INSTITUTIONAL ADAPTATION TO CLIMATE CHANGE PROJECT

Outlook Stakeholder Workshop on Water and Climate

(*Source: Jeremy Pittman*)

SUMMARY REPORT

Organized by the Prairie Farm Rehabilitation Administration (PFRA) and
The Institutional Adaptation to Climate Change Project

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Input for presentation summaries provided by presenters

BACKGROUND INFORMATION

This report summarizes the presentations and focus group discussions from the Institutional Adaptation to Climate Change (IACC) Water and Climate Stakeholder Workshop held at the Heritage Centre in Outlook, Saskatchewan on January 25, 2007. The purpose of the workshop was to consult with water stakeholders about climate-induced water issues and future scenarios, to ask for guidance from stakeholders on assessing the challenges and needs that water institutions face, to disseminate information collected by the project thus far and to verify the information is accurate (See the Agenda in Appendix 2).

The Institutional Adaptation to Climate Change (IACC) project is funded by the Social Sciences and Humanities Research Council of Canada (SSHRC) and is administered by the Canadian Plains Research Center (CPRC) of the University of Regina. This project requires the integration of multiple disciplines and involves the collaboration of approximately 30 researchers and a large group of research assistants, all with expertise in their respective discipline. The three objectives of this research project are:

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

The IACC project seeks to understand the adaptive capacities of rural communities and rural households and the roles played by governance institutions in the development of those capacities. In order to achieve this goal a comparative study between two river basins—the South Saskatchewan River Basin in Canada and the Elqui River Basin in Northern Chile—is being undertaken. The two regions differ in how they are vulnerable to climate change, primarily due to varying social, economic, political and environmental circumstances. However, they are similar in that they are situated in dry climate regions adjacent to a major mountain system, with the agricultural industry predominating in both basins. Furthermore, the basins' supply of water is snow and glacier-melt.

The conceptual model—Figure 1— is the structural framework around which the Institutional Adaptation to Climate Change project's clusters are organized. Presentations of initial insights obtained through research activities *in Clusters 1 and 2* were given at this workshop. Dave Sauchyn's presentation delved into *future climate conditions* and Darrell Corkal's presentation discussed the role of governance in the development of adaptive capacity. The focus group discussions focused into *past/present and future vulnerabilities*, providing significant insights for the work of the project.

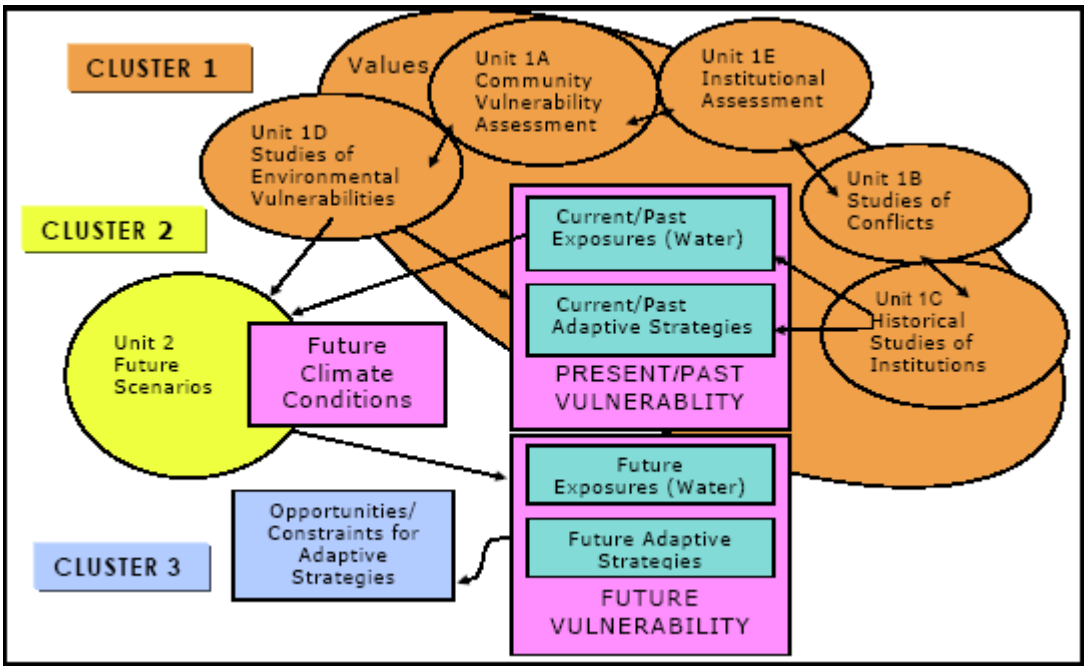

Figure 1*: The organization of the Institutional Adaptation to Climate Change clusters.*

The IACC project adopts a vulnerability assessment approach, where the vulnerability of a system is treated as a function of both its exposure and its adaptive strategies. *Current/past exposures* refer to past or present conditions that affect a particular system. In addition, the nature and specific characteristics of the system are taken into account. *Current adaptive strategies* refer to the ways in which the system has adapted or is adapting to the identified exposures. *Future exposure* refers to the future potential changes in current/past exposures as well as new exposures that may arise under climate change. *Future adaptive strategies* refer to the ways in which the system can adapt to and plan for these future changes. Forces that influence the ability of the system to adapt create *opportunities/constraints for adaptive strategies*.

For the purposes of this workshop, exposures relate to water, and thus adaptive strategies also relate to water. This report is divided into two sections: summary of presentations and focus group findings. The 'Focus Group Findings' section is divided according to the vulnerability approach (i.e. current and future exposures and current and future adaptive strategies). Opportunities and constraints for adaptive strategies are listed under the 'Adaptive Capacity' subsection of this report.

A variety of water stakeholders were invited to attend the workshop and participate in the focus groups, including representatives of industry, NGOs and federal, provincial, regional and municipal governments, as well as irrigators, farmers and mixed farmers. Stakeholders were divided into five focus groups, each with approximately 8 people. The purpose of the focus groups was to initiate discussions among water stakeholders and to provide researchers with a better understanding on the issues stakeholders have with water availability, how these issues are addressed and how these issues can be managed in the future under climate change (Appendix 1 contains the issues discussed during the

focus groups). These discussions provide insights into the vulnerabilities and the adaptive capacities of both rural communities and governance institutions, and will set the basis for unit 1E.

SUMMARY OF PRESENTATIONS

This section summarizes the presentations delivered at this workshop.

Water and Climate Scenarios for the SSRB (Dave Sauchyn, **P**rairie Adaptation Research Collaborative, University of Regina)

Research conducted by Dave Sauchyn, Jodi Axelson, Suzan Lapp and others provides insights into Saskatchewan's future climate and its effects on the province's water resources.

There is a general consensus among scientists that climate change is a real phenomenon and that the climate is indeed warming. However, we do not know how much warmer the climate will be in the future, or what it will mean for humans and the environment. Climate models are commonly used to simulate future climate conditions, and since the warming climate has been largely attributed to increasing concentrations of greenhouse gases in the atmosphere, these concentrations need to be incorporated into models. Since we cannot predict the future actions that may be taken in the future to mitigate greenhouse gas emissions, a number of greenhouse gas scenarios are used in the simulations.

Figure 1 was generated using the Canadian Global Climate Model and illustrates the expected changes in temperature across Canada in the 2050s. According to this model, Saskatchewan will experience a warming of between 2 and 4 degrees Celsius.

Future temperature and precipitation scenarios were generated for Saskatoon using an array of climate models and future greenhouse gas emission scenarios. The results, shown in Figure 2, indicate that Saskatoon may experience a 2 to 3.5 degree Celsius increase in temperature and a 10 to 20 percent increase in precipitation by 2050. The seasonal distribution of precipitation is also expected to change quite dramatically in the future. After examining snow in the mountains, Lapp *et al*. 2005 generated Figure 3 below which illustrates the magnitude of future potential changes in precipitation and temperature. As temperatures increase, more precipitation will fall in the form of rain, however, evapotranspiration rates will also increase, resulting in less available moisture in the soil. Lapp *et al*. 2005 simulated future snowpack in the mountains and compared it to historical snowpack at both high and low elevations (refer to Figure 4). Their results indicate that snow will not remain on the ground at lower elevations throughout the winter and spring like it has in the past (see the bottom scenario in Figure 4 and notice how the bottom bar fluctuates). Historically, snow began to fall in October, built up over the winter and then melted in April. According to this study, this will likely no longer happen in the future.

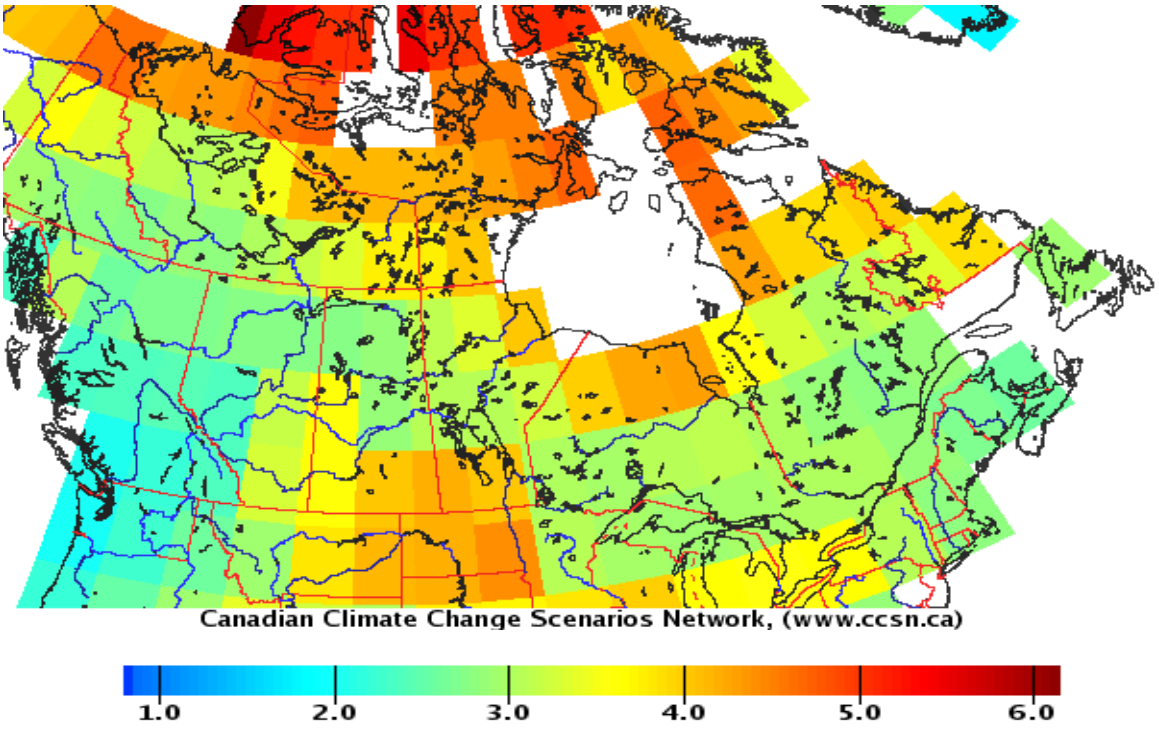

***Figure 1**: Change in temperature (◦C) from baseline (1961-90).*

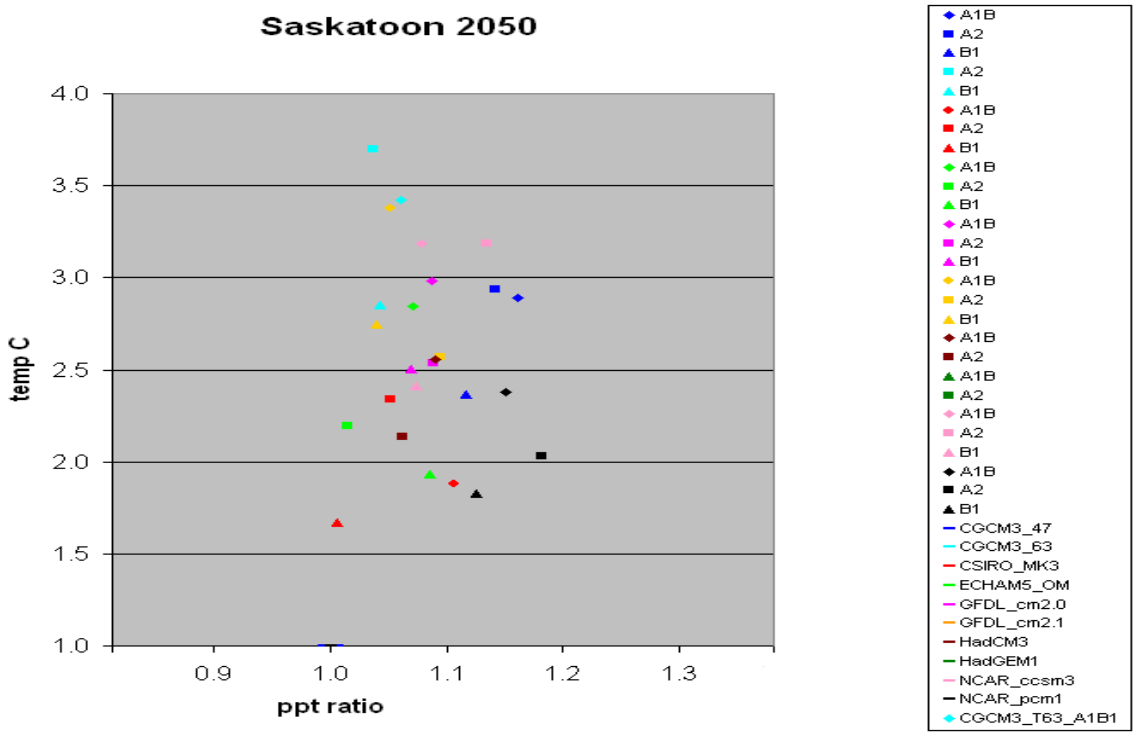

***Figure 2**: Future temperature and precipitation for Saskatoon in 2050.*

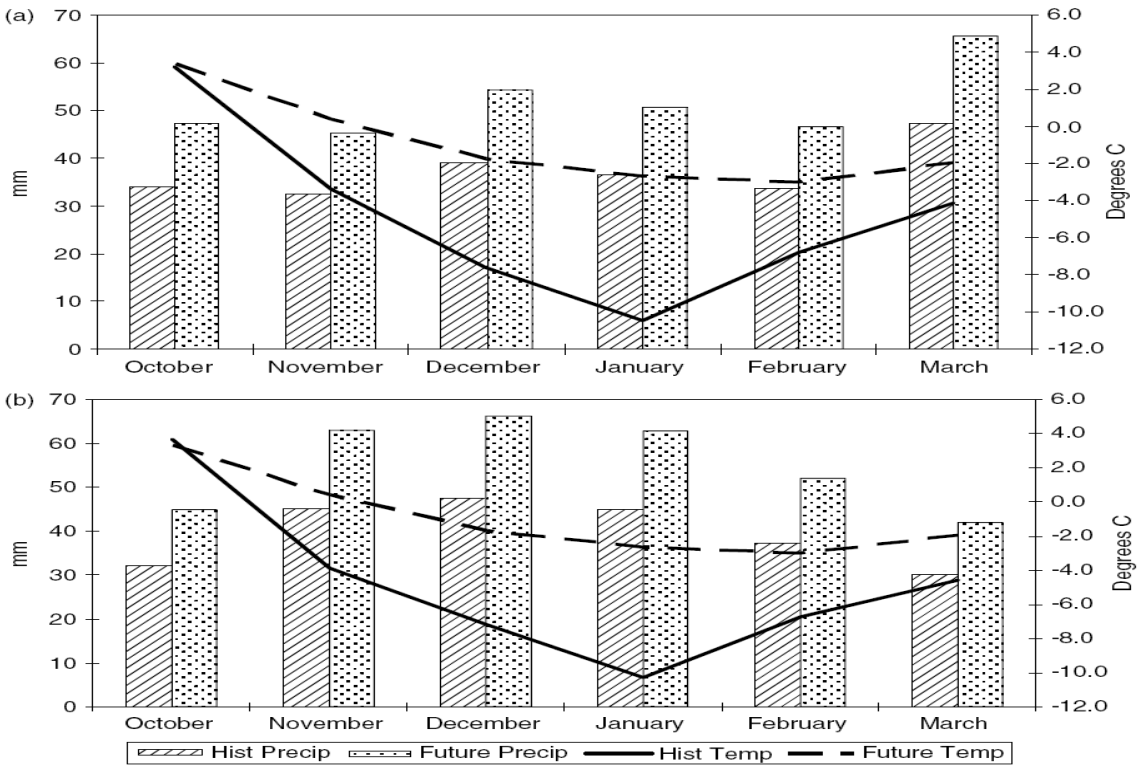

***Figure 3**: Historical and future (CGCM1) climate (Lapp et al. 2005)*

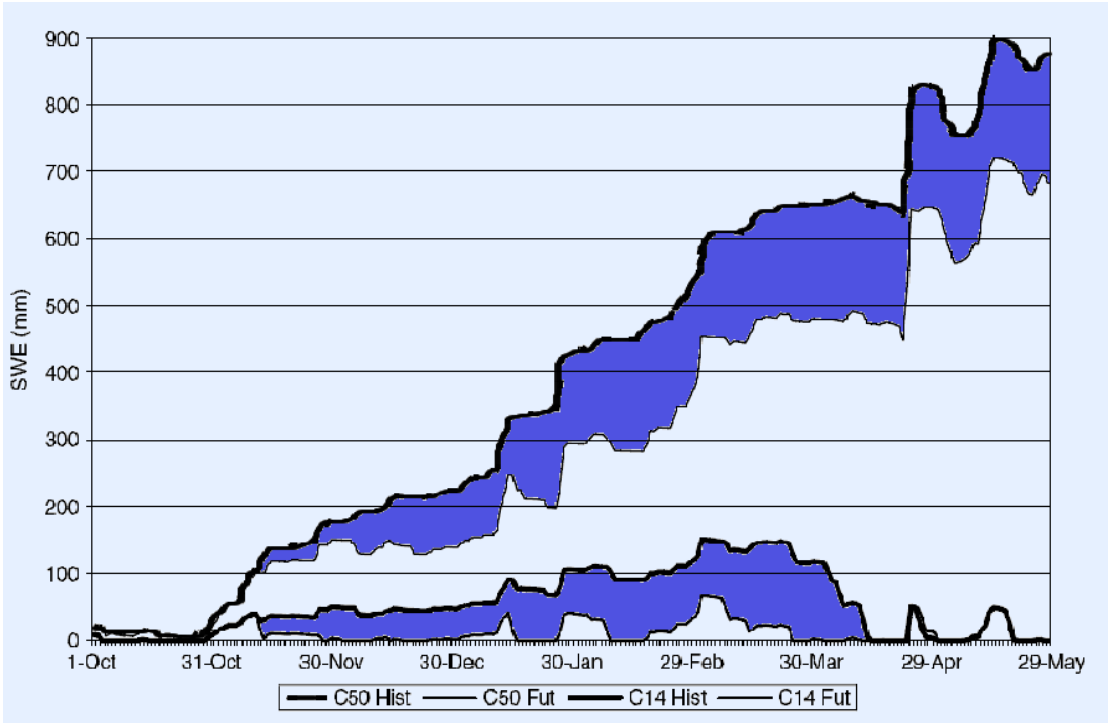

***Figure 4**: Cumulative snowpack (Lapp et al. 2005)*

Pietroniro *et al.* 2006 forecast future seasonal flow in the Oldman, the Bow, the Red Deer and the South Saskatchewan rivers (see Figure 5). Most scenarios indicate there is going to be more water in the rivers in winter and spring and less in summer. Pietroniro *et al*. 2006 also predict annual flow for these rivers (see Figure 6). There is a wide range in the annual flow predictions, and this can be attributed, in part, to uncertainties regarding future concentrations of greenhouse gases in the atmosphere.

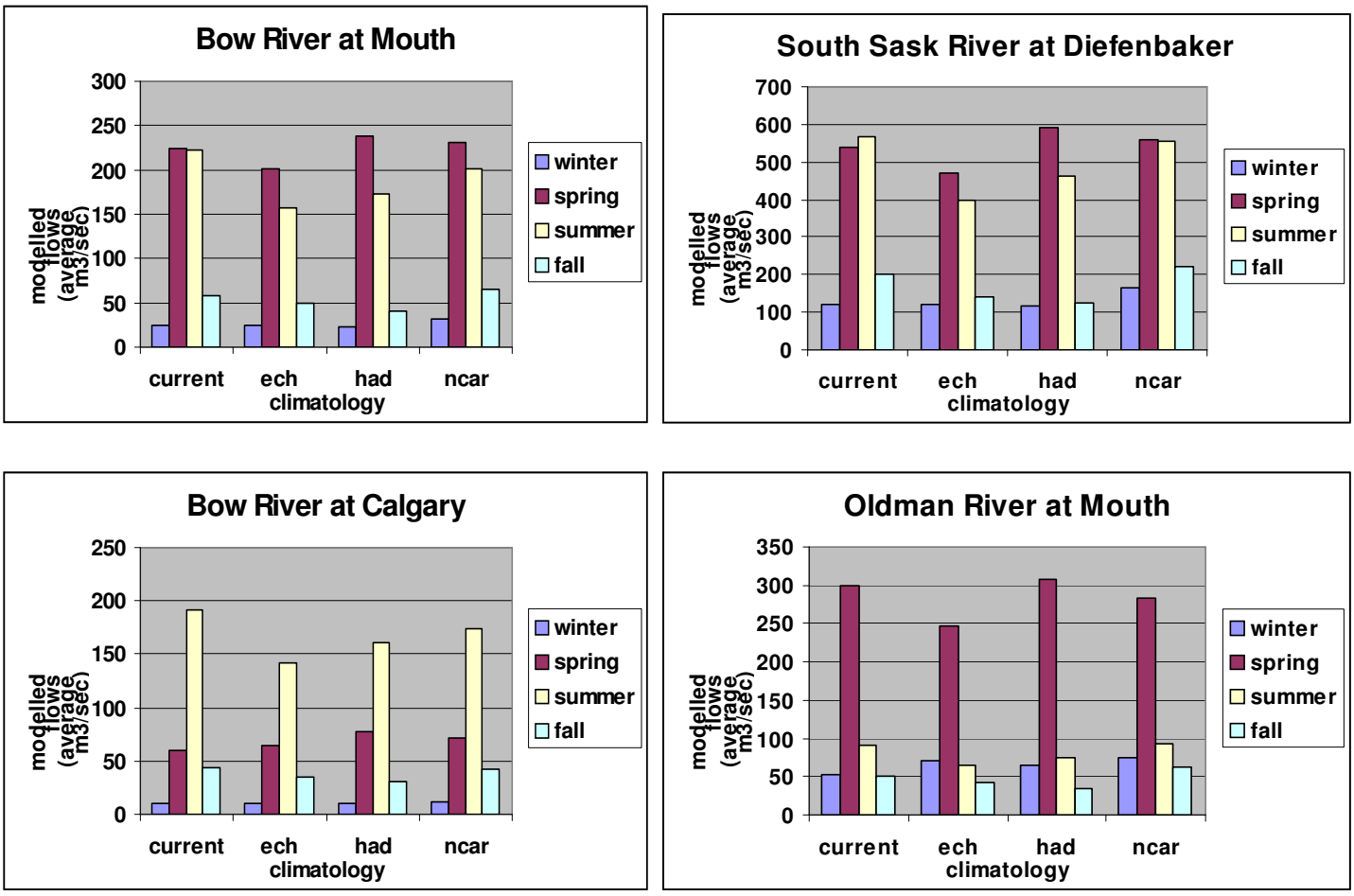

Figure 5*: Seasonal flows, SSRB, 2039-2070 (Pietroniro et al. 2006)*

The frequency of drought is expected to increase almost three-fold in the future. Currently the prairies experiences 30 days without rainfall once every 50 years. Scientists at the University of Victoria estimated that by the year 2070 the prairies can expect 30 days without rainfall once every 18 years. Warmer temperatures imply there will be a longer growing season, but there will also be less precipitation in summer, and therefore less available soil moisture. Droughts have severe implications for the province of Saskatchewan. The 2001-02 droughts affected the province's economy significantly: billions of dollars in crops and tens of thousands of jobs were lost. Droughts are expected to become more frequent and more severe in future years.

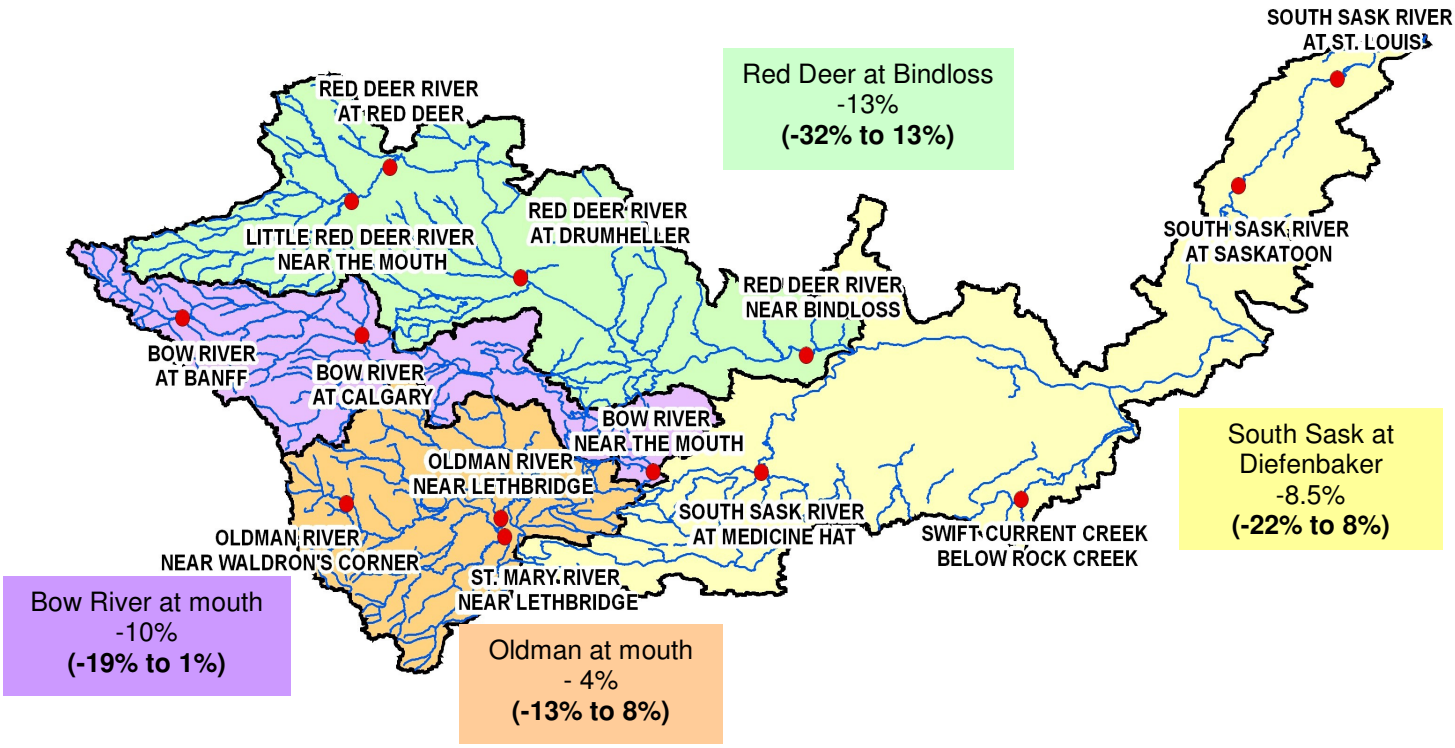

***Figure 6**: Projected annual flow, 2039 – 2070 (Pietroniro et al. 2006)*

Water Governance and Adaptation to Climate Change: the Cases of Canada and Chile (Darrell Corkal, Prairie Farm Rehabilitation Administration)

In Canada, water is recognized as a public good. Water management is a provincial government responsibility. Provinces own the water and allocate water rights to users. The federal government works with the provinces. Water management is not defined within the Canadian constitution. However, the Government of Canada could intervene in water management if deemed "in the interest of peace, order and good government" (which is a constitutional role). In reality, there are many federal, provincial and local institutions that are involved in the management of water. Most of the government institutions that deal with water are the departments of environment, health, watershed authorities and/or natural resources. Thus, there are numerous institutions with a vested interest in water management. There are also numerous water stakeholders with a vested interest in water management, and often with a unique perspective of how water should be managed.

Political boundaries have been established for good governance, but water knows no boundaries. The unit of natural movement for surface water is a watershed basin, and for ground water is geology and re-charge zones. Political boundaries do not match the watershed basins or aquifers. Water management is becoming increasingly more difficult

for society to manage. The primary concerns with respect to governance in Canada relate to the numerous institutions and water stakeholders, the fragmentation of roles, implementing water management activities when water stakeholders do not always have a common goal or vision, addressing water conflict, and balancing social, economic and environmental interests with timely decision-making. Climate-change and increasing competition for water demands will place increasing challenges on water governance in Canada.

In Chile, the Water Code was established in the constitution. The national government plays a strong role in water management. One of the unique features of the Water Code is that water rights are essentially a commodity, and can be bought, traded or sold. This has increased the role of the private sector in water management. The Water Code was essentially designed to increase irrigated agriculture in Chile. Those with water rights do not own the water but they own the rights to extract it. The national government allocates water rights. When there is a conflict over water rights, the users are expected to address the issue themselves, or resolve the issue in court. Revisions to the Water Code in 2005 gave additional power to the national government to address allocated but unused water rights and to deal with the issue of minimum ecological flows. The commodification of water rights in Chile has given unique powers to the private sector. The private sector has taken advantage of this opportunity, invested heavily in water infrastructure and irrigated agriculture, and is intimately involved in water management. This has significantly advanced the degree of infrastructure development in the country. The agriculture sector consumes 85% of the water in Chile with irrigated agriculture. High-value crops such as grapes, avocadoes, fruit crops dominate the industry, and there is a large value-added food and non-food processing industry. Wine, spirit liquors and food products are sold locally and internationally. Water management issues in Chile relate to sustainability and social equity. Climate-induced reductions in precipitation are expected to affect future available water quantity. The unique arrangement of government-private sector roles in water management has proven to be successful for water development and economic development, but may prove to be a challenge for sustainability and environmental protection.

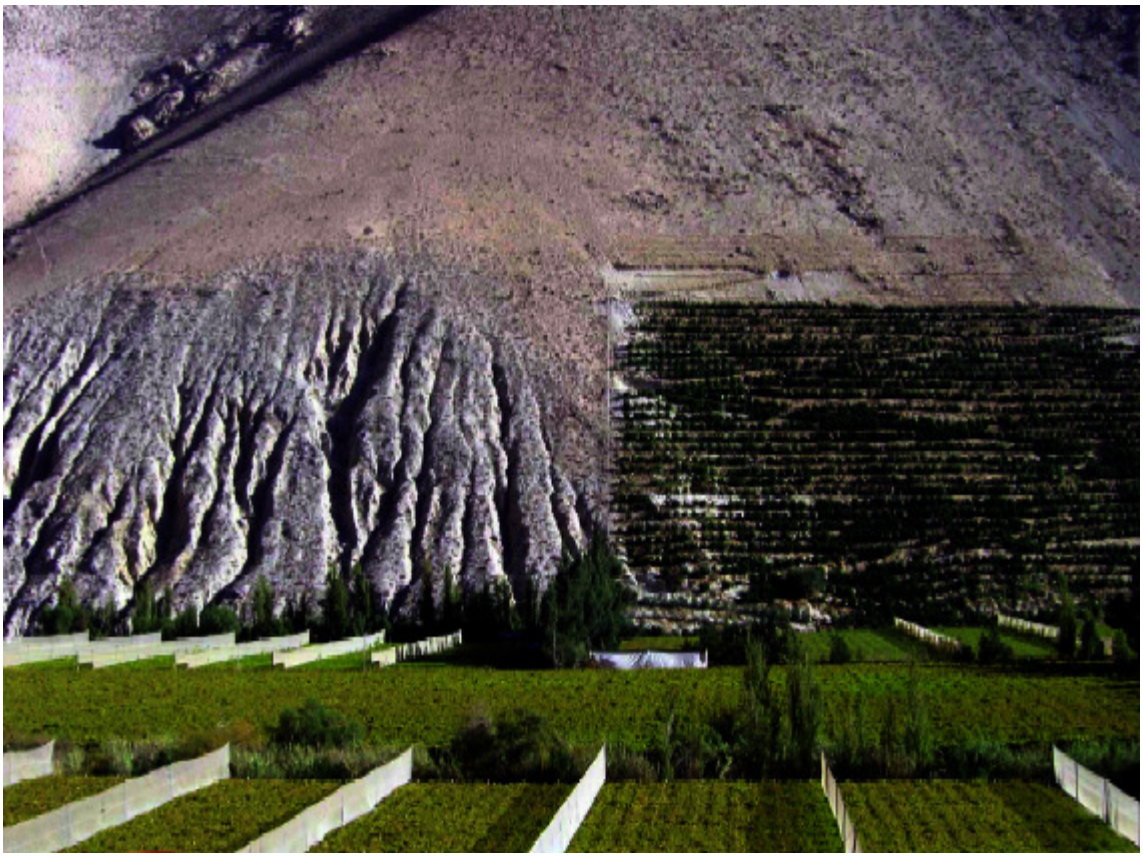

Figure 10: *Agricultural operation in Chile (Source: Darrell Corkal)*

FOCUS GROUP FINDINGS

The vulnerability approach emphasizes the need to treat vulnerability as a function of the current and future exposure and the current and future adaptive strategies of the system being considered (e.g. agency, community, individual, etc.). The vulnerability approach differs from many other approaches in that the conditions that give rise to vulnerability are identified by the system. That is, the conditions are not assumed by the researchers.

The purpose of the focus groups was to gain a first-hand understanding of the issues stakeholders see with respect to water availability (i.e. current exposures), how these issues are currently being addressed (i.e. current adaptive strategies) and how these issues might be managed under future climate change (i.e. future adaptive strategies). Dave Sauchyn's presentation provided information on future climate and water conditions (i.e. future exposures), establishing the context for the focus group discussions. A list of questions that effectively captures the information sought in the focus groups was developed by the research team (see Focus Group Questions in Appendix 1). The questions were given to each facilitator, whose purpose was to engage participants in discussion and ensure that all questions were addressed.

Workshop organizers realized that there were five general themes that the participating stakeholders could be divided into. Stakeholders were assigned to the focus group that best suited their interests and affiliation. The first group was geared towards stakeholders with government affiliations; the second towards irrigators; the third towards rural municipalities; the fourth towards a mixture of stakeholders; and the fifth towards stakeholders with development and environmental interests.

This section of the report summarizes the discussions from all five focus groups. Commonalities and differences in the discussions within and among the groups were identified and are discussed in this section. The findings are organized according to the vulnerability approach (i.e. current and future exposure and current and future adaptive strategies. See the 'Background Information' section for more details). The subtitles in each section represent the general themes discussed in the focus groups. Each theme precedes further details.

Current/Past Exposures

Biophysical

"As an irrigator I would take a drought any year and every year." – Focus group participant

Droughts are not uncommon in the province of Saskatchewan. The province has experienced several droughts in the past few decades, each varying in severity and its effects. Most droughts, however, have significant economic impacts. The drought of 2001-02, for example, cost the agricultural industry billions of dollars and left thousands of people unemployed. Saskatchewan's economy was negatively affected by that drought. During periods of drought, the amount of water Saskatchewan receives from Alberta decreases. The province has to meet water demands even though supply has changed. A few irrigators pointed out that so long as there is water available for irrigation droughts are beneficial because they allow for more precise management. Heavy rainfall events can damage crops and reduce crop quality, which reduces profitability. Rainfall events can have dramatic affects on river flow, and water managers are limited as to what they can do when flow is too high.

The rivers and lakes in Saskatchewan experience high evaporation rates, which reduces the amount of water that is available for use. Lake Diefenbaker loses more water to evaporation than the total amount withdrawn from the lake for consumptive uses. However, such little water is used for consumption from the lake that evaporation was not a big concern.

Livelihoods/occupation

"Personally our farm is small by Canadian standards…we only farm 1200 acres, but over half of it's irrigated, and we have livestock. It's intensive everything." - Focus group participant

Agriculture drives the economy in most of the communities represented at this workshop, and water is one input that is necessary for one to succeed in the agricultural industry. It was noted that precipitation has been especially variable the past few years. Uncertainties surrounding the amount of precipitation throughout the growing season poses a considerable challenge for farmers when they are deciding what and when to crop. Increasingly, farmers are feeling pressured to "go big" with their operations, and in many cases have acquired off-farm jobs to make ends meet.

Institutional

"…the governments can't stop fighting over whose authority and who's responsible and who pays and so forth…The government is the problem right now."—Focus group participant

Water resources are extremely difficult to manage in Saskatchewan as there is no clear policy on water and its management.

Prior to being elected, politicians seem motivated and eager to make changes within the system, but once elected, that seems to disappear and changes become unusual, unless they are faced with a crisis situation. The high turnover rate in the political system makes it difficult for long term plans to be realized, so long term planning is often put on the back burner for someone else to deal with in the future. Politicians are often so far removed from what is happening at the community level, whether it is because they are physically far away or because they do not have the time to hear everyone's voice, that they do not and cannot fully understand what is really needed.

Stakeholders are unsure as to who is responsible for what within government. People feel there are too many people and institutions involved in the management of water for proper management to ever occur. Agencies do not communicate effectively and this leads to overlap; that is, two or more agencies attempting to or actually doing the same thing without knowing. Provincial and federal agencies were identified as overlapping the most. Resources that could be devoted to other programs or studies are being used unnecessarily.

Infrastructure

There is sufficient water available for consumption (e.g. drinking, irrigation, etc.) in southern Saskatchewan. Many community representatives voiced their frustrations regarding the fact that even though they are spatially close to the water resource, they cannot access or benefit from it because the infrastructure needed to transport the water is

nonexistent. So even though the resource is plentiful, access is limited. The political will to invest in and commit to the infrastructure is lacking.

A considerable amount of water is lost to seepage and evaporation when water travels through canals to reach communities, making it an inefficient means of transporting water.

Financing for projects such as irrigation are "switched on and off like a tap". The funding is there one day, and then it is taken away, and then it is there again. These inconsistencies create confusion within the agricultural community and they limit the measures that can be taken to adapt to changing conditions.

Social

"You lose a connection to where your water comes when you live in a big city."
—Focus group participant

"Urbanites have a non-conservationalist attitude."—Focus group participant

A strong emphasis was put on the rural-urban disconnect in the focus groups. The general belief was that rural residents, due to their location away from the downtown core and their close connection to the agriculture industry, are more connected to the water resources because they are directly affected by water-related stresses such as drought and intense rainfall events. Since urban residents are not directly affected by water stresses, they therefore do not value water as much as rural residents. The urban disconnect from rural activities influences attitudes towards water conservation and water-use efficiency. The general consensus within the focus groups was that urban residents waste more water and are less likely to conserve than rural residents because they are less connected to and less knowledgeable about the resource. Generally urban residents take the resource for granted and use it as if it is an infinite resource.

Future Exposures

Biophysical
(See Dave Sauchyn's presentation summary for more details)

Models suggest that the province of Saskatchewan will experience a 2 to 4 degree Celsius increase in temperature by the year 2050 as well as an overall increase in precipitation. The seasonal distribution of precipitation is expected to change, with more rainfall in winter and spring and less in summer. Studies show that there will also be more water in the rivers in the winter and spring than there has been in the past and less in summer. The growing season will be longer but the warmer temperatures suggest less soil moisture for crops. The magnitude and frequency of droughts is also predicted to increase in the future.

The timing and amount of rainfall plays a huge role in the success of certain agricultural operations. Rain at the wrong time can make crops more susceptible to pests, reduce crop quality and affect harvesting, whereas rain at the right times can reduce input costs such as water for irrigation and chemicals.

Livelihoods/occupation

"Dry land farms, as it's been now, isn't going to work."—Focus group participant

Dryland farming may no longer be a possibility in Saskatchewan if there insufficient precipitation and low soil moisture throughout the growing season. The extent to which dryland farming will be affected by changes in climatic conditions depends on how dry it is going to be in the future.

Input costs for agricultural operations will go up with a longer growing season. More water will be needed for irrigation, even though there will be less supply. Soil erosion becomes an issue for farmers when there is inconsistent snow cover in winter because the snow protects the soil.

Crops that have done well in the past may not withstand future water stresses.

The lifestyle led by agriculturalists is not particularly attractive to young people. The business is even less attractive due to the associated risks. Traditionally, upon retirement of the farmer, the farm was handed down to someone in the family. In the future, farmers fear having to sell their farm off to someone outside the family.

Institutional

The wide ranges in future climate and river flow predictions pose serious challenges to resource managers. The Red Deer, for example, is estimated to have from 32% less water to 13% more water (refer to Figure 6). This is an incredibly wide range and does not facilitate changes to current plans and policies. Management decisions to accommodate 32% less water would be substantially different than if there were to be 13% more water.

Social

Diminishing river flows in summer are believed to affect water quality, which affects everyone who depends on the river for their water supply. Stakeholders that depend solely on rivers to satisfy their water needs may experience water shortages. Similarly, as communities become more dependent on the river, demand will increase, potentially leading to shortages in supply. The ability to meet future water demands was a concern for some people. As the economy develops and more people move to urban centers, there will be more pressure on the resource, and more will have to be done with less. Conversely, many stakeholders felt water quality and future water availability will not pose major concerns in the future.

Current/Past Adaptation Strategies

Water use efficiency

Low flow toilets and low pressure shower heads have been installed in households to conserve water.

Low pressure irrigation systems have been adopted by farmers to optimize water use. Center pivot irrigation systems have also been adopted because they are significantly more efficient than old flood irrigation systems, primarily due to their design and compatibility with low pressure nozzles. With center pivot, the appropriate amount of water can be applied when it is needed and evaporative losses limited.

Agriculture

Farmers have adopted no-till and continuous cropping practices in order to help maintain soil moisture levels and reduce erosion.

Irrigation systems have assisted in alleviating the effects of droughts on farming operations. They act as a buffer because they ensure the farmer that they will get a decent crop even if there is insufficient precipitation and/or soil moisture throughout the growing season. The farmer is no longer dependent on the climate to give them a good crop. Water can be applied to the crop regardless of climatic conditions, giving them more control over their operation and its success.

Managers of agricultural operations have opted to change crops and/or cropping times in the past. For example, growing lentils, field peas and beans was something that was unheard of, but conditions have changed and now they are feasible options. There are numerous cropping options due to advances in technology and changes in climatic conditions.

Institutional

During the 2001-2003 drought institutions did not grant water allocations according to priority license in Alberta because they realized there would have been major conflicts between water users. It was decided that everyone would share. Some people who received their full allocation but did not use it all could sell their license to someone in the same watershed that wanted it. It was a private deal between 2 people.

A water conservation policy framework has been developed for Saskatchewan. However, the policy still needs work before it can be implemented. Boards, whose purpose are to look at Saskatchewan's water resources, have been established by the watershed authorities. Land use planning projects are being undertaken in many municipalities, with common development policies as anticipated results.

Water has been scarce in some communities in the past. Municipal institutions have taken the initiative and begun to develop water conservation plans. Stakeholders believe that the promotion of water conservation is mandatory and that every member of society needs to take part in conservation.

People realize that water resources are complex and so, too, is their management. Collaboration within and among institutions has begun with hopes of better managing the water resource. However, focus group participants highlighted that the current level of collaboration is inadequate for effective management.

Canals have been lined with plastic to reduce the amount of water lost to seepage. However, once lined, a substantial amount of water is lost to evaporation. Pipelines are preferred to canals, as less water is lost to seepage and evaporation in the transfer process.

Committees have been formed to resolve or act as moderators in disputes over water resources.

Social

During periods of drought, community members pull together, put their differences aside and help each other out. People identify with one another and this brings people together.

Future Adaptation Strategies (Anticipated)

Education

Education is the key to preserving and protecting Saskatchewan's water resources. Most people are unaware of the larger scale effects of their actions. Everyone needs to fully understand that the choices they make have long term implications for society. The mindset that we deserve to have unlimited access to water is a fallacy, because there are limits to the resource. The water resource needs to be protected and preserved, and education should be the principal means of communicating that protection and preservation are imperative to securing an adequate water supply for Saskatchewan's population. Education should begin with, but not be limited to, younger generations, as they are likely to be more affected by changing climatic conditions and they tend to value the resource less. They should learn about water conservation, the reasons for conservation and human impacts on the environment in school. It should be part of the curriculum; however other programs and courses should be developed and made available to all members of communities.

Agriculture

The expansion of irrigation districts and the adoption of irrigation were discussed extensively in the focus groups. Since droughts will be more frequent, those who do not

have irrigation expressed serious interest in adopting it, primarily so they can remain viable. Dryland farmers will likely have no other choice but to turn to irrigation if they want to continue to farm. The government needs to make a commitment and invest in the infrastructure required for irrigation. Farmers need financial support from the government as irrigation is costly and most cannot afford it on their own. Farmers adopting irrigation will need to switch to higher value crops because it is not profitable to irrigate low value crops such as wheat and barley. Nonetheless, it was recognized that irrigation cannot solve all the water issues Saskatchewan will face in the future.

The crops currently harvested in Saskatchewan may need to be switched to crops that will do better under future conditions.

Institutional

"I personally believe that there's enough water in that Lake Diefenbaker to meet the environmental, the irrigation, all the other needs if it is managed properly."
–Focus Group Participant

"The people who manage the landscape are affecting the environment not government… And if we don't have the people who are managing the landscape involved in decision making I think we're fighting an uphill battle all the time."
—Focus Group Participant

Decision-making should be localized because it allows for more precise and place-specific strategies and plans to be developed. It also empowers stakeholders at the local level because their voices are more likely to be heard and taken seriously by someone in their community rather than someone in Ottawa.

Water conservation plans should be developed for each community in Saskatchewan. These plans ensure that everyone is on the same page and provide guidelines for people that are unaware of what they can do to make a difference.

There were disagreements among stakeholders when the notion of putting a value on water and charging people for its consumption was suggested. Some felt that this is the only way society will take the "water problem" seriously, while others felt that this would only bring about other issues that government is not prepared to deal with (e.g. how much to charge for water).

Water priorities have to be made and documented in order to effectively manage the water resource. No one knows who has priority access. A safe and adequate supply of drinking water for the province's population has to be at the top of the list, followed by the different sectors of the economy.

Industry, businesses, communities and individuals need to be given some incentive for conserving water and becoming more efficient in their water use because there is often an

economic sacrifice on behalf of the user. Not everyone is contributing, but society as a whole is benefiting from those that are taking the initiative.

Stakeholders believe government should be involved in the management of water resources, but not too involved. The threshold of government involvement varied significantly from stakeholder to stakeholder. It is believed that the government would be more productive if there was more effective communication and more collaboration within and among all levels of government.

Method as to how water will be treated in the future will need to be considered to address potential water quality issues.

Social

The United States and other countries are expected to experience water-related stresses similar to those predicted for Saskatchewan. Many countries are conducting studies and developing new technologies with hopes of mitigating the effects water stress in the future. Saskatchewan should look to other parts of the world for advice and ideas, as they may be relevant and applicable.

Storage

Saskatchewan will have to make adjustments to accommodate future changes in seasonal river flow. Substantial increases in river flow in winter and spring require adjustments to current infrastructure. The province needs more onstream storage so the early water can be captured and used when it is needed. Another dam could be built for additional on-stream storage. However, the construction of a dam requires political will, something that is lacking in Saskatchewan. Off-stream storage is another option. Locations for offstream storage are scarce, however. Diverting water from the main channel would create more offstream storage options. Stakeholders were in disagreement regarding the need for storage in the future. Some felt there is more than enough water in Lake Diefenbaker to satisfy everyone's water needs, while others were convinced more storage is imperative.

The environment should not be disregarded when discussing storage options. There are opportunities for storage in the 'natural' environment. Wetlands, for example, serve as reservoirs. They have the potential to hold a substantial amount of water. Wetland and habitat restoration should thus be promoted.

Adaptive Capacity

Focus group discussions revealed numerous constraints and opportunities that influence stakeholders' ability to adapt to changing climatic conditions. This section summarizes both the constraints and the opportunities identified in the focus groups.

Insights on constraints

"Well we got to a certain point where we just couldn't get anymore funding for it. It just wasn't a high enough priority to get funding." –Focus Group Participant

- Lack of funding and human resources limit the ability of institutions to carry out their tasks effectively. Funding shortages at the institutional level affect local stakeholders because it limits their adaptation options.
- The distribution of government funds is "bad politics".
- Rules and regulations often constrain adaptation in that they limit the actions stakeholders can take to cope with changing conditions. Institutions often act as barriers in the adaptation process.
- The information needed to make informed decisions either does not exist or is inaccessible.
- More precise stream flow predictions are needed to make "hard" decisions.
- Farmers feel overwhelmed with the amount of information directed at them. Most of the information available is so generalized that it is only applicable in few cases, and therefore, is not useful.
- The agricultural industry needs more support from the government and other institutions to succeed in this increasingly competitive economic activity. Subsidies for irrigation projects and rewards for good management are a good start.

Insights on opportunities

- A 2 to 4 degree increase in temperature may create opportunities for the agricultural industry. It may be feasible to grow crops in the future that would not otherwise do well. A longer pasture growing season may result in increases in livestock numbers.

APPENDIX 1

Focus Group Questions

A.M. Focus Group: Reaction to Sauchyn Scenarios

What are the issues your business/group sees with water availability? How is water used (day-to-day and seasonally)?

What are the implications of these scenarios for your business/group?

- lower baseflow in rivers?
- higher evapotranspiration / less moisture during growing season?
- warmer winters?

Would these scenarios become a problem? How? What actions would your business/group likely undertake? Are the scenarios within the coping range using existing actions?

What needs to change to put you in a better position of meeting these challenges?

What are the main types of water-related problems that have affected you in the past? What did you do to resolve these? In hindsight, what would you do differently?

P.M. Focus Group: Institutions and Climate Change

What types of future planning (wrt water) does your institution do?

With whom (other institutions, etc.) do you collaborate/draw upon for information?

What are the constraints to more effective planning?

In the past (e.g. 2001-2003 drought), how were things managed at the institutional level (i.e. within your institution)? What worked? What could have been done better, and how? Were there long-term changes within your agency as a result of this dry period?

APPENDIX 2

Agenda

Stakeholder Workshop on Water and Climate
Heritage Centre, 420 Railway Ave, Outlook SK
Thursday Jan. 25, 2007

Organized by Agriculture and Agri-Food Canada – Prairie Farm Rehabilitation Administration (PFRA) as a Project Partner
with the University of Regina research project: "Institutional Adaptation to Climate Change"

9:00 **Welcome; Overview of Institutional Adaptation to Climate Change, Introduction of IACC Research Team**

- Polo Diaz, Canadian Plains Research Centre, University of Regina

9:15 **Water and Climate Scenarios for Saskatchewan's South Saskatchewan River Basin**

- Dave Sauchyn, University of Regina

10:00 Coffee

10:30 **Breakout Sessions on Water Issues facing Saskatchewan's SSRB**

- discussion of water/climate issues, operations, barriers, opportunities

12:00 Lunch, provided

1:00 **Research Team Presentation: Water Governance**

- Darrell Corkal, PFRA

1:45 **Breakout Sessions on Challenges of Water Governance**

- discussion of vulnerabilities, adaptations, institutions

3:00 Coffee

3:15 **Plenary Discussion**

3:45 **Closing Remarks and Thanks**