Participatory mapping in climate change adaptation: the case of three rural communities in the Canadian prairies.

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Abstract

The purpose of this presentation is to introduce a methodological approach called participatory mapping session. The participatory mapping session was created in order to support rural community members to develop a set of community recommendations, relevant to policy-makers, to ameliorate the impacts of climate change on water resources in the South Saskatchewan River Basin (SSRB). A participatory mapping session aims at integrating: (a) the multiple dimensions of vulnerability to climate change (*e.g.,* social, economic, natural); and, (b) the multiple dimensions of knowledge of the vulnerability to climate change (*i.e.,* multiple realities). Participatory mapping sessions were pursued in Taber, Alberta, Cabri-Stewart Valley and Outlook, Saskatchewan. The result of the participatory mapping session is a set of community recommendations regarding climate change adaptation, valuable to policy-makers.

Background and Relevance

This study is one of many components involved in the Institutional Adaptation on Climate Change Project (IACC) Multi-Collaborative Research Initiative (2004-2008) program. The IACC project attempts to address the capacity of institutions in dry-land regions to adapt to the impacts of climate change, focusing on water (Diaz *et al.*, 2004). The IACC is a comparative study of two basins: the South Saskatchewan River Basin (SSRB) in western Canada and the Elqui River Basin (ERB) of north-central Chile. The project seeks to understand the adaptive capacity of rural communities and rural households and the roles played by governance institutions in the development of those capacities (Diaz *et al.*, 2005). For further information on the IACC project refer to www.parc.ca/mcri.

Climate change is predicted to have serious impacts on water availability and quality, particularly in dry-land areas where water is already a scarce resource (Barnett *et al.,* 2004; Cohen and Kulkarni, 2001; Gleick, 2000; Heejun *et al.*, 2002). The sustainability of rural communities in prairie dry-lands, under the forecasted impacts of climate change on water resources, depends in part on the capacity of government institutions to address the current and future vulnerabilities of those communities (Patiño and Gauthier, *in press*). Ideally, a consciously planned response to climate change would require and make use of information and perspectives reflecting the multiple dimensions of sustainability (*e.g.,* social, economic and biophysical) across diverse institutional levels (*e.g.*, formal and informal) and across appropriate spatial and temporal scales (Patiño and Gauthier, 2008). Furthermore, an integrated approach would aim at the development of strategies and policies flexible enough to include local

knowledge, values and conditions (Klein and Smith, 2003; Smit and Pilifosova, 2003), and information derived from both qualitative and quantitative modes of inquiry.

Unwin (1992) claims knowledge needs to be socially communicated in a meaningful manner. However, the acknowledgement of multiple realities makes this process of meaningful communication quite difficult. In terms of integrating multiple institutional constructions of vulnerability to climate change, this study focuses on two main institutional levels in the construction of the vulnerability to climate change of rural communities in the SSRB: (a) the rural communities; and, (b) the scientific institutional level. A participatory approach, considering the local community and the scientific community, will build collaborative institutions (Kyem, 2004), as well as support the integration of knowledge (*i.e.*, dimensions of climate change) within a multidisciplinary environment.

Public participatory geographic information systems (PPGIS) emerged as the result of the combination of participatory approaches and technologically based spatial analysis (Weiner *et al.,* 2001; Schlossberg and Shufford, 2005). GIS provides to PPGIS the means of a 'visual language' (Schlossberg and Shufford, 2005), that can facilitate: (a) the representation of different, conflicting and competing expressions of place (Weiner *et al.,* 2001; Warren, 2004; Kyem, 2004); the negotiation of the meaning of data and accuracy (Weiner *et al.,* 2001; Warren, 2004); and,(c) the means to support the process of collaboration, communication and knowledge transfer deemed at different scales of analysis (Sedogo and Groten, 2002; Kyem, 2004).

Under the umbrella of PPGIS, this study develops a methodological approach called participatory mapping session. This methodological approach, understands PPGIS as an integrative perspective to the multiple dimensions of knowledge. A participatory mapping session aims at integrating: (a) the multiple dimensions of vulnerability to climate change (*e.g.,* social, economic, natural); and, (b) the multiple dimensions of knowledge of the vulnerability to climate change (*i.e.,* multiple realities). A participatory mapping session combines sequences of mapping presentations and small group discussions, and uses maps to facilitate and stimulate discussion among participants. It attempts to link the everyday life experiences of rural community members concerning climate related events and water, and information regarding the science of climate change, in order to develop a set of community recommendations relevant to policy-makers.

This research contributes to the fields of climate change adaptation and public participation geographic information systems. It develops a methodological approach aiming at supporting the integration of information regarding the multiple dimensions of sustainability (*e.g.,* social, economic and biophysical dimensions), hence climate change issues. In addition, this research advances the application of public participation geographic information systems, by coupling ethnographic work results and public participation geographic information systems approach. Knigge and Cope (2006) and Mathews *et al.* (2005) have already explored the coupling of GIS and ethnographic work, mainly by incorporating the use of GIS while pursuing ethnographic work. However, this study draws upon knowledge (*i.e.,* main patterns and trends) resulted

from ethnographic work, and interpreted, represented and transferred those results through the use of a combination of sequences of maps and small group discussions.

Methods and Data

The participatory mapping session developed in this study ran for approximately 5.5 hours (9:00 a.m. - 2:30 p.m.) and comprised three main mapping-discussion sections. The dynamic of the participatory mapping sessions combined a sequence of mapping presentations and small group discussions in order to facilitate and stimulate dialogue, in an attempt to provide the means for integrating in peoples' minds the science and the everyday life experiences.

The first mapping portion of the first mapping-discussion section constitutes a series of maps representing or reflecting the main patterns and trends derived from the examination of the results of IACC project community vulnerability assessment reports. A consecutive mapping-discussion portion builds upon the latter by providing a visual representation, in map format, of future climate change scenarios constructed by IACC scientists. The third section of the participatory mapping session focused on a discussion on the role of government institutions under potential impacts of future climate change on water. In addition, the third section asked participants to reflect on how government could facilitate community members to adapt to the future impacts of climate change and water. The outcome of this section was a set of community recommendations, valuable to policy-makers, in terms of climate change and water issues.

The material developed for the participatory mapping sessions was primarily derived from the results of two main research components of the IACC project. These were: (a) the community vulnerability assessment reports for Cabri – Stewart Valley (Matlock, 2007), Taber (Prado, 2007), and Outlook (Pittman, 2008), based on participatory vulnerability assessment procedures developed by Smit and Wandel (2006); and (b) the climate change scenarios research component developed by IACC project Ph.D. candidate Suzan Lapp.

The community vulnerability assessment reports developed by IACC researchers were reviewed to carefully select the information to be mapped for each participatory mapping session. These maps were intended to reflect the rural community members' vulnerabilities perspectives to climate change and water, and at the same time, to provide community members with an alternative visual perspective and tool that allow them to spatially and temporally see their own identified vulnerabilities.

Simultaneously, IACC scientists have been developing a range of climate change scenarios. They have also been examining the potential effects of climate change impacts on the above identified vulnerabilities, as well as interpreting the potential impact of those scenarios on water. This component of the IACC project provided the perspective of those scientists to the issue of climate change and water in the SSRB. A number of maps reflecting potential future climate change scenarios on precipitation,

temperature and climate moisture indexes where created at the SSRB level, depicting 1961-1990 climatic normals and 2050s scenarios.

The above two components of knowledge (*i.e.,* community vulnerability assessments and climate change scenarios) were used to generate a number of maps that either have meaning mainly for community members and/or for IACC scientists. Rather than portraying specific rates and number figures, maps were used to depict main spatial and temporal trends and patterns. Furthermore, participants were specifically asked to focus on visualizing trends and patterns. Maps and images, and small group discussions were combined in order to facilitate and stimulate dialogue, in an attempt to provide the means for integrating in peoples' minds the science and the everyday life experiences.

The information was mapped for all the SSRB at the municipal level. Most social, economic, and agricultural related information was obtained from Statistics Canada through the University of Regina Data Liberation Agreement: (1) 1996a and 2001a Agricultural Census; (2) 1996b, 2001b and 2006 Census, and; (3) 1996c and 2001c Census - 20% sample data. Saskatchewan oil and gas digital map data was downloaded from the Government of Saskatchewan (2007) webpage. Climate scenario data were provided by Susan Lapp, Ph.D. candidate at the University of Regina, Saskatchewan, and research fellow of the IACC project. Forty to 60 maps were presented in each participatory mapping session. Maps were created using ArcGIS 9.1 geographic information systems from Environmental Systems and Research Institute © (ESRI©).

Results

In general, participants in the three communities called for the development of policies and strategies based on: (a) long-term planning; (b) improve communication between different levels of government (*i.e*. federal, provincial, local); (c) increase funding for agricultural research and technology; (d) improve funding and promotion of conservation programs (including water and climate change); and (e) improve funding to communities and people to allow change (*i.e*. adaptation). Table 1 shows recommendations identified by participants in the three communities.

Table 1. Recommendations identified in the three community session: Taber, Cabri-Stewart Valley, and Outlook.

Long-term planning on climate change, water, and all initiatives.
Improve communication between government levels
Increase funding for agricultural research and technology
Fund and promote conservation programs (including water and climate change)
Fund communities and people to allow change

Table 2 depicts recommendations identified by at least two of the three communities: Taber, and/or Cabri-Stewart Valley, and/or Outlook. These recommendations relate to the federal and provincial levels of government. Table 3 shows recommendations identified by participants only at the Taber, or Cabri-Stewart Valley, or Outlook session.

In addition, the participatory mapping session has enriched the capacity of participants to adapt to future impacts of climate change by helping them to foresee future alternatives/options to reach such a goal, and provide them with the means to develop a set of conscious recommendations valuable to policy-makers in terms of climate change and water issues. Five important components of the participatory mapping session facilitate the development of such recommendations: (a) participants take *ownership* of the session; (b) mapping presentations are *meaningful* to participants; (c) maps *validate* community and participants perspectives; (d) maps support the visualization of *patterns, trends and processes* enriching participants' perspectives, providing context, and promoting discussion; and (e) the combined mapping-discussion sequences are *informative* and facilitate a *progressive learning process*.

Table 2. Recommendations suggested by at least two of the communities: Taber, Cabri-Stewart Valley, and Outlook.

FEDERAL	PROVINCIAL
Long-term planning initiatives.	Cut crop insurance premiums and/or develop useful crop insurance (*e.g.* market neutral crop insurance; re-incorporation of hail into crop insurance).
Support world wide climate change efforts.	Listen to and get involved with the local government.
Increase existing utilization/construction of water storage capacity and associated irrigation operations.	
Fund research and technology, including agricultural research and technology and climate change institutes.	

Table 3. Recommendations identified only by Taber, or Cabri-Stewart Valley, or Outlook participants.

	FEDERAL	PROVINCIAL	LOCAL
TABER	Clear climate change leadership.	Invest in water conservation research.	More water conservation policies.
	Political power to set policies of best management practices for conservation purposes.	Develop water management strategy.	Education in water conservation and use.
	Political power to enforce existing legislation.	Inter-provincial agreements of water crossing boundaries.	
	More input of stakeholder groups in the decision making process.	Fund long-term solutions and balance economic level with environment.	
	Long-term funding for planning and research institutions with climate change mandate.	Need to work with federal government to lesser impact of climate change.	
	Better watershed management.		
	Oil industry best management practices regulations.		
	Provide provincial and local governments the authority to develop change.		
	Resolve outstanding water issues.		
	Measure water resources nationally		

Table 3. Recommendations identified only by Taber, or Cabri-Stewart Valley, or Outlook participants (Continue).

	FEDERAL	PROVINCIAL	LOCAL
CABRI-STEWART VALLEY	Increase utilization of existing water storage infrastructure (Gardiner Dam).	Intensify irrigation operation Increase utilization of Gardiner Dam.	
OUTLOOK	Education for both urban and rural population.	Encourage and fund vegetable production.	More decision-taking to ensure local relevance.
	Support agricultural/climate pilot projects.	Cooperate with federal government to develop agricultural projects.	Encourage better living standards.
	Target and streamline immigration towards rural communities.		
	Fund rural infrastructure.		

Conclusions

The participatory mapping session developed in this study has assisted rural community participants to interpret, discuss and reflect on community vulnerabilities to climate change and water issues, by enabling and opening a dialogue. Such dialogue supported the integration in participants' minds of the science and their everyday life experiences. The participatory mapping sessions assisted community members to reflect on community vulnerability to climate change, and provided the venues to validate, reject, and/or modify participants' perceptions and experiences. Participants were then equipped with knowledge and empowered to provide meaningful recommendations relevant to policy-makers.

References

Barnett, Tim, Malone, Robert, Pennell, William, Stammer, Detlet, Semtner, Bert and Warren Washington. 2004. The effects of climate change on water resources in the west: introduction and overview. *Climate Change*, **62:** 1-11.

Cohen, S. and T. Kulkarni (eds.). 2001. Water management & climate change in the Okanagan basin. Environment Canada & University of British Columbia. Project A206, submitted to the Adaptation Liaison Office, Climate Change Action Plan, Natural Resources Canada, Ottawa. 75 p.

Diaz, H., A. Rojas, L. Richer and S. Jeannes. 2005. Institutional adaptation capacity to climate change. IACC Project Working Paper No. 9.

Diaz, H.P., D. Gauthier, D. Sauchyn, J. Cepeda, D. Corkal, M. Fiebig, S. Kulshreshtha, G. Marchildon, H. Morales, B. Morito, B. Reyes, A. Rojas, S. Salas, B. Smit, E. Wheaton and H. Zavala. 2004. Institutional Adaptation to Climate Change. Social Sciences and Humanities Research Council (SSHRC) Multi-collaborative Research Initiative (MCRI).

Gleick, Peter H. 2000. Water: the potential consequences of climate vulnerability and change for the water resources of the United States. Pacific Institute for Studies in Developmet, Environment, and Security: Oakland, California. 151 p.

Heejun, Chang, Knight, C. Gregory, Staneva, Marieta P. and Deyan Kostov. 2002. Water resource impacts of climate change in southwestern Bulgaria. *GeoJornal,* **57:** 159-168.

Klein, R.J.T. and J. B. Smith. 2003. Enhancing the capacity of developing countries to adapt to climate change: a policy relevant research agenda. In Smith, J., Klein, R. and Saleemul Huq (eds.) Climate Change, adaptive capacity and development. Imperial College Press: London, 317-335.

Knigge, LaDonna and Meghan Cope. 2006. Grounded visualization: integrating the analysis of qualitative and quantitative data through grounded theory and visualization. *Environment and Planning A* **38:** 2021-2037.

Kyem, P.A.K. 2004. Of intractable conflicts and participatory GIS applications: The search for consensus amidst competing claims and institutional demands. *Annals of the Association of the American Geographer* **94**(1): 37-57.

Mathews, Stephen A., Detwiler, James. E. and Linda M. Burton. 2005. Geo-ethnography: coupling geographic information analysis techniques with ethnograpich methods in urban research. *Cartographica* **40**(4): 75-90.

Matlock, Brett. 2007. Report on the Community Vulnerability Assessment of Cabri and Stewart Valley, Saskatchewan. Institutional Adaptation on Climate Change Project working paper No. 52. Accessed on September 10, 2007. www.parc.ca/mcri/pdfs/papers/iacc052.pdf.

Patiño, L. and D. Gauthier. 2008. "Integrating local perspectives into climate change decision-making in rural areas of the Canadian prairies." Manuscript submitted for publication. December 17th, 2008.

Patiño, L. and D. Gauthier. *In press*. A participatory mapping approach to climate change in the South Saskatchewan River Basin. *Prairie Forum Special Issue* **34**(1) (Spring 2009).

Pittman, Jeremy. 2008. Report on the Community Vulnerability Assessment of Outlook, Saskatchewan. Institutional Adaptation of Climate Change Project working paper No. 52. Accessed on February 2008. www.parc.ca/mcri/pdfs/papers/iacc052.pdf.

Prado, Susana (with Polo Diaz). 2007. Report on the Community Vulnerability Assessment of Taber, draft. Institutional Adaptation of Climate Change Project working paper.

Schlossberg, M. and E. Shufford. 2005. Delineating “Public” and “Participatory” in GIS. *URISA Journal* **56**: (2): 69-81.

Sedogo, L. G. and S. M. E. Groten. 2002. Integration oflocal participatory and regional planning: A GIS data aggregation procedure. GeoJournal 56,2: 69-81.

Statistics Canada. 2006. Population Census. Data accessed through the University of Regina Data Liberation Initiative.

Statistics Canada. 2001a. Agricultural Census. Data accessed through the University of Regina Data Liberation Initiative.

Statistics Canada. 2001b. Population Census. Data accessed through the University of Regina Data Liberation Initiative.

Statistics Canada. 2001c. Population Census 20% sample data. Data accessed through the University of Regina Data Liberation Initiative.

Statistics Canada. 1996a. Agricultural Census. Data accessed through the University of Regina Data Liberation Initiative.

Statistics Canada.1996b. Population Census. Data accessed through the University of Regina Data Liberation Initiative.

Statistics Canada. 1996c. Population Census 20% sample data. Data accessed through the University of Regina Data Liberation Initiative.

Unwin, T. 1992. The place of Geography. Wiley: New York.

Warren, S. 2004. The utopian potential of GIS. *Cartographica* **39**(1): 5-17.

Weiner, D., T. Harries and W. Craig. 2001. Community participation and geographic information systems. Paper presented at the ESF-NSF Workshop on access to geographic information and participatory approaches using geographic information. Spoleto, 6-8 December.