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Institutional Adaptations to Climate Change: Comparative Study of Dryland River Basins In Canada and Chile

MCRI Project

Prepared by: the IACC Research Team

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I. INTRODUCTION

The Institutional Adaptation to Climate Change (IACC) project is funded by a grant from the Major Collaborative Research Initiatives (MCRI) program of the Social Sciences and Humanities Research Council of Canada (SSHRC). It is administered by the Canadian Plains Research Center (CPRC) of the University of Regina. The project was formally initiated in January 2004. Following a planning meeting of the research team in Regina from the 27-30 April 2004, major research activities of the project were initiated.

The project is conducted by an interdisciplinary team of fifteen researchers from a variety of disciplines—biology, ecology, engineering, psychology, mathematics, sociology, geography, climatology, economics, history and philosophy—and a significant number of research assistants (See Appendix 2). Five Canadian universities (the University of Guelph, the University of Saskatchewan, the University of Regina, Athabasca University, and the University of British Columbia) and a Chilean university, the Universidad de La Serena, are academic partners in the project. In addition, eleven government agencies and institutes in Canada and Chile have committed resources to the development and implementation of the proposal (see Appendix 1). Project activities are under the management of the Project Director, Harry Diaz, and a Management Committee composed of Harry Diaz, David Gauthier, David Sauchyn, and the Project Manager, Pat Barrett-Deibert. Sonia Salas coordinates the project's activities in Chile. The project is also served by an Advisory Board that provides advice and guidance to the Project Director and Management Team in particular, and the research team in general, on all matters that are relevant to the research project (see Appendix 3).

The critical issue that the IACC project addresses is the capacity of institutions in dryland regions to adapt to the impacts of climate change. The goal of the project is to develop a systematic and comprehensive understanding of the capacities of regional institutions to formulate and implement strategies of adaptation to climate change risks and the forecasted impacts of climate change on the supply and management of water resources in dryland environments. This goal is addressed through a comparative study of regions at different stages of social and environmental vulnerability: the South Saskatchewan River Basin (SSRB) in western Canada and the Elqui River Basin (ERB) of north-central Chile. The current semiarid climate of the ERB is a spatial analogue of the future climate of the SSRB according to forecasts from global climate models. Both regions have a dry climate adjacent to a major mountain system and landscapes at risk of desertification, as well as an agricultural economy dependent on irrigation water derived from mountain snow and glaciers. As a result of drier conditions and increased climatic uncertainty, they will be similarly affected by climate change.

The specific objectives of the project are:

1. to identify the current social and physical vulnerabilities related to water resource scarcity in the two dryland regions;
2. to examine the effects of climate change risks on the identified vulnerabilities; and
3. to assess the technical and social adaptive capacities of the regional institutions to address the vulnerabilities to current water scarcity and climate change risks.

The implementation of the project is characterized by an active and continuing integration of team members and research activities. Rather than developing a set of parallel studies, the project has emphasized a permanent integration of research activities that promote continuous collaboration among the members of the research team. A fundamental element in the process of integration has been the development of a common conceptual and methodological framework that defines the central activities of the project and their linkages, a framework that is discussed in Section III of this report.

The project has developed a website (www.parc.ca/mcri/) with the support of one of its partners: the Prairie Adaptation Research Collaborative (PARC). This website contains both a public component, which is

accessible to all those interested in obtaining further information about the project, partners and researchers. The website also contains a password-accessible area for project researchers and assistants. This area of the website is the "working area" of the project and contains work in progress, working documents, calendar of activities, and other tools of the project, serving as an important tool for the integration of project's activities.

This first project report covers the period May 1, 2004–April 30, 2005. It describes the main results of the first project seminar and the main activities in each of the components of the plan of activities or milestone report.

II. THE 2004 PROJECT SEMINAR

The first seminar of the project occurred in Regina from 27-30 April 2004. The seminar brought together all the researchers of the project team, members of the Advisory Board, and representatives of some of the institutional partners: the Prairie Farm Rehabilitation Agency, the Instituto de Ecología Política, Environment Canada, Centro de Estudios Regionales, the Prairie Adaptation Research Collaborative and the Canadian Plains Research Center.

Two central objectives of the four days of meetings were: (1) to discuss in detail a conceptual and methodological model that would allow for the attainment of the different objectives of the proposal and foster the process of integration of project activities; and (2) to work towards the completion of a detailed work plan for the first thirty months of the project referred to as the milestone report. Thus, this meeting became a central point in the development of the project.

Two documents were produced for the first seminar: "A Climate Change Adaptation Study for the South Saskatchewan River Basin" and "Description of the Elqui River Basin" (See Lac, 2004 and Cepeda, Fiebig, Morales and Salas, 2004 in Appendix 4). These two documents provide a social and biophysical description of the two basins and an initial assessment of the adaptation options.

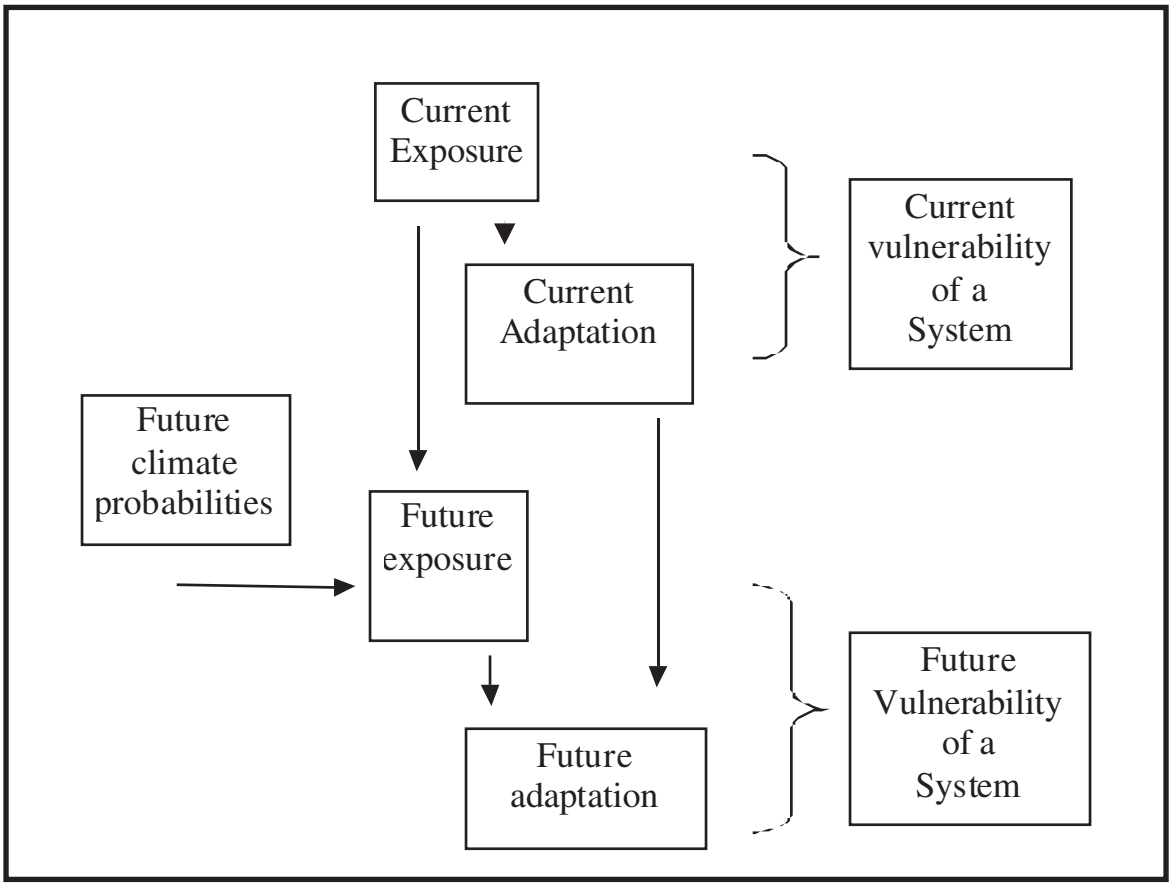
III. THE CONCEPTUAL AND METHODOLOGICAL MODEL

The central goal of the project is to assess the capacity of institutions to adapt to climate change risks in the area of water resource management in the two basins, the SSRB and the ERB. In more practical terms, the project seeks to identify opportunities to improve the way in which institutions manage natural resources, especially water resources, in the context of new climatic conditions. Given the large variety of human settings that exist in the two basins, the project focuses its interest in the vulnerabilities of rural communities, considering large urban conglomerates—such as La Serena in the ERB and Calgary in the SSRB—as part of the contextual conditions that define the management of water resources in the rural sector.

A key element in this approach is the idea of "vulnerability." The concept of vulnerability has been developed and employed with reference to various contexts and methodological approaches. In the course of the 2004 Seminar, vulnerability was understood as the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. In these terms, the most vulnerable systems are those which are most likely to be exposed to perturbation, possess limited capacity for adaptation, and are least resilient to recovery. Thus, vulnerability here is characterized as a function of the exposure of a system to climate change and its adaptive capacity. A system may be a household, community, sector, ecosystem, activity, nation and so on. Generally, a system that is more exposed to a climate stimulus will be more vulnerable, and a system that has more adaptive capacity will tend to be less vulnerable due to its ability to cope with the exposure. Based on this conception of vulnerability, the team adopted a vulnerability assessment model.

The model, as shown in Figure 1, emphasizes the need to analyze not only the future vulnerability of sys-

Figure 1. The Vulnerability Assessment Approach



tems, but also their current vulnerability in the context of current and future climate conditions. The model identifies three sets of interrelated activities: (a) the development of a systematic understanding of the current exposure of a system and its adaptive capacity; (b) the assessment of future climate conditions for the area where the system occurs; and (c) the assessment of future vulnerabilities based on an analysis of how the existing vulnerabilities of the system will be affected by future climate conditions. The strengths of this vulnerability model are that it offers a consistent framework for an interdisciplinary approach characterized by the use of different methods, allows for an active engagement of stakeholders, accommodates uncertainty, is relevant to climatic science, and easily connects with decision making (For a more developed discussion of this model see Smit, Wandel and Young, 2005 in Appendix 4).

In the context of this vulnerability assessment model, the activities of the project were organized relative to three research clusters:

Cluster 1: An analysis of the current vulnerabilities existing in the two basins, with a special emphasis on rural communities. This cluster involves several research projects: (i) an assessment of the current vulnerabilities of a group of communities in the two basins; (ii) an analysis of environmental vulnerabilities identified by stakeholders; (iii) a historical study of institutional adaptation in both basins in periods characterized by water scarcities; (iv) an analysis of the role of institutions in the resolution of a group of recent conflicts related to water scarcity; and (v) an assessment of the capacities of public institutions to reduce the vulnerabilities of rural communities. These research activities will facilitate the attainment of objectives 1 and 3.

Cluster 2: An assessment of the future climate scenarios for the two basins—based on different climatic

models—and their potential impacts. This cluster will facilitate the attainment of objective 2.

Cluster 3: An assessment of the capacities of public institutions to deal with the future vulnerabilities of the rural communities. This final cluster will facilitate the attainment of objective 3.

Clusters 1 and 2 constitute the core of the research activities during the first four years (2003-2007) of the project. Cluster 3 will involve an intensive process of discussion with stakeholders and it will occur mostly during the final year of the project (2008).

IV. THE MILESTONE REPORT

This milestone report is a plan of activities required by the MCRI program. Its purposes are: (a) to assist the team in planning and managing a realistic calendar of project activities and outcomes and in assigning responsibilities to team members; (b) to serve as a blueprint for the mid-term report to be presented to SSHRC in June, 2006; and (c) to provide a yardstick for a mid-term evaluation of the project by the MCRI program.

The Milestone Report for this project covers the period January 1, 2004–December 31, 2006. Its basic structure and organization were discussed and agreed to during the first seminar and developed and submitted by the Management Committee to SSHRC, which approved it in September 2004. The Report provides a detailed description of the research activities and resources planned around the first two clusters identified in the previous section (Units 1 and 2), as well as of several related activities (Units 3 to 7) oriented to support the research activities. The Milestone Report identifies a coordinator for each unit, the main expected outcome, a description of the unit and its completion date, the deliverables and their deadlines, the team members who will carry out the unit's activities, and the unit's approximate expenditures for the period covered by the Report.

V. REPORT ON PROJECT ACTIVITIES

The report of the project activities for the period January 2004–April 2005 is presented in the following pages. This report follows the organization of the project's Milestone Report, describing the main activities and accomplishments in each of the units.

UNIT 1: VULNERABILITIES TO CLIMATE VARIABILITY

This unit involves all research project activities that constitute the first cluster and, as such, it is one of the central research components of the project. It involves an assessment of the current social and physical vulnerabilities related to current water resource scarcity in the two dryland regions and it is composed of five related projects. The following pages identify each project and the main activities that were accomplished in each of the projects during the period January 2004–April 2005:

Unit 1.A: Assessment of Vulnerabilities of Rural Communities

The main goal of this specific project is to assess the current vulnerability of a group of rural communities and households in the SSRB and ERB. This involves identifying: (i) the conditions that have or are affecting the communities and households; (ii) the adaptive capacities that the community has used in dealing with those conditions; (iii) the different evaluations that community members make of the role played by external institutions in reducing the community's vulnerability; and (iv) the community members' assessment of the ability of existing adaptive mechanisms to deal with future climate conditions. The project is expected to be completed in December 2006.

Six researchers (H. Diaz, D. Gauthier, Hector Morales, Alejandro Rojas, Sonia Salas, and Barry Smit) and

their research assistants are directly involved in this assessment of the rural communities, with the support of five other researchers (Darell Corkal, Suren Kulshreshtha, Gregory Marchildon, Bruce Morito, and Humberto Zavala) who provide expertise in different areas relevant to the assessment. The coordinator for this sub-unit is H. Diaz.

Four main project activities have been identified in the Milestone Report for April 1, 2004–April 15, 2005. They are:

1. **Baseline data collection for the communities to be studied:** In the SSRB several partners and stakeholders were consulted about the diversity of conditions existing in the basin in order to select the communities to be studied. In addition, specific information for each of the selected communities was gathered, organized and posted in the website (section "Rural Communities"). A similar process took place in the ERB. Census data, consultations with partners and stakeholders, and informal discussion groups were used to identify the potential communities. The information that was gathered about each of the research sites has been posted in the section "Rural Communities" of the project website.
2. **Development of working papers:** Two methodological papers have been developed by unit members: "Vulnerability of Communities to Environmental Change" by B. Smit, Johanna Wandel and Gwen Young. This paper systematically discusses the concept of vulnerability and the vulnerability assessment approach and describes the necessary methodological approach to the assessment of the rural communities. The second paper is "Value and Ethical Analysis in Vulnerability to Climate Change: Establishing an Analytic Framework for Identifying, Classifying and Evaluating Vulnerability Issues" by B. Morito. This paper discusses the theoretical and methodological aspects of value analysis in the assessment of the rural communities. Both papers are available on the project website (see Smit, Wandel, and Young, 2005, and Morito, 2005 in Appendix 4).
3. **Selection of a group of rural communities:** Seventeen communities were initially identified as potential research sites in the SSRB (12 in Alberta and 5 in Saskatchewan) based on conversations with partners and stakeholder organizations in both provinces. From these seventeen communities, three were selected for the vulnerability assessment to take place in the second year: Cabri and Stewart Valley (Saskatchewan) and the Blood Tribe reservation (Alberta). The selection criteria used for choosing the communities were: (a) the institutional context of the communities in Alberta and Saskatchewan; (b) type of land use (e.g. cropland agricultural communities, ranching communities, and mixed communities); (c) the type of reliance of the communities on water (e.g. reliant on irrigation, dependent on rain water); (d) communities that have experienced water stress; and (e) communities that have been involved in water conflicts. In the case of the ERB, three districts with nine small communities were selected for the study. The selection criteria involved: (a) population concentration in small communities; (b) accessibility; (c) the sharing of a common geographical space with different economic and cultural features; (d) seasonal migration; and (e) water-related problems. Three communities were identified as potential cases for the ethnographic work—El Molle, Diaguitas and Pisco Elqui.
4. **Design of instruments and gathering of information about communities:** The paper developed by Smit, Wandel, and Young identifies the methodological approach to be used in the assessment of the communities' vulnerabilities. Four main issues inform the fieldwork: (a) the conditions (exposures or stresses) faced by the community; (b) how the community has dealt with those conditions (institutionally and individually); (c) the assessment of the community of external institutions that have constrained or facilitated the community's ability to deal with those conditions; and (d) the assessment of the capacity of communities to deal with possible changes in the future.

In order to support the research work that will take place in the second year (May 2005–April 2006) several documents were produced: (a) a resource guide to community vulnerability assessment; (b) a guide to fieldwork; and (c) a guide to NVivo, a qualitative data analysis software that will be used for the analysis of the collected data.

Unit 1.B: Analysis of Water Conflicts and Institutions

This project focuses on the analysis of conflicts in both basins associated with water scarcities. Given the expected impact of climate change upon the availability of water resources, it is important to analyze the role of institutions in conflicts that have taken place around water issues and the learning derived from those experiences. This project is expected to be completed in December 2006. It involves three researchers (H. Morales, Bernardo Reyes and A. Rojas) and their research assistants. As in the previous unit, this project is supported by researchers with expertise in areas relevant to the analysis of conflicts (D. Corkal, S. Kulshreshtha, B. Morito, and H. Zavala). This sub-unit is coordinated by A. Rojas

The specific activities for this unit defined by the Milestone Report for the period May 2004–April 2005 are:

1. **Literature review and completion of working papers:** A detailed review of the literature has been done by A. Rojas with the support of the research assistant, Lorenzo Magzul.
2. **Development of working paper:** Reyes, Morales and Rojas discussed the concept of the paper and a timeline in December 2004 in La Serena, Chile. A first draft of the paper has been written by A. Rojas. The paper will be completed during the second year (2005) of the project.
3. **Identification of cases and engagement with stakeholders:** In the case of Chile a preliminary identification of cases of conflicts took place during Rojas's and Reyes's visit to La Serena and to the Elqui Valley (December 2004). L. Morales joined the team and made significant contributions to the identification of possible cases: (a) potential conflicts in Gualliguaica, Diaguitas, and the impacts of large monocultures of avocado and grapes in the hillsides; (b) Minera El Indio in VicuËa: mining operations of la Quebrada de Marquesa; (c) mining operations Carmen y Dayton, in Andacollo; (d) Mining operations Pelambres at El Mauro, Caimanes, Municipality of Los Vilos. During the December 2004 visit, meetings were held with several key informants and stakeholders (representatives of the Direccion Regional de Aguas, Irrigation Association of the Elqui Valley, and a local committee from the town of Gualliguaica). The visit also involved trips to the communities of Nueva Talcuna, Marquesa and El Molle, Diaguitas, Paihuano and Quebrada de Paihuano and Pisco Elqui. In the end, it was decided to make the Puclaro Dam and the conflictive situations linked to it the main terrain of investigation of the role of institutions in water conflicts in the area of study in Chile. In the case of Canada, the main case identified is the Oldman River Dam conflict generated by the construction of the dam (Alberta). A preliminary fieldwork in Southern Alberta to be conducted in August 2005 by Alejandro Rojas and Lorenzo Magzul is expected to provide a more complete picture of the significance of the Oldman River Dam conflict (the main case study in Alberta) for the stakeholders involved and to identify and understand important institutional adaptations beginning to take place in the area.

Unit 1.C: The Historical Study of Institutional Adaptation

The main goal of this project is to assess past vulnerabilities of peoples and communities in the SSRB and the ERB and their respective adaptations to past periods of extreme water scarcity. Beyond providing a baseline for contemporary research and analysis, these studies should also highlight the experience and institutional capital that has accumulated over time in both the SSRB and the ERB in response to past crises and difficulties. This project should be completed by December 2006.

The project involves G. Marchildon—the coordinator for the sub-unit—with the support of Corkal, Kulshreshtha and Wheaton as advisors on the SSRB portion of study. A Chilean scholar and researcher, Prof. Hernan Cortes of the Universidad de La Serena, was identified in January 2005 as key participant on the ERB portion of study with Marchildon acting as an advisor. H. Cortes will initiate the Chilean portion of the project in May 2005.

Based upon the Milestone Report for April 1, 2004–April 15, 2005, the following progress has been made.

1. **Working Papers**: Three climate and human adaptation working papers covering the pre-agricultural history of the SSRB written by James Daschuk (post-doctoral research associate) and edited by Gregory P. Marchildon have been completed. Their titles are "Overview of Climate and Aboriginal Adaptation in the South Saskatchewan River Basin before the Settlement Period," "Climate and Aboriginal Adaptation in the South Saskatchewan River Basin, A.D. 800-1700," and "Climate and Aboriginal-Newcomer Adaptation in the South Saskatchewan River Basin, 1700-1800."
2. **Statistical compendium:** Work is ongoing on a comprehensive statistical compendium of agriculture and drought by province (Alberta, Saskatchewan and Manitoba), annually from 1905 to the present, including economic data such as crop yields and farm income (provincial averages). G. Marchildon, with the support of Carl Anderson (graduate student at the University of Regina) is in the process of completing a draft of that compendium. The first draft will be provided to S. Kulshreshtha who will then advise on possible improvements and extensions to the compendium.
3. **Drought study:** A spatial identification of drought and impact by municipality in Alberta and Saskatchewan, highlighting the SSRB, from 1905 to present, is being developed by G. Marchildon and S. Kulshreshtha, supported by C. Anderson, and in consultation with Elaine Wheaton and David Sauchyn. Research has begun and is expected to be completed in 2006.
4. **Historical case study:** A case study of the origins and impact of the Prairie Farm Rehabilitation Agency (PFRA) in response to the drought crisis of the 1930s has been carried out by G. Marchildon, supported by the research assistance of C. Anderson and Roberta Lexier (Ph.D. graduate history student at the University of Alberta). A survey essay (archival and secondary literature review) was completed by C. Anderson in 2004. Marchildon will produce a scholarly article in 2006 based upon the research.
5. **Case study of Alberta's early drought relocation efforts following the First World War:** A study done by G. Marchildon and supported by the research assistance of R. Lexier is in progress. A survey essay (archival and secondary literature review) will be completed by December 1, 2005, followed by a scholarly article in 2006.
6. **Case study of the Saskatchewan Relief Commission, 1931-1934:** The archival research for this study was completed in early 2005 and a working document is in progress.

G. Marchildon has also agreed to provide advice to the research team in the area of health and climate change. A working paper, "Climate and Health: Some General Observations for the IACC Project," was produced in early 2005 (see Marchildon, 2005, in Appendix 4).

Unit 1.D: Analysis of Environmental Vulnerabilities

The main goal of this project is to identify the current physical and environmental vulnerabilities related to water resource scarcity in the SSRB and the ERB. The project's completion has been planned for 2006. The participants are Jorge Cepeda, Melitta Fiebig, David Sauchyn (the coordinator of the sub-unit), and Elaine Wheaton, with the support of S. Kulshreshtha, D. Corkal, and H. Zavala, and research assistants.

The activities identified in the Milestone Report for the first year of the project are:

1. **Development of working papers:** Two papers that integrate the current knowledge on natural aspects of both basins were developed during the first year. The first paper, "South Saskatchewan River Basin Biogeography," was produced by D. Sauchyn and Silvia Lac. The second paper, "A general description of the ERB," was produced by J. Cepeda, M. Fiebig, and H. Zavala, with the support of several research assistants (see Sauchyn and Lac, 2005, and Cepeda, Fiebig and Zavala, 2005 in Appendix 4).
2. **Baseline data collection:** Several activities took place in the context of the baseline data collection. They are
   a. A review of the current and available literature on the physical geography, climatic and hydrological characteristics, and biological and ecological information about the two basins is in progress.
   b. Development of data bases on physical aspects of the SSRB and ERB (e.g., topography, soil types,

land use, geomorphology, climatic types, hydrology, plant formations, and natural hazards). From this data base, several thematic maps were prepared using geographic information systems to be included in the papers.

c. Databases on climatic and hydrologic aspects of the SSRB and ERB have been prepared. Information from these databases has been used to update the corresponding sections of the papers.

d. Physical, landscape and human features of the ERB have been photographed to implement a pictorial data basis for teaching and dissemination purposes.

Unit 1.E: Assessment of Formal Institutions

The main goal of this sub-unit is to assess the current and future capacity of public institutions to reduce the vulnerability of rural communities and households in the SSRB and the ERB. Most of the research activities in this unit have been planned as a continuation of the community vulnerability assessment. Thus, activities during the first year have been restricted to the development of a conceptual framework and the establishment of initial links with institutions. These activities have been carried out by H. Diaz (the sub-unit coordinator), D. Gauthier, A. Rojas, S. Salas, H. Morales, and D. Corkal, with the support of research assistants.

The activities identified in the Milestone Report for April 1, 2004–April 15, 2005 are:

1. **Development of working papers:** A paper was been developed by A. Rojas and H. Diaz, with the support of H. Morales and research assistants L. Richer and S. Jeannes. The paper focuses on the definition of "institution," the operationalization of the term for the purposes of the project, a discussion of the term "institutional adaptive capacity," and the identification of the components of this capacity. The paper has been posted on the website. A second working paper was written by A. Rojas and L. Richer on "Successful Institutional Adaptation to Climate Change Impacts Posed on Water Resources." The paper explores the concept of successful adaptation and provides an extensive review of the literature on the topic. The paper has been posted on the website.
2. **Selection of institutions:** Two types of activities have been carried out in this area.
   a. Contacts with institutions: Several meetings with institutional representatives have taken place in Canada and Chile. In Canada, D. Gauthier, D. Corkal, and H. Diaz visited several institutions in Alberta and Saskatchewan to discuss the project and to establish initial links. Some of these institutions are the North Saskatchewan Watershed Alliance, the Northern Forestry Centre, Alberta Research Council, PFRA, Bow River Basin Council, Alberta Environment, University of Lethbridge Water Institute for Semiarid Ecosystems, Alberta Agriculture, Canada West Foundation, Partners for the South Saskatchewan River Basin, and the Saskatchewan Watershed Authority. Similar encounters in Chile took place with the ARCIS University, the Economic Commission for Latin America, the Centre of Mathematical Modelling of the University of Chile, National Commission of the Environment, Directorate of Hydrological Works, General Directorate of Water, Department of Environmental Sciences and Natural Resources of the University of Chile, the Centre for Planning and Research of the Environment (CIPMA), the Water Centre for Arid and Semi-Arid Zones (CAZALAC), the Institute for Rural Education, and the Junta de Vigilancia del Rio Elqui.
   b. **Information about institutions:** Information was gathered about the main institutions in the areas of climate and water resources in Chile and Canada. An appendix to Rojas' and Diaz' paper identifies the main institutions and institutional dynamics in both countries. In addition, a working paper (in Spanish) produced by Morales and Espinoza describes the main institutions in Chile and their functions.

UNIT 2: CLIMATE CHANGE SCENARIOS

This unit involves Cluster 2 activities. It examines the potential contingent effects of climate change risks on the identified vulnerabilities to water resource scarcity. Achieving this outcome involves: (a) an analysis of a range of climate change model scenarios; and (b) an assessment of how these scenarios could impact the current social and physical vulnerabilities in the regions as determined from Unit 1. The completion date for this project is June 2007. Participants in this project are D. Sauchyn and E. Wheaton (Canada) and J. Cepeda and M. Fiebig (Chile), supported by research assistants and one technician (Virginia Wittrock). D. Corkal and H. Zavala are advisors to this project. D. Sauchyn is the coordinator of the unit.

The main activities identified in the Milestone Report for this project during the period January 1, 2004–April 30, 2005 are:

1. **Baseline data collection:** Data collection for the two basins is in progress.
2. **Development of working papers:** A draft of a working paper that describes the climate and impact scenarios for the SSRB has been developed. It will be completed during the second year of the project.

UNIT 3: STUDENT TRAINING

Student training is an important component of project activities. Training is oriented to increase the students' methodological skills and their knowledge of climate change issues. It takes place through: (a) specific courses that students could take as part of their course requirements; (b) training materials posted to the project web site with capability for on-line discussion among students and researchers; and (c) training on the job – acquiring practical skills by being engaged in the research activities of the project. All researchers are responsible for on-the-job training and website dissemination materials. The coordinator for this unit is D. Sauchyn.

During the period January 1, 2004–April 30, 2005 the following training activities took place:

1. **Courses:** Two courses were offered by members of the research team for a group of research fellows:
   a. a course focused on the impacts of climate change on biophysical and social systems, and the adjustments to policies and practices that will be required to minimize the negative impacts (Geography 491/891, Department of Geography, University of Regina); and
   b. a course focused on issues related to the social impacts of climate change and the possibilities for a just, effective, and sustainable adaptation to the new climatic conditions (Sociology 880, Department of Sociology and Social Studies, University of Regina).
2. **Material posted in the website:** Three documents were posted in the website (http://www.parc.ca/mcri/training.php) with the purpose of improving the assistants' capabilities in the area of research:
   a. **Resource Guide for Community Vulnerability Assessment:** This guide is an introductory overview of the ethnographic research approach that characterizes the community vulnerability assessment. It describes the main components of ethnographic research and acts as a guide to different sources containing more detailed discussion of these components.
   b. **Fieldwork Guide:** This guide provides the research assistants working in the area of community vulnerability assessment with some common guiding principles for undertaking fieldwork.
   c. **NVivo Guide:** This is a brief introductory overview and guide to NVivo (a qualitative data analysis software) for researchers and research assistants undertaking community vulnerability assessment. NVivo will be used for the analysis of the collected data and preparation of project reports. The purpose of this guide is to introduce researchers to the NVivo software in a cursory manner, laying out some of the basic characteristics and functions of the software.

3. **Training on the job:** Several research assistants have been active in the collection of baseline material, the preparation of documents and the elaboration of working papers, and in the organization of seminars, under the direction and supervision of the members of the research team.

UNIT 4: GEOSPATIAL DATA

This unit has as its main purpose the development of a geospatial dataset. Data produced by activities in Units 1, 2, and 6 will be organized in a geospatial format using GIS to provide regional context for team members such that the scenarios can be readily applied to regional planning and resource management and used for dissemination purposes. The coordinator for this unit is D. Gauthier

During the period January 1, 2004–April 30, 2005 the following geospatial data activities took place:

1. Information about geospatial data sets (physical, social, economic) for the SSRB and ERB has been gathered and is available for all project researchers and assistants. In addition, summary digital data sets for SSRB and ERB are in development (D. Gauthier, Lorena Patino and Andres Bodini).
2. Preliminary SSRB watershed maps were produced by PFRA Calgary (D. Corkal).
3. Application was made to the Canadian Space Agency to gather Radarsat data from Convair 580 aircraft of the St. Denis wetlands in SSRB; this collaboration with Environment Canada and the National Hydrology Research Centre will be used to correlate drought index data with soil moisture (D. Corkal).

UNIT 5: DISSEMINATION OF MATERIALS

This unit has as its purpose the development and delivery of materials to stakeholders, partners, academics, policy-makers, and the general public. To maximize access to these audiences during the life of the project, research processes and results will be communicated through annual project reports; a website; dissemination meetings (local workshops) involving stakeholders; public presentations; and information about the project that will be distributed among stakeholder groups and the public in general using NGO and government newsletters as well as radio programs and local newspapers. The coordinator for this unit is D. Gauthier.

During the period covered by this report the following activities were carried out in this unit:

1. Design and implementation of the project website. As indicated before, the website was developed with the support of one of its partners: the Prairie Adaptation Research Collaborative. This website contains both a public side, which is accessible to all those interested in obtaining further information about the project, partners and researchers.
2. Public presentations.
3. Media information.
4. Stakeholder meetings

Details of the presentations, media releases, and stakeholder meetings are found in Appendix 5.

UNIT 6: INTEGRATION

The purpose of this unit is to promote mechanisms for the development of a broadly based collaborative research as the central mode of research activity among the members of the team, as well as between the team and partners. The coordinator is H. Diaz.

During the period under report some of the most important activities in this area were the following:

1. **Development and revision of conceptual frameworks**: As indicated previously, one of the most important accomplishments of the 2004 project meeting was the development of an integrative con-

ceptual model. This model has played a central role in the planning and delivery of all the project activities.

2. **Development of information on integrative frameworks**: Information is being gathered using GIS and indicator frameworks as integrative tools.
3. **Planning of integrative activities:** Significant efforts have been made to integrate people from different disciplines in the initial visits to institutions and research sites, as well in the planning of research activities.
4. **Exchange activities—web site:** The website of the project contains a section that is private to project members. This section contains a variety of information designed to keep team members informed of the different developments and implementation of activities. In addition to information about meetings, working papers, research instruments, training, and other project activities, the section includes a calendar of activities and a message board.
5. **Exchange activities—annual meetings:** The first annual meeting of the project took place at the University of Regina in April 27-30, 2004. During the reported period the second meeting was organized. This meeting took place at the Universidad de La Serena, La Serena (Chile) in April 25-29, 2005.
6. **Exchange activities—internal reports**: two internal reports were developed during the year. The first covered the period May 1-October 31, 2004 and the second the period November 1, 2004–March 31, 2005. These two reports were posted on the website for the team members.
7. **Exchange activities—teleconferences and others:** Several teleconferences took place with the purpose of organizing and delivering the activities of the project.

UNIT 7: PROJECT ADMINISTRATION

The project is under the direction of the main investigator, Harry Diaz, who is responsible for the general supervision of the project activities and financial expenses. The management of the project is carried out by a Management Committee composed of H. Diaz, D. Gauthier, D. Sauchyn and the Project Manager, Pat Barrett-Deibert. The managerial functions of the management committee involve: (a) the development of general work-plans based on the agreements reached by the team members during the annual project meetings; (b) the monitoring and coordination of project activities; (c) supervision of financial activities; (d) preparation of narrative and financial reports; and (e) organization and chairing of the project's annual meetings.

For further information about the report and/or the project please contact any of the following persons:

Dr. Harry Diaz, (306) 585-4151, harry.diaz@uregina.ca

Dr. David A. Gauthier, (306) 585-4758, david.gauthier@uregina.ca

Dr. David Sauchyn, (306) 337-2299, david.sauchyn@uregina.ca

Ms. Pat Barrett-Deibert (306) 585-4788, pat.barrett-deibert@uregina.ca

For free copies of the report see the IACC website: http://www.parc.ca/mcri

APPENDIX 1: PROJECT PARTNERS

- Alberta Environment, Canada
- Athabasca University, Canada
- Canadian Plains Research Center (CPRC), Canada
- Centro del Agua para Zonas Áridas y Semiáridas de América Latina y el Caribe Chile
- Centro de Estudios Regionales, Chile
- Comisión Nacional del Medio Ambiente, Chile
- Instituto de Ecología Política, Chile
- Meteorological Services of Canada, Environment Canada
- National Water Research Institute, Canada
- Prairie Adaptation Research Collaborative (PARC), Canada
- Prairie Farm Rehabilitation Administration, (PFRA), Agriculture and Agri-Food Canada
- Saskatchewan Research Council, Canada
- Saskatchewan Watershed Authority, Canada
- University of British Columbia, Canada
- University of Guelph, Canada
- University of La Serena, Chile
- University of Regina, Canada
- University of Saskatchewan, Canada

APPENDIX 2: PROJECT TEAM MEMBERS

The project team consists of fourteen researchers from five Canadian universities and two Chilean universities and three collaborating partners. The project team members are as follows:

Researchers:

- Dr. Jorge Cepeda-Pizarro (Ecology, Biology, University of La Serena, Chile)
- Dr. Harry Diaz (Sociology, University of Regina, Canada)
- Dr. Melitta Fiebig (Mathematics, Universidad de La Serena, Chile)
- Dr. David Gauthier (Geography, Arts, University of Regina and Director, Canadian Plains Research Center, Canada)
- Dr. Suren Kulshreshtha (Agricultural Economics, University of Saskatchewan, Canada)
- Dr. Gregory P. Marchildon (Economic and Regional Development, Administration, University of Regina, Canada)
- Dr. Bruce Morito (Philosophy, Athabasca University, Canada)
- Dr. Héctor Luís Morales (Administration/Tourism, Universidad de La Serena, Chile)
- Bernardo Reyes (Environment and Sustainability, Universidad ARCIS and Universidad de Chile, Chile)
- Dr. Alejandro Rojas (Faculty of Land and Food Systems, University of British Columbia, Canada)
- Dr. Sonia Salas (Psychology, Universidad de La Serena, Chile)
- Dr. David Sauchyn (Geography, Arts, University of Regina, and Research Coordinator, Prairie Adaptation Research Collaborative, Canada)
- Dr. Barry Smit (Geography, Global Environmental Change, University of Guelph)
- Elaine Wheaton (Climatology, University of Saskatchewan and Saskatchewan Research Council)

Collaborators:

- Hernan Cortes (History, Universidad de La Serena, Chile)
- Darrell Corkal (Water Quality, Prairie Farm Rehabilitation Administration)
- Humberto Zavala (Engineering, Universidad de La Serena, Chile)

The work of researchers and collaborators has been supported by several assistants. Assistants are graduate students who are integrated into the project as Research Assistants or Research Fellows. Research assistants participate in the project by doing specific work in the area of research and/or dissemination. They are paid on an hourly basis and are not requested to participate in the project beyond their specific work. Research Fellows are graduate students with a higher level of integration into the project. In addition to working as research assistants these students receive training, produce related graduate theses, and participate in the annual meetings of the project. They could have a high degree of permanency in the project (up to three years for Masters and five years for doctoral students).

The students who have participated in the activities of the first year of the project, both as research assistants and research fellows, are the following (team members acting as supervisors are identified within brackets):

Research Assistants

- Alfaro, Salvador: PhD. Candidate, Sociology, University of Regina, (H. Diaz)
- Anderson, Carl: PFRA, Master student, History, University of Regina. (G. Marchildon and D. Corkal)
- Cabezas, Ricardo C. Licenciate student, GIS and Remote Sensing, Universidad de La Serena, (J. Cepeda)

- Daschuk, James: research associate, University of Regina (G. Marchildon)
- Duthier, Katherine: Master student, Philosophy, University of Alberta, (B. Morito)
- Knuttila, Erin: Master candidate, Sociology, University of Regina (H. Diaz)
- Lexier, Roberta: PhD student, History, University of Alberta. (G. Marchildon)
- López, Francisco C.: Licenciate student, Biology, Universidad de La Serena (J. Cepeda).
- Massie, Merle, independent researcher, (D. Gauthier and H. Diaz)
- Munizaga, Ivan: Licenciate student, Engineering, Universidad de La Serena, (H. Zavala).
- Perez, Cesar: Master student, Universidad de la Serena (M. Fiebig)
- Pizarro, Jaime A.: Licenciate student, Biology, Universidad de La Serena (J. Cepeda)
- Richer, Liska: PhD candidate, Agricultural Sciences, University of British Columbia (A. Rojas)
- Robles, Marcela I.: MS Student, Geography, Universidad de La Serena (J. Cepeda)
- Schwartz, Enrique: Licenciate student, Universidad ARCIS, (B. Reyes)
- Trigos, Hernaldo: Licenciate student, Engineer, Universidad de La Serena, (H. Zavala)
- Turner, Jeff: Master student, Geography, University of Guelph (B. Smit)
- Weiss, Stephen: Master student, Geography, University of Regina (D. Gauthier)
- Wuschke, Brian: Master student, Geography, University of Regina (D. Sauchyn)

Research Fellows

- Espinoza, Roxana: Master student, Economics, Universidad de La Serena (H. Morales)
- Jeannes, Stephanie: MA student, Sociology, University of Regina (H. Diaz)
- Jimenez, Elizabeth: MA candidate. Center for Latin American Studies, Universidad de La Serena (S. Salas).
- Lac, Sylvia: PhD Candidate, Canadian Plains Studies, University of Regina (D. Sauchyn)
- Magzul, Lorenzo: PhD candidate, Agricultural Studies, University of British Columbia, (A. Rojas)
- PatiËo, Lorena: PhD candidate, Geography, University of Regina (Gauthier)
- Wandel, Johanna: PhD Candidate, Geography, University of Guelph, (B. Smit)
- Young, Gwen: Master Candidate, Geography, University of Guelph, (B. Smit)

Finally, the project has been supported by the work of a group of technicians and administrative assistants. They are:

Technicians:

- Bodini, Andrés, GIS, Universidad de La Serena (J. Cepeda, S. Salas).
- Lac, Silvia, Website, Prairie Adaptation Research Collaborative (D. Sauchyn, H. Diaz, D. Gauthier)
- Velez, Maria, Website, Prairie Adaptation Research Collaborative (D. Sauchyn, H. Diaz, D. Gauthier)
- Wittrock, Virginia, Data, Saskatchewan Research Council (E. Wheaton and S. Kulshreshtha)

Administrative Assistants:

- Barrett-Deibert, Pat, Project Administrative Assistant, Canadian Plains Research Center, University of Regina.
- Araya, Solange, Project Administrative Assistant, Universidad de La Serena, Chile.

APPENDIX 3: THE ADVISORY BOARD

The Advisory Board offers advice and guidance to the Director of the Project and the Management Team in particular and the research team in general on all matters relevant to the project. Its members meet formally once a year, at the same time and location of the annual project team meeting.

The Advisory Board of the IACC project has three members. They are:

- Phil Adkins. Mr. Adkins is the Acting Director of the Agricultural Water Directorate, Agriculture and Agri-Food Canada (AAFC) PFRA, and was recently the Acting Manager of the Prairie Agroclimate Unit. He is a civil engineer with considerable experience in the management of water supplies and engineering of water control structures. This includes participation in CIDA missions in Ethiopia and Indonesia and work as a CIDA consultant to the U.N. Food and Agriculture Organization.
- Horacio Larrain. Dr. Larrain is a social anthropologist with a significant interdisciplinary background. In addition to having a large number of publications in social anthropology and ethnohistory, Dr. Larrain has also published in the areas of bioclimatology, biogeography and zoology, with an emphasis on coastal fog issues in Northern Chile. He teaches at the Universidad Bolivariana, in the Iquique Campus.
- Martin Mujica. Dr. Mujica is a former professor of Sociology at the Université de Moncton (Canada) and a research fellow of the Interdisciplinary Research Group on Environmental Management of the Université de Québec ą Montréal. He has significant experience in international research, having worked with CIDA and IDRC for several years in the areas of sustainable development.

P. Adkins and M. Mujica became members of the Advisory Board in March 2004. H. Larrain joined the Board in April 2005. They have agreed to serve for the duration of the project.

APPENDIX 4: WORKING PAPERS

The documents described in this appendix are those that were produced during the period January 1, 2004–April 30, 2005. Each entry provides the author(s), year in which the paper was delivered, title, the language of the document, an abstract, and the website address where the document can be found. The papers are either in English or Spanish.

Alfaro, Salvador, 2004, Institutions and Sustainability. An Analytical Report. (English)

Abstract: Today, we constantly hear of a wounded planet in need of urgent human actions. Through patterns of production and consumption, we are facing problems such as resource depletion, climate change, desertification and deforestation. These patterns are largely determined by institutional arrangements. This paper is a contribution to the discussion of institutional adaptation to climate change. It discusses some of the fundamental issues associated with institutional arrangements and the changes that might be implemented within existing political and institutional settings in order to contribute to the process of sustainability in the context of global change. (www.parc.ca/mcri/papers.php)

Cepeda, Jorge, Melitta Fiebig-Wittmaack, Hector Morales, and Sonia Salas, 2004, "Description of the Elqui River Basin" (English)

Abstract: This paper provides a preliminary description of the Chilean study area. It includes five parts: introduction (part 1); a general description and the economic activities of the study area (part 2); a general description on the regional climate and hydrology, including ENSO effects on hydrological cycle with emphasis in the study area (part 3); the climate change vulnerabilities in natural systems with relevance to the study area (part 4); a description of the social systems and a preliminary assessment of the climate change vulnerabilities and adaptation options in human systems with relevance to the study area (part 5). (www.parc.ca/mcri/papers.php)

Cepeda, Jorge and Jaime Pizarro, 2005, "Ecología del Valle del Elqui. Insectos y Otros Artrópodos" (Spanish)

Abstract: From an altitudinal transect, information on the presence and importance of arthropods associated with agricultural crops and human health in six localities of the Elqui river valley is provided. The localities are El Molle, Diaguitas, Quebrada Huanta, Pisco Elqui, Horcón and Alcohuaz. The presence of 46 species of insects and 19 of arachnids is recognized. Of these, nine and one, respectively, can be considered as of economical importance to agricultural crops. They attack one or more hosts being grown in the area. Among the species important to human health, it is recognized that the arachnids Loxosceles (brown recluse spider) and Latrodectus (black widow spider), and the hemipterans Triatoma (indoor kissing bug) and Mepraia (outdoor kissing bug), are vectors of Chagas' disease in the valley. The most diverse family in the rain-fed sites is Tenebrionidae, represented by nine species; Carabidae comes next with three genera. As further demographic studies may indicate, some of the species making up the arthropod assemblage can be good indicators of climate change. (www.parc.ca/mcri/papers.php)

Cepeda, Jorge and Francisco López, 2004, "Sistemas Naturales de la Hoya Hidrográfica del Rió Elqui: Variabilidad Climática y Vulnerabilidad" (Spanish)

Abstract: Different numerical models predict that surface mean temperature of the Earth will increase by at least 2ľC by the year 2030. According to such climate predictions, north-central Chile will experience a decrease in rainfall, an increase in frequency and temporal extension of droughts, a rise in air temperature, upward displacement of snowline, and increments in snow melting and summer and spring flowstream. Given the Mediterranean climate, winter rainfall is the main source of water in the basin; a key element in the hydrologic budget is amount and the time of arrival of mountain snowfall. As a result of prevailing arid

conditions, the Elqui Valley basin constitutes an ecosystem of low natural productivity; both biodiversity and ecological productivity are strongly linked to land units where water is available. Because of this, low and midland valleys are characterized by a high inter-annual variability in water availability, accompanied by extensive and severe droughts. On this environmental scenario, a high priority needs to be set on the possible effects of these climate changes on the local biological and productive systems. Hazard occurrence (derived from floods, high stream-flows, runoff and landslides, extended droughts, aridization and intensification of desertification) may increase under these climate-related changes. Risk of damage to humans, property and local economical productivity will also increase if preventive strategies are not anticipated to confront these events. (www.parc.ca/mcri/papers.php)

Cepeda, Jorge et al., 2005, "Caracterización Bio-Geo-Física de la Cuenca del Rió Elqui" (Spanish)

Abstract: This document describes the main bio- and geophysical characteristics of the Elqui River Basin. The document is a monograph composed of different papers, all of them prepared by members of the IACC project in the Universidad de La Serena. These papers are:

1. Cepeda, J., M. Robles and R. Cabezas, "Una Descripcion General Biofisica de la Hoya Hidrografica del Rio Elqui (IV Region de Coquimbo, Chile)," describing the climate and vegetation of the ERB;
2. Cepeda, J., M. Robles and R. Cabezas, "Geomorfologia y Suelos de la Hoya Hidrografica del Rio Elqui (IV Region de Coquimbo, Chile)," containing a description of landforms and soils in the basin;
3. Fiebig-Wittmaak Melitta and Cesar Perez, "Aspectos Climatologicos del Valle del Elqui," focusing on the climatologic aspects of the ERB;
4. Zavala, Humberto, Hernaldo Trigos, Ivan Munizaga, and Enrique Mall, "Hidrologia Cuenca Rio Elqui," explaining the hydrological characteristics of the basin;
5. Cepeda, Jorge and Jorge Pizarro, " Ecologica del Valle del Elqui," describing the main characteristics of the basin's ecology; and
6. Fiebig-Wittmaak Melitta and Cesar Perez, "Eventos Catastroficos Naturales," containing a discussion of the main natural hazards in the area. (www.parc.ca/mcri/elqrb.php)

Daschuk, Jim and Greg Marchildon, 2005, "Overview of Climate and Aboriginal Adaptation in the South Saskatchewan River Basin before the Settlement Period" (English)

Abstract: This paper provides a brief overview of climatic change and human adaptation in the SSRB from A.D. 800 to the beginning of European settlement period at the end of the 19th century. The analysis is based on the variables identified by Smit et al. in their "Anatomy of Adaptation to Climate Change and Variability" (2000). Prior to the adoption of introduced forces such as the horse and the European-based market economy, the SSRB, though more prone to drought than in the 20th century, served as a refuge for aboriginal groups whose home territories were unsustainable. Susceptibility to negative climatic stimuli increased as a consequence of the integration of the region into the global economy. By the end of the 19th century, the bison herds, the bedrock of the aboriginal economy for millennia, were extinct and with the exception of the Blackfoot people of Southern Alberta, First Nations were expelled from the SSRB to make way for European agrarian settlement of the region. (www.parc.ca/mcri/elqrb.php)

Daschuk, Jim and Greg Marchildon, 2005, "Climate and Aboriginal Adaptation in the South Saskatchewan River Basin, A.D. 800-1700" (English)

Abstract: Climatic variability was the principal cause of cultural changes in the SSRB and the Northern Great Plains during the late prehistoric period. During the benign conditions associated with the Neo-Atlantic Climatic Episode (A.D. 900-1200), the SSRB and surrounding grasslands were relatively stable with regard to human occupation. During the same period, populations in the adjacent woodlands, particularly to the east and southeast of the SSRB, underwent an extended period of cultural change and expan-

sion as a consequence of longterm improvement in climactic conditions. In regions surrounding the SSRB, the climatic deterioration associated with the Pacific Climatic Episode (A.D. 1200-1550) drove many woodland groups to the relative stability of the SSRB and northern Great Plains. Southeast of the SSRB, protracted desiccation prompted a region-wide abandonment of agriculture and a shift toward bison hunting. As conditions worsened during the Neo-Boreal Climatic Episode (A.D. 1550-1850), migrations to the SSRB from the woodlands to the east continued. Competition for resources, particularly bison, increased as groups originating south of the 49th parallel shifted their focus northward to the SSRB. Although long-term temperature decline and protracted drought undoubtedly reduced the biomass and available food supply in the SSRB, the impact of declining conditions in the regions surrounding it were much more severe. For more than 500 years after A.D. 1200, the SSRB and vicinity served as a relative refuge for groups experiencing climatically driven environmental stress. The dynamics of those migrations, undertaken during a period of protracted hardship, is essential to the understanding of both climatic adaptation and tribal occupation of the SSRB and the northern Great Plains generally. (www.parc.ca/mcri/papers.php)

Daschuk, Jim and Greg Marchildon, 2005, "Climate and Aboriginal-Newcomer Adaptation in the South Saskatchewan River Basin, 1700-1800" (English)

Abstract: The 18th century marked a time of unprecedented changes in indigenous adaptation patterns to climatic variability in the SSRB. European influences usurped climactic stimuli as the pre-eminent cause of material and cultural change in the region. Inhabitants of the region had to contend with new challenges arising from the fur trade economy and found themselves increasingly vulnerable to the effects of negative climatic stimuli. The four-hundred year pattern of westward migration by woodland peoples into the SSRB dramatically accelerated as they moved to meet the demands created by the fur trade. Additionally, in the mid-1700s, the introduction of the horse led to an equestrian dependency that further compromised the security of groups to the climatic variability. Differential access to horses and European goods, particularly firearms, affected the balance of power in the SSRB and contributed to the forcible displacement of some groups. Finally, in the 1780s, a devastating epidemic struck the plains with such ferocity that some groups ceased to exist as distinct entities; leading to the emergence of new equestrian communities. The fragility of horse populations in the face of unpredictable harsh weather patterns at the end of the 18th century highlighted the increased susceptibility of Basin peoples to negative climactic stimuli. Herd depletion limited the ability of various groups to participate in the commercially driven bison hunt. Afflicted parties sought to replenish their herds by engaging in opportunistic raids upon adjacent populations. The ensuing warfare over horses, territory, and status within the fur trade further endangered the ability of all groups in the region to survive extreme climactic episodes. Once aboriginal societies in the SSRB began making adaptations to accommodate the European-controlled fur trade economy, they ceased employing and refining those coping strategies which had previously buffered Basin occupants from destructive climatic stimuli. (www.parc.ca/mcri/papers.php)

Diaz, Harry, Alejandro Rojas, Lisa Richer, and Stephanie Jeannes, 2005, "Institutions and Adaptive Capacity to Climate Change" (English)

Abstract: The paper is focused on conceptual and methodological issues relevant to the evaluation of the roles played by formal public and private institutions in reducing the vulnerability of rural communities. It discusses the need to study and understand institutional adaptations and clarifies the definition and operationalisation of institutions. It provides a working definition of institutional adaptive capacity and discusses the main components for a successful evaluation required for creating a successful structured institutional adaptive capacity, relating these components to three elements: inputs, processing, and outputs that are described to be later assessed during the evaluation of the adaptive capacities of public institutions. The paper contains an appendix that provides a detailed description of the main institutions in the area of water management in Chile and Canada. (www.parc.ca/mcri/papers.php)

Espinoza, Roxana and Héctor Morales, 2004, "Estudio de Comportamientos y Opiniones de Dirigentes y Socios de los Comités de Agua Potable Rurales, Provincia del Elqui, Chile"

Abstract: The document discusses the profile of the organizations that manage rural potable water in Chile. The main functions of these organizations are to obtain, to distribute, and to administer the potable water rural in the rural community. Their members are the homeowners in the community and they participate, with right to vote, in the meetings of these organizations. The document discusses the results of two studies carried out among members of these organizations in the Elqui Basin. The studies emphasize problems related to internal control and planning, and make several proposals on how to deal with them. (www.parc.ca/mcri/papers.php).

Espinoza, Roxana and Héctor Morales, 2005, "Planeacion Estratégica para los Comités de Agua Potable Rural" (Spanish)

Abstract: The document discusses the institutional problems of the Rural Potable Water Committees in the Coquimbo Region of Chile. These committees do not have a proper regulatory framework and, consequently, they lack juridical stability. The document discusses a strategic plan to transform these committees into strongly structured and sustained organizations. The conversion of these committees into co-operatives could be a viable means of maintaining community participation. (www.parc.ca/mcri/papers.php)

Lac, Silvia, 2004, "A climate change adaptation study for the South Saskatchewan River Basin" (English)

Abstract: The paper provides a preliminary assessment of adaptation options for the SSRB and the identification of the most important key players involved. This study includes six parts: an introduction (part 1); a description of the study area (part 2); a review on the climate change prediction tools and impacts for the study area (part 3); the climate change vulnerabilities and adaptation options in natural and human systems with relevance to the study area (part 4); conclusions and discussions (part 5); and references (part 6). Among the human systems vulnerabilities to climate change, further analysis has been done on the water resources sector. (www.parc.ca/mcri/papers.php)

Marchildon, Gregory, 2005, "Climate and Health: Some General Observations for the IACC Project" (English)

Abstract: Because human communities and individuals are part of both local and global ecosystems, health conditions within them are influenced to a significant degree by climatic fluctuation. Changes in microbial ecosystems, the source of disease among human and animal populations, are often the direct result of variability of water. This paper considers three aspects of the interaction between water, disease, and human populations. The three aspects are temperature (in particular the significant warming of the past decades), drought, and overabundance of water. The three variables are intimately related and, as with any other aspects of ecosystems, cannot be easily separated from one another. (www.parc.ca/mcri/papers.php)

Morales, Héctor Luís and Roxana Espinoza, 2004, "Adaptaciones Institucionales al Cambio Climático. Instituciones Relacionadas con el Agua en Chile y en la Región de Coquimbo," (Spanish)

Abstract: The institutional system concerned with water issues in Chile is composed of a large number of public and private organizations. The document describes the history and roles of these organizations, as well as their relationships with stakeholders interested in water resources. The organizations discussed in the document involve (a) a group of public institutions (General Water Directorate, Hydrological Work Directorate, the National Commission of the Environment, and the National Commission for Irrigation; (b) research organizations (CAZALAC and CEAZA); (c) irrigation organizations (Juntas de Vigilancias); and

(d) service provider organizations (Aguas del Valle and Comités de Agua Potable Rural). (www.parc.ca/mcri/papers.php)

Morales, Héctor and Roxana Espinoza, 2005, "Organizaciones de Usuarios de Agua de la Cuenca del Rió Elqui" (Spanish)

Abstract: The distribution of the water from the Elqui River is under the direct management of user organizations called "Asociaciones de Canalistas." Those who have received water allocations organize themselves into these "Asociaciones de Canalistas," which administer and coordinate the use of water among the users. The document discusses the existing irrigation infrastructure in the Elqui valley and describes the two main "asociaciones" existing in basin, as well as the legal norms that define their existence. (www.parc.ca/mcri/papers.php)

Morales, Héctor and Roxana Espinoza, 2005, "Inversiones Regionales en Infraestructura en Recursos Hídricos. Región de Coquimbo, Chile 1990-1994" (Spanish)

Abstract: The document presents statistical information for expenditures on public works in the area of water and sewage for the Coquimbo Region. It discusses these expenditures under different governments, focusing in the periods 1976 to 1984 and 1990 to 2000. These investments are important for both social and productive purposes. The document notes that expenditures on infrastructure are directly related to the country's economic growth and the role of state as a facilitator for capital investments. (www.parc.ca/mcri/papers.php)

Morito, Bruce, 2005, "Value and Ethical Analysis in Vulnerability to Climate Change: Establishing an Analytic Framework for Identifying, Classifying and Evaluating Vulnerability Issues" (English)

Abstract: The function of a values analysis is to provide a comprehensive framework for identifying, categorizing and evaluating the values affected by decision and policy making. In part, it is motivated by a need to ensure appropriate representation and weighting of the sorts of values that are often seen as incommensurable with economic values and cost-benefit analysis. This paper describes the reasoning behind the development of a value analysis, the procedure involved in conducting such an analysis and how values analysis can be connected to ethnographic research. The paper also assesses the literature on vulnerability to climate change with an eye to how well it represents the diversity of values pertinent to stakeholder vulnerability. It then incorporates the three functions of value analysis with the functions of ethnographic research as set out in the team's working paper by Smit, Wandel and Young, "Vulnerabilities of Communities to Environmental Change." (www.parc.ca/mcri/papers.php)

Rojas, Alejandro and L. Ritcher, 2005, "Successful Institutional Adaptation to Climate Change Impacts Posed on Water Resources" (English)

Abstract: The purpose of this paper is to contribute to the project by: (1) providing a discussion of the ways that success can be defined when talking about successful institutional adaptation to climate change impacts posed on water resources; (2) providing a review of specific "successful" institutional adaptive measures and principles; and (3) providing suggestions about some general principles that can aid successful institutional adaptation (institutional design, process, environment, and principles). This paper is based upon both a review of literature and the views of the authors. (www.parc.ca/mcri/papers.php)

Salas, Sonia, Héctor Luís Morales, Elizabeth Jiménez, and Roxana Espinoza, 2005, "Descripción de Áreas de Estudio, ERB" (Spanish)

Abstract: The document describes the areas selected for community assessment in the Elqui River Basin.

Three areas were selected. Each of these areas involves two or more interconnected rural communities. From a demographic perspective, the selected areas correspond to a group of census units, allowing for a statistical analysis using census data. The document contains demographic information on the selected localities, complemented by information gathered through focus groups with representatives of the community organizations existing in the localities. These focus groups were organized to identify climate adaptative experiences and climate vulnerabilities. (www.parc.ca/mcri/papers.php)

Sauchyn, David, Silvia Lac, and Camilla Colan, 2005, "South Saskatchewan River Basin Biogeography" (English)

Abstract: This document is intended to provide a description of the SSRB biogeography and the identification of areas within the SSRB which are more exposed to permanent degradation, from which the rural communities can be assumed to be at greater risk to climate change impacts. This report is divided into six parts: introduction (part 1); biogeography description of the SSRB which includes a general overview of the SSRB and a description of its ecozones and ecoregions (part 2); the natural hazards, which includes a review on drought definition, its causing factors and past (long-term) records (part 3); the sensitive areas selected in the SSRB as an indicator of vulnerable communities (part 4); the conclusions (part 5); and references (part 6). (www.parc.ca/mcri/papers.php)

Smit, Barry, Johanna Wandel and Gwen Young, 2005, "Vulnerability of Communities to Environmental Change" (English)

Abstract: This paper provides an overview of the concepts of vulnerability, adaptation and adaptive capacity, with reference to related concepts like resilience, risk, sensitivity, hazard, exposure, stability, coping and adaptability, especially as they have been used in the context of climate change. The paper reviews common interpretations and applications of the terms, and develops a general conceptual model of vulnerability as it relates to human societies or communities. The paper also provides a critique of analytical approaches and methods to assess vulnerability and to identify opportunities to enhance adaptive capacity and to provide information directly applicable to the development of adaptation strategies. These methods are described to show how ethnographic principles and procedures provide insights that can be systematically integrated with institutional analyses and modeling of climatic, hydrologic and ecologic systems. (www.parc.ca/mcri/papers.php)

Velez, Maria, 2004, "Holocene Paleoclimatology in the South Saskatchewan River Basin" (English)

Abstract: The focus of this report is climate variability during the Late Holocene. The reason to focus on the Late Holocene is because the climate of the early and early-mid Holocene was still under the influence of glacial retreat, ice melt and crustal rebound (Last and Teller, 1983; MacDonald and Case, 2000). The great majority of the climate records included in this report come from the study of lake sediments and these lakes have been formed as a consequence of glacial retreats; therefore, the climate signal can be analysed after all the influence from glaciers has ended. This report includes six sections: (1) a summary of the present climate; (2) the main findings from the limnological and palynological records; (3) the climate changes detected by the geomorphogical evidence, mainly dune activity; (4) the changes in biomes as a response to climate change; (5) the general trends of climate change for the last centuries as indicated by tree ring analysis; and (6) a discussion about climate change in the SSRB area. (www.parc.ca/mcri/papers.php)

APPENDIX 5: DISSEMINATION ACTIVITIES

Public Presentations

- B. Smit, Climate Change Impacts, Vulnerabilities, Adaptations Assessment for Decision-Making. Presented to Ouranos–Consortium sur les changements climatiqu. January 19, 2004, Montreal, Quebec.
- B. Smit, Climate Change and Adaptation. Presented at the University of Waterloo, February 23, 2004.
- B. Smit, Climate Change: So What for Agriculture? The Role of Adaptation. Presented to the Canadian Federation of Agriculture. February 24, 2004, Ottawa, Ontario.
- B. Smit, Climate Change Adaptation: A Producer Perspective. Presented at the C-CIARN Agriculture Workshop. February 25, 2004, Gatineau, Quebec.
- B. Smit, Risks and Opportunities for Canadian Agriculture: Approaches and Applications. Presented to "Climate Change: its influence on the Canadian Economy," Environment Canada and Natural Resources Canada. Feb 26-27, 2004, Ottawa, Ontario.
- H. Diaz, D. Gauthier, D. Sauchyn, "Stormy Weather: Climate Change and Sustainability," Coffee House Controversies, March 4, 2004, Roca Jack's, Regina.
- B. Smit, Science and Practice of Vulnerability and Adaptation to Climate Change and Mainstreaming. Presented at C-CIARN Training and Information Session. March 8, 2004, Vancouver, British Columbia.
- D. Gauthier, "Land use overview on the prairies," Prairie Habitat Joint Venture Science and Policy Forum, March 24, 2004, Hyatt Regency Hotel, Calgary, Alberta.
- D. Sauchyn, "Potential Climate Change Impacts on Prairie Habitat," Prairie Habitat Joint Venture Policy Forum, Calgary, Alberta, March 24-25, 2004.
- D. Sauchyn, "Recent and Forecasted Change in Prairie Hydroclimate," Environmental Research and Studies Centre, University of Alberta, March 25, 2004.
- D. Sauchyn and M. Vetter, "Drought history and impacts on the northern margins of the Great Plains," The 18th Biennial Meeting of AMQUA,the Student Union of the University of Kansas (KU), Lawrence, Kansas, June 26-28, 2004.
- D. Sauchyn, "Do We Have the Tools to Change? Confronting Water Scarcity: Challenges and Choices," July 13–16, 2004, Lethbridge, Alberta.
- H. Morales and S. Salas, Social Adaptation to Climate Change. Pacific Regional Science Conference. PRESCO. Valdivia Chile. September 21, 2004.
- H. Diaz, D. Gauthier, and D. Sauchyn, "Overview of the SSHRC MCRI Project on Institutional Adaptation to Climate Change, South Saskatchewan River Basin (Canada) and ERB (Chile)," Inter-American Organization for Higher Education, Annual Conference of the Institute for University Management and Leadership (IGLU), October 6, 2004, University of Regina, Regina, Saskatchewan.
- H. Diaz, D. Gauthier, D. Sauchyn, "Institutional Adaptations to Climate Change: Comparative Study of Dryland River Basins in Canada and Chile," CWRA-PFSRB 2004 Workshop. Climate Variability: Planning for Floods, Droughts and Change Saskatoon, October 7–8, 2004.
- H. Diaz, "The Challenge of Climate Change. Adaptation and Mitigation Policies in Chile," Canadian Association for Latin American and Caribbean Studies, October 28–31, 2004, Guelph University, Guelph, Ontario.
- D. Corkal, Presentation to federal departmental staff at "Meeting the Millennium Development Goals through Sustainable Agriculture," November 1–3, 2004, Ottawa, Ontario
- M. Fiebig. "Catástrofes Naturales y Vulnerabilidad en el Valle de Elqui," at the seminar "Cambio Climatico, Desastres y Adaptación," December 1–2, 2004, Santiago.
- D. Sauchyn, "SSRB Chile Project," Quarterly Educational Forum, December 8, 2004, Bow River Basin Council, Calgary, Alberta.
- H. Diaz and D. Gauthier, "Adaptive Capacity for the South Saskatchewan River Basin," workshop

organized by C-CIARN Agriculture and the Global Environmental Change, February 17, 2005, Edmonton, Alberta.

- D. Sauchyn, "Climate Change Impacts on Prairies Region," Climate Change Adaptation and Canadian Agriculture: Impacts And Capacity, February 17, 2005, Edmonton, Alberta.
- D. Sauchyn, "What is Climate Change?" Agency Chiefs Tribal Council, Climate Change, Alternative & Renewable Energy Conference, March 1, 2005, Saskatoon.
- D. Sauchyn, "What's With the Weather? The Controversy of Climate Change," QUEST: North Conference, March 4–5, 2005, Winnipeg.
- D. Gauthier, "Participatory stakeholder participation processes." Presentation to the national workshop on Assessing Biodiversity on Agricultural Lands, March 7–8, 2005, Delta Airport West Hotel, Toronto, Ontario.
- D. Sauchyn, "Reconstructing Alberta's climate from tree-rings for the past 500 years," Alberta Geological Survey, March 14, 2005.
- H. Zavala and E. Mall, "Hydrological Budget in Semi-Arid Mountainous River Basins in Coquimbo Region, Chile, under Climatic Change Conditions," International Association of Hydrological Sciences, Foz de Iguazu, Brazil, April 3, 2005.

Media Releases

- S. Salas, ULS develops a new project to battle desertification. Tiempo Journal. March 2004.
- D. Sauchyn, "Alberta, Chile and Climate Change," Innovation Alberta (http://www.innovationalberta.com/), July 15, 2004.
- S. Salas, Against Desertification—New Project. Special Edition. Diario el Dia. Lunes 28 de Junio 2004.
- D. Sauchyn, CBC Newsworld Documentary on Canadian weather disasters, October 18, 2004.
- H. Diaz, Radio Interview, Radio Canada International, June 7, 2004.
- A. Rojas, "A Thirst for Water Research," *Reach Out,* a publication of the Faculty of Agricultural Sciences at UBC, Summer/Fall 2004 (A. Rojas)
- "Canada and the World Map," *Canadian Geographic*, Nov.–Dec., 2004, Vol. 124, No. 6.
- M. Fiebig, Interview at the TVN (Televisión Nacional de Chile) about climate change evidence in the Coquimbo Region, January 2005.
- D. Sauchyn, CTV—Canada Weekend, January 18, 2005.
- H. Diaz, University of Regina Update Publication, *Leader-Post*, Regina, February 3, 2005.
- D. Sauchyn, CTV Farmgate, April 2, 2005.

Conferences and Workshops

B. Reyes, S. Salas, and M. Fiebig, Organization of the conference "Cambio Climático. Desastres y Adaptación. Perspectivas Ciudadanas Hacia la Décima Conferencia de las Partes de la Convención Sobre Cambio Climático," Santiago, December 1–2, 2004.