Agriculture Adaptation to Climate Change in Alberta:

Focus Group Results

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Alberta
AGRICULTURE, FOOD AND RURAL DEVELOPMENT

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Executive Summary

Even though agriculture is continually adapting to changes in weather, Alberta Agriculture, Food and Rural Development (AAFRD) wished to examine whether the recent global climate patterns and more extreme weather events across the Canadian landscape were concerning producers. Therefore, producers from different locations within Alberta were randomly selected and invited to participate in one of four focus group discussions. This focus group approach was used so the participants would feel comfortable and free to state their opinions, disclose their practices and any thoughts, with minimal interference where differences were encouraged. To avoid any possible bias, no climate change specialists were in attendance at these discussions. The discussions focused on the producers' risks, opportunities, and capabilities due to climate change. Also discussed were their views on what support they need in the management of risks associated with climate change. The focus groups ended with a survey of questions that mirrored the facilitated discussion and the four groups all met within the first two weeks of March 2005.

Fifty-three producers participated in the focus groups in which 12 attended Taber, 14 at Red Deer, 12 at St. Paul, and 15 at Fairview. Most participants were from either a cow/calf, cropping, or a mixed operation and had farmed for over fifteen years. Overall the participants had a wide difference in their views about climate change and their level of concern. Almost half of the participants had seen extreme to many changes in the weather and growing season within the past 10 years. Some of the participants' answers differed by location, most notably between St. Paul and Red Deer. Their concerns ranged from water sources and water use to agriculture being blamed for climate change, economics, sustainability, and about the unknown impacts of climate change. Almost half of those participants that had recently changed their operation stated it was because of climate change. A wide range of opinions to the capabilities of participants and their neigbours to adapt to climate change on their operations was given. The two most popular strategies to adapt to climate and weather related risks as listed in the questionnaire survey, were income stabilization (89 percent) and changing crop types and varieties (75 percent). The participants also stated they would implement any necessary strategies to adapt to climate changes in order to be sustainable and listed several strategies. They stated it is not about if they will adapt but when they will adapt. However, financial squeeze and short-term views both limit farmers' abilities to mitigate climate risks. Lastly, the participants hoped that communities would stop blaming agriculture and work together to reduce the impacts of global warming, have better access to educational resources, and hoped that governments would enhance crop insurance and reward farmers who have improved their management practices.

Background

The agricultural industry has a history of adaptation and innovation – a legacy that has producers well positioned to make the best decisions, for their land, their families, and their businesses. There has been little choice but to respond and adapt to change, no matter what the source. Agricultural sustainability, survival, and prosperity all depend upon adapting. Although agricultural producers are continually adapting to changes in weather, Alberta Agriculture, Food and Rural Development (AAFRD) wished to examine whether the recent global climate patterns and more extreme weather events across the Canadian landscape were concerning producers. Agricultural production, more so than any other form of production, is impacted the most by the weather. Both short term and long term weather conditions influence the form and growth of the plants and animals that grow or can be grown in a specific region. It was recognized that management decisions for crops, livestock, water, pests, and diseases will be affected by increasing climate variability and climate change along with changes in markets, environmental, societal, and economical conditions.

Acknowledgements

Stroh Consulting would like to acknowledge all of the focus group participants and thank them for their contributions to this project. As well, Stroh Consulting would like to acknowledge Tom Goddard, Kendall Tupker, and Kristian Stephens from the AAFRD Advisory Team, who oversaw the project and helped interpret the gathered data. The Advisory Team and consultants would also like to acknowledge Alberta Environment for funding this project.

Summary of Focus Groups

Objectives of Study:

Stroh Consulting and a government advisory committee worked together to design and prepare for the four focus groups to:

a. Discover how a sample of invited producers describe the ways they historically and currently deal with risks and opportunities arising from changing climate and what they intend to use as longer term strategies.
b. Have participating producers assess their current capabilities and capacity to manage business risks due to impacts of climate change.
c. Assess how participating producers plan to respond differently, if any, to future risks and opportunities due to climate change
d. Find out what producers think AAFRD, partners and others could do to support them in the management of risks associated with climate change

Study Approach:

There were four focus groups: Taber on March 1, Red Deer on March 5, St. Paul on March 8 and Fairview on March 14. Twelve to fifteen participants were randomly recruited from a contact list provided by AAFRD. The list was compiled from recommendations of regional AAFRD staff, industry contacts, listings of agriculture organization executives from the 2004-2005 edition of the Alberta Farm and Ranch Directory and from previous contacts. The farmers who were selected represented different enterprises and a wide geographic area in Alberta. They are also recognized as leaders in their agriculture practices and are engaged in their industry.

A focus group approach (as described in Appendix A) was used so the participants would feel comfortable and free to state their opinions, disclose their practices and thoughts, both positive and negative, with minimal interference. No climate change specialists were in attendance to maintain the integrity of the focus groups and discussion. The facilitated discussion lasted approximately five hours. Participants had two ways to provide their responses to questions, both in a group and a survey. The facilitator encouraged participants to express what they were thinking and why, in which differences were encouraged (Appendix B). Their comments and answers were recorded collectively as a group. It was not the intension to reach a consensus regarding climate change. Participants were then asked to fill out a written survey (Appendix C) at the end of the focus group, which mirrored the facilitated discussion. Participants completed the survey in approximately 15 to 20 minutes. However the data for each of the focus groups were kept separately, in order to compare for similarities and differences on a regional basis. The data was analysed to assess if any statistical differences existed amongst the answers through the use of Chi-Square and Fisher's exact test. However, in part due to the small sample sizes of the focus groups, no significant differences ($P < 0.05$) in the participants' answers were determined.

Both mileage and honorariums were paid to recognize the participants' time and contributions. Following the focus groups, to minimize biases, participants were offered handouts including information on climate change. Most participants were open to the information provided and took home the handouts. The following handouts were available to the participants: a one page summary of an article written by Shen et al. (2005) titled "Temporal and Spatial Changes of the Agroclimate in Alberta from 1901 to 2002", "Climate Change Impacts and Adaptations for Agriculture in Alberta" (Alberta Agriculture, Food and Rural Development 2005) which is contained in Appendix D and various AAFRD climate change and greenhouse gas producer oriented fact sheets. Participants expressed interest in being sent the proceedings of the four focus groups.

Summary of the Focus Group Participants

The intention was to get commitment from about 12 to 15 farmers to attend each focus group. There were in total 53 participants in which 12 attended Taber, 14 at Red Deer, 12 at St. Paul, and 15 at Fairview. Forty-five (or 85 percent) of the attendees had been on their operation for over 15 years, six had been on their operation between five and fifteen years, one had been on an operation for less than five years (Table 1 and Figure 1), and one participant did not respond to this question.

Table 1. Type of operation and number of years farming.
(Note: three participants did not respond to this question)

	Crop	Mixed	Cow/Calf	Dairy	Feedlot	Other Livestock	Total
Less than 5 years	0	0	1	0	0	0	**1**
5-15 years	0	4	2	0	0	0	**6**
More than 15 years	13	13	11	2	1	3	**43**
Total	**13**	**17**	**14**	**2**	**1**	**3**	**50**

Participants' Views on Climate Change

Participants had a variety of views about climate change, from being skeptical about it happening to definitely observing changes. Some were very informed and knowledgeable about current research on climate change.

Those that were skeptical thought the available information regarding climate change from different sources was conflicting and didn't know what to believe. Some thought the science behind the information seemed to be unreliable even though technology for management practices and data collection has improved. Some viewed climate change as long term, over 150 years or more and had not experienced it first hand in their lifetime. All participants did note observing changes in weather patterns but not all related these changes in weather patterns to climate change. Others think climate change is not new and has always been a concern for the agriculture industry where climate change is gradual that farmers have had to adapt to over the years. They had different views about humans and agriculture's impacts on climate change.

Overall 48 percent of the participants have seen extreme to many changes in the incidences of drought, amount of moisture, winter temperatures, extreme weather events, and growing season in the past 10 years (Figure 1). Twelve percent have seen few to no changes in their operations. In contrast, 71 percent of the participants at Red Deer had noted many changes in their operations.

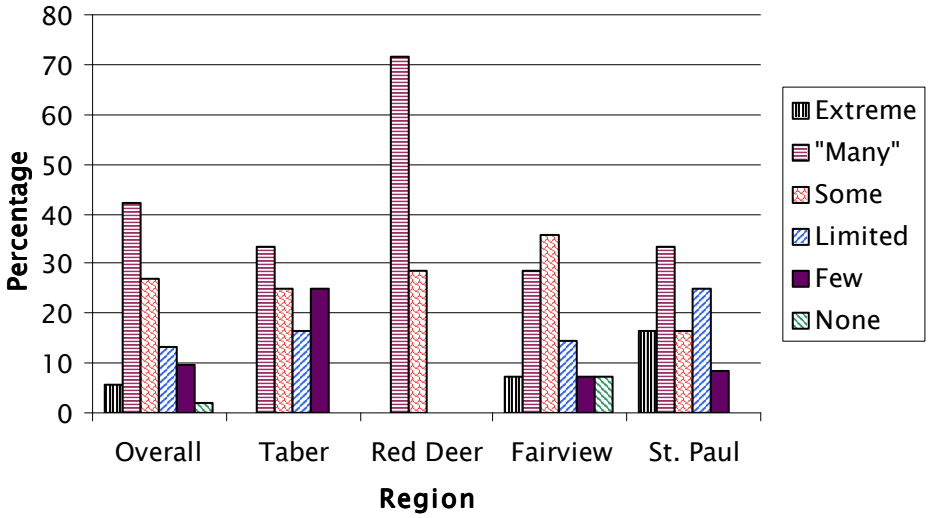

Figure 1. Changes in the incidences of drought, amount of moisture, winter temperatures, extreme weather events or growing season in the last 10 years as seen by the participants.

Overall, 39 percent of the participants indicated they were very to extremely concerned about climate change (Figure 2). In Red Deer it was 64 percent, Fairview 36 percent, Taber 33 percent and the least concerned were from St. Paul at 16 percent. Twenty seven percent overall said they were little or not at all concerned about climate change, where 50 percent of the participants at St. Paul indicated the same.

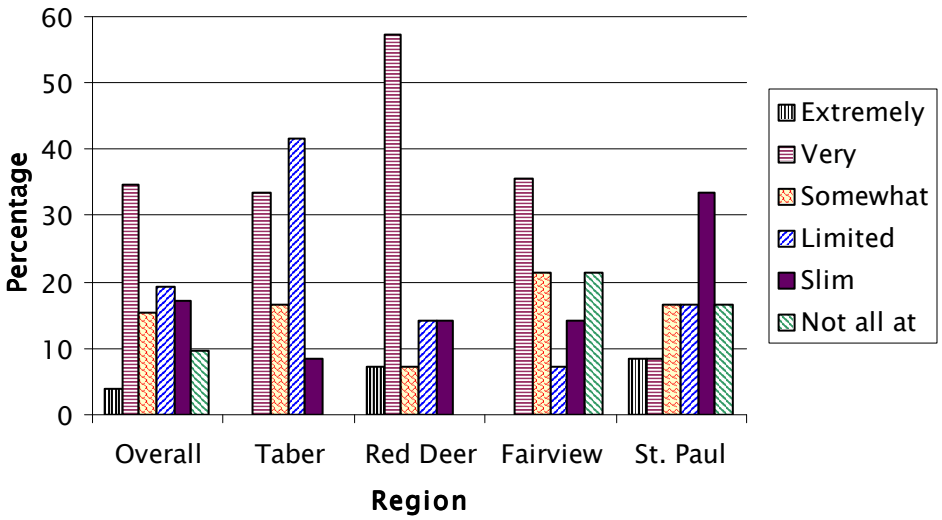

Figure 2. Participants' concerns about climate change.

Their concerns ranged from irrigation water sources and water use, limited ground water reserves, agriculture being blamed for climate change, and about the unknown impacts of climate change. Participants cited that economics and the sustainability of their business are their major concerns. Taber participants ranked amount of moisture and drought as being the two largest climate concerns (Table 2). St. Paul and Fairview rated drought and amount of moisture, respectively. Red Deer cited drought and the timeliness of moisture as the top two concerns. Some participants commented that drought and amount of moisture is the same thing, whereas others saw the difference in the two. Some Red Deer participants noted that the amount of moisture in the region may have not changed drastically but rather has diminished with respect to historical levels. In Fairview participants expressed the point that the Peace Region is made up of several distinct areas and therefore it is difficult to generalize about the entire region.

Table 2. Most vulnerable weather variables in the regions.
(1–most important and 5 –least important)

	Overall	Taber	Red Deer	Fairview	St. Paul
Drought	1	1	1	1	1
Amount of moisture	2	2	3	1	2
Winter temperature	5	5	5	3	5
Extreme weather events	3	4	2	4	4
Growing Season	4	3	4	5	3

Historical Strategies used by Farmers and their Neighbours

Participants felt their parents and grandparents adapted as well as they could given the available information and technologies. They acknowledged that today there is greater awareness, more options, and information. For example proven management practices to mitigate weather related risks exist. In St. Paul, participants remembered farmers changing the locations of their operations in order to adapt to changes. This included changing location within the region as well as into and from the region. In Fairview, participants shared how they had learned by previous experiences the importance of shelterbelts and bushes on their farms to conserve moisture and reduce wind.

Past strategies included:

- continuous cropping
- reduced tillage
- crop insurance
- altering time of calving season

- seeding earlier
- clearing trees

Current Strategies Being Used

Overall eighty seven percent of the participant's operations have changed in the past five years (Figure 3). Of those, 54 percent indicated their decisions to change were related to climate change (Figure 4). The Red Deer participants said that 71 percent of their decisions to make changes within last five years were related to climate change compared to only 21 percent at St. Paul.

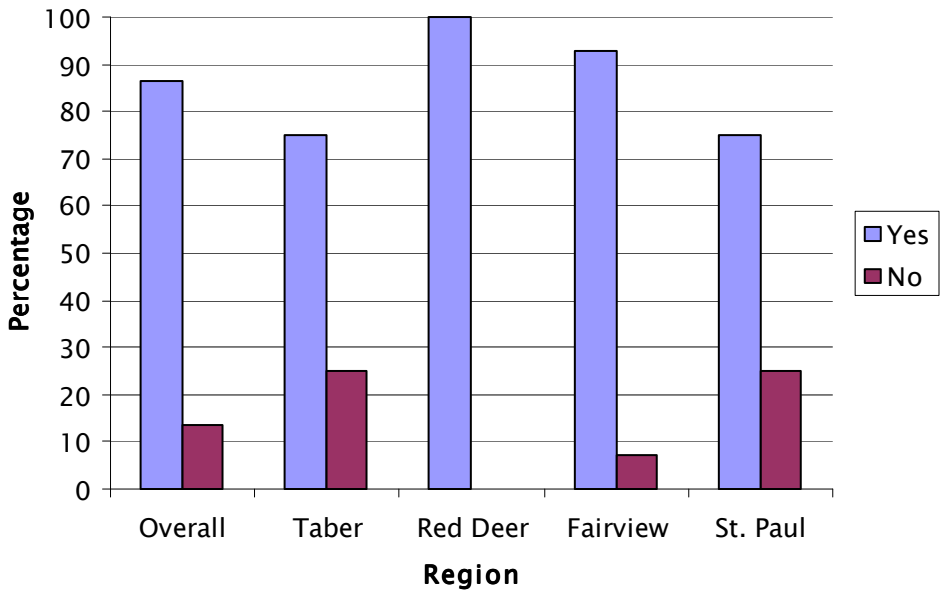

Figure 3. Changes to participants' operations in the past five years.

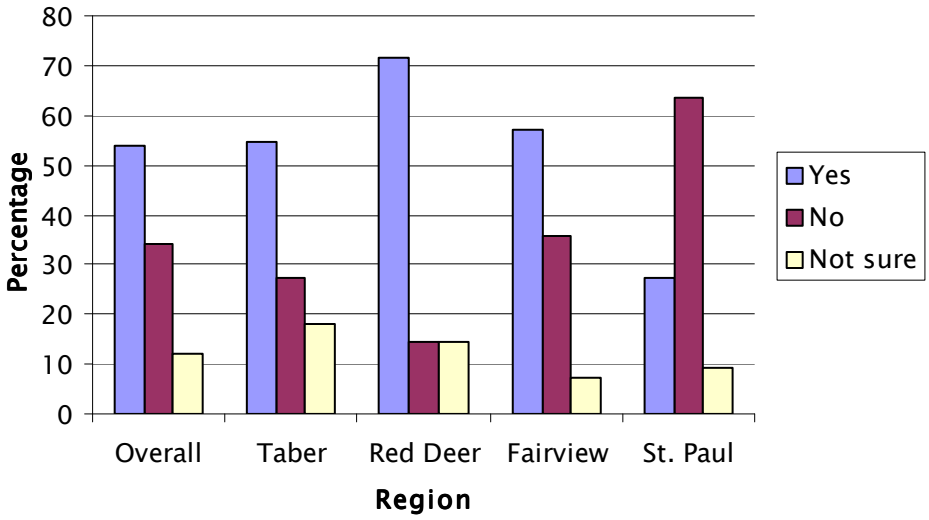

Figure 4. Changes to participants' operations related to climate change.

Of the thirteen strategies listed in the survey, the two most popular strategies were income stabilization (89 percent) and changed crop types and varieties (75 percent). In each location someone had tried each of the strategies listed.

Participants discussed other strategies that they are using which included reduced or zero tillage, improved irrigation technologies (e.g. water efficient equipment), swath grazing, stock piling feed in case of drought, direct seeding, and keeping cover on the land. Another farmer recommended increasing the number of species (plant and animal) on the land base. Participants listed the following financial management strategies to mitigate risks. These strategies included crop insurance, stabilization programs, long term planning, forward contracting, and diversifying operations. One person recommended staying out of debt.

When asked what triggers new management practices most participants said economic drivers. Economics sends a stronger signal to farmers although some had a hard time separating economics, the environment, and climate. Farmers said they would not implement changes unless there is a bottom line and an economic payoff.

Assessment of Capabilities

There was a wide range of opinions to the capabilities of participants and others to adapt to climate changes on their operations. In general, participants rated themselves as more capable than their neighbours. Overall thirteen percent of the participants said they were extremely capable with the top being 21 percent at Fairview to none of the participants saying they were extremely capable at Red Deer (Figure 5).

Participants at Red Deer and Fairview rated themselves less capable. When asked about capabilities of other producers in their area or region, none of rated them as being extremely capable (Figure 6).

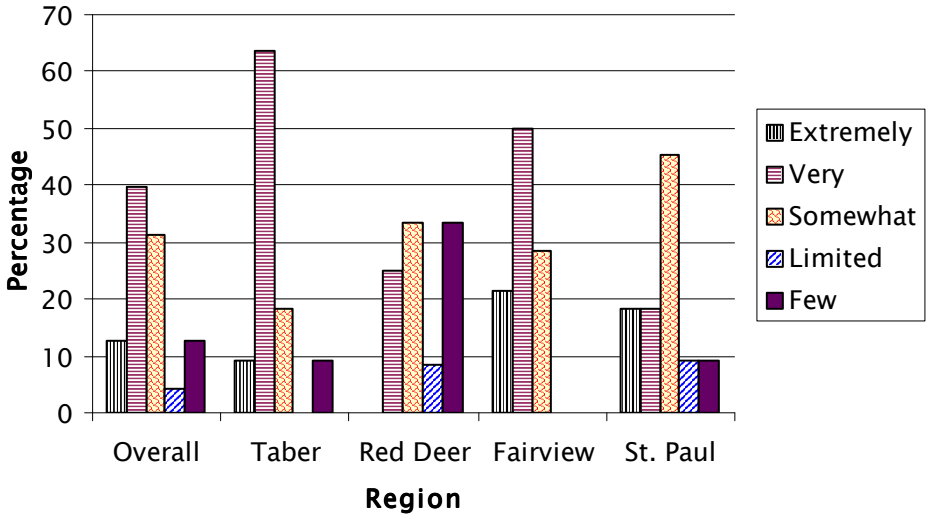

Figure 5. Participants' assessment of their capabilities to adapt to climate change.

One farmer commented that the collective capabilities in the Taber region are very good, although some producers are still not adapting as well as they could. Another said that those who are still farming are adapting effectively. The facilitators heard many times that the financial squeeze and short-term views limited farmers' abilities to mitigate climate risks. Some participants thought that younger producers could see the advantage and payback of adapting to climate change. Therefore it can be easier for them to adapt. Some thought older farmers were less accepting of changes and therefore were less capable. In St. Paul, many thought that weather and climate change is out of farmers' influence and control and therefore felt less capable.

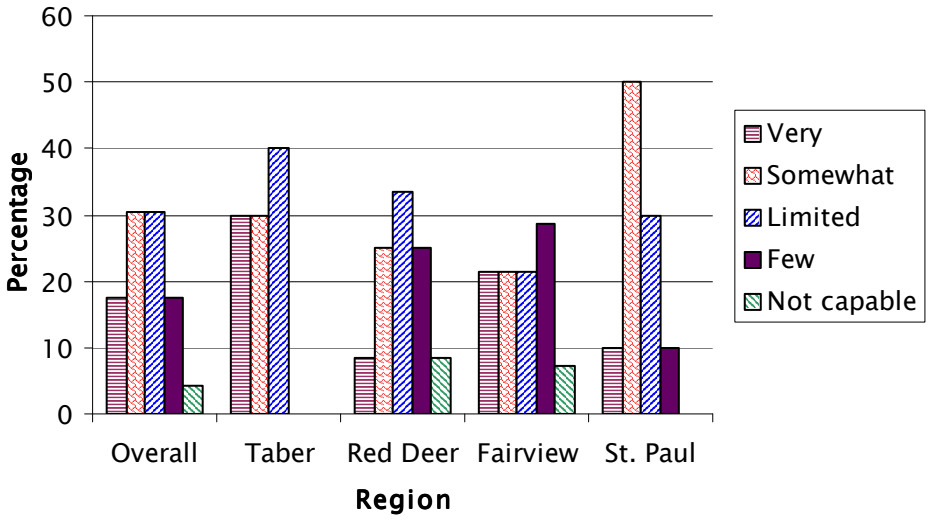

Figure 6. Participants' assessment of the capabilities of other producers in area/region to adapt to climate change.

A range of opinions was given on how climate change risks stacked up against other risks such as price risk. Price risks were seen as shorter term, whereas climate change was viewed as longer term. Climate change was seen as both a risk and opportunity. The risks were related to moisture and the opportunities were focused around warmer temperatures and a longer growing season, which allowed for different crops and animal practices.

Future Strategies under Consideration

Farmers said that they would implement necessary strategies to adapt to climate changes in order to be sustainable. They said it is not about if they will adapt but when they will adapt. Some of the participants hoped that climate change would bring on new opportunities. They listed the following ways to reduce the impacts of climate change in the future:

- Education of farmers (extension)
- Improve organic matter and carbon in soil
- Plant trees and grass
- Enhance available crop insurance
- Remain vocal, keep talking to neighbours and urban people
- Organic farming and decreasing inputs into the land

Supports for Farmers: Communities, Industry, and Governments

The participants were very engaged in what they could do for themselves to respond to climate related risks. Some individual actions included: complete an environmental farm plan, accept change, and use new technologies. Other options included: start a dialogue with non farmers to build trust and awareness to work together as well as learn from other farmers who have been dealing with limited moisture for a long time. One participant said that farmers need to have individual solutions to manage their own operations effectively- there is not going to be one solution for everyone.

The participants hoped the communities at large would stop blaming and finger pointing at agriculture and would collectively work together to reduce the impacts on global warming. Participants wanted industry associations to produce materials for educational purposes and provide access to new equipment (e.g. zero tillage equipment).

The participants also hoped governments would enhance the current crop insurance, which doesn't work for all farmers, provide relevant research as well as provide a link from researchers to farmers. All locations except Fairview mentioned the loss of the extension services and the negative effects it has had on agriculture. The participants also stated that government should be involved in education, as they are a neutral source. They should also recognize and reward farmers who have improved their management practices, through such actions as tax incentives. Farmers wanted to be provided with information from an unbiased source and then will customize the strategies for their own circumstances.

Participants also listed the following technologies that could help them respond to climate related risks:

- develop better weather forecasts and data collection
- GPS related technologies
- improved irrigation systems
- new crop varieties
- zero tillage equipment
- improved genetic science of perennials

Regional Differences

Upon reflection, the Advisory Team and Facilitators identified some similarities and differences among the four focus groups. All the participants were serious and focused on the focus group topic of climate change. Most participants were fairly

intense since climate change is closely related to the profitability and the sustainability of their operations.

The facilitators observed some differences in attitudes, beliefs and opinions of the participants in the four locations. Participants in Taber, in general, appeared to be very knowledgeable about the current climate change research. They were confident in their capabilities to adapt to climate change. Red Deer participants seemed to have experienced the greatest number of changes on their operations due to weather and climate change. They were most concerned about climate change. Red Deer participants indicated most of their decisions were as a result of climate change and weather.

The St. Paul participants were the most difficult to recruit. Some of the participants appeared to be more skeptical and less concerned about climate change and how it related to their operations. The St. Paul focus group was held the day after the March announcement that the USA border would still remain closed to Canadian beef. This could have contributed for the differences noted. In St. Paul, participants talked about the negative effects that the oil and gas industry are having on agriculture and the environment.

In Fairview, recruiting was another challenge. The recruiter reported that people in the region talked about previous poor experiences with focus groups. Fairview participants spoke about the benefits of organic farming and biodiversity on their operations. They were also confident in their capabilities to adapt to climate change. Fairview was the only location where two couples attended the focus group. The report results have indicated other similarities and differences in the focus groups in the four locations.

Appendices

A. The Facilitated Group Process

Self Introductions:
Please introduce yourself, your operation and briefly describe how climate and weather have influenced your operation and management decisions in the past few (five) years.

History:
1. How have the incidences of drought, amount of moisture, winter temperatures, extreme events or growing season changed in your area in the past ten years? How did you (or your parents) respond to the weather variables in the past?

Probes
If you implemented changes, what were they? How effective were those changes? Did your neighbors respond the same? How, if any, do you wish you had responded differently? What triggers changes in your decisions or new management practices?

Current thinking on risks due to climate change/ weather:
2. What does climate change mean to you? How concerned are you about climate change, extremely concerned to not concerned?

3. Would you consider climate related risks more/ less difficult to manage than other risks such as price risk?

4. Which climate variables (i.e. drought, growing season) is agriculture in this area/region most sensitive or vulnerable to? Which of the main climate and weather risks are you currently managing for?

Probes
For example:
(a) Temperature increases- how will it impact crops or livestock?
(b) Extreme weather events – How would you deal with the idea of increased hail storms? Thunder storms? Localized flooding? Drought- 10 vs 40percent less precipitation what will be the impact on pesticides, fertilizers, tillage management, crop rotations, crop variety.
(c) Water management- quality and quantity, irrigation- crops choice, pasture range management- e.g. what forage species?

How do you currently manage these risks?

Assessment of Capabilities:

5. How would you rate your current capabilities to adapt to climate changes on your operation, specifically to mitigate risks and capitalize on opportunities? For example, rate yourself extremely capable to not capable. How does this compare with other farmers in your area/region?

Support for Farmers:

6. What would you like to see the community do to help producers respond/cope with climate related risks?

7. What would you like to see industry (e.g. banks, equipment dealers) do to help producers respond/cope with climate related risks?

8. What would you like to see governments (policy and/or services) do to help producers respond/cope with climate related risks?

Future:

9. What do you think are going to be the consequences and/or opportunities due to climate change in this area/region in the next ten years? What are the most important things farmers in the area/region can do to reduce the impacts of climate variability and changes?

Probes: Will we see anything different as we drive along the country roads? Will conversations in the community be different or focus on different topics that are currently discussed? Will attitudes and strategies be different?

B. Qualitative Results from Facilitated Discussions

Taber

Participant Profiles

- All participants have been on their land for over 10 years
- Farming for 25 years at Bow Island, irrigation farm with mainly beans and cereals
- Farming at Bow Islands for over 15 years, mostly irrigation with grains and dry beans
- Irrigation farmer for 43 years, highbred canola and wheat
- Farming various crops, such as chick peas, winter wheat and canola
- Dry land farming at Foremost
- Mixed farmer at Red Cliff, cattle and cereals

- ❖ Farming for 35 years at Nanton, all seeded to grass except 80 acres, custom grazing
- ❖ Farming in Canada since 1985 at Grassy Lake, mostly irrigation, grains and potatoes
- ❖ Third generation farmer at Taber, mostly irrigation, sugar beets and cattle
- ❖ Ranch at Taber, some irrigation, native prairie, everything seeded to grass except small portion rented out for potatoes
- ❖ Mixed farmer at Coaldale since 1972, feedlot, all irrigation, mainly timothy and canola
- ❖ Dairy farm at Medicine Hat, irrigation land, oilseeds and cereals (as rotations)

History

How have the incidences of drought, amount of moisture, winter temperatures, extreme events or growing season changed in your area in the past ten years?

- Moisture (rain, snow, dew) falls at a different time than in the past, now during harvest time
- Not a month goes by that you are not checking the quality of the feed, what we are experiencing in regards to climate change has probably been happening all along
- In the last 40 years the weather pattern has changed, there is more moisture east of Lomond that there used to be
- Think that there were as many extreme weather occurrences in the past. Politics are trying to control the masses and confusing pollution with climate changes. Politicians are trying to put enough fear in our hearts to make us stop polluting. Good has come out of this because people are polluting less.
- When we moved to the area in the late '70s, there was a small lake (3 or 4 ft of water) on our operation, now it is only seasonal water.
- When father farmed, once every 7 years a part of the farm would get hailed out, haven't had hail since
- Not seeing climate changes just seeing a weather cycle
- Possibly more extreme weather now than in the past
- Not climate change, experiencing weather fluctuations (cycles)

How did you (or parents) respond to the weather variables in the past?

- Parents did as best they could to adapt with the technology that they had
- We currently have more technology to better adapt to climate changes

If you implemented changes, what were they?

- Seeding earlier in the spring

- Minimum till or zero tillage
- Better water management practices
- Adjusted to climate change by moving seeding date up at least a month, which shows economically and better utilizes the little moisture in the region
- In the past was all dry land farming and sheep. Presently it is all seeded to grass now except 80 acres. Sold ewes because of drought and now custom graze.
- Has made several changes, work land less, seed much earlier (2nd weekend in April) as well as have taken courses on how to manage water better from AAFRD

What triggers changes in your decisions or new management practices?

- What has driven us to be more economical and find better technologies is government is encouraging producers to use certain methods and we are driven by the population. Not driven by economics but rather climate, may have economic implications but ultimately make changes to operation because of climate change
- More respect if producers are driven by climate change rather than economics
- Climate change is so gradual, farmers react to economics which sends a stronger signal
- Economics
- Economically driven to improve technology (i.e. no till) at producer level
- We are stewards of our land, economics and taking responsibility for the land trigger decisions
- Farmers are economically driven and as long as technology is affordable farmers will use it
- Change practices not necessarily because of climate, possibly intuitively because of climate. Soil is not the same as before, need to be in tune with environment. Economics and the environment are interrelated.

Current thinking on risks due to climate change/ weather

What does climate change mean to you?

- Each of us have a different definition of what climate change is
- Greenland in the past and now it no longer exists. In Egypt there used to be extensive farm land, now the land is no longer being farmed
- Variability of weather over a long period of time (500-1000 years)
- Some things have happened because of poor management and over use rather than climate change
- Weather stations are at airport used to be in open fields, this could contribute to changes climate
- Extreme changes, for example Mt. St. Helen's erupting
- Our perceptions are different from our fathers and grandfathers, the world's population has doubled, and energy use has increased significantly since our grandfathers' time. Such radical changes in perceptions and now more

technology and information available that it is hard to know if climate change is occurring
- Perceiving things the wrong way is a big problem, media contributes to this. The publics sees stuff and blows it out of proportion
- Hard to find out what the actual truth is because there is so much conflicting information on climate change
- Can't image what I as an individual can do about some effecting climate change, i.e. if all the glaciers are going to be gone

How concerned are you about climate change, extremely concerned to not concerned?
- Public is extremely concerned about climate change and the implications on the environment
- Producers are going to lose resources if they don't manage water effectively
- Public is going to dictate concern (i.e. City of Calgary)
- Public is getting more concerned but not fair to stay the farmers are behind that, farmers were ahead of the public before in regards to concern
- Climate change has not been a major concern but sustainability, which ties in with climate changes, is a major concern
- Hard to put all the information into perspective and then make decisions and survive
- Farmer's debt is causing the greatest pollution because they are pulled to make a profit but stewardship is also important. Farmers must maximize output to manage debt
- Concerned with weather, economics and sustainability
- Concerned about the amount of irrigation water and how efficiently and effectively we use the irrigation water

Would you consider climate related risks more/ less difficult to manage than other risks such as price risk?
- Climate is both an opportunity and a risk
- Climate is longer term, price risk is shorter term
- Had to take a risk in order to find the opportunity, made changes in practices which was a risk but then became an opportunity to improve farming operation

Which climate variables (i.e. drought, growing season) is agriculture in this area/region most sensitive or vulnerable to?
- Amount of moisture (snow or rain), it is the same thing as drought
- Not as vulnerable to growing season compared to Fairview
- Chinooks can be hard to deal with in this area
- Not as vulnerable to hail in the South

Which of the main climate and weather risks are you currently managing for?

- Moisture
- Availability of irrigation water is an issue

How do you currently manage these risks?

- Determine practices to get the soil/seeds to best use available moisture
- No tillage
- Climate has made us better water managers
- Adjust to dry weather by going to zero tillage
- Changes in irrigation technology – low pressure irrigation, less energy use and less evaporation
- Strategies are very linked to economics, not adapting necessarily because of climate change
- Fertilizer usage
- Adjusts to climate change by changing to pivot irrigation and minimum tilling practices
- Irrigation systems have increase efficiently in the last 10 years by approximately 20percent
- Selenium is not an issue any more, proves management strategies are working
- Changes are good for the climate as well as economics
- Soil improvements
- Plant research and genetics
- Livestock are becoming very predictable (i.e. tenderness), genetics
- Crop rotation
- Stewardship of the land
- Information that was gather on the efficiency of water uses, has open the eyes of the producer
- Adjust by stockpiling more feed for livestock in case of a longer drought period
- Seeding more winter varieties of crops
- Tried to put crops in that don't require lots of moisture, has changed operations significantly
- Always been early seeders, improvement in technology has allowed farmers to adapt to climate change in southern Alberta. Need to adapt technology to the local conditions in southern Alberta

Assessment of Capabilities

How would you rate yours and others current capabilities to adapt to climate changes on your operation, specifically to mitigate risks and capitalize on opportunities?

- Adapt quicker and easier now because of technology available
- Whole farming community is certainly more capable and farmers are doing the required actions. Much further ahead than the general public
- Very frustrating when people tell us how we should be managing our land
- Everyone who is still in the business has been adapting quite effectively

- Collective capabilities in the region are very good, some producers are still not adapted as well (i.e. overgrazing, tilling)
- If I farmed the way my father did in the past, would no longer be farming
- Adapting daily
- Frustrated for not being recognized for adapting and making changes
- Only takes one "bad apple" for the rest of producers to look bad as well and not being recognized for their capabilities
- Bigger operations (land size) are less capable to manage (not all participants agreed with this)
- Technology has allowed us to adapt more quickly, able to conserve more moisture and put more carbon back into soil
- Farmers have the capability and are doing are best job they can do
- Not as capable in the past to adapt to risk as farmers are currently

Support for Farmers:

What would you like to see the community do to help producers respond/cope with climate related risks?

- Producers need to be smart about how their products are being marketed
- Farmers as individuals can't do anything
- Complete an EFP, which shows that you are running a good farm business, can prove this with documentation
- Responsibility of producer to be as proactive as possible, whether it be through EFP or lobbying government
- Farmers have been negligent to be advocates for themselves and need to support each other more

What would you like to see industry (e.g. banks, equipment dealers) do to help producers respond/cope with climate related risks?

- Producer groups need resources to educate the public
- Industry is not always trusted by the general public

What would you like to see governments (policy and/or services) do to help producers respond/cope with climate related risks?

- Education at all levels (i.e. publics, politicians), public have very little understanding of what farming is all about. Need education of farming practices (i.e. fertilizer use, water usage) and sustainability. Should be done by the farmers as well as the government
- Public awareness, if public awareness is increased it will reflect in the prices of product. The public should be responsible as well as the government in consultation with the producers and associations
- Educating the public won't work – only works one on one

- Pollution index put on all the products from grocery stores so that when the consumer goes there they are educated; would help our home grown producers. Would need industry, community and government to implement (this puts farmers against farmers – all in group don't necessarily support this)
- Facilitation
- Support EFP
- If there are benefits or opportunities (i.e. carbon credits), direct the benefit back to the primary producer. If the government wants the producers to implement changes, some of the income needs to comes back to the farmer
- Government is responsible for research around climate changes and keeping technology coming forward to the producer. Research needs to be for the critical mass and driven by industry
- Have experts available
- Coordination of research to producers, science and extension. The distribution channel is no longer there (i.e. DAs), connection to research is gone
- Currently have to go to chemical companies for information on research, not always sure the information isn't biased
- Farmers need access to reliable, unbiased research information and producers need input into what research needs to be happening
- Tax incentives to farmers who are making changes that are environmentally friendly and reducing impact on climate changes and have proven differences
- Money to make changes in infrastructure, i.e. new irrigation systems – this could be a disincentive for farmers who have already implemented changes
- No system in place to sell carbon credits in Western Canada, government needs to do this

Future

What do you think are going to be the consequences and/or opportunities due to climate change in this area/region in the next ten years?

- Climate change will provide lots of opportunities for producers
- New crops – opportunity
- Another tax – consequence
- Economic and environment pull is a consequence
- Can't afford technology, bit stuck right now
- Likely the last one in family on the farm – that's a problem
- Youth taking over farms in the future is going to be a problem, it is a hard industry to get into. In other lines of work there is not the risk, time commitment and investment of a farmer
- Farmers are going to implement whatever necessary to adapt to climate change in order to survive. It is not about if they will do things but when they will do it
- Carbon credits–future opportunities

- Farmers are not at the table to help influence policies to help farmers, government does not have the ability to look after the best interest of the farmers if they are able to provide input

What are the most important things farmers in the area/region can do to reduce the impacts of climate variability and changes?

- Education
- Need to implement some system in this country to put into place a resource that will help the future generation of producers
- Plant trees and grass
- Improve organic matter in soil, transfer carbon
- Decentralize the feedlot system
- Buy hail and crop insurance
- Better forage insurance
- Better crop insurance that mitigates the risk of climate change
- If government is serious about food supply, need to support farmers because they can only take on so much risk
- Continue to adapt
- Remain vocal, keep talking to neighbors and urban people
- More involved with market place

Red Deer

Participant Profile

- ❖ Sheep farmer in Spruce View, sustainable grazing management for the past 6 years
- ❖ Fifth generation farmer at Cremona
- ❖ Fourth generation farmer (110 years) at Carstairs, hay, grain and custom pasture (rotational grazing)
- ❖ Farming at Killam, crops including wheat and barley
- ❖ 240 Cow/calf operation at Cremona, son will be fourth generation on farm, currently expanding business
- ❖ Cow/calf and feedlot operation at Pine Lake
- ❖ Farming at Three Hills, barley and canola
- ❖ 5th generation (98 years) at Eckville, cow/calf operation, Reeve of Lacombe County

- ❖ Cow/calf and field crops at Red Deer
- ❖ Second generation cow/calf operation at Rocky Mountain House
- ❖ Fifth generation at Cremona, farming for less than five years, 2500 acres barley, canola, timothy and 100 cow/calf operation
- ❖ Third generation farmer at Veteran, 3500 acres, 200 cow/calf
- ❖ Farming at Cochrane in Bow Valley, third generation, 300 cow/calf
- ❖ Third generation at Beiseker, small cow/calf, feedlot, grain & oilseed.

History

How have the incidences of drought, amount of moisture, winter temperatures, extreme events or growing season changed in your area in the past ten years?

- Growing seasons are longer
- Currently struggle with lack of moisture
- Weather patterns are more severe
- Incidence of frost at uncommon times is occurring
- Warmer winter weather
- On operation had a grass fire on March 3rd and there is no snow left
- Time of moisture
- Because of climate change he is seeing more severe weather i.e. rain storms, drier and warmer
- Moisture seems to be a common factor across province, occurring in different locations and too much or too little
- Compared to the past it is tougher to water cattle, grazing options are different
- Seeing more weather extremes.
- Used to graze the cattle all winter and feed hay in storms
- Timely rain is very critical now. Total rain fall has not changed that much but different locations and time of rainfall
- Less moisture
- Weather has been very cyclical, same weather trend happened may years ago
- He is a firm believer that there are changes happening. There are more severe localized weather events, moisture is a large factor
- Slew on their property that was dry in 1890, in the last 80 years it has never been dry.
- Seeing more localized rainstorms on different quarters.
- More severe weather i.e. rain storms, drier and warmer
- Currently getting into a warming trend, it is generally a couple degrees warmer than the past

- Growing season is quite short and moisture at different times of year

How did you (or parents) respond to the weather variables in the past?

- Options and technologies to adapt were not as available in the past
- Now we are more aware, there is more options and information available
- Better practices in place to mitigate some of the risks from weather than in the past

If you implemented changes, what were they?

- Use swath grazing because of less snow not necessarily because of warmer temperatures. Swath grazing wouldn't have worked in the 60's with the amount of snow.
- Seed two weeks earlier due to weather and variety of crops available
- Compress more work into a shorter season
- Changed farm to sustainable grazing management 6 years ago
- Growing different crops than 15 years ago

What triggers changes in your decisions or new management practices?

- Economics are tied to the climate, each influences the other and they are very interrelated. For examples changing to drought resistance barley was both for climate and economics reasons
- More information and knowledge than in past
- Environmental best practices
- If it is not sustainable it is not going to be done
- Made changes on operation for economic benefits and for environmental reason but if they don't see a bottom line, they won't make a change.
- Farmers will not implement changes unless there is a bottom line and an economic benefit

Current thinking on risks due to climate change/ weather

What does climate change mean to you?

- No definitive reason for why climate change is happening, definitely seeing changes in climate and weather trends, they are always changing
- Skeptical about climate change but there is a cause for change in management
- Something is going on but is still a little skeptical about the science behind climate change
- Climate change is a natural progression; farmers have little to do with climate (environmental reasons).
- Climate change is longer term, over 100 years. Since last drought in the '30s we are just in a cycle, not climate change.
- The public is more in tune with the news that years ago and therefore change is more due to awareness than actual changes and ability to measure. Not sure

that anyone really understands about climate change. 150 years isn't long enough to measure changes significantly.

- Much different weather patterns, more variable weather, stable period from '40s to '79, then more severe changes.
- Man is responsible for what is happening in there area in regards to climate change. There is 160 miles of drainage ditch in their area and rainfall goes around the ditch. Farmer need to realize that practices that worked in the past may not work anymore
- No definitive reason for why climate change is happening but he is definitely seeing changes in climate (always changing) and trends, farmers are always adjusting.
- Don't think anyone really knows about the climate, 150 years isn't long enough to measure changes significantly.
- There is something going on, still skeptical about the science behind climate change
- Some changing patterns are affected by man
- What is going into the atmosphere is not necessarily causing climate change
- Lots of information on climate change but it is all conflicting, not sure on who you should believe
- Find someone like Tim Ball's ideas more believable than radical thinkers, who are getting funding from areas that may have other agendas
- Hard to figure out who to believe, hidden agendas behind some of the information
- Sources of information of climate change have changed.
- None of us live long enough to see changes, only have anecdotal information from the past. People will not see climate change first hand, information is always passed on
- We are discussing weather patterns rather than climate change
- Difficult to define what we are suppose to be talking about regarding climate

How concerned are you about climate change, extremely concerned to not concerned?

- Neighbors are concerned.
- All depends where you live, not as big of issue in western Alberta compared to eastern Alberta.
- More attention and talk about holistic management. People are starting to access more available information and training to manage farms
- Concerned with decrease in surface, ground and sub surface moisture, there is only a 3 or 4 day tolerance for rain or crop suffers. There are no longer the water reserves.
- Can't ignore this anymore, very concerned about climate change
- Have always been concerned in our area for generations, but have learned to adapt and make changes

- People are becoming more concerned in areas where historically they have not had as many problems with weather and climate
- Reactive to many changes rather than proactive
- In 1980s, major concern on how to get rid of the moisture
- Everyone is quite concerned about climate change

Is Climate Change a Risk and/or Opportunity?

- Next generation, sees climate change and global warming to be a potential opportunity for farmers i.e. longer growing season
- Global warming may give the opportunity to grow more crops
- Both, in our area we are not used to having drought
- I have a healthy skepticism about the impacts of climate change
- Climate change is always an opportunity for someone i.e. in a drought year, buying hay from Saskatchewan, opportunity for those producers
- Dependent on whether you can afford to invest in equipment to conserve water and improve soil quality

Would you consider climate related risks more/ less difficult to manage than other risks such as price risk?

- Price is more risky in the short term
- Long term management of climate change is harder because farmers are in the "survival mode" often
- Difficult to sell the long term benefits for managing climate change at this time, especially to older farmers
- When managing climate farmers are always being reactive, price you can be more proactive. Difficult to be proactive when dealing with climate, easier to manage for other risks

Which climate variables (i.e. drought, growing season) is agriculture in this area/region most sensitive or vulnerable to?

- Amount of moisture
- Timely moisture, can get by on very little moisture if it comes at the right time
- Moisture is the more sensitive but temperature is also related. If there is less moisture than need cooler temperatures

Which of the main climate and weather risks are you currently managing for?

- Amount of moisture
- Drought
- Growing season

How do you currently manage these risks?

- Lost half of crop due to drought last year. Made lots of management changes and had to conserve moisture. Always trying to minimize risk as much as possible.
- Made changes in the last five years as well as diversified into livestock equipment
- Required to fence creeks and have more intensive water management practices in the last two years due to climate change as well as environmental management
- Not used to not having rain, have had to implement more pasture management
- Compress more work into a shorter season and are not growing the same things as 15 years ago. Micro view of climate, there is a long term trend to warming, farmers will have to adapt.
- Changed to zero till and winter cereals, this was driven by climate and economics.
- Minimum till
- Zero till
- Minimum tillage, cannot afford to do zero till – if you want all farmers to go to zero till, need to support farmers through access to equipment
- Different varieties of crops

Assessment of Capabilities

How would you rate yours and others current capabilities to adapt to climate changes on your operation, specifically to mitigate risks and capitalize on opportunities?

- "Financial squeeze" doesn't allow our operation to go to zero tillage, which would be beneficial for the farm
- Can't keep producing things that don't make money
- No benefit to have better management strategies, no remuneration to farmers
- Farmers are getting older and will not necessarily invest in the long term because won't see the benefit in economics in their life time
- Younger producers see the advantage and pay back down the road, easier to accept and make the change. Younger farmers are more optimistic and feel that there are still options (Facilitator note: Some of the older farmers in attendance also were optimistic about the future of farming)
- Many outside influences, don't feel that farmers are making the rules, this reduces are capabilities
- Have the capabilities to make the right decisions (than past) but now there are more players with their own agendas (i.e. environmental companies) making up the rules
- Collectively, farmer are very capable to adapt

- Attitudes are very important, it is important to not de-motivate the young farmers
- Farmers are constantly adaptation to the weather and hope you make the right decisions.
- Farmers in general are optimists, cynicism comes in when outside influences are making decisions and regulations
- Farmers have relative capabilities in a global sense now compare to only having a regional capability in the past (i.e. Central Alberta to Brazil)
- Capability of farmers has decreased, opportunities are restricted by rules and regulations
- Farming industry is in dire straights, without money to make decisions this limits farmers' capabilities
- Some farmers don't feel very in control of their future
- Farmers are in survival mode, not going to put out money that will not come back in the short term, they are not looking forward to 20 years
- Lots of options to manage right now, but no money to implement these options
- There are still farmers doing "recreational tilling"

Support for Farmers:

What could farmers do?

- Promote the benefits of buying the products to the consumer and building the trust between the consumer and farmers
- Build the bridges to start the dialogue between the farmers and urban people – find common ground to build trust
- Crop insurance
- Have to learn how to adapt to what we have with proper cropping methods and seed varieties. Individual practices need to be supported with education or guidance
- More technology happening much quicker than in the past, farmers need to accept change and adapt to change
- Bottom line is still economics and how farmers solve the problem is dependent on this
- Encouragement cooperative ownership of equipment for better management
- Don't really think the government needs to be involved, should be the responsibility of the farmers
- Public perception is that farmers are always looking for incentives, need to change this perception
- Having producers look at the collective affect they are having on climate change and better understanding of how they can manage for climate change
- Hard to find a solution to a moving target, which climate change is. Do we really know what the impacts are of climate changes or just the symptoms? What are

the impacts of less moisture? We currently just understand the symptoms of less moisture
- Learn from other farmers who have being dealing with less moisture for a longer period of time
- Farmers need to start dialogues with MLA to understand the farmer – farmers need to take the information directly to the MLAs rather than them receiving the information via another source
- Water attracts water, look at strategies to attract water i.e. water collection basis

What would you like to see the community do to help producers respond/cope with climate related risks?

- If public would buy food for what it was worth to producer, farmers would not require subsidies
- Foster a sense of being part of the same team and ultimately have the same goals, i.e. city people, farmers, government, community
- Public opinions drive policies
- Collectively building relationships with the "community" – consumers and neighbors
- Urban community is getting further and further away from the farmers, there are less exchanges and relationships. Currently have an adversary relationship with the end-user. Consumer doesn't really care where their food was grown if it is safe, quality and affordable
- Public generally does trust the producer
- Bar code in Safeway in France that tells the consumer who has produced the product – need to put a "face" on the producer. Both the consumer and producer have to take responsibility for the marketing tool
- Provide a financial benefit to the consumer for buying the product produced locally which is then reflected down to the producer

What would you like to see industry (e.g. banks, equipment dealers) do to help producers respond/cope with climate related risks?

- Farmer and agri businesses need to get around the mainstream urban daily media, work with the media. Need to take the information to the public, not likely going to go through the mainstream media. Farmers and associations need to keep taking the message out, although there are limited funds for farmers to do this
- Access to rental minimum/zero till equipment i.e. Clearwater County
- Classroom Agriculture (Grade 4) – producer organization driven, should be a yearly program to educate all ages

What would you like to see governments (policy and/or services) do to help producers respond/cope with climate related risks?

- Need better crop insurance on an individual farm basis, not based on what other farmers are doing. Based on the history of the specific farmer, more customized insurance to the farmer
- Looking for more regulations not less regulations from the government
- Research technology to predict the weather – time of moisture, weather tracking and varieties of crops
- Open up the Canadian Wheat Board
- Government needs to develop programs to generate knowledge about climate change and the environment
- Carbon credits
- In past few years government has supported the farmers through subsidies and incentives but very difficult to apply for the funding. Takes lots of time, applications are constantly changing and complicated. No longer support for farmers, such as DAs, to help apply for government funding. Not enough money coming down to grassroots to pay for someone to help the farmers in applying for subsides or incentives.
- If conserving water if for the benefit of the general public, there should be incentives for this from beyond agricultural i.e. environment and health
- Better consultations between agriculture department and other departments i.e. environment, health
- Farmers are interested in having things to benefit the general public (i.e. public trails), but need regulations to protect the farmer. Eventually there are too many rules for farmers to continue to offer these services
- Farmers need to be consulted more often, have opportunity to provide input
- Improve crop insurance – if zero tillage crop insurance doesn't work, discourages good practices, pay out crop insurance earlier, provide support for purchasing crop insurance
- No support regionally for the farmers, counties and MDs fieldmen are being downloaded on – huge gaps from county to county. Ag offices used to support farmers
- Delivery system used to be more consistent across the province
- Concerned that farmers will not get credit for changing to zero till from Kyoto, need to provide credit back to 1990
- Supports have too long of a timeline, too long for the money to get to the farmers
- Farming needs to be looked at as a bona fide business, instead of as the bottom of the heap. Farmer have no control of the money coming back
- Support variety research, which is not a priority at this time, variety research is critical for climate change
- High speed internet in more rural areas to better access information

Future:

What do you think are going to be the consequences and/or opportunities due to climate change in this area/region in the next ten years?

- Irrigation is going to have to start further south because of glaciers being gone in the next 20 years, water source not available. Move expectation of irrigation further north

St. Paul

Participant Profile

- ❖ Farmer at Cold Lake, commercial cow/calf operation
- ❖ Farming since 1982 at Bonnyville, cow/calf operation and forages
- ❖ Third generation farmer at Lavoe, family started farming land in 1922, mainly grain, pulses and peas
- ❖ First generation farmer since 1976, straight grain and crops (i.e. canola, peas, barley, canary seed and alfalfa)
- ❖ Farming since 1974 at Wainwright, cereals and oilseeds
- ❖ Cattle operation at Iron River
- ❖ Mixed farm, cattle, hay, grain, at St. Paul for 25 years
- ❖ Farmer at Iron River, commercial cattle and grain operation
- ❖ Farming at Viking for 31 years with husband and son, diary for 20 years, '98 sold dairy and went to beef and grain
- ❖ Second generation farmer at Elk Point, family on farm since 1920
- ❖ Farming for 40 years at Lac La Biche, cow/calf and grain operation
- ❖ Grain and cattle farmer at Vilna

History

How have the incidences of drought, amount of moisture, winter temperatures, extreme events or growing season changed in your area in the past ten years?

- Longer growing season, no frost in August like in past
- Last five years, average temperature is the same. Less extreme weather, weather always goes to the average
- He is experiencing less moisture, and the drought cycle is the largest factor on farm. Land is light land and in the heat of summer need rain every two weeks for a profitable crop.

- Don't have dryness, usually too much rain rather than not enough.
- Record colds in the past few years
- During '70s in a wet cycle, optimum growing. 1981 started a drying trend, still today.
- Same amount of moisture but at different times
- No longer getting three day rains like in the past
- Months where there is usually more moderate temperature, now seen more cold weather
- Moisture is always variable
- '73, '74 didn't seed until May because of amount of snow

How did you (or parents) respond to the weather variables in the past?

- More options currently – varieties, truck feed in from farm away
- Feed left over from the previous year to provide insurance if crop isn't good the following year
- Farmers moved and changed locations – still happening currently. Some farmers manage where they are and adapt on original land – some may move in order to expand operation rather than because of climate change – some that stayed were not totally dependent on the land to supply the income (i.e. teacher)
- More sustained unit in the past (i.e. made food, clothing)
- In south (Hanna, Cereal), driven by economic change rather than climate change

If you implemented changes, what were they?

- Zero tillage is not economically feasible to change over to, nothing to do with climate or retaining moisture
- Have made changes such as late maturing crops because of no frost in August like in past
- Changed calving season to April- May from February-March; swath grazing; no till, continuous cropping, crop/pasture insurance. Changes were made due to economics
- Continuous cropper since '76, selective tillage, then went to zero tillage. Changes were more because of economics than weather changes. Conserve moisture equals more money in your pockets, bottom line is economics
- Have changed to low disturbance tillage and doing everything at once (seed and fertilizer)
- Zero changes directly as a result of climate change – changes could help to manage , issue you address in economics, it is the only way to survive

What triggers changes in your decisions or new management practices?

- Economics

- Changes have been because of economics and have coincidentally dealt with climate
- Bottom line is always economics

Current thinking on risks due to climate change/ weather

What does climate change mean to you?

- Are we just experiencing weather cycles or actually climate change? Recognize that there are lots of emissions from vehicles, but farmers only 3percent, other things farmers could do.
- We are experiencing a weather trend than, may be a 400 or 700 year trend or micro-climate change. There are many trends within bigger trends. Not likely caused by human emissions, may be speeding up a weather trend but not likely a cause.
- Not caused by humans, we have a small effect on climate change.
- Natural cycle, all cycles fit together, maybe in a 1000 year cycle. Humans haven't looked at what we can do within to deal with changes i.e. drought.
- Everyone is jumping at the gun because there is a couple years of not so good, need more information from years ago to determine if climate change is really occurring.
- We are dealing more with weather cycles than climate change. Farmers need to look at connection with climate and environmental sustainability
- Climate change is always happening, good thing it does change, helps to make decisions on farm
- Difficult when politics come into climate change. Kyoto is a money exchange - may be to bring standard of living up in other countries. Kyoto is going down the wrong path
- Participated in lots of discussion on climate changed in university, always been exposed to the idea of climate change. Worked for PFRA on carbon sinks in the past.
- Do believe we have an effect on climate change, but does not necessarily matter because we aren't going to change it or reverse. Carbon credits are kind of a scam, but would still like to get in on it as a moneymaker.
- Biggest contributor to drought in this region is clearing of trees and wind.
- Don't like what university is teaching regarding climate change i.e. CO2 (not significant). Water vapor does impact the environment. Changed dramatically over the years, doubt about the talk of climatologists about climate change. Using fossil fuels have little to do with climate change, but farmers need to be stewards of the land and responsible for the impacts on the environment (nitrous oxide).
- Climate change is always an issue of crop production, not new stuff to agriculture. Agriculture is everyone's business, in which we need to understand this. Farmers are personally involved.

- Need more weather stations, forestry data is not valid (from other departments).
- Climate change has always been here, changed from very dry, to very wet, to very dry and starting to swing back to wet in lifetime.
- What affects the climate is more than the emissions. Topography is an issue (making more farm land), if keep changing topography this is going to keep changing the climate, probably this region more of an issue than other parts of Alberta. In some areas (South of St. Paul) seeing more replenishment of bush.
- Since '02 only 2 inches of rain, 9 inches last year.
- Insurance is a necessity on most farms today. Don't think that weather stations should play a role in farmers income totally, should be on an individual farm basis. More rain on operation than neighbor only ½ mile away.
- More wind now, weather patterns has changed but think is a result of the warming oceans
- Natural phenomenon (i.e. lakes) change the ambient temperature and wind and rain in the area – water and trees attract water
- Frost every year in '76 (in August), now late maturing crops because haven't been getting frost, better yielder and better resistant. Had crop left out in last three years. Different weather patterns in area, in the four different locations. Not the snowfall like in the past. Concerned that farmers may need to go back to a shorter growing season
- Alberta is an area of extreme weather variance, one of the most temperature changing areas in the world, not climate change
- Moose Lake was dry at wartime, but haven't seen it dry since then. If we are causing the problems, why was it so dry in the 30s?
- Climate change is not a new thing, being adapting and changing for many years
- No ones lived long enough to see climate change, just seeing weather changes
- 75 year average Lethbridge gets more rain than this area, wind is the major factor
- Perceived that climate change is a modern phenomenon, not aware of change in the past
- Not an issue of climate changes but more about environmental stewardship

How concerned are you about climate change, extremely concerned to not concerned?

- Concerned to the extent that there is a greater awareness of climate change and environmental stewardship that is all tied together. But it probably won't effect what I do on the farm, bottom line is always economics
- Economics is the driver rather than climate
- What has given the general community the need to look at climate change is the data generated and awareness from NASA's Space Program
- Not concerned at all
- Extremely concerned – issue is water, not just for agriculture (i.e. City of Calgary, limiting water going to irrigation)

- Very concerned, but not going to do anything about it. Not always economics, buy technologies to make farming easier
- Have to be convinced that climate change is something to be concerned over or is it just something that happens

Is Climate Change a Risk and/or Opportunity?

- More of a risk in the shorter term situation, in the longer term may be more opportunities
- Need to not assume that all climate change is bad, there are lots of potential benefits. The only bad thing is the perceived drought
- More difficult to see climate change as an opportunity
- Risks are less for farmers in livestock compared to crops, it is easier to manage. For example frost and amount of moisture doesn't affect the livestock as much. It take more start up money for crop production compared to livestock and the risk are higher for grain production
- If other regions of the world are experiences more climate change, will be an opportunity for Canada
- Climate is not a risk, it is a fact of life and something that you have to manage. This is the same for weather changes

Would you consider climate related risks more/ less difficult to manage than other risks such as price risk?

- Price change is difficult to control
- Climate change because you can't control
- Cannot manage things like BSE, no management choices there, with climate there is management choices and farmers adapt as necessary
- Weather changes your short term plans, not long term planning
- On the farm, farmers must produce a product; look at cropping plan and tools needed. Because it is dry need to look at ways to manage this, you are managing the risks not managing weather
- Weather is a risk
- Climate is a small risk in the grand scheme of all risks that farmer are facing

Which climate variables (i.e. drought, growing season) is agriculture in this area/region most sensitive or vulnerable to?

- Amount of moisture/ground water (always had been an issue) – oil activity is changing the quality of the water table
- Growing season
- Drought
- Wind and trees
- Subsoil moisture is decreasing, possibly due to oil drilling

Which of the main climate and weather risks are you currently managing for?

- Growing season
- Amount of moisture
- Wind
- Ground water, all starts above the ground (muskegs)
- Soil in region not suitable to produce high yield/quality crops each year

How do you currently manage these risks?

- Zero tillage
- Recently using more annual crops for grazing (can abuse annual crops with cattle but not perennial forages) and is stockpiling feed.
- Zero tillage, drought tolerance crops (grasshoppers & drought)
- Looking at crops we grow and make sure they work with climate change
- Implemented direct seeding on farm partially because of climate change
- Swath grazing
- Crop insurance
- Cross fenced pasture in last few year, all a matter of economics and some environmental issues that made changes for.
- More marketing through paper recently, marketing most important thing that farmers can learn today
- Off farm income
- To manage for climate change on operation, rent more pasture as insurance against drought as well as purchased crop insurance (if didn't haven't wouldn't be farming still)

Assessment of Capabilities

How would you rate yours and others current capabilities to adapt to climate changes on your operation, specifically to mitigate risks and capitalize on opportunities?

- Not to do with being capable, more to do with luck – can't control the weather, the weather controls you
- Manage risks of weather not climate
- Capabilities of yours and other doesn't exist around weather –weather is out of your control
- Can't change the weather, so cover the risks by purchasing crop insurance
- Capable with tools and information available and because of varieties of crops available
- Some places in the world could produce cattle for less money than in Alberta, only able to be sustainable in Alberta because of cheap grain
- Not capable, can't control the weather

Support for Farmers

What could farmers do?

- Farmers are not using water but is recycling water, farmers redistributed the water
- Manage land for what it is best suited for
- Protect the ownership of your product
- Farmers need to look at what they could be doing with the money for insurance premiums and investing it elsewhere for self-insurance

What would you like to see industry (e.g. banks, equipment dealers) do to help producers respond/cope with climate related risks?

- Bigger businesses take advantages of the opportunities and "engineer" programs to benefit themselves
- New industry developed because of the science around climate, but the period of information is so limited and there are no benchmark

What would you like to see governments (policy and/or services) do to help producers respond/cope with climate related risks?

- Participants were concerned with government pulling support money from agriculture
- Better and more weather stations
- Make sure that programs do not have negative consequences on the environment
- Carbon credits should be based on best practices instead (What are the best practices, for whom?)
- Would like to see them put best management practices for the particular portion of land (not general BMP for every farm). This puts the responsibility on the farmer. Kyoto doesn't allow for best practices for protein for human consumption
- Governments do not recognized the importance of small farms, more important to produce large quantity of foods
- Crop insurance really doesn't work, but must have crop insurance due to loans from AFSC, there needs to be efficiency brought into the crop insurance program.
- Who decides the BMPs? Need to be customized to the producer based on economics, land and weather
- Like to see governments opinions more objective about the information on climate change – farmers are the worst kind of speculators, follow the market
- Government should be more concerned about the idea of environmental sustainability rather than carbon credits
- Motivation behind Kyoto is not climate change, especially not drought, rather economics is driving Kyoto

- Farmers have been told not to sell carbon credits, lease them but don't sell. Not possible to generate a carbon sink prior to 2008.
- Farmers have been ridiculed about clearing trees, the general public doesn't know what industry and government have done
- Government needs to stay out because they don't understand the climate and environment
- Improve crop insurance, experiences with crop insurance is poor
- Government needs to give farmers information on research and provide input to farmers on how they can best adapt to the land
- Government doesn't know about the climate and should not be making policies. It is scary if government thinks they can control the weather
- Would like government to set up a broker exchange in communities – builds Alberta and brings pricing home and allow farmers to value add
- Government needs to set policies on water management, it is a critical issue that they need to be involved in – farmers can't manage this issue alone

Future:

What do you think are going to be the consequences and/or opportunities due to climate change in this area/region in the next ten years?

- Agriculture will always be here in one form or another. Always adapting, going to continue to adapt to climate change. Tougher to adapt (i.e. cost of equipment), less than 2 percent of population and not a lot of political influence. Definitely going to need help in long term

What are the most important things farmers in the area/region can do to reduce the impacts of climate variability and changes?

- Climate change is going to happen, farmers are going to profitable or not

Final Comments from Participants

- Very impressed with the focus group – well run, good opinions. The general consensus is the group is that climate change is not that big of an issue, not much can we do
- Focus group had lots of merits, if interested in knowing about what farmers are doing it is a good way to do it – good networking opportunity and opportunity to learn from other farmers
- Wondering what AAFRD are trying to find out, skeptical. Hope that we are not just here to say that they got farmers' input. Thank you for opportunity to be here and see how well versed people are in the industry.
- Tremendous amount of knowledge and experience in group – good representation of farmers, intellectual people

Fairview

Participant Profile

- Farming at La Crete since 1964, 2000 acres of grain and 200 cows
- Third generation farming in the Peace Region, cereal and cattle farm at North Star
- Farming since 1981, beef operation
- Dairy and grain farmer, 1000 acres
- Farming for 30 years at Fairview, 250 cattle, grain for silage
- Cattle operation at Crooked Creek for 11 years
- Farming for 12 years at Highland Park, cow/calf operation, small feedlot
- Mixed farmer southwest of Fairview
- Farming at Debot since 1964, beef cattle and sheep
- Third generation farmer southeast of Fairview, 3000 acres of grain and seed production
- Third generation farmer north of Fairview, beef cattle and alfalfa seed
- Farmer north of Fairview, livestock
- Fourth generation mixed farmer south of Fairview

History

How have the incidences of drought, amount of moisture, winter temperatures, extreme events or growing season changed in your area in the past ten years?

- Mainly see difference in the winter
- Many tougher winters in past. Since 1975 all winters have been milder, less snow and higher temperature
- From 1998-2003 there has been a drought in the region
- Summers are cooler than they used to be
- Getting warmer and dryer over the last 30 years, especially in the last five years
- Not as much change in the summer compared to the winter
- Less snow, winters are shorter
- Now have to worry more about sunburn because the sun is more intense, this is an indication that something is changing

- Longer growing season didn't used to be able to grow wheat. This could be due both to climate and variety of wheat, as well as changes to landscape (i.e less timber)
- Because of clearing trees, the ground is hotter and the moisture is up higher – this causes the temperature fluctuate more
- Land is not wet for more than two weeks because of drainage, the land used to not dry out all year. Water holding capacity of soil is disappearing. Drainage is affecting the water cycle.
- Rare that our parents used to be able to cut the whole field, now it is rare that farmers are not able to get the whole field off.
- Temperature

How did you (or parents) respond to the weather variables in the past?

- Did the best they could but didn't know how they were affecting the land
- Less technologies to adapt to change
- Would summer fallow fields to dry them out in order to seed at beginning of May.
- Fathers used to hate trees and would clear them all because they believed that if they cut the trees more crops would grow as nothing would grow right by tree rows. In past, farmers didn't understand the value of trees.
- Some farmers did understand importance of trees but due to economics reasons cleared trees

If you implemented changes, what were they?

- Farmers are now improving the organic quality of soils more due to management practices and new technologies
- Can't farm the same way our parents did, must be smarter and continually adapt to changes.
- Minimum or zero tillage
- Keep land covered with grass
- Can farm much better with zero tillage than practices in the past
- On operation for every tree that comes out, one must be planted

What triggers changes in your decisions or new management practices?

- Economics
- Drought
- Have person tracking weather in North Star area – 30 inches was a wet year in our area, 15 inches was normal, below 15 inches was drought. This helped to influence some decisions
- Driven by economics to clear trees, hay sloughs etc.
- More economical to farm a big square piece of land without trees, people are still clearing trees in area. Economics trigger these changes

- Health of land, looking after the ecosystem and goals for future landscape of farm
- Being good stewards of the land on an individual basis
- Every decision we make is going to effect the climate
- Concerned that it is economics that drives us, what is the price for being driven by economics? All participants were deeply concerned about this.

Current thinking on risks due to climate change/ weather

What does climate change mean to you?

- Warmer in the winter, hotter in the summer, obvious temperature difference
- Less water and moisture available
- Not sure exactly what climate change is. Observing that the weather is getting more erratic and the temperature was more stable years ago
- Been quite aware of how climate affects our industry. Moisture isn't something you should take for granted. Climate has shifted drastically there is more moisture in south, less in north (Peace River country).
- Don't think much about climate change, but farmers are always adapting. Have seen many changes in area in regards to moisture. People are going to pick on the most vulnerable group (farmers) to do something about climate change, all the blame and responsibility shouldn't fall on the hands of the farmers who are producing the food.
- Everything is interconnected. Some of the results that we might not initially think of will be showing up later on (i.e. microbiology in the soil). Even a change in one degree of temperature will affect farming. Chemicals and fertilizers are contributing to global warming, but traditional farming generally contributes to the carbon sink.
- Still not convinced that the climate is changing but agree the temperature is changing and there is less moisture in last 15 years. Could be experiencing natural cycles and changes in the weather, not sure whether it is a long-term trend or not.
- Used to be too much water, now it is the reverse. Never have seen it this dry, something is definitely changing.
- More concerned with nutrient balance now, can't read a whole lot into climate changes. Just managing it much better than in the past with more technology.
- Never thought about climate change being an issue. Very aware of changes but not sure if climate change is just a cycle. Clearing trees for cropping have caused more changes than climate.
- Sunspot cycle every 7 years cause more extremes in weather than climate.
- Such a varied subject. See most of the differences in the winter rather than in the summers. Winters have been getting easier all the time, shorter cold spans and less blizzards. Summers have not changed that much.
- Fairly cynical about information on climate change, agree with Tim Ball

- Never been that concerned about climate change rather more about weather changes. Climate change is very gradual.
- Definitely see climate change occurring
- Trees and climate change are very closely linked

How concerned are you about climate change, extremely concerned to not concerned?

- Not concerned because they have a landscape plan, goals for their operation, and ways to test if they are going to achieve this. Feel in control because of the plan and goals for land. Able to adapt for different years of drought
- Concerned about the effects climate changes has on communities. Goes back to economics as farmers are so focused on economics
- Concerned about the unknown, don't know how we will effect the climate until we make changes
- Concerned about losing control of making decisions on the land.
- Little bit concerned, wonder about the impact in the future
- Very concerned, but not convinced that farmer have had a huge impact. If this is a long term trend, this is a huge concern
- Farmers would be "stupid" if they are not concerned
- Low priority on operation, not as concerned about climate change. Something that we cannot do much about. In past, farmers were not aware of the effect we were having on the land or changing the climate.
- As human beings we tend to be too short sighted, decisions are short-term gains. We don't stop and think because we are too busy doing
- Concerned that we are taking responsibility for global climate change, agriculture cannot take all of the blame for what is going on.
- Idea of selling/buying carbon credits is ridiculous. We are not producing more carbon, just shifting it around. Need to look into best practices instead
- Farmers are not concerned with long-term issues because they are so concerned with the economics and day to day issues. Farmers need to understand that their actions have long-term impacts and need to see the bigger picture. Takes all the people of the community and country, not just farmer to do this
- Not overly concerned about climate change

Is Climate Change a Risk and/or Opportunity?

- Warmer temperatures present many opportunities to grow different crops
- Is both and opportunity and a risk
- Looking forward to climate change, warmer temperature will allow farmers to grow corn and other crops further north
- Because of economics it is a risk, especially the way agriculture is right now. Climate affects production; weather risks are very real to farmers.
- Can be an opportunity
- Opportunities are dependent on the soil and moisture

Would you consider climate related risks more/ less difficult to manage than other risks such as price risk?

- Price risk is way bigger concern because it is more important to make a profit
- Not even like apples and oranges, can't compare climate change to the price of your commodity, it is a different subject. Can't say one is more important or more difficult to manage than the other
- Climate change is directly related to price risk, they are interrelated

Which climate variables (i.e. drought, growing season) is agriculture in this area/region most sensitive or vulnerable to?

- Amount of moisture
- Water is the limiting factor for everything
- Global temperature change is going to have a huge effect on the water cycle. Most vulnerable over a longer period of time to temperature, probably won't happened in the short term
- Varies extensively from one area to the next in the region, different climates and lots of variation. They are huge difference in the Peace region, can't be describe as one region

Which of the main climate and weather risks are you currently managing for?

- Amount of moisture
- Moisture is coming at different times than in the past

How do you currently manage these risks?

- Farmers should be catching runoff from land
- Doing management practices we normally wouldn't do because of climate
- Last 10 years have been using direct seeding. Changing to this was a matter of technology and economics; it had nothing to do with the drought.
- Better able to cope with changes in moisture because of direct seeding, better technologies and more awareness.
- Crops and production has improved drastically in the last 15 or 20 years due to new knowledge.
- "Out of the box thinking" i.e. Quackgrass is a good variety if you have adverse conditions; wild oats if you cut it at the right time can feed to cattle.
- If we understood the water cycle better we would have better management strategies
- New technologies have helped.
- If you are not into large production of grain, it is too expensive to buy new technologies for smaller operations for better management.
- Must run our operation with the mindset that moisture will not be there in the future. Gauge our operation on dry rather than to the average.

- When driving through Saskatchewan, the only place that there was snow left was where there were trees. We should all force ourselves to plant trees, this will give retention of more moisture. Had there been regulations to enforce leaving trees, farming would be more sustainable and profitable. What was naturally there for us, farmers saw as a barrier and didn't understand the benefits
- Keep cover on land (i.e. grass), let some of fields go seed to build up a seed bank and don't put cattle on them
- Planned grazing for the last few years, rotating pastures
- Swath graze more now than in the past
- Drought proofing farm – keep plants very healthy, move cattle off pasture often, creating a carbon sink and building up organic matter in soil to build nutrients that keep plants healthy rather than moisture.
- If there were no government subsidies, probably wouldn't still be farming.
- Management practices (as a result of changes in weather patterns) have helped to increase production despite less rain in the area. Incredible what you can do if you change your management practices
- Brittleness scale will have a big impact on how you manage for climate change. High brittleness scale climate change could be a huge risk, lower rating would not be as effected by climate changes
- More minimum/zero till because of erratic moisture condition
- Continually moving back calving dates from March to May because of climate changes
- Swath grazing
- Growing corn
- Replanting trees
- Concentrated on keeping soils healthy through keeping the ground covered all the time (plant material & manure), moderates the soil and keeps the extremes out of the soil as well as not disturbing the land as much
- Minimum till
- Digging more dugouts to keeping moisture on land as much as possible, collecting runoff in dugouts rather than running off through creek
- Drought management is an important strategy
- Direct seeding to conserve moisture (but kept soils cooler and made longer growing time). Seeing farmers sacrificing moisture a bit to get warmer soils for crops to grow faster
- New crop varieties
- Ruminants on the land (variety of ruminants, i.e. cattle, sheep), which is a holistic management tool
- Calve and lamb later on the pasture rather than in pens
- Manage for water cycle, mineral cycle, energy flow from sun and community (more species, more suitability) – if you enhance one of the cycles you enhance them all

Assessment of Capabilities

How would you rate your and others current capabilities to adapt to climate changes on your operation, specifically to mitigate risks and capitalize on opportunities?

- Concerned because the people that are selling the products from the farm are having more control. Producers are losing control of what they are growing and giving power over to someone else
- Farmers are not always open to adaptability
- Society forces farmers to go down a certain path of focusing on economics and being profit driven
- General public are making decisions for the farmer, giving away their control. Big companies are driving the industry and farmers do not have as much influence as some of the big companies, who are looking at profit for today rather than the long term.

Support for Farmers

What could farmers do?

- Need to have a plan on how we are going to maintain control of what is happening on our operation
- Needs to be a larger awareness of the struggle that we all face as farmers, should be a concern of all people.
- How farmers adapt to change directly influences the community. Awareness needs to start with farmers.
- Changing to organic farming, to reduce emissions that are contributing to global warming. Can farm organically way cheaper than farming traditionally with chemicals and have higher production
- Climate and environment would be okay if farmers would do less to effect it, if we would all chose to do less work, it is a matter of choices. We would impact the environment less and have less climate change
- Having goals and a process to manage their operation and adapt to climate change, individuals have the ability to change the climate on their operation
- Still skeptical about climate change, don't necessarily need solutions to adapt to climate change
- Everyone needs to have individual solutions to manage their operations most effectively, there is not going to be one solutions for everyone
- Ongoing growth, learning and education
- Farmers need to present a unified front and work together

What would you like to see the community do to help producers respond/cope with climate related risks?

- Consumer doesn't really care about farmers using fertilizer on their food. Not willing to pay more for wholesome food.

- Collectively people need to do what they can to reduce their emissions that contribute to global warming
- Consumers are going to dictate what farmers are producing
- Don't blame agriculture

What would you like to see industry (e.g. banks, equipment dealers) do to help producers respond/cope with climate related risks?

- Need to get the whole thing working together, reexamine the cheap food policy and determine if the consumer still wants to have food produced locally
- Everyone has to do what they can
- Must be at all levels

What would you like to see governments (policy and/or services) do to help producers respond/cope with climate related risks?

- Do governments already have information on what the landscape will look like in 50 years?
- Need to educate the next generation about farming and have this curriculum in schools. Should be from the government instead of industry because they are a more neutral source
- Farmers need to be given all the information to have more options to adapt to climate change
- Incentives to get more people in the smaller rural communities and have more diversity (i.e. more crop varieties and livestock), this will help communities manage the risks of climate change
- The problem is the cheap food policy
- If you want to do anything, you must start with the children – agriculture and its relationship to them
- Support program must be linked to economics, people won't change unless there is something in it for them
- Regulation of larger companies contributing to climate change
- Policies to make sure that global warming is being kept track of and we know where we are at in regards to climate change
- Needs to be more research into what really is going on with climate change, no concrete evidence one way or another – government must initiate this. Need information and research on what the best solutions are to adapt
- Look at how other countries are adapting, Europe is 10 years ahead of Canada
- Against carbon credits and Kyoto

Future

What do you think are going to be the consequences and/or opportunities due to climate change in this area/region in the next ten years?

- Able to grow different crops

- Able to feed more people with the same amount of acres

What are the most important things farmers in the area/region can do to reduce the impacts of climate variability and changes?

- Must try to adapt to it the best they can and make necessarily changes
- Farmers are adapting better and quicker to changes than in the past – economics are the driver compared to climate
- Farmers are adapting very well to weather changes and need to continue to adapt
- Try to cut pack on insecticides, being more aware of what we are doing and look for alternatives
- Look to simplify things and look at how you effect climate change and the environment
- Plant more trees
- Awareness-this is not just an agricultural problem and everyone needs to work together. It will be good for us as a community, industry and country
- Go back to the way we farmed years ago, less chemicals and reduced energy inputs into the land
- Change to organic agriculture which is economical and sustainable. Need to convince people in the country that this is the way we go
- Some farmers are used to adapting to change others need to learn this
- Getting the city more involved in the farm, promote such ideas as ag-tourism
- Gear your operation to handle to both drought and flood
- No body hates chemicals more than the people (farmers) that use them
- Need to keep all the perspectives on the table

C. Individual Collection Survey

Climate Focus Group Survey

Please answer the following questions.

1. Which focus group did you attend?

- ❑ Taber
- ❑ Red Deer
- ❑ Fairview
- ❑ St. Paul

2. What type of operation do you have? _____

Size of operation? _____

How long have you farmed?

- ❑ Under 5 years
- ❑ 5 to 15 years
- ❑ Over 15 years

Has your operation changed in the last five years?

- ❑ Yes
- ❑ No
- ❑ Not Sure

If your operation has changed, were any of the decisions related to climate change?

- ❑ Yes
- ❑ No
- ❑ Not Sure

3. Have the incidences of drought, amount of moisture, winter temperatures, extreme weather events or growing season changed in your area in the past ten years?

Extreme changes☐☐☐☐☐☐ No change

If so, what have you experienced?

_____
_____
_____

4. How concerned are you about climate change?

Extremely concerned ☐☐☐☐☐☐ Not concerned

5. Would you consider climate related risks more/ less difficult to manage than other risks such as price risk?

Extremely more difficult ☐☐☐☐☐☐ Not as difficult as other risks

6. Rank in order which climate variable in this area/region is agriculture most sensitive or vulnerable to? (Use number 1 for most sensitive/vulnerable)

- ❑ Drought
- ❑ Amount of moisture
- ❑ Winter temperatures

- ❑ Extreme weather events
- ❑ Growing season
- ❑ Other, please specify _____

7. The following are some ways to deal with climate and weather related risks. Check which ones you or producers in your area have tried and how effective the measures have been to mitigate climate related risks.

Scale:
VE – Very Effective
E – Effective
Ok
LE – Limited Effectiveness
N – Not Effective

Management strategies to adapt to climate and weather related risks	**I have considered using or tried this strategy**	**How effective have you found this strategy in reducing risk?**	**Producers in our area have used this strategy**	**How effective have producers found this strategy in reducing risk?**
Changed intensification of production				
Changed the crop types and varieties				
Changed location of crop production				
Changed location of livestock production				
Diversified farm				
Used alternative fallow and tillage practices				
Added irrigation system				
Changed timing of farming operations				
Purchased crop insurance				

Invested in crop shares and futures				
Participated in income stabilization programs				
Obtained off farm income				
Purchased consulting services				
Other				

8. How would you rate your capabilities to adapt to climate changes on your operation, specifically to minimize risks and capitalize on opportunities?

Extremely capable ☐☐☐☐☐☐ Not capable

9. How would you rate the capabilities of producers in your area/region to adapt to climate changes on your operation, specifically to minimize risks and capitalize on opportunities?

Extremely capable ☐☐☐☐☐☐ Not capable

10. Please list the farm production decisions for farmers to respond to climate change related risks.

_____
_____
_____

11. Please list the financial management strategies, which could be effective for dealing with climate related risks.

_____
_____
_____

12. Please list any technologies (new or existing) that could help you to respond to climate related risks.

_____
_____
_____

13. Please describe what you would like to see government, community and industry do to help producers respond/cope with climate related risks, in terms of policy decisions or services.

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14. Please list what you consider will be the major climate related opportunities facing your operation in the next ten years? How will you capitalize on each of these opportunities?

Opportunity	Capitalize on the opportunity

15. Describe what you consider will be the major climate related risks facing your operation in the next ten years? How will you minimize each of these risks?

Risk	Response to mitigate risk

16. Any additional comments

D. Climate Change Impacts and Adaptations for Agriculture in Alberta Handout

In agricultural production, changes in weather and climate affect many aspects of daily life, the environment, agricultural businesses and the economy. Over the coming decades producers will need to take into account changes in weather and climate when planning for the future, and to integrate weather and climate risks into every-day decision-making to minimize risks. Currently, most management decisions dealing with climate change focus on the mitigation of greenhouse gases (GHG), where **mitigation** is:

- The act of reducing or eliminating the likelihood of adverse conditions due to human influences on climate change (Easterling III et al. 2004).

Although reducing GHG emissions through mitigation practices is the only effective mechanism in preventing adverse impacts of climate change, in the scientific community there is the recognition that additional future climate change is now inevitable despite mitigation efforts (Easterling III et al. 2004). **Adaptation** is now an important compliment to GHG mitigation practices since adaptation strategies involve:

- Adjustments in ecological, social or economic systems in response to actual or expected climate or weather changes and their effects or impacts (Smit et al. 2001) and,
- Taking steps to minimize potential damage due to future climate change, while as the same time taking advantage of new opportunities presented by this change (e.g. technological developments, government programs and insurance, farm production practices and farm financial management) (NRCan 2002).

Therefore, adaptation and mitigation both needed to develop a strategy that addresses the problem of climate change since GHG mitigation practices work to slow down the rate of climate change and adaptation practices work to reduce the severity and costs as a result of changing climate.

Predicted changes due to climate change will have both positive and negative impacts on crop and livestock production in Canada, however the magnitude of those impacts will vary on a regional basis. Many scientific studies (Wall et al. 2004, NRCan 2002) indicate that changing climate will have a wide range of impacts on Canadian agricultural systems that include:

- increase in the frequency and intensity of extreme weather events (storms/droughts),
- warmer climate due to a global temperature rise,
- warmer winters,
- drier or wetter conditions due to changes in amount and timing of precipitation,
- changes in wind dynamics,
- increase in soil erosion,
- change in occurrence and intensity of pest problems, fires,
- damage to water sources in terms of quality and quantity,
- warmer, longer growing seasons and,
- elevated CO_2 levels, which can lead to increased photosynthesis.

In order to reduce the magnitude of impacts due to climate change, there are a wide variety of long and short-term adaptive actions that are available to Canadian producers. Canadian researchers (Wall et al. 2004, Natural Resources Canada 2002, Smit and Skinner 2002) have divided adaptation strategies into four categories:

1. Technological developments
   - New crop varieties, resource management innovations (e.g. water, soil)
2. Government programs and insurance
   - Agricultural subsidies and support programs, private insurance
3. Farm production practices
   - Crop or livestock diversification, implement irrigation or improve irrigation efficiency, changes in land use or topography, change timing of farm/ field operations

4. Farm financial management
   - Crop insurance, crop shares and futures, income stabilization programs, diversify household incomes

Historically, the agricultural sector is highly adaptable to change (e.g. social, environmental), however it is crucial that producers take proactive measures in order to enhance their ability and capacity to deal with future risk, including those associated with climate change. Producers will have to build on their strengths and identify where their farm operations are vulnerable in order to adapt to predicted changes in climate.

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