Executive Summary

Agricultural producers are a critical component of the agricultural sector feeding the world, generating employment, income and savings, contributing to health and prosperity, cultural identity, farm tourism, and household food security. In most low-income countries, this sector is one of the most important economic sectors representing 30% of GDP and utilizing the most labour. Three quarters of the world’s poor and hungry reside in rural areas. Achieving the Sustainable Development Goals of ending extreme poverty and hunger will necessitate supporting rural agricultural producers.

The agricultural sector and farmer livelihoods are vulnerable to climate variability. The expected effects of climate change that may increase the frequency and severity of, inter alia, extreme events of drought and flood (d&f) will exacerbate their vulnerability. The cost and destruction associated with d&f also draws attention to the need to plan for and respond to d&f. However, this problem is characterised by contested science and values, uncertainty of impacts and risks, complexity, its systemic nature, and the fact that the costs and benefits of addressing this problem are inequitably distributed. Such problems require institutions capable of double and triple loop learning. It is recognized that often part of the problem is a problem of governance; events of d&f become disasters because of inadequate institutional governance practices.

Adaptive governance is the theoretical framework of this research. Adaptive governance responds to the key elements of the problem as it reduces risk and uncertainty, can address systemic problems (recognizing networks and structures), allows for the contestation of science and values (but advances their resolution through public participation and social learning), and creates a space for equitable distribution (through participation and inclusive development). The adaptive governance literature seeks to enhance the adaptive capacity of institutions and reduce the extreme risk of disasters through disaster risk reduction and thereby minimize the risk to livelihoods. This research develops an expanded model of adaptive governance by subsuming literature surrounding adaptive co-management, adaptive management, and anticipatory governance and explaining the relevance of each in relation to the literature on problem framing, the social construction of risk and uncertainty, livelihood capitals, social learning (important for tackling the wicked problem of d&f), and public participation (which when done properly results in trust building and inclusive development). This thesis develops two new models: 1) Adaptive governance and problem structuring (Hurlbert and Gupta 2016) and 2) Adaptive governance and the split ladder of participation and learning (Hurlbert and Gupta 2015).
There is considerable research on the vulnerability of agricultural producers to climate change; we know that the institutional governance system is an important component of adaptive capacity impacting on the agricultural producers’ livelihood capitals that determine their livelihood success; and we have knowledge of best practices of adaptive policies. However, there is much we don’t know. We don’t know how the problems of d&f are being framed by policymakers, the types of governance instruments (regulatory, market, etc.) that promote agricultural livelihood capitals, the impacts different instruments have on agricultural producers and their livelihoods, and which instruments promote social learning, trust, and inclusive development, all given perceptions of risk and uncertainty.

Hence, this research answers the question:

**How can a theoretical and policy framework (norms, principles, and instruments (including regulatory, economic, suasive, and managerial)) be designed to build capacity for rural agricultural producers to respond to the increasing likelihood of d&f, defined by uncertainty?**

The research was carried out in four study areas: two in Canada, one in Chile, and one in Argentina. All case study areas are glacier fed, dry land riverbeds, with some irrigation and experience with d&f. All four study areas have very disparate governance structures, especially in relation to water (a fundamental system in relation to d&f). The two Canadian study areas represent a developed country, and Chile and Argentina developing countries. These differences allowed for comparison of institutional practices.

The analytical framework of this study is a multi-level institutional analysis that coordinates well with adaptive governance and its institutional focus. This comprehensive framework draws upon six prominent methods for analysing responses to environmental problems. A model developed by Gupta et al. (2013) incorporated the International Human Dimensions Programme’s institutional analysis framework (Young et al. 2005) and the multilevel governance theory of the Earth System Governance Project (Biermann et al. 2009). In addition to this, the policy framing analysis (Hisschemöller and Gupta 1999) and the livelihood capital analysis focusing on enhancing social, human, economic, technological, and natural capital is utilized (Moser 2009; Allison and Ellis 2001; IPCC 2001). Finally, the literature surrounding the adaptive capacity dimensions of institutions (utilizing the adaptive capacity wheel of Gupta et al. 2010) inform recommendations for redesign.

The analytical framework leads to the identification of secondary research questions: What are the main institutions (organizations and instruments) that are capable of building capacity of agricultural producers and responding to d&f at the global, national and regional level of study? How are these policies and instruments framed in relation to the embedded problems of climate change, d&f, and what environmental governance approach is used (utilizing a new adaptive governance and problem structuring model)? What are the other driving forces affecting rural agricultural producers’ livelihood capitals? How effective are the main instruments at achieving their mandate? What are the effects of the instruments on agricultural
producers and their capitals (technological, human, economic, social, and natural) in respect of d&f? What social learning have the instruments facilitated (utilizing the new adaptive governance participation, and learning model)? Based on an assessment of what works and what doesn’t in specific contexts, how can instruments and institutions be redesigned to better build capacity of rural agricultural producers to cope with the uncertainties of d&f?

This thesis is based on previous studies in the case study areas, four related research projects on adaption to climate change and extreme events in which I have participated in, and semi-structured qualitative interviews with people with a deep expert knowledge of climate change, emergency response, d&f. These interviews were semi-structured qualitative interviews.

The thesis answers the question of how a policy framework can be designed to build the capacity of agricultural producers to cope with d&f by assessing which instruments are and are not working in the context of the drivers with an expanded analysis of adaptive governance (policy framing, participation, and learning) and a focus on redesign. Some of the findings follow.

There are many institutions and organizations at the international level in relation to climate change related d&f. However, there are few international policy instruments that can effectively enhance the capacity of local farmers and communities to cope with extreme events at the case study level. A content analysis revealed a highly dense organizational network and that triple loop social learning (a marked change in values and norms underpinning assumptions) in relation to disaster risk reduction is beginning to occur at the global level. Nevertheless, there was no evidence that this learning is taking place at the local, regional, or national level of the case study areas.

In Saskatchewan, many institutions and instruments respond to d&f and only a handful to climate change. Strong linkages between the levels of government and suite of instruments positively impact many livelihood capitals. However, few instruments tackle increasing inequality and aging producers (also the case in Alberta). Significant single loop learning has occurred in relation to drought (flood has not occurred in the study region so is not socially constructed as a risk). But, few instruments facilitate public participation and there is no evidence that groups of people are learning together to change values, norms, and assumptions based on deeper understanding of the issues (i.e. double and triple loop learning).

Alberta has the greatest diversity of institutions and instruments responding to climate change d&f addressing most drivers of vulnerability. Many instruments facilitate participation in Alberta and attempt to address wicked issues, but triple loop learning has not occurred recently (the Special Areas Board created in the 1930s was a fundamental institutional change). The Canadian driver of climate change scepticism (non-existent in the developing country case studies) was strongest in Alberta affecting the effectiveness of instruments addressing climate change.
In the developing countries the multi-level institutional system and its instruments are fragmented. The state governments are weak; development tends to exclude producers without water rights. Although more flood events are predicted in the area due to climate change, floods are not recognized as risk events. In Chile local governments respond to d&f without support from the central government. They lack instruments dealing with producer vulnerability (e.g. bankruptcy and insolvency instruments, human rights for drinking water, accessible financial aid for small and medium producers) and the privatized water market takes many policy problems outside the purview of the state. Chile’s irrigation instruments, in combination with the water market, have increased the economic capital of large powerful producers and enhanced some double loop learning.

A strong local institutional system exists in Mendoza, Argentina. Its weak links with the federal government affects its financial capacity. Few instruments respond to d&f and address climate change. The rigid water governance system protects the small and medium agricultural producers. Few instruments address global drivers, which strengthens the large producers with better ability to access economic, technological, natural, and linking social capital. However, strong social capital, a vibrant civil society, and provincial government leadership successfully combined to achieve triple loop learning when a glacier protection law changed fundamental norms surrounding development.

The four case study areas frame climate change, d&f as a disjointed wicked problem. As a result, there are few instruments capable of enhancing the capacity of producers to deal with these extreme events. These findings coincide with the discovery of few examples of triple loop social learning.

Suasive instruments have been effective at achieving their mandate of providing information and persuading people to take action (e.g. changing environmental practices or embracing adaptation measures) in Canada; economic instruments have effectively facilitated access to economic capital stabilizing income (but small and medium producers often can’t access these) and management instruments have been effective at increasing adaptive co-management of water. In respect of d&f, management instruments have been particularly effective, but less so in relation to climate and water (quality and quantity) issues. Regulatory instruments have been particularly ineffective because of the lack of resources and political will to enforce. There are also missing instruments. Implementation instruments do not accompany the plans for climate mitigation and adaptation.

**A better policy framework would:**

- adopt effective instruments where appropriate, disband the ineffective (or redesign them in order that they be effective) and implement appropriate missing instruments; these have been identified in the case studies;
- create instruments for unaddressed drivers (climate change, global market trends, financial capital trends, government austerity, aging agricultural producers, growing inequality, changing size of farms, urbanization,
increasing demand for energy and aging infrastructure) that are identified as important in the case studies;

c) create instruments to implement the environmental governance approaches of adaptive management (hypothesis testing), anticipatory governance (public engagement utilizing climate scenario planning), or adaptive co-management (extensive public participation in relation to resource management to achieve inclusive development) in relation to d&f. For instance, the public has been rarely engaged in anticipatory governance in planning for d&f utilizing climate science or mechanisms of adaptive co-management in relation to water;

d) address the lowest ranking of the dimensions of adaptive capacity (Gupta et al. 2010) identified below.

Figure II1 shows that in Alberta, where the water property interest reflects both regulatory and market instruments, and an entire suite of instruments exist in relation to d&f, the adaptive capacity wheel is predominantly green. This means that there is high to very high adaptive capacity of institutions. Lower ranking occurs in the case of Saskatchewan because there are fewer instruments (only a government water licence, no water market), and fewer resources. Responsiveness and institutional memory are issues. In industrialized countries a variety of instruments, and response to the entire policy problem of d&f (as in the case of Alberta) increases the institutional practices enhancing adaptation and reduces risk and uncertainty.

However, the adaptive capacity is lower in Argentina and Chile. In Chile, where a water market exists, there are low levels of trust, no participation by the public in the governance of water, d&f. In Argentina problems of redundancy, problem framing, and single loop learning exist. However, in all study regions instruments exacerbate existing inequities.

The issues of equity, the lack of instruments for engaging participation with people, and the marginalization of indigenous people (and in the developing countries people without water rights) detract from inclusive development. In order to make governance more inclusive, the participation of people in policy problems, especially those without water rights, is critical.

In order to achieve resilience a broader conception of policy problems and risk is required. The policies on climate mitigation and adaptation including d&f need to be integrated and involve public participation in both discussing the science and the policy in order to ensure the social learning needed for wicked problems like climate change and d&f. This discussion will need to be on-going and iterative in order to achieve inclusive development. More research on how the suite of instruments and changes in livelihood capitals interact is required. The inter-relationship of institutional dimensions of adaptive governance and capitals is not well understood. Lastly we need to know how to build inclusive development and enhance equitable outcomes in light of current global drivers.
This research contributes to theory as it designs a theoretical framework (norms, principles, and instruments (including regulatory, economic, suasive, and managerial)) to build capacity for rural agricultural producers to respond to the increasing likelihood of d&f, defined by uncertainty. This theoretical framework is a new model of adaptive governance capable of responding to and expanding knowledge in relation to the problem of d&f:

1) it expands adaptive governance to include adaptive management, adaptive co-management, and anticipatory governance and assesses their application;
2) it responds to uncertainty and risk by deepening the discussion of real objective risk and socially constructed risk uncovering insights into cognized risk in relation to d&f;
3) it responds to the complexity and systemic nature of the problem by adding triple loop social learning and policy framing (which assists in identifying missing instruments);

4) it addresses contested values and science in relation to d&f by developing the model of adaptive governance and problem structuring, breaking down problems for uncertainty to those related to uncertain science and those related to uncertain norms and values;

5) it addresses the unequal distribution of benefits and burdens of d&f by including participation and inclusive development in the analysis. Participation is expanded and focused such that it can be meaningful in relation to the policy problem and environmental governance approach in order to resolve contested values and science and assess when participation should be used;

6) it tackles the wicked nature of the problem of d&f through incorporating social learning in a model of adaptive governance, participation, and learning uncovering aspects of triple loop learning; and

7) lastly, it provides a holistic governance framework illustrated (through the models identified in 4 and 5) by identifying measurable outcomes (impact on livelihood capitals and institutional dimension of adaptive governance (Gupta et al. 2010)) offering insights into each.