COMMUNITY PERSPECTIVES OF FLOOD RISK AND SOCIAL VULNERABILITY REDUCTION:

THE CASE OF THE RED RIVER BASIN

BY

ROBERT M. STEWART

A Thesis presented to
The Faculty of Graduate Studies
In Partial Fulfillment of the Requirements for the Degree of

Doctor of Philosophy

Natural Resources Institute
University of Manitoba
Winnipeg, Canada
R3T 2N2

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Abstract

It has been a decade since the 1997 Red River Flood of the Century in Manitoba Canada. Since the event federal, provincial and local efforts have improved emergency management procedures, structural and non-structural flood mitigation, and the public's awareness of response and recovery plans. They have significantly reduced the exposure of the regional population to similar large-scale flood events. However, there has been an institutional failure to address social vulnerability that affects community resilience and the capacity to cope with uncertainty in the floodplain.

In these contexts the purpose of this study was to explore community-based risk management approaches to reducing social vulnerability through planning and communication linkages (to raise public awareness and mobilize action), bottom-up activity (experience, involvement, and application) and floodplain management partnerships. The objectives of the study were to: 1) identify residual floodplain issues that affect risk acceptance and partnership development among floodplain stakeholders; 2) explain the processes of social vulnerability that affect community capacity to cope with flood risk in the Red River Basin; 3) assess social vulnerability at the community level; and, 4) develop policy recommendations and community-based plans to reduce social vulnerability.

A goal of the research was to develop a new conceptual framework of social vulnerability in the context of flooding and the floodplain environment. Using interviews, surveys and a local decision-makers' forum, the methodological approach contributed to participatory action research by engaging floodplain stakeholders in

identifying social vulnerability and developing operational tools for anticipatory risk management.

The findings indicate that residents and municipal managers have a good deal of knowledge and experience regarding local risk and hazards in the floodplain and know how to reduce vulnerable conditions at the household and community levels. It is the external pressures from regional floodplain policy and development that restricts local action and empowerment, and reduces the public's tolerance for risk management initiatives and partnership development. Significant variations in residents' perceptions of risk and what makes them vulnerable in the floodplain have developed between urban and rural communities, between geographical locations in the rural setting (i.e. private farm and river lots and rural communities), and among different socio-economic groups (i.e. age, income and employment characteristics).

Policy recommendations highlight the need for local-level information generation and communication processes to identify and assess vulnerable pathways to a range of ongoing risks. Local action can first be initiated through regular community involvement in water resource conservation initiatives and sustainable planning opportunities that strengthen social networks and enhance rural representation in regional floodplain management and decision-making. Provincial policy is needed to develop broad standards for the social dimensions of vulnerability in the floodplain, and to provide opportunities to mediate existing management conflicts that hinder partnership development and action between communities and provincial agencies.

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A number of provincial agencies provided ongoing consultation and information in the study and deserve acknowledgement. The Manitoba Emergency Measures Organization, Water Stewardship Branch, Manitoba Community Planning Services and the Red River Basin Commission were willing participants in the research and provided a foundation for university involvement in the Red River Basin. The Rural Municipalities of Ritchot and Montcalm and the floodplain residents of the Red River Basin gave considerable time relating their experiences with me. I am appreciative of the manner in which respondents shared both their positive and challenging memories of flooding for the benefit of this study, and in the spirit of contributing to community-based research.

Finally, I would like to thank my wife and family, who are the ones who gave me the privilege, opportunity, and belief in myself to complete this independent research.

Table of Contents

List of Tables

List of Figures

Chapter 1
Introduction

1.1 Community-Based Approaches to Disaster Risk Management

Community-based approaches to disaster risk management have become increasingly important in a society faced with complex and uncertain change. Grassroots action can provide the local knowledge and social capital needed to identify the root causes of human vulnerability and generate adaptive solutions to confront livelihood risk and enhance resilience (Maskrey, 1989; Blaikie et al., 1994; Cannon, 2000; Burby, 2003; Pearce, 2005; Allen, 2006). Bottom-up activity can fill the gaps of previous top-down and centralized forms of management and reduce our reliance on short-term technological fixes and expert-driven solutions (Wisner and Luce, 1993).

Disaster studies towards the end of the 20th Century demonstrated the inability of science and technology to reduce social vulnerability and enhance adaptive capacity (Haque, 1988; Rasid and Mallik, 1995; Hewitt, 1997; Godschalk et al., 1998). The research drew awareness to the need for the public's input in disaster management (Dorcey et al., 1994; Mileti, 1999; Pearce, 2003). Policy recommendations from this body of research encouraged more anticipatory and sustainable solutions to address livelihood risk and increase citizen representation in risk decision-making (Lavell, 1998; Patton et al., 2000; Wisner et al., 2004).

In response to recommendations like these, government agencies are attempting to integrate the concept of vulnerability and public involvement into disaster and emergency management policy. There is a profound shift in both international and

national policies towards greater community planning and civil society-government-private sector partnerships aimed at reducing vulnerability and increasing sustainable planning to mitigate risk (Haque, 2000; Folke et al., 2002; Eger, 2002; Lister and Nyamuiasira, 2003; Pearce, 2003). The main goal of these policies is to generate cost-effective solutions to increase information-sharing and cross-scale activity to transmit knowledge and experience to address environmental and development problems (Ludwig, 2001).

However, the implementation of these policy ideals has not been actualized at the local level. Both governments and the public are 'out of practice' or perhaps 'out of touch' with grassroots integration from a century of centralized control and societal dependence on government agencies and skills. Communities have been left out of most decision-making processes that affect their lives. Recent efforts to conceptualize vulnerability in disaster policy are void of effective public input and experience (Heijmans, 2004). As a result, a dominant view (Hewitt, 1983) continues to define vulnerability using physical and economic criteria. The social and political dimensions of community capacity are absent from the risk management debate (Lavell, 1994).

The absence of public involvement in institutional forms of risk management (i.e. the legislated roles and responsibilities of government in risk reduction) has allowed divergent risk perceptions or risk cultures to develop between government representatives and the public who bear risk (Quartinelli and Dynes, 1969; Slovic, 1986; Quartinelli, 1998). A lack of communication (Walker, 1995) and mediation of past management conflicts (Lavell, 1998) has created an atmosphere of distrust between governments and

the public. Few opportunities actually exist to resolve these operational problems (Sandman, 1989).

Communities themselves struggle to act, as they have had little opportunity or incentive to be involved in the management cycle in the past. Communities have not developed grassroots social learning networks related to risk. Building and maintaining such networks could help to unify public discourse (Dryzek, 1997) and increase political representation in the creation of legislation and regulation to engage communities (Smith and Prystupa, 1997). Many communities do not have the extra resources or professional skills to initiate planning or adaptive solutions, and many are simply overwhelmed with existing development issues (Eade, 1997; Masing, 1999; Skertchly and Skertchly, 2001). A recent study on community-based disaster preparedness (CBDP) concluded that the success of community-based initiatives today is limited by (Allen, 2006):

1. Institutional procedures and funding arrangements of supporting organizations that limit community empowerment.

2. Divergent worldviews of stakeholders that affect relative negotiating power.

3. Initiatives that do not match the socio-economic and political context of community capacity.

Fostering resilient communities requires greater attention to understanding community vulnerability and building the social capital needed to increase participation at the local level. The social and political aspects of vulnerability deserve immediate attention if communities are to be engaged and pro-actively access cross-scale support linkages (Berkes and Folke, 1998; Cash and Moser, 2000; Cash et al., 2004) and

participate effectively in defining and reducing vulnerability. There is a need to develop social learning opportunities, or initiatives in the community that promote public involvement in observing, retaining and replicating behavior that leads to greater vulnerability reduction and community health. Social learning can also help to increase the public's ability to act and represent local interests in the decision-making process. New institutions can then develop that redefine community-government partnerships and instill a new appreciation for grassroots activity and knowledge about social, economic and environmental conditions at the local level. Only then can risk sharing and knowledge transfer among stakeholders exist to generate the diverse solutions needed to adapt in the context of an uncertain and changing world.

1.2 Disaster Risk Management in the Red River Basin

Disaster risk management in the Red River Basin provides a contemporary case study to explore the challenges that restrict community-based participation and grassroots action in floodplain management. In addition to a history of catastrophic flooding and drought, the Red River Basin faces emerging challenges (Cloutis et al., 2000), extreme hydro-climatic events (Warkentin, 2005), and development-related issues in rural agricultural regions (GCSI, 2000). The uncertain nature of risk at the local level and the presence of management conflict and poor stakeholder communication (Sinclair et al., 2003; Haque, 2000) underscore the need to develop community-based approaches and to integrate these with regional floodplain management (i.e. promote cross-scale linkages).

However, federal-provincial arrangements in the floodplain have relied largely on engineered and command and control approaches to risk management and development

in order to protect communities from the catastrophic risk of flooding. Communities are encouraged to participate in mitigating local risks but are not empowered in decision-making processes. Social vulnerabilities have emerged that are marginalized from this dominant view of flood risk and floodplain management. Social factors, however, have implications for a community's capacity to act and sustain a motivated effort to participate in floodplain management.

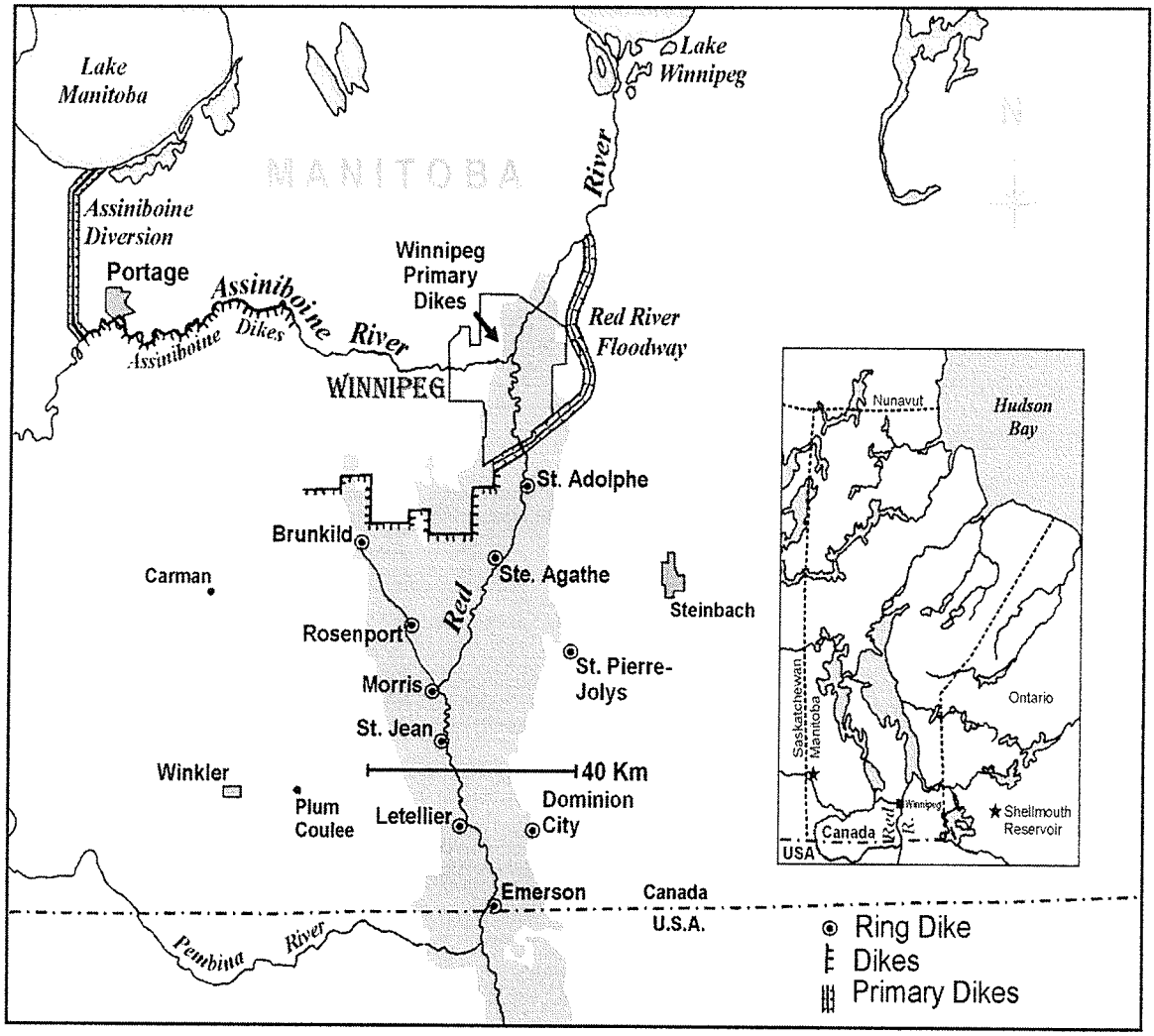
The following section provides a brief introduction to floodplain management issues in the Red River Basin. The potential impacts of climate change on flood risk and water resources in rural municipalities give a renewed awareness of the complex and uncertain nature of future risk in the floodplain. There is a need for greater involvement of stakeholders in decision-making at all levels of management in order to address current issues and the ability to avoid future risk. Secondly, a discussion of the institutional arrangements that have defined community involvement in floodplain management is provided. The inability of rigid federal-provincial arrangements to adapt to the uncertainties created by climate change requires that communities be engaged and be capable of participating in anticipatory planning. An initial step is to work with communities in the floodplain to develop and enhance fundamental participation skills and facilitate stakeholder collaboration that supports grassroots action to reduce vulnerability.

1.2.1 Flooding in the Red River Basin

The Red River Basin stretches into three American states (Minnesota, N. Dakota and S. Dakota) and the province of Manitoba, covering 116 500 square kilometers of land

(IJC, 2000). The headwaters of the Red River begin in Minnesota and the river flows to its outlet at Lake Winnipeg in Manitoba. The elevation of this terrain drops only 70 meters over 877 kilometers of river (IJC, 2000) and the banks and valley of the river are susceptible to catastrophic and overland flooding that can spread out to 40 km in width. Figure 1.1 illustrates the extent of the designated flood zone from riverine flooding in the Red River Basin, without the influences of control structures. The figure shows the full extent of flooding in the Red River Basin from a composite of the 1950, 1979 and 1997 floods. The location of flood control structures that protect the City of Winnipeg are evident, however it is important to note that these structures did not exit in 1950, and the figure illustrates the regions of Winnipeg that were inundated.

The basin is composed of sub-basins with unique hydrologic and topographic characteristics. The fertile soils that exist from flooding, and the transportation networks provided by the Red River and its tributaries, have encouraged the development of communities along the extent of the river. The largest population cluster in Manitoba is in Winnipeg (population over 650 000), followed by Selkirk to the north (population 9752). To the south of Winnipeg, St. Adolphe and Ste. Agathe (total population of 500), Dominion City (population 1651), Morris (population 1616), St. Pierre-Joly (population 907), Letellier and St Jean-Baptise (total population of 1606) and Emerson (population 721) compose the rural floodplain populations (Statistics Canada, 2001).



(Source: Manitoba's Water Stewardship Branch)

Figure 1.1: The Extent of River Flooding in the Red River Basin

The settlements of the Red River Basin developed on the historical remains of glacial Lake Agassiz. The basin has a long history of flooding that resulted in the near-destruction of the entire Selkirk Colony in 1826 (now the City of Winnipeg) and the partial inundation of the City of Winnipeg in 1950. Table 1.1 displays the 20 largest floods experienced in the Red River Basin. Very large flood events have been documented in the basin in 1826 (6,400 cumecs est.), 1852 (4,700 cumecs est.), 1950 (3,060 cumecs), 1979 (3,030 cumecs), 1996 (2,960 cumecs) and 1997 (4,600 cumecs) (IJC, 2000). The observed flood record from 1940 to present provides the most reliable source of information on large floods in the Red River. Archival records have also been used to reconstruct flood and runoff histories as far back as 1793 (Rannie, 1999a).

The 1950 flood dislocated approximately 100 000 people and damaged 10 500 homes. The most recent flood in 1997 was termed the 'Flood of the Century' because it had the highest recorded magnitude of the 20th century and because it cost the region approximately $500 million (Farlinger et al., 1998). The 1997 flood had about the same volume of water as did the 1950 flood, but had a peak that was much higher and of shorter duration. In the United States, flood stages at 29 of the 34 recording stations in the Red River basin exceeded previous floods of record. At Winnipeg, the 1826 flood remains the largest on record (data was not recorded in the U.S. portion of the basin). The 1997 flood was the largest in the Manitoba portion since current settlement patterns were established. These floods can inundate regions of the floodplain for over three weeks. The maximum width of the flood at its peak discharge can be over 40 km wide in some regions of the rural municipalities south of the City of Winnipeg.

Table 1.1: 20 Largest Floods in the Red River Basin, Manitoba

Rank	Year	Discharge (m^3s^{-1})	Comment
1	1826	6400 est.	The 'flood of record' that severely impacted the Selkirk Settlement at what is now Winnipeg. A poorly documented flood in 1776 is alleged to have been larger than the 1826 flood.
2	1852	4700 est.	
3	1997	4600	The 'Flood of the Century' and largest observed flood on record. This flood level (+ 2 feet) is now the flood-proofing standard in the Red River floodplain.
4	1861	3500 est.	The third of the large 19th century floods.
5	1950	3060	This flood caused a major disaster in Winnipeg and the Red River Basin that ultimately led to the construction of the Red River Floodway in the 1960s.
6	1979	3030	Slightly smaller than the flood of 1950, but substantially smaller impact to area communities.
7	1996	2960	Slightly smaller than the flood of 1950, but substantially smaller impact to area communities. Second largest of three major floods in period between 1996 and 1999.
8	1974	2720	
9	1966	2500	
10	1916	2430	Last sizeable flood for 32-year period; the next occurred in 1948.
11	1987	2340	
12	1970	2280	
13	1904	2210	
14	1969	2210	Flow from this flood was the first to be diverted around Winnipeg in the Red River Floodway.
15	1999	2180	Third largest of three major floods in period between 1996 and 1999.
16	1948	2120	First sizeable flood since 1916. Ten larger peak flows occurred in the next fifty years.
17	1956	1970	
18	1960	1970	
19	1892	1960	
20	1897	1950	

(Natural Resources Canada, 2005)

Historical hydro-climate data, combined with the observed flood record, has allowed for an historical analysis of the Red River Basin that has shown flows of the Red River to be erratic and highly variable (IJC, 2000). This is because the Red River Basin lies within a bioclimatic transition zone that is a divide between a sub-humid boreal forest region and a humid, semi-arid parkland region. The basin is very sensitive to precipitation and temperature variations that influence evapotranspiration rates and river runoff ratios. Residents along the length of the Red River have, therefore, had to deal with floods and droughts from variable physical conditions in the basin. These natural processes have been further complicated by intense urban and rural development that poses a number of water concerns in addition to flooding (IJC, 2000):

- Run-off and nutrient loading from pig-farm and field drainage;
- Decreasing wetlands and natural recharge potential from development;
- Development impacts (i.e. roads, urbanization) on water flow, tables and aquifers;
- Cumulative drainage impacts that increase bank erosion;
- Sedimentation in the river;
- Excessively low water tables during drought years;
- Irrigation projects for increasing commercial farming needs; and,
- Water quality (industry sewage lagoons; flooding of pig farms and effluent).

A renewed awareness of complex and uncertain water quantity and quality issues such as these, and the highly variable nature of flooding in the Red River Basin, has prompted the Manitoba government to prepare an integrated water strategy. A holistic approach to long-term planning, sustainability, and the consideration of all key components within a watershed are the foundations of this new vision. These insights and policy directions will bring changes to the conventional roles and responsibilities found in provincial floodplain management.