



VULNERABILITY AND ADAPTATION: The Canadian Prairies and South America Edited by Harry Diaz, Margot Hurlbert, and Jim Warren

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Vulnerability and Adaptation to Drought

The Canadian Prairies
and South America

Edited by
**HARRY DIAZ,
MARGOT HURLBERT,
AND JIM WARREN**



Vulnerability and Adaptation to Drought

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CONTENTS

Introduction	1
AUTHORS: <i>Harry Diaz, Margot Hurlbert, and Jim Warren</i>	
PART 1: FRAMING THE BOOK	13
Chapter 1: Drought and Vulnerability: A Conceptual Approach	15
AUTHORS: <i>Johanna Wandel, Harry Diaz, Jim Warren, Monica Hadarits, Margot Hurlbert, and Jeremy Pittman</i>	
PART 2: PAST AND FUTURE DROUGHT: LESSONS FROM CLIMATE SCIENCE	37
Chapter 2: Canadian Prairies Drought from a Paleoclimate Perspective	39
AUTHORS: <i>David Sauchyn and Samantha Kerr</i>	
Chapter 3: Future Possible Droughts	59
AUTHORS: <i>Elaine Wheaton, David Sauchyn, and Barrie Bonsal</i>	

**PART 3: DEALING WITH PRAIRIE DROUGHTS:
CRISES AND ADAPTIVE RESPONSES** 77

Chapter 4: The Impacts of the 2001–2 Drought in Rural
Alberta and Saskatchewan, and Canada 79

*AUTHORS: Suren Kulshreshtha, Elaine Wheaton,
and Virginia Wittrock*

Chapter 5: The “Min Till” Revolution and the Culture of
Innovation 107

AUTHOR: Jim Warren

Chapter 6: The Troubled State of Irrigation in Southwestern
Saskatchewan: The Effects of Climate Variability and
Government Offloading on a Vulnerable Community 133

AUTHOR: Jim Warren

Chapter 7: Gendering Change: Canadian Farm Women
Respond to Drought 159

AUTHORS: Amber J. Fletcher and Erin Knuttila

**PART 4: GOVERNANCE SYSTEMS FOR PRAIRIE
DROUGHT AND WATER MANAGEMENT** 179

Chapter 8: Drought and Public Policy in the Palliser
Triangle: The Historical Perspective 181

AUTHOR: Gregory P. Marchildon

Chapter 9: The Governance of Droughts 199

AUTHOR: Margot Hurlbert

Chapter 10: Water Governance in the Prairie Provinces 217

AUTHOR: Margot Hurlbert

PART 5: STRATEGIC PLANNING AND DROUGHT	249
Chapter 11: Values Analysis as a Decision Support Tool to Manage Vulnerability and Adaptation to Drought	251
<i>AUTHORS: Darrell R. Corkal, Bruce Morito, and Alejandro Rojas</i>	
Chapter 12: Bridging Knowledge Systems for Drought Preparedness: A Case Study from the Swift Current Creek Watershed (Canada)	279
<i>AUTHORS: Jeremy Pittman, Darrell R. Corkal, Monica Hadarits, Tom Harrison, Margot Hurlbert, and Arlene Unvoas</i>	
PART 6: LEARNING FROM OTHER EXPERIENCES	301
Chapter 13: Drought Risks and Opportunities in the Chilean Grape and Wine Industry: A Case Study of the Maule Region	303
<i>AUTHORS: Monica Hadarits, Paula Santibáñez, and Jeremy Pittman</i>	
Chapter 14: Drought in the Oasis of Central Western Argentina	327
<i>AUTHORS: Elma Montaña and José Armando Boninsegna</i>	
PART 7: CONCLUDING REMARKS	349
Conclusion	351
<i>AUTHORS: Margot Hurlbert, Harry Diaz, and Jim Warren</i>	
Index	361

INTRODUCTION

Harry Diaz, Margot Hurlbert, and Jim Warren

Scope and Purpose

Climate change is perhaps one of the most prominent indicators of global environmental change as well as an important source of increased human vulnerability. An unprecedented concentration of greenhouse gases in the atmosphere is linked to an overall warming of the planet, which has been affecting climate and weather patterns. The World Meteorological Organization has estimated that more than 370,000 lives were lost between 2001 and 2010 as a result of extreme climate conditions, including heat waves, cold spells, droughts, storms, and floods, marking a 20% increase in deaths compared to 1991–2000 (WMO 2013). The potential impacts of climate change are of significant concern for those regions of the world subject to drought. Should future droughts exceed previous experience in terms of frequency, duration, and severity, the threats to human lives, livelihoods, and ecosystems could be substantial.

Drought is the one of the most significant natural hazards affecting social and economic systems in many areas of the world. It is particularly hazardous for agricultural communities, where livelihoods depend on

natural systems. This is especially true for the Canadian Prairies, where droughts have been one of the most serious recurring natural hazards. Indeed, even when viewed from a national perspective, droughts are among the most economically devastating natural disasters experienced by Canadians over the past century. The most recent widespread severe Canadian drought in 2001–2 produced a \$5.8 billion drop in gross domestic product (GDP) and was responsible for an estimated 41,000 lost jobs (Wheaton et al. 2010: 280). Saskatchewan and Alberta were the hardest-hit provinces. Moreover, the magnitude and frequency of Prairie droughts are projected to increase under climate change, potentially increasing people's vulnerabilities and associated risks (Sauchyn et al. 2010).

Drought is arguably one of the most problematic disasters, not only because of the magnitude of its damages but also because "it is one of the most underrated and least understood of disasters" (Sheffield and Wood 2011: xi). The main goal of this book is to contribute to a better understanding of the complexities of drought and its impacts on people's livelihoods from a perspective that emphasizes both vulnerabilities and adaptive capacity in the context of an increasingly complex relationship between nature and society.

The book is the product of a decade of international collaborative interdisciplinary research effort by a network of Canadian and Latin American researchers to understand rural people's vulnerabilities to climate in arid areas. Most of the studies done by the network, both in Canada and Latin America, have adopted the same conceptual and methodological approaches discussed in the first chapter of this book. In most chapters, we have been particularly interested in the ways in which rural people formulate their responses to past, current, and forecasted climate risks and the limits that their social, economic, and political conditions impose on these responses. Most chapters in the book are related to studies on the vulnerabilities and adaptive capacities of Canadian Prairie communities, but we have also included two chapters based on *regional* drought studies in Argentina and Chile from our collaborators in these two countries. Today, more than ever, the global nature of the environmental transformations associated with climate change imposes a need for an explicitly comparative perspective. This perspective allows us to study the complexities and challenges of the processes that emerge in the coupled social and natural systems, which is required to find solutions and alternatives.

A considerable portion of the research supporting many of the chapters in this book was developed in the context of several research projects. Two of these projects were the “Rural Community Adaptation to Drought” (RCAD) project, which focused on the exposure and adaptive practices to drought impacts for rural communities in Saskatchewan (RCAD 2012), and the “Water Governance and Climate Change: The Engagement of Civil Society” project (Hurlbert et al. 2015). The other projects were multinational research efforts involving scholars and drought-management practitioners from Canada and Latin America. These projects were the “Institutional Adaptation to Climate Change” project (IACC 2009), the “Vulnerability and Adaptation to Climate Extremes in the Americas” project, and the “Coming Down the Mountain” project, which allowed for a study of drought vulnerabilities in Argentina, Chile, and Bolivia.¹ The international composition of these projects constituted efforts to share insights from the drought-related experiences of a variety of communities with different levels of exposure and adaptive assets. In these terms, the two Latin American cases presented in this book, Chile and Argentina, are important because they provide insights from regions characterized by long histories of water scarcity and use of irrigation to reduce local vulnerabilities, and also by an unequal distribution of vulnerability among producers.

The book also emphasizes the need to integrate both the natural and social sciences in understanding vulnerabilities. Droughts are “normal” events in the history of the regions covered in this book, but they can become hazards and disasters in the context of the prevailing social and economic conditions that exist in social systems during the drought. The magnitude and severity of the drought are relevant to understanding its impacts, but no less relevant are the social circumstances that shape the capacity of people and their livelihoods to cope with those impacts. In these terms, we have made a special effort to integrate chapters that emphasize both the social and natural scientific perspectives.

This book has been organized into six sections. The first section includes a single chapter that discusses the theoretical and methodological perspectives applied by most of the following chapters. Chapter 1, by Wandel, Diaz, Warren, Hadarits, Hurlbert, and Pittman, frames the discussion in terms of the vulnerability approach. In simple terms, this approach contends that the resilience of a social system—which could be a

community, farm, family, or any other social entity—exposed to a natural hazard is a function of the characteristics of the hazard and of the balance between the relative sensitivity of the system to the exposure and its adaptive capacity. More precisely, the chapter defines vulnerability as the degree to which systems, such as a farm or a community, are susceptible to the adverse impacts of climate variability and extremes (such as drought), as well as to other types of stressors and change (Kiparsky et al. 2012; Smit and Wandel 2006; Wisner et al. 2003). The literature indicates that the adaptive capacity or resilience of a community is affected by its access to certain biophysical, social, and economic resources. These resources are referred to as the “determinants of adaptive capacity” and alternatively as the “assets” or “capitals” required to support resilience. Access to the appropriate mix of these assets enhances the capacity of a community to adapt to adverse conditions (IPCC 2001).

Most social systems are capable of adjusting to climate conditions that vary within the parameters of average long-term experience. Indeed, agriculture on the Canadian Prairies, as well as in the agricultural regions of Argentina and Chile discussed in this book, would appear to be relatively resilient to drought conditions that occur below a certain threshold of intensity and duration. However, when climate variability exceeds previous experience and thresholds for resilience, the level of adaptive capacity resident in the community may or may not prove sufficient. When confronted by climate forecasts that predict exposures will far exceed previous experience, one would reasonably expect prudent actors to assess their current levels of vulnerability and adaptive capacity, and endeavour to enhance those facets of adaptive resources that might be lacking.

Access to and control of these resources are important in reducing vulnerabilities, but it is the capabilities of actors to organize them into adaptive activities that define the balance between sensitivity (determined by the lack of or limited resources) and adaptation (defined by the existence of resources that could be mobilized to reduce sensitivity). The first chapter also emphasizes the argument that local vulnerabilities are the product of the multiple interactions between several processes that affect the locality, what Leichenko and O’Brien called “pathways of double exposures” (2008: 5). Thus, issues such as local sensitivities, adaptive capacity, and resiliency acquire a challenging complexity.

The second section of the book deals with the dimension of drought as a hazard to which Canadian rural people are exposed. The section, composed of two chapters, discusses drought from the perspective of climatology, focusing on the past and future features of drought in the Canadian Prairies. In these terms, the section contributes lessons from climate sciences, which should allow for a better understanding of the following three sections.

Chapter 2, by Sauchyn and Kerr, provides an overview of paleoclimatic research for the Prairies region. Their work suggests that if the long-range climate history of the Prairies is a meaningful clue to what we might expect in the short- and long-term future, current drought management practices may not be sufficient to sustain agriculture and Prairie communities in their current form. They show that severe and protracted drought has been a recurrent phenomenon on the Prairies for at least 1,000 years; thus, if past climate is any indication of what the future might bring, residents of the Canadian Prairies can expect to encounter multi-year periods of severe drought in the decades ahead. The adaptations that have sustained Prairie agriculture over the past century were made in response to droughts which were less extreme than many of those which occurred in preceding centuries. Some of those droughts far exceeded the thresholds of severity and duration in which current adaptive strategies were developed.

Sauchyn and Kerr's insight into the Prairie climate of the past is followed by a chapter by Wheaton, Sauchyn, and Bonsal (Chapter 3), which provides a regional assessment of the latest climate science for the Prairies and provides insight into the potential intensity and frequency of future droughts in the region. They explain that the variability of the region's already highly variable climate conditions will increase. Severe weather, including severe drought along with occasional extreme rainfall events, is expected to become more common over the course of the twenty-first century. This suggests the need for major departures from agricultural practices and water management strategies that were developed in response to droughts over the past century. Taken together, these two chapters show that similar warnings arise whether we look into the climate past or future. Communities on the Canadian Prairies could benefit by preparing to adapt to a climate future and associated hazards that present new challenges which threaten to exceed past levels of drought resilience.

The third section contains five chapters, all focused on drought crises and the adaptive responses of Prairie agricultural producers to these crises. It is in the context of the insights presented by climate sciences in the previous section that we endeavour to understand drought and its effects on people and their social systems. The chapters in this section explore the effects of past and recent droughts on the Canadian Prairies and the ways people have adapted to drought conditions. We assume that learning what has and has not worked to enhance people's drought resilience is valuable, in terms of understanding how to better deal with drought both today and in the decades ahead.

Chapter 4, by Kulshreshtha, Wheaton, and Wittrock, discusses the vulnerability of several rural communities in the Canadian Prairies using the 2001–2 drought as a point of reference. This was one of the most serious severe droughts experienced in recent times in the Canadian Prairies, where dry conditions were accompanied by high temperatures, which increased the severity of the drought because of higher evapotranspiration. The chapter provides us with a comprehensive view of the economic and social impacts of drought on different economic sectors and on a group of rural communities in southern Alberta and southwestern Saskatchewan, including the adaptation measures undertaken by agricultural producers.

Chapter 5, by J. Warren, focuses on specific processes of adaptation to drought implemented by Prairie farmers. The chapter deals mainly with technological innovations—new farming practices and the use of appropriate machinery—designed to reduce exposure to drought. Warren shows how community innovation and adaptation processes are well-understood and valued processes that have emerged as a result of increasing human capital in the region and have been integrated into the cultural material of the rural communities. The chapter demonstrates the existence of an adaptive capacity that is linked to creativity, flexibility, and adaptability as important local values.

Chapter 6, also by Warren, discusses “the other side of the coin,” showing us that conventional measures of adaptation, such as irrigation, do not always ensure drought resiliency. The chapter is focused on irrigation infrastructure in southwest Saskatchewan, and it demonstrates how the agronomic impacts of drought can be exacerbated by social and economic conditions. The case discussed by Warren shows how the coincidence of drought with depressed farm commodities prices, rising input costs, and

institutional weakness can reduce the effectiveness of irrigation, contributing to a heightened state of local vulnerability.

The last chapter in this section, Chapter 7 by Fletcher and Knuttila, provides important insight into the socially constructed and experienced elements of drought on the Prairies. Following the argument that vulnerabilities and adaptive capacity are unequally distributed in society, the chapter examines the gendered characteristics of the impacts of drought and vulnerability reduction in the context of the farm economy. The authors propose that gender vulnerabilities to climate must be linked to an understanding of the processes of industrialization, corporatization, and rapid farm expansion, and accordingly, adaptive policies must consider these processes to increase the resiliency of women.

Section 4 focuses on governance, which is a very specific aspect of vulnerability and adaptive capacity. The first chapter in this volume, which provides the theoretical framework for the book, indicates that institutional capital is an important determinant of adaptive capacity. In most countries, the most important expressions of this form of capital are the programs and policies developed and implemented by governments in co-operation with the institutions of civil society. The availability of resources related to these programs and policies to local people contribute significantly to their adaptive capacity.

The impact of past droughts, particularly the dry decade of the 1930s, has been seared into the socio-economic and political fabric of Prairie communities. And while drought-induced crop failure and water shortages have been the cause of great hardship and adversity, and of the disappearance of many farms and ranches, they have also encouraged the development of a variety of coping strategies. A range of adaptations involving the creation and adoption of new institutional frameworks emerged in response to drought conditions on the Prairies.

Chapter 8, by G. Marchildon, is focused on these institutional interventions developed as a response to the extreme weather conditions of the earlier decades of the past century. Focusing on two case studies, the Special Areas Board and the Prairie Farm Rehabilitation Administration, Marchildon shows how these new institutional arrangements contribute to reduce individual and community vulnerabilities in the most drought-affected areas of the Prairies. An important insight from this

chapter is the need for more robust policy interventions in the context of future droughts.

The following two chapters, by M. Hurlbert, assess the present institutional framework, which has evolved to manage the challenges that drought presents to communities. In Chapter 9, Hurlbert assesses the Canadian government agencies and programs that currently deal with drought. She reviews several programs at the federal level, as well as those existing within the provinces of Alberta and Saskatchewan, in terms of their capacity to assist local agricultural producers in drought situations. She argues that these programs have existed for some time, but they have not been reinvigorated to respond to drought periods lasting more than two years. Hurlbert's argument certainly supports the insight developed by Warren in his chapter on irrigation in southwestern Saskatchewan.

In Chapter 10, Hurlbert reviews a set of policies and programs in the context of water governance in the Prairies. Given the essential role of water availability in drought conditions, Hurlbert examines some of the adaptive institutional principles applicable to water governance; the structure of this type of governance in the Canadian Prairie provinces; and the regulatory, management, and market instruments relevant to water. She concludes that there is an urgent need for more defined institutional boundaries, enhanced communication of the roles of water organizations, and coordination among water organizations.

Section 5 assumes a less conventional approach to drought. Our contributors propose that understanding drought and enhancing people's drought resilience is an interdisciplinary activity. However, combining the work of scholars and drought management practitioners with different areas of interest and methodological approaches with practical resilience-building activities can require new or better interactive processes to be developed. The two chapters in this section take the perspective that interdisciplinarity and transdisciplinarity are essential to understand the dynamics of global environmental change and to resolve the "wicked problems" created by this transformation (Brown 2010: 62–63).

Chapter 11, by Corkal, Morito, and Rojas, provides insight into how seemingly disparate disciplines and areas of concern can be brought together to develop vulnerability-reducing responses to drought-related stress on water resources. The chapter focuses on the idea that vulnerability is a socially constructed concept that expresses people's conceptions

and ideas toward the harms that threaten them. In these terms, the issue of values is central to understanding how people conceive and react to events such as droughts and how value-analysis could be an important instrument to address conflicts that emerge in the context of water scarcities.

In Chapter 12, Pittman, Corkal, Hadarits, Harrison, Hurlbert, and Unvoas offer a transdisciplinary alternative to primarily reactive past models, incorporating not only the perspective from science but also the concerns and interests of a large number of stakeholders. These authors, coming from a variety of perspectives, describe the value of preparedness planning, anticipating the challenges presented by future droughts and working to avoid adverse impacts through vulnerability reduction. Their interest is, in part, a response to predictions that droughts in the future could be far more intense and damaging than those yet experienced by Prairie communities.

In conformity with the principle that enhancing drought preparedness and resilience in one part of the world may provide insight for those dealing with similar problems in another region, we have included examples of scholarship from two regions in Latin America. The last section of the book describes how agricultural producers in regions of Argentina and Chile deal with livelihood disruptions caused by drought and how they are confronting new prospects related to climate change. The comparison is interesting since the studies that support these last two chapters used the same conceptual and methodological approaches used in the Canadian studies. As in the Canadian case, both regions have economies that are predominantly agricultural and that depend, to a large extent, on snowpack in the mountains—the Andes in the case of Latin America and the Rockies in the case of Canada—that feeds the regional rivers, the main source of water for irrigation purposes. No less relevant to the Canadian case is the role of social and economic conditions in framing the conditions of vulnerability of local producers in these two regions. The imposition of neo-liberal policies and the institutional incapacity to secure equitable access to resources provide clear examples of how the social and political dimensions could transform a drought from being a climate hazard into a disaster for many people. In these terms, these two regions provide a glimpse of potential future conditions of vulnerability if Canada continues with the trend of neo-liberalizing its economy, restructuring its agricultural sector, and reducing its institutional support for producers

(see Chapter 6 by Warren on irrigation in southwest Saskatchewan; see also Wiebe 2012; Magnan 2014; Young and Matthews 2007).

Chapter 13, by Hadarits, Santibáñez, and Pittman, discusses the implications of drought on Chilean agricultural producers in the Maule region of Chile, a region that, as in the case of Mendoza, Argentina, is mostly a wine-producing region. Similar to many other regions in Chile, the Maule region is seriously affected by droughts. The chapter describes the drought-related vulnerabilities for the regional wine industry based on a case study and a vulnerability assessment approach, as discussed in Chapter 1. It demonstrates the complexity of drought impacts, arguing that the exposure/sensitivity of the wine industry could be adverse or beneficial depending on many variables. To reduce detrimental impacts, many producers have developed a wide range of strategies, which could be important to face the near future challenges of declining precipitation and increasing demand for water due to increases in temperature. These strategies offer important lessons for Canadian agricultural producers.

The last chapter, Chapter 14 by Montaña and Boninsegna, discusses drought preparedness in the Mendoza River basin in central-western Argentina. The area is mainly dryland with large oases that depend on water provided by the Mendoza River and that support very intensive agriculture which produces world-renowned wines. The chapter discusses the climatological conditions of the region as well as the influence of its social and economic structures in shaping the vulnerabilities and adaptive capacities of agricultural producers in the basin. As in the Canadian case, the chapter illustrates another example of the weakness of short-term adaptation strategies compared with long-term solutions planning. In this vein, the chapter ends by emphasizing the need for structured policies that could improve water efficiency in this drought-prone region and provide conditions for a reduction and a more equitable distribution of the vulnerabilities.

NOTE

- 1 The Rural Communities Adaptation to Drought project took place between 2009 and 2013. It was carried out by a group of Canadian researchers from the universities of Regina, Saskatchewan, and Waterloo. The Institutional Adaptation to Climate Change project ran from 2004 to 2011 and involved a team of academics and drought and water management practitioners from Canada and Chile. Both projects were supported financially by the Social Sciences and Humanities Research Council of Canada. Their institutional home was the Canadian Plains Research Center at the University of Regina. The Vulnerability and Adaptation to Climate Extremes in the Americas project was launched in 2013 and it will be completed in 2016. It has

been supported by International Development Research Center, the Social Sciences and Humanities Research Council of Canada, and the Natural Science and Engineering Research Council of Canada. The project team includes academics and practitioners from Canada, Chile, Columbia, Brazil, and Argentina. The Water Governance and Climate Change: The Engagement of Civil Society project was launched in 2010 and completed in 2014. For more information on these projects, visit the Prairie Adaptation Research Collaborative website at <http://www.parc.ca>. The project Coming Down the Mountain was supported by the Interamerican Institute for Global Change Research; it was initiated in 2008 and ended in 2011.

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