I'm not saying that the government should give me money and say here, buy a new tractor, but I also don't think that the government should be paying a consultant to tell me how to do a business plan…But I don't want to be jam-maker, run an agritourism business, wineries are just a bad idea in this valley - I just want to grow vegetables! And I don't want to get subsidized to do it! But an extension agent would be great!*

The focus on financial security was not surprising - infrastructure costs and general risks involved in small-scale organic farming are considerable and can be overwhelming. One young farmer interviewed had decided to shift out of farming for the following year; the uncertainties were too great. The cost of land in the study region is prohibitive to most new farmers, making it difficult to grow the farming community, and the support, knowledge and innovation that goes with it.

> *JM: …it's very rare that you find a farmer that supports himself as a farmer on his own land. I can see myself finding ways to farm, but I can't see myself finding ways to farm in which I feel that I have enough control over my own destiny and future.*

> *JW: there is no real way that you can farm successfully in a community today where a critical mass of farms doesn't exist.*

Only one farmer-couple and one farm family obtained their income solely from the farm, whereas the other interviewees had off-farm jobs or a second income from a spouse in order to allow them to continue to farm. Most farmers described the need to work off-farm as a direct result of agriculture policies:

> JW: *Canada's cheap food policy keeps us in the poor house…we are in direct competition with the peasant cultures of the world…it's just about impossible to farm.*

The below table describes the supports and barriers to adaptation that were listed by most of the farmers in this study.

Table 4 Summary of Supports and Barriers to Adaptation

Supports to Adaptation	Barriers to Adaptation
Sharing Knowledge, Farmer-to-Farmer	Lack of Time to visit with other farmers
New Young Farmers	Cost of Land and uncertainty of the profession can make it unappealing
Financial Security	Some farmers were hesitant to try experiments due to the potential for failure.
Government Support: appropriate policies that reflect a true understanding of the operations of a small-scale organic farm	Inappropriate Policies: e.g. the promotion of value-added products is not directly addressing climate change, but the financial challenges that are a result of climate change.
Older farmers / learning "traditional" ways of growing	There is much research and support for semi-industrialized/industrialized style of growing.

Summary of Interview Results

Farmers were experiencing climate impacts that resulted in cascading challenges in their farming systems. All of the climatic changes experienced were posited as challenges as opposed to opportunities. When considering their willingness to learn, experiment and be creatively flexible while working with their agroecosystems, their adaptive capacity appeared to be quite high. It is anticipated that these farmers will continue to adapt as best as they can depending on the various possible contexts of change that were presented. However, "ecological change" or "climatic change" appeared to be less of a concern to farmers than financial stability, and some adaptations require considerable financial input.

The farmers frequently cited the lack of locally relevant information and research available to them, and this lack of information may be a factor when considering why farmers are unclear or uncertain about the current and future effects of climate change. Overall, farmers felt that they were lacking sufficient locally-relevant information in order to help them with the adaptation process, and were dissatisfied with the sources of information that were available to them.

Interview results showed that farmers overwhelmingly preferred learning farmer-to-farmer, yet they felt that their overall lack of time made it difficult to find opportunities to

share information and experiences farmer-to-farmer. Farmers wanted an interchange of information between both experienced and new farmers, as they felt that this is where a significant amount of innovation took place.

Videos and Website

The initial consultations with farmers and the interviews provided the idea for sharing farmer-to-farmer knowledge through video. The below sections review the findings with regards to the second part of the research, which focused on video production and website creation.

The video captured from interviews was edited using Final Cut Express Pro X and then uploaded to a blog-site that was created on Wordpress. The blog was made public on the 14th of April, 2012, and was initially shared through the Canadian Organic Association of British Columbia (COABC) listserve, through Facebook, and through emails to personal contacts in the farming community and beyond. As news of the site spread, it was also picked up by other online platforms such as online and print magazines (EAT magazine, BC Organic Grower), blogs, the University of Victoria Knowledge Mobilization Unit (KMU) site, Canadian Organic Growers (COG), the Organic Agriculture Center of Canada (OACC), Capital Region Food and Agriculture Initiatives Roundtable (CRFAIR), Small Farm Canada, and other informational gardening and farming websites. In some cases the site was shared by the site administrator, and in other cases it was distributed independently.

The busiest day for views on the website was April 15th, where over 800 views were recorded. The total number of views over 5.5 months (October 5, 2012) is nearing 7,000, with at least 500 views per month. The most frequently viewed videos were those in the New Crops section, with 280 views. Processing and Handling garnered the least amount of views at 125.

The term "views" may be misleading, as this does not necessarily indicate that there have nearly 7,000 *unique* visitors to the site; this reflects overall *usage* over time, rather than number of individual visitors, and it does not differentiate one user from another, and it does not indicate whether one user has returned multiple times. However,

it does differentiate the site administrator views, which is significant, as the frequency of site visits by the administrator is not of interest and would have skewed the results.

Figure 3 Different farmer videos

Figure 4 Screen shots of The Farmer's Filmanac. www.farmersfilmanac.com

Online Questionnaire

The online questionnaire was an attempt to gauge the efficacy of the videos and the site in sharing adaptive strategies and knowledge farmer-to-farmer. It does not give any real indication of whether or not these videos have been helpful in sharing adaptive strategies farmer-to-farmer (for details regarding questionnaire responses, see Appendix 3.0).

Age demographic of farmers

The questionnaire had a very low response rate, and the sample size was only 10. This indicates the questionnaire format may not have been the most effective way to receive feedback regarding the utility of the site. The majority of respondents identified as "new farmers", and this may be due to the likelihood of more proficiency in internet-use by younger farmers, therefore making them more likely to answer an online questionnaire.

This draws the question as to whether the online format is only attracting participants of a younger generation. During interviews, intergenerational learning was highlighted as one of the important elements of learning, adaptation and innovation. While the questionnaire reflected a higher proportion of "new farmers", there was also a group of very experienced farmers who, after viewing the site, subsequently wanted to

participate and share their knowledge through videos. While there is no way of knowing the average age of those who accessed the site, both older and younger farmers have been engaged with the project to this point.

The Utility of this Site

There were several strong indications through the questionnaire responses that the site was considered to be useful. When asked if it was an improvement to the knowledge transfer tools that currently exist, 30% chose "strongly agree", 60% chose "agree", and 10% chose "neutral". Also, when asked whether or not they would be interested in contributing their knowledge or techniques to this site in the future, 80% of respondents chose "yes".

However, when respondents were asked if they would use this site to learn locally-relevant knowledge techniques in the future, only 10% chose "strongly agree" 40% chose "agree" and 50% chose "neutral". This is a bit puzzling, as all but one of the responders who chose "neutral" were interested in sharing their knowledge on the site, and all but one respondent said that they "strongly agreed" or "agreed" that it was an improvement to current knowledge transfer tools. There are various possibilities to explain this result, and one is that the respondents were not aware that the site was structured to continually gain new material from more farmers; if the site was static, holding only the videos that it held to date, then it would be less appealing or useful to visit the site for knowledge-needs in the future. Another possible reason for the strong "neutral" response could be that the respondents were not from this particular bioregion, thereby rendering the information less useful to them; this was actually indicated by a respondent from Alaska, who noted that he would have chosen "strongly agree" rather than "neutral" had the farmers been from his bioregion.

Further Feedback

The limited number of respondents to the questionnaire clearly indicated that this was not the preferred or best method to give or receive information regarding the site. Much more detailed responses were shared through email correspondence. All of these emails expressed favorable responses to the site, all were encouraging the continued development of the project, and some even offered insight as to how making minor

adjustments to the layout in order to make it more effective. One respondent mentioned that it would be helpful if the option to share knowledge through photo rather than video was available, and several suggested a "discussion forum" should be connected to the site.

Further positive response was reflected through the continued interest of farmers who were not part of the original group of participants, but were instead viewers of the site. After viewing the site, several farmers wrote emails to share their appreciation, and also to request participation and offer new ideas of techniques to share. These "new participants" wanted to share a technique on the site to share with their community.

These responses did not capture the wide potential for negative responses from viewers who did not find the site useful, or did not wish to spend time responding to the questionnaire or voicing their concerns through email correspondence. However, there was never the intent to find a "one size fits all" solution, and the response to date has shown that it does work for some farmers.

Chapter 5: Discussion

Introduction

This research unfolded in two phases. The first posed the question: "how do farmers perceiving climate change, and what adaptive strategies are being used in the context of changing environmental conditions?" The second phase entailed a pilot project, which examined the effectiveness of participatory media techniques in learning and knowledge transfer of adaptive strategies, farmer-to-farmer. Here farmers' perception of climate change and their use of adaptive strategies are analyzed, based on

the interview data and analysis, and the use of participatory media for sharing knowledge farmer-to-farmer is evaluated.

It is argued that while farmers are experiencing challenging changes in weather conditions and consequently engage in adaptive behavior in the face of these changes, greater collaboration between farmers, researchers and policy-makers is necessary when exploring and executing adaptive strategies in changing climatic conditions. While small-scale organic farmers can be economically unstable and therefore more vulnerable to climatic stressors, they also employ unique adaptive strategies and resilience-building measures that enable them to succeed. These strategies are in effect experiments, through which farmers are gaining valuable insight on a bioregional level, allowing them to adapt to the increasing complexities of their agroecosystems in a timely manner.

Farmers have unique, in-depth, expert knowledge of their multi-faceted agroecosystems, and researchers and policy-makers will gain to work closely with them to understand the multiplicity of factors and areas of concern, both internal and external, inherent in agroecosystem management. While farmers always will require additional information and knowledge on *how* to adapt, and what they can expect to adapt *to*, this information needs to be delivered in a format that is directly useful to farmers. This is a return to a historically tried and true model of information transfer within agricultural communities as opposed to the demonstrably inferior current top-down model. Farmer-to-farmer knowledge sharing through video is a way for bioregional information that is directly applicable to farmers to be relayed in a timely and inexpensive manner. Sharing knowledge and adaptive strategies ultimately is a potential step forward in building resilience in a changing climate.

Perception of Climatic Change

> *HS: "Weather patterns and climate have changed in the past ten years but it's hard to say what's climate and what's a blip."*

It is essential to understand perceptions of climate change at the community level as it allows greater insight into how that community will respond, recover and adapt (Dolan &Walker, 2006). For example, if a community has experienced a climatic event in the past, such as flooding from heavy precipitation, it may be more likely to be

prepared with a risk management strategy, or at least be cognizant of the threats posed by the precipitation.

Farmers may not express climate change as being of great concern to them if they are not experiencing overwhelming exposure to climatic challenges (Bryant *et al*., 2000) even if they are exposed to climatic stress, it may be viewed primarily as an economic stress; often responses to perceived economic challenges are really climatic challenges that are felt in economic terms (Smit, McNabb, & Smithers, 1996). Many farmers accept variable weather as a part of farming (Milestad, *et al.* 2012), which is consistent with the findings of this research where variable weather was expected, and the more immediate concerns were expressed in financial terms rather than in climatic terms. For example, in this research one farmer reported: "*we're getting the growing down, barring major climate events*", but then later discussed financial stress of crop losses which were due to an uncharacteristically truncated season (which is a climatic stress). It is well documented that climatic stress is intertwined with a host of other internal (e.g. farmer decision-making, techniques, etc.) and external (e.g. regional policies, market forces, etc.) factors (Bryant *et al.*, 2000; Chiotti *et al*., 1997; Smith *et al.,* 2000; Wall, Smit, & Wandel, 2007), therefore making a specifically "climate-related" stress difficult to discern from other stressors. As one participant pointed out:

> *RF: …there are other fluctuations that [make it] hard to tell whether it's just natural thing that would have happened at any stage or something you could ascribe to climate change.*

An extensive review of the literature regarding climate adaptation in agriculture in Canada clearly showed that there were no simple links between climate stimuli and farmer decision-making, due to the host of interlinked processes at play (Bryant *et al*., 2000). In Southwestern Ontario, some barriers to adaptation were farmers being unaware or unconcerned with climate change, farmers not linking climate change to their immediate concerns, and farmers being confident in their own abilities and generally accepting of their own limitations in the face of extreme weather conditions (Wall *et al.*, 2007). Similar perspectives emerged in the findings of this research, where farmers were indeed aware of and concerned with climate change, as well as familiar with the concept

of ecological change on their farms, yet many did not directly link climate change to their immediate concerns, with immediate concerns being more financial in nature.

While awareness of climatic stress can increase adaptive capacity, flexibility in decision-making has also been found to be a significant factor (Milestad *et al.*, 2012); if a farmer is unwilling to change, they won't. All of the farmers in this research accepted that their agroecosystems were highly variable and change was expected. Ecosystem "feedbacks" may be more easily observed in organic systems, as they are not suppressed by certain management techniques (e.g. herbicides, pesticides, monocropping, etc.). It is possible that this awareness and acceptance of variability may be linked to the observation of these feedbacks, engendering the understanding that a farmer must be flexible in order to succeed. While most of the farmers in this research were highly focused on *economic* challenges rather than *climatic* challenges, their acceptance of the "general variability" of agroecosystems would appear to be increasing their adaptive capacity. It follows that the adaptive capacity, and therefore the overall resilience, of an agroecosystem will be in part dictated according to the awareness of the possibility of coming climatic changes, as well as flexibility and creativity of decision-making in the face of change.

If farmers perceive climate change as a relevant, though somewhat peripheral concern, what sorts of changes are of significance to growers? What sorts of changes are important enough to be noted by farmers, and how are these changes affecting their agroecosystems? In the next section the specificities of change are discussed, and the cascading challenges created from these changes are explored.

Changes and Challenges

Underlying vulnerabilities and increased sensitivities to climate change can be severe and have the potential to put a small-scale organic farmer out of business – overnight. Yet farmers continue to forge ahead in the face of these sometimes seemingly impossible odds. The findings of this research show that the farmers' responses regarding the changes that they are experiencing are consistent with climate models for this particular region (Pike *et al*., 2008), highlighting their keen abilities of observation in

regards to their natural environment and changing climatic conditions. It is foreseeable that farmers would be more attuned to such variation in their landscape, as they are directly dependent on them for their survival, yet it was not the distinct and complex details that were mentioned during interviews, but particular patterns.

As such, the changes discussed by the farmers were less in the form of distinct events, such as the dates of the first and last frost, but were instead focused on tendencies or patterns that were observed to have changed over the past two to four years. It should be noted that this is a short time frame when considering that *climate* is defined as average weather (precipitation, temperature and wind), typically measured over at least a thirty year period (IPCC, 2007). We must consider that there has been a considerable shift in the demographic of farmers over the past few generations, characterized by an aging farmer population, and a reduced number of people being raised in farming families. Many of the farmers interviewed did not have a history of farming in their immediate family, and therefore they were not privy to the historical accounts of weather patterns or, perhaps more importantly, farming practices that would be passed down in a farming-family.

Changes: Short-term and Long-term

While climate change is typically viewed through a long-term lens, the frequency of precipitation and temperature extremes are also considered to be a component of a changing climate, and the variable weather and increasing extremes that farmers experience in the *short-term* are significant nonetheless (Walker & Sydneysmith, 2007). Indeed, variability or extremes in temperature and precipitation in a single season can be significantly challenging to a farm. While farmers may be masterful at shifting within the dynamic equilibrium of their oscillating agroecosystems, it is the variation that can prove extremely challenging to crop survival, and thus, farmer survival. Farmers desperately need to be able to plan, not simply for the act of growing, but also in order to employ organic techniques such as crop rotation, cover cropping, and to be able to market their produce effectively – and a truncated or unpredictable season can be extremely debilitating, if not irreconcilable, with the best-laid plans.

The short-term, more immediate changes (such as extremes in temperature) may be more significant than long-term changes. Farmers noted that if a change of overall

increase of rain and cool weather were to be predicted, they would then focus on solely growing "green leafy things", which are known to thrive in rainy, cool weather; in other words, if they had reliable information and time to adjust, they would be able to adapt to changes in climate. While longer-term projections have the potential to be easier to adapt to, farmers will only be in the position to adapt if they are made aware of these projections (Bryant *et al.,* 2000*;* Smit & Skinner*,* 2002*)*. This can be done through a process of collaborative knowledge-transfer, where farmers are seen as decision-makers, knowledge-holders and collaborators, rather than the "technology-transfer model" which has dominated much of past and current agricultural research (Chambers *et al*., 1989; Schneider, *et al.,* 2009; Van de Fliert & Braun, 2002); this collaborative learning process will be discussed further in another section.

While long-term changes will certainly bear ramifications for agriculture, it is the shorter-term variability and extremes that uncover some of the more pressing vulnerabilities which are also more likely to illicit adaptations, (Chiotti & Johnston, 1995; Smit & Skinner, 2002), presumably due to their immediate nature. It has been suggested (Lee, 1999; Milestad *et al*., 2012), that rather than responding reactively to the challenging impacts of a change, adaptive capacity should be strengthened by focusing on potential creative responses to the change, and to the new circumstances this change has brought about. This approach would require continuous learning and innovation, and a suite of alternative approaches or options with which the farmers can engage. It was found in this research that while the farmers did have other potential strategies to "fall back on" in response to a change (i.e. diversity of crops, cooperative marketing, etc.), bolstering agricultural knowledge regarding different approaches or alternatives relevant to their specific needs, as well as in their specific bioregion, would have the potential to increase their resiliency, and therefore reduce overall vulnerability.

Cascading Challenges

The changes discussed so far have been posited as challenges, but it must be noted that there is certainly the potential that a climatic change can produce new opportunities for growers. Unfortunately, quite often the drawbacks can easily outweigh the benefits. It was suggested by Walker & Sydneysmith (2007) that the projected milder winters may

lead to an increase in cropping opportunities in British Columbia. This would seem feasible, yet on closer inspection it is not so simple as warmer weather equating more plant growth. Increasingly warm weather will also need to be adapted to in various ways. The increasingly warm winters may also mean more rain, which can push back sowing dates and also encourage certain pests (Crawford & MacNair, 2012). Participants in this research correlated the increase in winter/spring rains with increased slug populations, which in turn would mean greater crop damage due to slugs feeding on crops. Other research cases from British Columbia and Ontario, showed that longer, warmer growing seasons were have potential to increase crop yields; yet the research also showed distinct challenges with water in those particular regions, thereby muting the possibilities of future "bumper crops" (Brklacich & Smit, 1992). When farmers were interviewed for this research, all of the resultant ecological, social and economic events that appeared to arise from climatic changes were presented as challenges; none were posited as advantages. However, it is possible that there were advantages that were simply not mentioned during the interviews.

Many challenges caused by unpredictable weather and extremes are inextricably linked ecological, economic and social challenges, especially in an agroecosystem when success is directly linked to the weather. As such, changes and challenges can be felt and experienced beyond the farm-level, reverberating into the fabric of the wider community. For example, if farmers cannot meet the market demands of certain crops, this may translate as unreliability on the part of the farmer, which is can in turn translate into lost business from restaurants. Younger generations who see farmers struggling may be discouraged from the idea of pursuing agriculture as a profession in the future. Increased financial investment (e.g. labour, seed purchasing, etc.) due to lost crops may translate into higher embedded and expressed costs of produce at market, potentially dissuading consumers from buying local organics. Many insurance companies provide a service that is better suited for large-scale operations and untenable for small-scale organic farmers. Ultimately, farmers themselves may decide that the substantial challenges surpass their ability to survive, propelling them to sell their land to the highest bidder. One participant described the challenge:

RT: If it got any harder, I would just stop. Which breaks my heart because that's what I want to do, but there are already points in the year, there is just no money in this, what kind of future do I have, there is just no future in this, but I continue because it's what I love. But I think if it got much harder I would just stop and I think that anyone in their rational head frame would just stop, but unfortunately I don't think that most farmers are in their rational head space so they just continue against all odds – [laughter] –but I think I would stop. I think that if I couldn't, I mean I only have so many resources to keep going, and each crop lost means I take a hit.

Again, while the situation may appear bleak, farmers are managing to persist by adapting to these new changes. Farmers are well-positioned to be the front-line researchers when it comes to experimenting and scrutinizing practical, bioregionally-based techniques. While farmers are facing unforeseen changes in their systems, responding to, adapting to and taking advantage of changes in ecosystems is something that agriculturalists undertake as a matter of course.

Adaptation

Types of Adaptation

IA: I think we change a little bit here and there every year. Changing the plants and what we grow and adapting, like using different sorts of mulches to make things warmer, or things wet or planting things a bit farther apart, to get more air circulation. So I guess we're adapting here and there.

Gaining a greater understanding of climatic change and adaptive capacity at the farm-level is highly complex. While adaptations are directly linked to resilience, in that adaptations are a way to reduce vulnerability by responding to climatic change (Smit & Wandel, 2006), there are a variety of external forces that instigate or mitigate change on the farm-level, and identifying and understanding each of these forces is difficult. For example, in a study by Smit *et al*. (2000) droughts had a similar impacts on agricultural yields in two different regions, but the impacts on the farmers in those regions varied due to differing economic and institutional arrangements, which thereby elicited a different adaptive approach in both short and long-term scenarios. But it is not only the economic

and institutional arrangements that matter, but also the flexibility and creativity on the part of the farmer, which can have considerable influence on adaptive response (Milestad *et al.*, 2012).

While isolating the source(s) of change is complex, understanding the adaptive strategies used in response to these intertwined forces of change is an important place to start when trying to understand adaptations at the farm-level (Bryant *et al.,* 2000; Smit *et al.,* 1996*)*, as it can give some indication of what the farmers are capable of, and what their priorities lie. Also, interviews in this research revealed that analyzing adaptive strategies at the farm level may also prove to be the most useful for farmers, as it provides opportunities for farmer-to-farmer learning regarding current changes, challenges and adaptive responses.

Farmer-led Adaptation

Adaptive strategies can be classified as being either reactive or planned (Smit *et al.*, 2000); for example, a farmer may react to a heavy rainfall by digging a drainage trench, or a farmer may put aside money to buy a greenhouse in anticipation of heavy precipitation in spring. Some studies have proposed the idea of evaluating certain adaptations (Smith *et al.,* 2000) but this is out of the scope of this research, as the findings have shown that successful or maladaptive adaptations are particular to the farm, the individual, and the social and economic systems within which they are embedded. It follows that it will be best decided by the farmer whether or not to implement a particular adaptive strategy on their landscape, and whether or not it is successful or maladaptive. However, evaluation by the farmer can take a long time and sometimes success or failure is difficult to discern (Smith *et al.,* 2000). This awareness of the 'whole system' complexity is beautifully captured in the below quote:

> ***HS:*** *And the hard part for me - and I know the hard part is coming - is knowing when to abandon varieties. Or to abandon entire crops! It's just that there are so many variables. It's several years before you realize, was it the plant or was it…? For example, a particular variety of melons, did great one year, then didn't do well then for three years - since I rotate my crops, was it where I planted it in the field? Was it the planting date? Did I plant them too deep? Did I not water them enough? Did I water them too much? So by the time you come around to thinking, okay, these melons just aren't working for me anymore, it could be eight*

or ten years of complete crop failure before you decide no, these just aren't working for me anymore. I run through all the human error possibilities first, maybe it was the seed? Maybe it was old seed?

While findings in this research indicate that even though the farmers interviewed were perfectly positioned to undertake reactive adaptive strategies, there still may be a lot of uncertainty as to the effectiveness of their approach. There was much that they were still learning, and much that they did not know. On one hand, organic farmers have been shown to be intimately aware of the tendencies of their agroecosystems, in part due to protracted observations and direct participation in and awareness of nature (Sullivan, *et al.,* 1996); yet considering the complexities of the agroecosystem, it would be reasonable to assume that many agricultural producers still deal with a lot of uncertainty.

Adding to the complexity of isolating successful, and specifically *climate-related* adaptation are the qualities that are inherent to organic or sustainable farming - qualities that promote practices that have already been shown to be conducive to overall ecological resilience[8] (Rosset, *et al.*, 2011; Holt-Giménez, 2002). Also, decisions to adapt are simply not likely to be made solely in response to climatic stimuli or risks as there will always be a multiplicity of events or forces that are driving a change (Smit & Skinner, 2002). In this research, highlighting specific climate adaptations was at times challenging, as practices that were being undertaken (e.g. crop rotations, cover cropping, integrated pest management, etc.) could have been initiated as "better management" for a more resilient system. Indeed, all of the farmers highlighted the importance of having a multi-crop system in order to buffer them against weather, pests or disease, which is a common strategy among organic growers, though not always specifically used to buffer the effects of climatic change.

RF: In light of climate change, having a mono-culture farm is like set up for failure

DB: The sheer diversity of this place is the buffer.

HS: …every year, increasingly every year, I'm glad that I grow forty different crops.

Regardless of whether these farmers adopted techniques in direct response to climatic change, they are effective at buffering against extremes and variability

[8] See www.rodaleinstitute.org/fst30years for detailed 30-year study comparing organic farming to conventional farming.

nonetheless, thereby increasing adaptive capacity and resilience (See Table 2.0). Considering the wider scope of this issue, farmers across Canada should consider what strategies they can use to buffer climatic changes, though these changes may appear only indirectly related to climate.

Table 5 Agricultural Adaptive Strategies in the Face of Changing Weather

Adaptations	Details
Changing Crop Varieties	**Slow gradual change to varieties better suited to changes* **Experimentation with small selection of slightly different varieties* **Experimentation with widely different varieties at either end of the climate spectrum*
Season Extension	**"Remay" floating row cover* **Hoophouses, Cloches and Greenhouses* **Moveable greenhouses*
Changing Other Cultural Practices	**Mulching more or less* **Changing transplant spacing for more circulation* **Creating more drainage in field through digging ditches*
Local Seed Production	**Developing local seed varieties that will be more adapted to local conditions*
Breeding more resilient bee stock	**Bee breeding programs are underway on Vancouver Island, with the intent to breed more resilient local bees that are more resistant to bees and the "vagaries of climate"* **This also involves moving bees up to the mountains for better forage*
Changing/Adjusting Seeding and Planting Dates	*Seeding dates are proving unreliable compared to how they have worked in the past.*
Planting more perennial crops	*Perennial crops are less dependent on planting dates*
Planting Flowers as a form of Integrated Pest Management	**Farmers are planting flowers in order to provide food for bees during the months where the crops are not flowering. This is intended to help sustain the bee population.* **Certain flowers are also used as "trap" plants, "deterrent" plants to protect against pests.* **Edible flowers can also provide a dual purpose by adding them to salad greens to the increase market value*
Season Extension	**"Remay" floating row cover* **Hoophouses, Cloches and Greenhouses* **Moveable greenhouses*
Growing unique crop varieties	**Growing unique crops for niche markets can bring in a good source of income. However, There can be a large financial burden when transitioning to a new crop. Also, it can sometimes be difficult to introduce new crops to suit a consumers' palate*
Marketing co-operatively	**Some farmers have created a joint marketing and distribution company so that they can control their prices, and so that most of the income goes directly to the farmer*

Working Towards Adaptation: Collaboration

> *BL: From a beekeeper's perspective, I find it particularly frustrating having sat in on a meetings earlier this year with Minister of Agriculture, Assistant Minister of Agriculture, Deputy Minister of Agriculture, about ten of their protégés, in a day-long meeting in Victoria with our industry, and some of the leading people in our industry…we essentially walked out of the meeting with hollow promises. [There was] nothing really concrete other than a few handshakes and "geez, this is important, we'll look into it." That's really not important enough keep farmers going.*

While recent years have yielded extensive research in the field of small-scale agriculture and climate change, there are still significant gaps, and the research that is occurring may not be presented in a way that is considered useful by farmers in British Columbia (Crawford & MacNair, 2012; McNamara, 2011). A collaborative approach between researchers, farmers and policy makers is necessary to gain greater understanding and increased effectiveness in climate adaptation in agriculture. As one participant in this research pointed out:

> *RT: The research isn't showing us how to make do with less - it's showing us how to take advantage of all the technology out there in order to succeed against all odds. You're not going to get that ecologically focused research coming out…it would be good if researchers were more grounded in ecological boundaries. But, they're not.*

This lack of locally relevant information regarding agricultural adaptation to climate change in BC may be due to the reduced involvement of government and greater reliance on agricultural-industry organizations that are exceedingly struggling with financial resources (Crawford & MacNair, 2012). Many participants in this research felt that the lack of information was frustrating, and the information that was available tended to show insufficient understanding of the needs of small-scale organic farmers. Many of the farmers interviewed felt that most researchers and policy-makers were unsuccessful at grasping the distinctly multidimensional character of small-scale organic farming. They

expressed their frustration that this lack of understanding led to agricultural research that was insufficient, or even useless, to small-scale organic growers.

> HS: *often in a situation such as a farm, there are so many variables and there is so much improvisation…there can be such a delay before [scientific research] is actually applicable*.
>
> *RT: Researchers often assume, or they have presuppositions that everybody is farming in a semi-industrial manner, but instead we have remay cloth that we've been using for at least four years that is full of holes. What do we do?*
>
> *JW: And usually you're ending up in this total cross-jurisdictional cross fire of illegalities when it comes to what you can and cannot do on the farm. There are so many people trying to micromanage you these days, that if you don't take an outlaw holistic approach to farming, nothing will get done at all. Experts don't look at a full cost accounting approach to farming - they're usually just talking nonsense.*

While it is important to understand the changeable nature of the agroecosystem, the flexibility of the farmers in the agroecosystem is also an essential part of understanding it's overall resilience and vulnerabilities, and will perhaps allow for some more insight on how to best provide research that is useful for farmers. There is the potential for climate change research in agriculture, as there is the potential in all research, to ultimately become un-useable to the intended population – in this case, the farmers themselves.

> *"Researchers need to understand the required level of diversity that balances the inevitable trade-offs between short-term survival and long-term resilience, i.e. between efficiency and adaptability. Assessing the diverse sources of flexibility in the various farming systems and farm types can contribute to better understand the strategies farmers implement to cope with surprises and to shape transition processes."* - (Milestad *et al.*, 2012)

Organic farmers have faced pressures from outside the organic movement in the form of large agribusiness and increasing regulation, and also from inside the movement where there is natural attraction towards "conventionalizing" their management approach, due to the lures of efficiency (Milestad & Darnhofer, 2003). This suggests that an organic farmer must be creative and flexible in order to exist; indeed, there are many

cases where organic farms have proved to be more resilient in the face of climatic changes (Altieri, 2008; Di Falco & Chavas, 2006, 2008; Jackson, *et al.*, 2007; Lotter, *et al.*, 2003; Rosset *et al*., 2011). Milestad also argues elsewhere (Milestad *et al*., 2012) that conventional farm management encourages the removal of surprises, thereby suppressing responses to environmental feedbacks in the system, whereas organic farmers seek to learn from these feedbacks.

As systems-researchers Milestad and Darnhoffer (2003) have argued: "*creative ideas and innovative people have always been at the heart of the organic movement*" – therefore, why not depend on farmers for ideas on how to adapt? As farmers are the "front-line workers", it would follow that the whole agricultural industry, not only the farmers themselves, would benefit from providing opportunities for farmers to be trained as researchers. Farmers will not only be able to quickly discern what sort of research topics will be useful and important to them and their peers, but they will be able to engage in both long-term research, as well as short-term experiments with greater acuity, due to their in-depth understanding of their particular bioregion and political and economic situation. The information garnered by the farmer-researchers will also need to be delivered in a timely manner, as not only can an agroecosystem change rapidly within a single season, but the farmer also changes (management, crop, inputs, etc), and research can quickly become irrelevant. Certainly, rather than viewing farmers as "end users" of climate knowledge, they could be best viewed as "collaborators".

Challenges to Adaptation

Government Programs and Financial Vulnerability

While there are government programs that are intended to take into account farmers concerns regarding climate change, sometimes these programs can impede adaptation or adaptive capacity, by offering misinformed services such as subsidies for crops that are not resilient to changing climatic conditions (Smit, 1994). Other research has shown that government programs may actually be a deterrent to the search for risk-reducing adaptive behavior, and in some cases (Mcleman & Smit, 2006). Programs such as the Canadian Agriculture Income Stabilization Program (CAIS) (now known as the AgriStability Program), which is intended to help increase farmers adaptive capacity,

actually may function to increase vulnerability in some ways. Apple growers (Belliveau, *et al.* 2006) in Kelowna pointed out that diversifying their crops in order to buffer themselves against climate change could reduce their overall adaptive capacity, as weather-related damage to one crop may not make them eligible for assistance under CAIS, as the financial repercussions may not be as great as if it were to a monocrop (Belliveau *et al.*, 2006).

During interviews, farmers were not asked specifically about crop insurance or assistance programs; when they did discuss them, it was of their own accord, explaining that these programs consisted of lengthy application processes which they felt they had little time and interest for, as the programs were constantly changing. Reid *et al*. (2007) showed the potential for these programs to become an additional risk for farmers to deal with, as they have to constantly put energy into adapting to changing programs.

In cases such as these, where climate-related payments have stimulated a different societal-response to the climate stress and influenced individual adaptive behavior, questions must be raised as to how sustainable payment-programs are, especially with the potential for increasing-extremes and variability in the future (Bryant *et al*., 2000). Which types of farms are these programs best suited for? Will these programs create a cycle of dependence without addressing underlying ecological concerns, or exploring alternative management approaches? There is still potential for subsidies or insurance programs to support changes in farm-level production by sharing the climatic risks among a variety of actors (Ye & Yeh, 1995), though these may be only useful as temporary short-term solutions. Again, due to the myriad external and internal influences that affect farm-level dynamics, it is difficult to discern whether subsidies have been successful in mitigating climatic risks in every case.

There are many possible aspects that can contribute to greater financial security at the farm-level, from more affordable insurance programs specifically tailored to small-scale organic producers, to greater understanding by consumers of the risks and vulnerabilities inherent in small-scale organic production. This study found that farmers felt dissatisfied with government-funded programs that address financial vulnerabilities brought about by crop losses. Many of these programs address financial challenges that are a result of climate change, but interview findings showed that farmers felt that these

programs did not explore or support ecological practices that may buffer the challenges brought about by climate change. The subsidy, incentive or support may not match the desires or needs of the farmers. Farmers in this research pointed out that the programs provided by the government did not aid in the direct act of growing food, but were instead geared towards other on-farm products such as value-added products, tourism, or another form of business – and these areas were not necessarily where the farmers needed support. While there are trained agricultural consultants in the province who can provide insight and detailed knowledge regional to farmers, many farmers in BC cannot afford to pay for this costly service (Crawford & MacNair, 2012).

> ***HS:*** *And I think that there wouldn't necessarily need to be more money from the government…it just seems like there's always like "you can apply for this funding to hire a consultant to look at some problem" ….it just seems like there is a lot of money out there to pay consultants. And I think that's where the money is. "Here, you can get a consultant to help you write a business plan to show you how value added could add to your farm". I don't want to be a jam maker, and I don't need a consultant to tell me that. And I don't want to do an agritourism business, and I don't want to put in a corn-maze, and wineries are a terrible idea in this valley - I just want to grow vegetables! So don't tell me that I can add sugar to vegetables so that I can sell them at a higher price, and don't tell me to put in a B&B, I just want to grow vegetables! And I don't want to get subsidized to do it!*

Government programs that focus primarily on financial subsidies or similar types of supports are not surprising, considering that many farmers in Canada require off-farm work to survive, with the recent census showing this to be the case for nearly 50% of all farm operators (Statistics Canada, 2011). Small-scale organic farmers already tend to be a financially vulnerable group, and this was also evident in the participants in this study. Existing underlying vulnerabilities, such as few financial resources, can certainly exacerbate the stress brought about by climatic change, and in this way the attempts of the government to provide financial supports is certainly a necessary step forward. Yet different types of farming have different needs, and even when dealing in economic terms, there is no "one size fits all" solution.

Lack of Agricultural Extension Agents

> *HS: An extension agent would be great! It would be absolutely great...I'd like the money to go to people in rubber boots, and it just seems as though more of it goes to people in offices. Rubber boots, not shiny shoes.*

While various government programs are offered to agricultural producers, this research showed that one of the main things that farmers desired was an agricultural extension agent. Lack of agricultural extension is considered a barrier to adaptation in both this research and in other Canadian research (McNamara, 2011; Reid *et al.*, 2007). In the past, agricultural extension has typically followed a "technology transfer" model where the input from farmers is less important, and the education has been likened to "domestication" (Rosset *et al.*, 2011). However, this has changed in recent years, where the farmer is acknowledged as a collaborator in the learning and teaching process (Van de Fliert & Braun, 2002). Based on the findings of this research, the previous British Columbia Organic Extension Agent, Rochelle Eisen, was lauded as a carrier of innovative techniques, and a conduit for farmer-to-farmer communication, derived from both research as well as from on-farm experiments or practices. Unfortunately, funding for this position was cut in the fall of 2010.

While for a period of three years between 2007-2010 the provincial government of British Columbia funded an organic extension agent, Washington State supports seven organic extension agents, as well as other conventional farming extension agents (no author, 2011). Not only is it difficult to cater to number of farmers with a single agent, it can also be difficult for extension agents to satisfy knowledge-requirements of the various types of farming method located in various bioregions. One farmer from this research pointed out that they were experimenting and sharing their results precisely because the extension services were lacking the specific information that they required for their particular farming practices in their particular region. This further highlights the need for more regionally-specific information, and ultimately more collaboration between researchers and farmers to enable more applicable knowledge to be available at the farm-level.

Persistence

> *RT: If it got any harder, I would just stop. Which breaks my heart because this is what I want to do, but there are already points in the year, there is just no money in this, what kind of future do I have, there is just no future in this, but I continue because it's what I love. But I think if it got much harder I would just stop and I think that anyone in their rational head frame would just stop, but unfortunately I don't think that most farmers are in their rational head-space so they just continue against all odds – [laughter].*

Through all of the uncertainties and challenges that the farmers in this research were facing, the underlying fact was that they were still managing to persist; though it was clearly not an easy task. Overall, the findings of this research show that while individual behavior seemed formative as to how they can manage, the element which allows them to persist is firmly planted in the strength of community. The importance of community in creating opportunities, information, inspiration, and motivation to adapt was unquestionable. During interviews, when farmers were asked how they were best supported in their learning, how they could be best supported to adapt or innovate, all of their responses highlighted community as the most important element.

> *CB: Community. Absolutely. I mean, talking to other farmers and seeing what they're doing, for sure.*

> *HS: Community is probably the single biggest one, both on the farm and then just communicating with the broader farming community around here. I get really re-inspired, which is not an insignificant part of it, I get re-inspired by meeting other farmers wherever I go...All my innovation comes from other [farmers].*

> *BL: Just getting together and chatting with people from our industry, helps us keep ahead of the curve and learn a few ideas.*

> *RF: you know just asking and talking to other farmers, I would say when my learning curve was steepest, that was what really helped me learn.*

Supports for adaptation can all be related to increased knowledge, experience or understanding, and much of this was gained through farmer-to-farmer learning.

Understanding the supports for adaptation allows us to explore how we can foster these elements in the future, and how other farmers can learn from them.

Farmer-to-Farmer Learning: Locally Relevant, Practical Knowledge

> *BL: I think it's critical to any endeavor of agriculture to be able to share the knowledge if we are going to succeed. We have lots of abundance on Vancouver Island. I think where we need to increase our area is in knowledge.*

It has been shown in this research and others (Kroma, 2006; Rosset *et al.*, 2011) that farmers are more willing to adopt new technique if it has been demonstrated to be successful by other farmers. As Ilya Amrhein, a farmer participant in this research said, "*sometimes we think – is this [idea] crazy? And then we research to find if someone else has done it first*". A recent study focused on farmer-learning and climate change showed that the communication of information in an experiential and observable way encouraged transformative learning, which in turn is important for decision-making in variable and changing environmental conditions (Tarnoczi, 2011).

It is understandable that farmers would rather learn from other farmers in order to see if a technique or practice actually works – experimentation can be costly if it fails.

> *RT: So I think that bioregional knowledge sharing could be how we could be supported best. I think that though I've been farming for 15 years I'm still a new comer…there's all this knowledge to know about food and we only know a little bit. And we just need more mentorship through this.*

Interestingly, it was clearly indicated during interviews that new, aspiring farmers were recognized by the experienced farmers as contributors of innovative ideas on the farm, and were thereby considered useful in initiating adaptive behavior. Interviews therefore revealed a distinct desire for intergenerational knowledge-sharing. The more experienced farmers were interested in sharing their knowledge with the younger generation, and also wanted to learn from the older generation.

Recent census data has shown that intergenerational farms are also more profitable (Statistics Canada, 2011)._Intergenerational knowledge sharing between

farmers may foster greater adaptive capacity for agriculture at the farm-level, as well as provide potential for greater long-term resilience through the passing down of valuable knowledge, as well as a possible increase in financial security.

Local bioregional knowledge is of utmost importance to a successful agricultural venture. As one farmer, John Wilcox, commented:

> *JW: there is no real way that you can farm successfully in a community today where a critical mass of farms doesn't exist.*

Organic farmers typically apply agroecological principles in their management practices, and these necessitate the inclusion of local realities, local knowledge, along with skill and creativity of individual farmers. This idea has been richly expanded upon in the highly successful *Campesino-a-campesino* (CAC), or Farmer-to-Farmer movement, in Latin America, where: "*rather than bringing knowledge to the (presumably) ignorant, the extensionist now concentrates on facilitating and supporting a process of farmer exchanges"* (Rosset *et al*., 2011). We can assume that with greater climatic variability and extremes forecasted, the need for more farmer-to-farmer extension will become more poignant as further vulnerabilities are exposed.

While many challenges have been highlighted with regards to changing climatic conditions, it has been suggested that there is potential that some crop production areas will be able to accommodate these changes, and producers will be able to take advantage of new opportunities (Zebarth, *et al.*, 1997). It would appear that those who are best positioned to experiment with these potential new crops or growing patterns would be the farmers themselves.

While expanding the knowledge base surrounding climatic change and the resultant adaptations that will have to occur is of utmost importance, developing methods and tools for dissemination of this new knowledge is of equal importance (Walker & Sydneysmith, 2007). Developing ways for this information to be transmitted in ways that can be absorbed and grasped in ways that it can then be acted upon, and even added to, is a crucial component of creating links between knowledge-holders and knowledge-users. Meinke *et al.* (2006) suggest that the translation of climate knowledge or information into "real-life" action is dependent upon the three following components: a) salience

(relevance of information for the user), b) credibility (the perceived quality of the information), and c) legitimacy (the perceived objectivity of the process by it is shared). Meinke posited these guidelines to be used by climate scientists, but in my research it is proposed that these components can also be addressed through farmer-to-farmer knowledge sharing.

> *"A fundamental tenet of CAC is that farmers are more likely to believe and emulate a fellow farmer who is successfully using a given alternative on their own farm than they are to take the word of an agronomist of possibly urban extraction. In Cuba, farmers say, 'cuando el campesino ve, hace fe',which translates roughly to 'seeing is believing'."* (Rosset *et al*., 2011, p.169)

Findings in this research showed that farmers were clearly frustrated by the apparent lack of locally relevant information that was applicable to them as small-scale organic growers; yet they were quick to highlight their local community as being their greatest support in learning, and therefore adapting or innovating. While experimentation was also highlighted as another important factor when developing innovative approaches, there were certain financial limitations that restricted experimentation. When there are such significant financial concerns, farmers in this research and others (Crawford & MacNair, 2012) have stated that it can be difficult to invest funds into experimenting with adaptive strategies that are not demonstrably viable in some way. Ultimately, research needs to be applicable and practiced by other farmers.

Farmer-to-Farmer Learning: Videos

Examining the effectiveness of using video for learning and innovation in agricultural development has been explored using a variety of approaches in a variety of contexts (Lunch, 2004; Lunch & Lunch, 2006; White, 2003; Zossou, *et al.*, 2009a, 2009b). In my research, the production of videos with farmers was an attempt to find an innovative way to address some of the major barriers to developing adaptive strategies. The most often reported barriers that discouraged adaptive capacity were lack of locally relevant information, lack of extension services, lack of time and, for certain things, lack

of economic stability. The most often reported sources that enhanced adaptive capacity were local community, and on-farm experimentation. The videos were seen as a way to share locally relevant adaptive strategies, farmer-to-farmer, through a medium that was quick and low-cost. Farmer videos are what conventional programs are not; they are spatially relevant, temporally relevant, and theoretically relevant. They also attempt to engage in a "farmer-to-farmer" knowledge sharing that has been shown to be favoured by many agricultural producers.

Chowdhury & Hauser (2010) did an extensive literature review that focused on participatory video as it has been used in agriculture and natural resource management. They concluded that there is significant potential in using videos for knowledge sharing both horizontally, from farmer-to-farmer, as well as vertically, to researchers and policy-makers. Chowdhury and Hauser (2010) also found that use of participatory video bridged gaps between different bodies of knowledge, for example through the exchange of the perspectives of local practices with other types of scientific knowledge. While my study did not explore vertical knowledge transfer, it would appear as though the potential is there for policy makers and researchers to view the videos to gain greater understanding of the particular concerns of the farmers. However, the efficacy of horizontal transfer (farmer-to-farmer) was explored and was shown to produce both learning and reciprocal knowledge exchange between farmers.

While videos cannot replace the act of being in the field, which is certainly a much more visceral experience when compared to sitting in front of a computer viewing a video, it was an attempt to address the reported gap in locally relevant, applicable information, as well as a lack of time for face-to-face learning with other farmers. The videos were poised as more of a supplementary learning tool. Even under "perfect" conditions, farmers are counting on an inherently dynamic and fluctuating system with a myriad of interconnected, and many times unforeseeable, variables. According to Schiere *et al.* (2012), farming systems "*'morph', 'change', or also 'emerge' as a result of internal dynamics, and as a result of co-evolution of the farming system with its context*"; essentially, the system is constantly in a process of "becoming", therefore speed in knowledge transfer can be essential.

Chowdhury and Hauser (2010) concluded that there was no guarantee that "innovation" would take place through video knowledge transfer, and this instead would depend on the institutional climate, the facilitators, as well as the intermediary role of facilitating organizations. However, Van Mele *et al*. (2010) found when using video knowledge transfer to share information between farmers in Africa and India, there was evidence that the knowledge was adopted and subsequently innovated upon. Findings in this research showed some evidence of learning and adoption of new techniques through video-viewing, though whether farmers subsequently altered the technique they learned to fit their particular farm (in effect, "innovating"), is unknown.

Drawbacks and Limitations of Farmer-to-Farmer Videos

My initial question at the start of this research sought to examine the efficacy of using participatory video to assist in learning and building adaptive capacity in the face of climatic change. As discussed in the above sections, considering the complexities of the intertwined forces that connect with climatic change makes it difficult to extract a true understanding of whether this technique has been useful in this regard. Defining the boundaries of climatic change from the eyes of the participants proved to be extremely complex in itself, and it cannot be definitively said that this method can help increase adaptive capacity in the face of changing climatic conditions. While this method can be said to be useful in sharing adaptive techniques, which in itself is useful in increasing adaptive capacity, this is dependent also dependent on whether the techniques shared are adaptive or maladaptive.

While this method has the potential to provide locally relevant information in a timely manner, as well as drawing directly from farmers to provide practical information, there are several drawbacks. Ultimately the success of this method depends on the participation of farmers, and there are several factors that may prevent their participation. Though most participants in this research appeared enthusiastic when asked to share knowledge, one participant declined to participate in this study due concerns of proprietary rights. Other possible factors that may prevent participation could be time-constraints, as it was clearly indicated during this research that farmers are hard-pressed for time, especially during the growing season, which in some regions can span well into the winter months. Another challenge is the availability of the necessary technology in

order to download and view videos online; the latest agriculture census showed that only 50% of farmers in BC have access to internet in their homes (Statistics Canada, 2011).

Another potential drawback to this approach is the absence of "quality assurance" – how can it be known whether the information provided is indeed correct? While only conjecture, it is assumed that farmers will only share techniques that have been proven to be successful on their own farms, or that viewers of the video will be able to distinguish reasonable techniques from those that appear improbable. Ultimately, if this approach was used in a more locally-based context, it is assumed that the videos would be scrutinized by the community of farmers who use it, and the reliability of information would be judged accordingly.

In order for this method to follow a truly a "farmer-to-farmer" approach, farmers were encouraged to contribute videos that they had made themselves. While all of the farmers interviewed were actively involved in choosing a farming technique to share on video, all of the actual filming and subsequent editing of videos was done by the researcher. While several farmers suggested that they were willing to do so, only a single farmer contributed videos that they had filmed themselves. Again, this may be due to time-constraints, or lack of technical expertise with media tools. It follows that a full-time video-producer and researcher would be required for the continuation of this project.

It must be considered that an administrator for this type of project would require funding support as the time requirements are considerable, but perhaps funding may be better directed towards an actual extension agent. If this is indeed the case, there still appears to be great potential for this method of knowledge sharing to be used by an extension agent in conjunction with their regular role. Adding new video content to the website will attract more viewers and potential contributors.

Potential for Success

Findings have shown that there have been a significant number of viewers of the videos, with nearly 7,000 visits to the site over a period of 25 weeks. The questionnaire that was provided in order to gain feedback regarding the utility of the site had low response rates, with only 10 respondents filling out the questionnaire. The questionnaire showed that 9/10 respondents consider the videos as an improvement to current knowledge-transfer tools that currently exist, 8/10 respondents were interested in

contributing knowledge to the site, 7/10 respondents were interested in being notified when new videos were uploaded to the site, yet only 5/10 of respondents said they would be interested in using the site in the future to learn locally-relevent farming techniques. While most of the responses indicated interest in the site and enthusiasm for its continuation, this last response is a bit more ambiguous. When asked in what ways the site could be improved, suggestions were mostly focused on increasing the video content, and creating a forum or discussion area where there could allow for more sharing and interaction between the farmers. It was evident that many more viewers visited the site when new content was uploaded. See Appendix 3.0 and 4.0 for detailed Questionnaire results and website analytics.

While the questionnaire was available for people to share their thoughts and suggestions regarding the website, many chose to write emails or discuss it in person. The overall response was favorable, and many farmers encouraged the continuation of the project. Another indicator of success was the increasing interest for more video production from farmers who are outside the original study group.

Overall, these indicators show that there is significant potential for this method to assist in the dissemination of practical, adaptive techniques or practices, farmer-to-farmer, in the face of climatic change, as a way to help increase adaptive capacity through knowledge building and learning.

Altieri, M. A. (2008). Small farms as a planetary ecological asset: five key reasons why we should support the revitalisation of small farms in the global south. Third World network (TWN). Retrieved from http://www.twnside.org.sg/title/end/pdf/end07.pdf

Belliveau, S., Smit, B., & Bradshaw, B. (2006). Multiple exposures and dynamic vulnerability: Evidence from the grape industry in the Okanagan Valley, Canada. Global Environmental Change, 16(4), 364–378.

Brklacich, M., & Smit, B. (1992). Implications of changes in climatic averages and variability on food production opportunities in Ontario, Canada. Climatic Change, 20(1), 1–21.

Bryant, C. R., Smit, B., Brklacich, M., Johnston, T. R., Smithers, J., Chjotti, Q., & Singh, B. (2000). Adaptation in Canadian agriculture to climatic variability and change. Climatic Change, 45(1), 181–201.

Canadian Organic Association of British Columbia. (2011). Status of Organic Extension in BC. Retrieved from www.certifiedorganic.bc.ca/docs/Extension_info_sheet.pdf

Chambers, R. G., Pacey, A., Thrupp, L. A., & others. (1989). Farmer first: farmer innovation and agricultural research. Intermediate Technology Publications Ltd. Retrieved from http://www.cabdirect.org/abstracts/19891872400.html

Chiotti, Q., Johnston, T., Smit, B., Ebel, B., Ilbery, B., Rickard, T., & others. (1997). Agricultural response to climatic change: a preliminary investigation of farm-level adaptation in Southern Alberta. Agricultural restructuring and sustainability: a geographical perspective. (pp. 201–218).

Chiotti, Q. P., & Johnston, T. (1995). Extending the boundaries of climate change research: a discussion on agriculture. Journal of Rural Studies, 11(3), 335–350.

Chowdhury, A. H., & Hauser, M. (2010, July 28). The Potential of Moving Pictures, Does Participatory Video Enable Learning For Local Innovation? Presented at: Innovation and Sustainable Development, Montpelier, France.

Crawford, E., & MacNair, E. (2012, March). BC Agriculture Climate Change Adaptation Risk and Opportunity Assessment Provincial Report. British Columbia Agriculture and Food Climate Action Initiative.

Di Falco, S., & Chavas, J. P. (2006). Crop genetic diversity, farm productivity and the management of environmental risk in rainfed agriculture. European Review of Agricultural Economics, 33(3), 289–314.

Di Falco, S., & Chavas, J. P. (2008). Rainfall shocks, resilience, and the effects of crop biodiversity on agroecosystem productivity. Land Economics, 84(1), 83–96.

Holt-Giménez, E. (2002). Measuring farmers' agroecological resistance after Hurricane Mitch in Nicaragua: a case study in participatory, sustainable land management impact monitoring. Agriculture, ecosystems & environment, 93(1-3), 87–105.

IPCC. (2007). Climate change 2007: the physical science basis: contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge Univ Pr. Retrieved from

Jackson, L. E., Pascual, U., & Hodgkin, T. (2007). Utilizing and conserving agrobiodiversity in agricultural landscapes. Agriculture, Ecosystems & Environment, 121(3), 196–210.

Kroma, M. M. (2006). Organic farmer networks: facilitating learning and innovation for sustainable agriculture. Journal of Sustainable Agriculture, 28(4), 5–28.

Lotter, D. W., Seidel, R., & Liebhardt, W. (2003). The performance of organic and conventional cropping systems in an extreme climate year. American Journal of Alternative Agriculture, 18(3), 146–154.

Lunch, C. (2004). Participatory Video: Rural People Document their Knowledge and Innovations. IK Notes, World Bank., No. 71. Retrieved from www.worldbank.org/afr/ik/iknotes.htm

Lunch, N., & Lunch, C. (2006). Insights into participatory video: A handbook for the field. InsightShare.

Mcleman, R., & Smit, B. (2006). Vulnerability to climate change hazards and risks: crop and flood insurance. The Canadian Geographer/Le Géographe canadien, 50(2), 217–226.

McNamara, K. (2011, April 29). Small farms and climate change adaptation in British Columbia. Unpublished.

Meinke, H., Nelson, R., Kokic, P., Stone, R., Selvaraju, R., & Baethgen, W. (2006). Actionable climate knowledge: from analysis to synthesis. Climate Research, 33(1), 101.

Milestad, R., & Darnhofer, I. (2003). Building farm resilience: the prospects and challenges of organic farming. Journal of Sustainable Agriculture, 22(3), 81–97.

Milestad, R., Dedieu, B., Darnhofer, I., & Bellon, S. (2012). Farms and farmers facing change: The adaptive approach. Farming Systems Research into the 21st century: The new dynamic, 365–385.

Pike, R. G., Spittlehouse, D. ., Bennett, K. E., Egginton, V. N., Tschaplinski, P. J., Murdock, T. Q., & Werner, A. T. (2008, Spring). Climate Change and Watershed Hydrology: Part ! - Recent and Projected Changes in British Columbia. Streamline, Watershed Management Bulletin, 11(2).

Reid, S., Smit, B., Caldwell, W., & Belliveau, S. (2007). Vulnerability and adaptation to climate risks in Ontario agriculture. Mitigation and Adaptation Strategies for Global Change, 12(4), 609–637.

Rosset, P. M., Sosa, B. M., Jaime, A. M. R., & Lozano, D. R. Á. (2011). The Campesino-to-Campesino agroecology movement of ANAP in Cuba: social process methodology in the construction of sustainable peasant agriculture and food sovereignty. The Journal of Peasant Studies, 38(1), 161–191.

Schiere, J. B., Darnhofer, I., & Duru, M. (2012). Dynamics in farming systems: of changes and choices. Farming Systems Research into the 21st Century: The New Dynamic, 337–363.

Schneider, F., Fry, P., Ledermann, T., & Rist, S. (2009). Social learning processes in Swiss soil protection—The “From farmer-to farmer”project. Human ecology, 37(4), 475–489.

Smit, B. (1994). Climate, compensation and agriculture. In Proceedings of a Workshop on Improving Responses to Atmospheric Extremes: The Role of Insurance and Compensation. Environment Canada.

Smit, B., McNabb, D., & Smithers, J. (1996). Agricultural adaptation to climatic variation. Climatic change, 33(1), 7–29.

Smit, B., & Skinner, M. W. (2002). Adaptation options in agriculture to climate change: a typology. Mitigation and adaptation strategies for global change, 7(1), 85–114.

Smit, B., & Wandel, J. (2006). Adaptation, adaptive capacity and vulnerability. Global environmental change, 16(3), 282–292.

Smith, B., Burton, I., Klein, R. J. T., & Wandel, J. (2000a). An anatomy of adaptation to climate change and variability. Climatic change, 45(1), 223–251.

Smith, B., Burton, I., Klein, R. J. T., & Wandel, J. (2000b). An anatomy of adaptation to climate change and variability. Climatic change, 45(1), 223–251.

Statistics Canada. (2011). 2011 Census of Agriculture. Retrieved July 12, 2012, from http://www.statcan.gc.ca/ca-ra2011/index-eng.htm

Sullivan, S., McCann, E., De Young, R., & Erickson, D. (1996). Farmers' attitudes about farming and the environment: A survey of conventional and organic farmers. Journal of Agricultural and Environmental Ethics, 9(2), 123–143.

Van de Fliert, E., & Braun, A. R. (2002). Conceptualizing integrative, farmer participatory research for sustainable agriculture: From opportunities to impact. Agriculture and Human Values, 19(1), 25–38.

Van Mele, P., Wanvoeke, J., Akakpo, C., Dacko, R. M., Ceesay, M., Béavogui, L., Soumah, M. (2010). Videos bridging Asia and Africa: Overcoming cultural and institutional barriers in technology-mediated rural learning. Journal of Agricultural Education and Extension, 16(1), 75–87.

Walker, I. J., & Sydneysmith, R. (2007). Chapter 8: British Columbia. From Impacts to Adaptation: Canada in a Changing Climate.

Wall, S. E., Smit, B., & Wandel, J. (2007). Farming in a changing climate: agricultural adaptation in Canada. Univ of British Columbia Pr.

White, S. A. (2003). Participatory video: Images that transform and empower. Sage Publications Pvt. Ltd.

Zebarth, B., Dicaprio, J., Broersma, K., Mills, P., & Smith, S. (1997). Effect of Climate Change on Agriculture in British Columbia and the Yukon. Volume 1. Canada Country Study: Climate Impacts and Adaptation. (E. Taylor & B. Taylor, Eds.).

Zossou, E., Van Mele, P., Vodouhe, S. D., & Wanvoeke, J. (2009a). The power of video to trigger innovation: rice processing in central Benin. International journal of agricultural sustainability, 7(2), 119–129.

Zossou, E., Van Mele, P., Vodouhe, S. D., & Wanvoeke, J. (2009b). Comparing farmer-to-farmer video with workshops to train rural women in improved rice parboiling in central Benin. Journal of agricultural education and extension, 15(4), 329–339.

Chapter 6: Conclusion

Climate change in BC is forecasted to deliver greater extremes and variability in precipitation and temperature, which farmers are already experiencing and observing in their agroecosystems. These changes are causing considerable social, economic and ecological challenges for small-scale organic growers, who are already struggling with exisiting financial vulnerabilities. Even so, small-scale organic farmers are well positioned in other ways to deal with these changes, and demonstrate considerable resilience through their wide breadth of ecological knowledge and ability to adapt.

The major factors affecting on-farm adaptation were community support, knowledge and information, time constraints, financial security, and government programs. Farmers rely on their community to learn new techniques and ways to adapt, and are dissatisfied with the quality and quantity of informational resources currently available from the government and researchers in Canada. Farmers prefer learning "farmer-to-farmer", but heavy workloads make it difficult to visit with other farmers and discuss adaptations. While farmers are more keenly focused on economic concerns than climate change at this stage, climatic change has the potential to threaten the financial viability of a farming system, and the full extent of the cost of this threat or adapting to this threat is not thoroughly understood. Conversely, it is possible that climatic change will produce beneficial effects in agroecosystems, but farmers will need to learn how to adapt to any change, whether beneficial or detrimental.

The challenges faced by small-scale growers can seem so overwhelming, that it may appear prudent to direct our energies to larger-scale operations. However, this would surely represent a lost opportunity, as small-scale farms make up a significant proportion of the farms in BC, and have shown to be more ecologically resilient than large-scale farms, though perhaps less resilient financially. This ecological resilience is necessary for dealing with extreme weather and variability, and more work needs to be done to foster the importance of this ecological resilience both at the farm-level and at the policy-level.

Resilient systems have the capacity for self-organization, and in the case of agriculture, this can be seen when there is reliance on the networking between farmers for information exchange rather than dependence on external institutions for knowledge and expertise (Milestad & Darnhofer, 2003). It is not the individual elements of a farm that are essential for adaptive capacity and resilience, but the relationships that are created between the farm and the environment, the farmers and their peers, and the learning and knowledge that flows through these linkages. Though it can be difficult to discern whether a change is directly or indirectly related to climatic change, farmers across Canada should consider what strategies they can use to buffer climatic changes. Strengthening knowledge networks with other farmers in their bioregion, and working collaboratively with researchers and scientists to better understand the changes in their systems, would help to build adaptive capacity.

Using the method of participatory video with farmers is one way of engaging farmer-to-farmer knowledge sharing in a quick and affordable way. While there are drawbacks to this method, such as unavailability of internet access and time-constraints, it has the potential to disseminate knowledge widely to a large number of farmers. Periodically uploading fresh video content to the website will help keep the site active and attract more viewers, and potentially more contributors.

The fact that this research was conducted with only a small group of participants is a limitation of this research, as it may have produced biased results that only apply to a certain group of farmers that farm in a particular way. This is the challenge of using the process-based approach, as it may only produce findings that are relevant to the community of study; this can be said to be of value in itself, as each community will experience and deal with climatic change in a different way. However, there does appear to be the potential for this particular research to stretch farther than the immediate community, due to the use of the internet in sharing some of the findings. If time allowed, it would have been interesting to initiate another pilot in a different type of farming community (e.g conventional) in order to compare and contrast the utility of the video knowledge transfer method. However, this was considered a pilot project and was limited by size and scope due to its exploratory and experimental nature.

There are a myriad of factors that contribute to the vulnerability of small-scale organic farmers, climatic change has the potential to further exacerbate these vulnerabilities. While small-scale organic farmers do not have all of the solutions, they have expert knowledge regarding the particular requirements of their agroecosystems, and are well-positioned to adapt and innovate in the face of change. They may have great ideas, but little recourse when it comes to adapting, especially when there is minimal assistance through government programs.

When seeking alternatives or innovative solutions to their unique challenges, farmer-knowledge can be the most accurate and expedient source for adaptive strategies in the face of climatic change. This knowledge, coupled with greater collaboration and understanding by researchers and policy-makers, as well as some form of economic support, can lead to advancements in overall resilience at the farm-level. Farmer-to-farmer knowledge sharing through videos has the potential to bridge the gaps of knowledge between these various bodies of knowledge in a low-cost, expedient and useful manner. However, it must be emphasized that this knowledge has the potential to be lost if the financial vulnerabilities that farmers experience still threaten their underlying viability in both the long and short term. Overall, this research highlights the potential of a unique knowledge-sharing method that can engage farmers in a diversity of adaptive strategies, as well as help share valuable ecological practices farmer-to-farmer.

Appendices

Appendix 1.0: Outline for Interview Questions

Personal:

1. Tell me a bit about yourself and your farm

   Prompts:

   - Farmer, gardener, land steward and/or permaculturalist?
   - How long have you been farming?
   - How would you describe your farm?
   - How much land do you own> How much land do you farm?
   - What led you to start?

Current Changes and Challenges:

1. Have you noticed any significant environmental change during your time farming?

   Prompts:

   - Have things become more (or less) wet/dry/cold/hot?
   - When did this change happen? Short term/long term?
   - What do you think caused this change?

2. What are the challenges that these changes pose for you?
   - is this one of your greatest challenges as a grower, or
   - are there others that are of more concern?

Adaptation:

3. How do you adapt to these changes? (Do you adapt?)

   Prompts:

   - What allows you to persist
   - Any special/favorite innovations/techniques you have developed
   - What encourages you to adapt/innovate/experiment?

4. What RESOURCES do you need to adapt/innovate?

   Prompts:
   - personal
   - community
   - ecological
   - knowledge

Networks and Information Exchange:

5. Where/How do you learn about how to farm using new techniques/ how do you learn how to adapt?
6. In what ways could you be better supported in your learning?
7. Are there any particular farming techniques that you would want to learn more about? (e.g. seed-saving, polycultures, IPM, etc.) that you are lacking information for?
8. Do you use or have access to a computer? Do you use your computer for learning?

Future/ Adaptability:

9. If the precipitation increased/decreased, or if the temp became hotter/colder, how would you change things (do you think about it)?

Prompts:

- What would you need to do it?
- Continue farming?
- What would help you/make it easier to continue
- What would make it challenging to continue/make it so that you were unable to continue?

Appendix 2.0: Online Questionnaire

1. Please check the most appropriate for you:

- ○ new farmer
- ○ 5+ years farming
- ○ 10+ years farming
- ○ 15+ years farming

2. With regards to my farming knowledge, I feel:

- ○ a) Really confident; I know most of what I need to know
- ○ b) Confident; but I have more to learn
- ○ c) Between an intermediate and novice
- ○ d) Novice
- ○ e) I know a little but have a lot to learn
- ○ f) I will always have more to learn about farming

3. Where do you get locally-relevant information about farming? Please list the top THREE ways that you obtain locally-relevant information about farming (in order of importance). Do these meet all of your needs (yes/no)?

4. Relative to question #3, does farmersfilmanac.com represent an improvement to the knowledge transfer tools that currently exist? Please select the most appropriate answer.

- ○ a) Strongly agree
- ○ b) agree
- ○ c) neutral
- ○ d) disagree
- ○ e) strongly disagree

5. I will use this site in the future to learn locally-relevant farming techniques. Please select the most appropriate answer.

- a) strongly agree
- b) agree
- c) neutral
- d) disagree
- e) strongly disagree

6. How concerned are you about climate change as it relates to farming:

- a) Very concerned
- b) Concerned
- c) Neutral
- d) Not Concerned
- e) Not even worth thinking about

7. I would be interested in contributing knowledge to share with my farming community through this site

- yes
- no

8. What are THREE ways that this site could be improved?

9. List THREE things that you LIKE about this site, in order of importance.

10. List THREE things that you DISLIKE about this site, in order of importance.

Any other comments?

☐ Please check this box to be notified when new videos are uploaded to the site.

Appendix 3.0: Results of Online Questionnaire

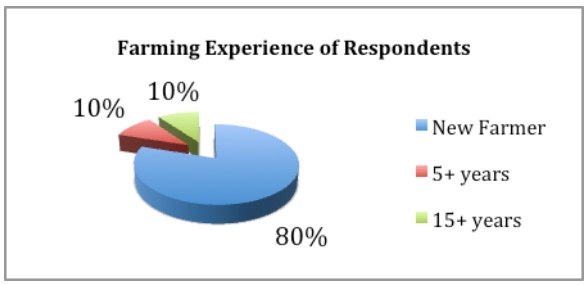
1. Please check the most appropriate for you:

○ new farmer 8/10

○ 5+ years farming 1/10

○ 10+ years farming

○ 15+ years farming 1/10



2. With regards to my farming knowledge, I feel:

○ a) Really confident; I know most of what I need to know

○ b) Confident; but I have more to learn 1/10

○ c) Between an intermediate and novice 1/10

○ d) Novice 1/10

○ e) I know a little but have a lot to learn 3/10

○ f) I will always have more to learn about farming 4/10

3. Where do you get locally-relevant information about farming? Please list the top THREE ways that you obtain locally-relevant information about farming (in order of importance). Do these meet all of your needs (yes/no)?

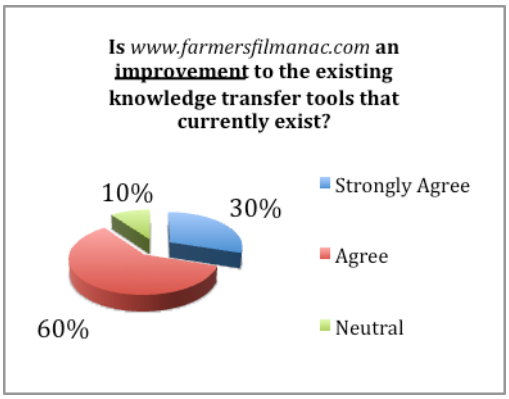
1. Other farmers
2. Internet
3. Books

4. Neighbors (other farmers?)
5. Research
6. Videos

Only two respondents answered the second half of this question regarding whether all of their needs were met. These two respondents noted that these were not sufficient in meeting the requirements of learning, and noted that they were not locally relevant, or they were not able to address the larger issues (such as colony collapse disorder, etc.)

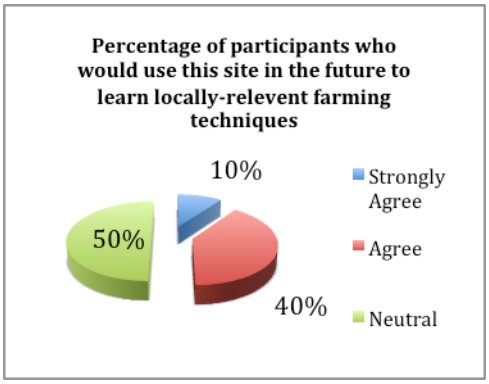
4. Relative to question #3, does farmersfilmanac.com represent an improvement to the knowledge transfer tools that currently exist? Please select the most appropriate answer.

- a) Strongly agree 3/10
- b) agree 6/10
- c) neutral 1/10
- d) disagree
- e) strongly disagree



5. I will use this site in the future to learn locally-relevant farming techniques. Please select the most appropriate answer.

- a) strongly agree 1/10
- b) agree 4/10
- c) neutral 5/10
- d) disagree
- e) strongly disagree

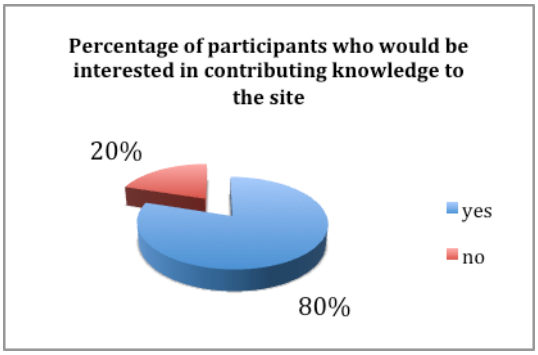


6. How concerned are you about climate change as it relates to farming:

- a) Very concerned 4/10
- b) Concerned 4/10
- c) Neutral 1/10
- d) Not Concerned 1/10
- e) Not even worth thinking about

7. I would be interested in contributing knowledge to share with my farming community through this site

- yes 8/10
- no 2/10



8. What are THREE ways that this site could be improved?

6/10 of respondents suggested “more videos” would improve the site.

5/10 of respondents suggested a forum/discussion area that could allow for more sharing and interaction between the farmers

2/10 of respondents suggested better titles/descriptors of each video

9. List THREE things that you LIKE about this site, in order of importance.

The most common responses were as follows:

- Videos
- Written summary at the end of videos
- Content, not too technical, perfectly useful for farmers
- Aesthetically pleasing, easy navigation, clean layout, not too technical overall
- Nice to hear what local farmers are saying
- Two people just wrote that they are simply happy that it exists and they just love the overall idea

10. List THREE things that you DISLIKE about this site, in order of importance.

The most common responses were as follows:

- Need better titles for videos
- Not easily searched, just able to search for broad categories not specific info
- Needs forum area
- Videos should be displayed more prominently throughout the site.
- The name of the site is difficult to remember and spell

11. Any other comments?

“Thanks for working so hard on this Hannah...it already looks so awesome and it has great further potential! I'll definitely be checking in on the videos even while I'm farming in the Kootenays!”

“Awesome I'm impressed”

“This is such a valuable project! Thanks for helping farmers and growers. These short videos are just right for our liimited time and they show so much more than any other medium - the intonations of degree of success, of experimentation, of the site they are on, their challenges compared t o our own....”

☐ Please check this box to be notified when new videos are uploaded to the site.

7/10 of respondents were interested in being notified when new videos were uploaded to the site.

Appendix 4.0 : Website Analytics

(Updated October 5, 2012)

Number of Views per Month

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Overall
2012	3,164	762	929	866	703	244	42			6817

Average Views per Day

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Overall
2012	105	25	31	28	23	8	10			38

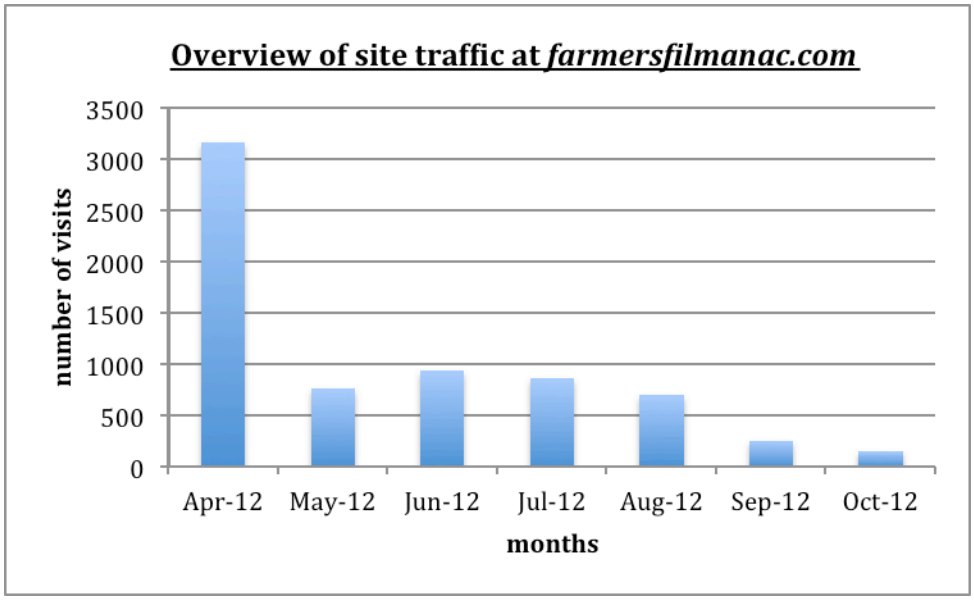


Figure 5 Number of Website Visits from April- early October, 2012