ABSTRACT

A safe and secure drinking water supply is vital for human health and well-being. Increasingly, drinking water management and sustainability have been identified as major public health challenges worldwide. Managing this precious resource is important, especially in the water rich province of Alberta where agriculture is one of the largest consumers and polluters of freshwater. Confined beef feedlots can be a significant source of water pollution and vector water born infections. Research related to cattle feedlot operators’ and family members’ views about drinking water supply and human health is sparse, a topic examined in this article.

In 2005, a pilot study was conducted in the Lethbridge Northern Irrigation District (LNID) in southern Alberta, Canada. Using an interviewer-administered survey, data were collected from 33 cattle feedlot operators and/or family members.

All study respondents made a connection between drinking water supply and human health. While 88% believed that clean and safe drinking water is essential for good health, 61% expressed concern about the possible adverse effects of poor water quality on their health and well being. Sixty-six percent believed that access to clean drinking water within this region is not an issue because they access treated irrigation water from LNID. However, all respondents used bottled water and/or household water treatment systems for purifying water for consumption and household use. Slightly less than half conducted annual water quality tests as recommended in the provincial water quality guidelines.

Within this population, regular water quality monitoring occurred on a sporadic basis. This water monitoring practice of the study respondents may have been influenced by LNID water management practices and their personal experience. The results of this study are likely to have implications for public health policy, practice and education. For example, the infrequent water monitoring practices of study respondents suggest a need for public health policy development related to water management (e.g., regular water quality monitoring) and sustainability.

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Regional Health Authorities are encouraged to become sensitive to and involved in addressing Albertans’ drinking water quality concerns. In particular, health authorities need to become directly involved in regular rural water testing and monitoring. The development of national legislation governing water treatment devices in Canada also is recommended.

Key Words: Drinking water supply, Human health, Feedlot operators’ and Family members’ perspectives, Southern Alberta.

INTRODUCTION

A safe and secure drinking water supply is vital for human health and well-being. It is essential that people have access to safe and ample drinking water, a daunting challenge for about 2.6 billion people worldwide\(^1\). Increasingly, drinking water management and sustainability have been identified as major public health challenges worldwide. This article presents the findings of a pilot study that explored Alberta cattle feedlot operators’ and family members’ views about the relationship between drinking water supply and human health.

Managing the drinking water supply is critical, especially in the water rich province of Alberta where agriculture is one of the largest consumers\(^2\) and polluters of water. Located in southern Alberta, the Oldman River basin has the greatest concentration of confined feeding operations (CFOs) in Canada. Recent research suggests that runoff from the manure application associated with CFOs may be one of the greatest contributors to the degradation of Alberta’s surface and ground water. Researchers such as Hyland et al. (2003), Johnson et al. (2003), and Gannon et al. (2004) have demonstrated that water samples from several locations in the Oldman River watershed contain high levels of bacterial indicator species (e.g., fecal coliforms) and bacterial pathogens (e.g., E. coli O157-H7, Salmonella spp. and Streptococcus spp.), especially near high cattle density areas and agricultural sites, particularly evident following heavy rainfall events.

A clear link between water use practices, and animal and human health has been previously established.\(^3,7,8\) Increased water use has been purported to have an adverse impact on water quality and quantity which, in turn, poses a major challenge related to the sustainability of animal and human health as well as economic development in this region.\(^3,7,8,9\) Recently, the Alberta Government Water Strategy entitled Water for Life\(^10\) and the March 2005 United Nations Water for Life Millennium Development Goals (MDG)\(^1\) highlighted the importance of advocating for improved access to a safe and secure drinking water supply and basic sanitation for all people by 2015. These documents emphasize the importance of maintaining and/or improving human health by reducing the risk of waterborne and water-related health problems, and developing strategies to improve water sources. Closely related, the Alberta government also aims to increase water use efficiency by 30% by 2015.\(^10\)

Alberta Environment has established water quality guidelines for the protection of both ground and surface water.\(^3,12\) However, these guidelines do not apply to drinking water supply. Health Canada has published Guidelines for Canadian Drinking Water\(^12\), a national guideline for domestic water use. These guidelines stipulate that the everyday responsibility of providing safe drinking water to Albertans generally rests with Alberta Environment and the Regional
Health Authorities, while municipalities oversee the daily operation of the treatment facilities. Monitoring, testing, and reporting water quality regulations vary, based on the types of water use and water source. For instance, privately owned water systems are not regulated by either provincial or federal governments; hence, responsibility for water quality rests with the individual. Nonetheless, it is recommended that urban domestic water supply be tested annually and that rural supply be tested two to four times per year. While there are no established water treatment guidelines for livestock watering, water treatment for human consumption is mandatory in Alberta.

Currently, there is no legislation in Alberta, or in Canada, governing rural water household treatment devices, despite the fact that more than 20% of Canada’s reported waterborne diseases outbreaks affected private supplies during the period 1974-1996, and disease outbreaks and deaths from contaminated drinking water supplies occurred in Walkerton during May 2000, and North Battleford in April 2001. Instead, rural residents are advised to test their water before treatment devices are installed, and during use, to ensure that the treatment system is performing as designed. Regional Health Authorities generally provide assistance in selecting proper sampling procedures for water testing in public institutions.

Health Canada recommends using treatment technologies certified by NSF International, Underwriters Laboratories and/or CSA International (private American organizations) for both rural home and farm use.

Study Site Description

The Lethbridge Northern Irrigation District (LNID) is one of 13 irrigation districts located in the southern Alberta. Like other irrigation districts within this water scarce, semi-arid region, LNID is directly responsible for water quantity management through the delivery of water to irrigators and those with whom the district has agreements to supply water (e.g., industry, municipalities, rural households). Sometimes LNID partners with other organizations to monitor and improve water quality (e.g., Ducks Unlimited).

As a result of LNID’s well established irrigation systems, within the last 25 years, this region has experienced growth in both the livestock and food processing industries. Today, for example, there are over 160 livestock owners with 219 operations located within the district, including 80 feedlot operators working in 92 operations. A survey of feedlot operators conducted by Acharya, Grant Kalischuk, Klein, and Bjornlund (2007) within this district, reported that feedlot operation was their main agricultural activity; on average these operators fed 15,484 animals per year. Irrigation practices have also contributed to the production of forages (including silage barley) and cereal grains (mainly barley and wheat) within the LNID. Despite the agricultural, societal, and economic benefits accrued within this region, manure and herbicide concentration and animal unit density within the LNID are worrisome for many people residing in southern Alberta. This situation has created public concern about the safety and quality of drinking water supply in the LNID. In fact, The Chinook Regional Health Authority, which has responsibility for health matters in southwestern Alberta, cautioned that this area has the highest level of E. coli and one of the highest rates of Campylobacter and Salmonella in its irrigation canals, rivers, and stream systems.

METHODOLOGY

In 2005, a mixed-method, pilot study exploring southern Alberta cattle feedlot
operators’ and family members’ views about drinking water supply and human health was conducted. Study aims focused on: exploring the connection between drinking water supply and human health; identifying health problems and concerns associated with drinking water; and, describing drinking water management practices for addressing water-related health concerns.

The office manager at LIND was contacted and informed about the purpose of the study; subsequently a list of 64 potential respondents was provided. All respondents were contacted by telephone and invited to participate in this study. Representing a 52% response rate, 33 adult family members living in different families agreed to participate in a face-to-face, interviewer-administered survey.

Based on a comprehensive literature review, a 23-page survey containing both quantitative and qualitative items was developed by the authors and administered in the homes of those who voluntarily signed an informed consent form. Survey questions were related to: water use and health practices, drinking water supply sources and storage facilities, and water management practices for both domestic and feedlot operations. Prior to undertaking the study, ethical approval was obtained from an Ethical Review Committee at a Canadian university. Quantitative data were coded into an Excel spreadsheet to determine the frequency distribution of variables. A thematic analysis was used to analyze the qualitative data.17

RESULTS AND DISCUSSION

Three themes were developed to explain Alberta cattle feedlot operators’ and family members’ perspectives regarding drinking water supply and human health: awareness of the connection between drinking water supply and human health, health-related concerns, and drinking water management practices. In turn, each theme is addressed.

Awareness of the Connection between Drinking Water Supply and Human Health

Descriptive analyses revealed that 94% of respondents believed that there is a connection between human health and drinking water supply. For instance, 88% thought that drinking water quality, that is clean and safe water supply, was necessary for achieving health. When asked about what clean and safe water supply meant to them, most responded that water needs to be “free of chemicals” and “bacteria.” When asked about what good health meant, most responded “being free of illness.” Consistency was noted in how the connection between water quality and health was explained by respondents. For example, one respondent suggested that: “dirty water can cause health problems” while another said: “when water does not smell or taste good it reduces water consumption, and such behavior will have an adverse effect on health, economic, and human development.” Extending this idea, another respondent commented: “we need good food and good water for health.” When asked if water quality was an issue, 61% expressed concern about the quality of their local drinking water supply for households.

Like water quality, water quantity can have a potentially negative impact on human health and economic growth, which, in turn, often affects well-being.1,7,8,12 It was observed that, although the LNID is the principal source of water for most human activities, including both drinking and recreational use for the area,3,4,6,13,14 many respondents (66%) reported that access to ample clean water was not an issue within the region in that most believed that the area has plenty of water.
Health-related Concerns

Most respondents (88%) believed that they were healthy. Many (78%) discussed how their health status, based on a medical diagnosis, had remained unchanged despite trying times related to three flood events that had occurred in the previous year. All respondents recognized the risk of encountering waterborne or water-related health problems, especially in light of the 2005 summer flood events.

When asked to describe their greatest health-related concern(s) regarding drinking water supply, multiple responses were provided. Table 1 indicates that water pollution was the most important concern followed by: E-coli contamination; neighbors’ water use practices, manure runoff management; and animal health. Other concerns included: water smell and taste, sickness and illness, watershed contamination within the region, and water testing. A few spoke about decreased immunity resulting from regular consumption of treated drinking water and how this may have an adverse effect on their health.

Table 1: List of Types and Percent of Health Concerns Regarding Drinking Water Supply of 33 Confined Cattle Feeding Operations

<table>
<thead>
<tr>
<th>Health Concerns</th>
<th>% Indicated</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water pollution</td>
<td>88</td>
<td>29</td>
</tr>
<tr>
<td>E-coli</td>
<td>67</td>
<td>22</td>
</tr>
<tr>
<td>Neighbor’s water use practices</td>
<td>58</td>
<td>19</td>
</tr>
<tr>
<td>Animal performance</td>
<td>33</td>
<td>11</td>
</tr>
<tr>
<td>Smell and taste of water</td>
<td>27</td>
<td>9</td>
</tr>
<tr>
<td>Sickness and illness</td>
<td>24</td>
<td>8</td>
</tr>
<tr>
<td>Contamination of watersheds</td>
<td>21</td>
<td>7</td>
</tr>
<tr>
<td>Testing of water sources</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td>Lack of immunity</td>
<td>6</td>
<td>2</td>
</tr>
</tbody>
</table>

Drinking Water Management Practices

Like many rural Canadians, respondents in this study utilized multiple water sources and home water treatment technologies to access a clean and safe drinking water. For example, irrigation water, though treated and monitored by both Alberta Environment and LNID on a regular basis, was the primary source for watering lawns and gardens, and for feedlot operations. Explanations given for this practice include: “lawns and gardens do not need treated water,” “it is safe for cattle to consume water supplied by LNID,” and the “high cost is associated with further treating irrigation water for farm use.” Nobody reported using treated irrigation water directly for human consumption. In fact, all respondents minimized the risk of water-related illness or waterborne infection by using at least one of the following: bottled water (48.5%), home-treated well water (21.2%), home-treated irrigation water (33.3%), home-treated hauled water (6%), or treated county water (9%).

Respondents emphasized that the most effective way for reducing the risk of waterborne disease was to use a household water treatment system. Nobody reported
boiling water for domestic consumption, even during the 2005 summer flood events as a preventive measure, because local Public Health Authorities did not administer a ‘boil water’ advisory.

Home water purification technologies adopted by the respondents included: water filters, reverse osmosis (RO), ultraviolet light (UV), water softeners, chlorination, and the use of cisterns for storing household water (Table 2). For example, many used home filtered and/or bottled water for drinking and cooking. However, several used reversed osmosis (RO) and ultra violet (UV) systems to further reduce chemical and bacteria levels in their drinking and cooking water, and as a means of protecting their children’s health. A few used LNID treated irrigation water directly from their reservoirs for household use (e.g., bathing, flushing, and laundry), but not for consumption.

Table 2: Types and Percent of Water Treatment Technologies used by 33 Confined Cattle Feeding Operations

<table>
<thead>
<tr>
<th>Water Treatment Technologies</th>
<th>Consumption %</th>
<th>Bathing and Flushing %</th>
<th>Washing Clothes and Dishes (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filters</td>
<td>76</td>
<td>73</td>
<td>73</td>
</tr>
<tr>
<td>Ultra violet light (UV)</td>
<td>33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse Osmosis (RO)</td>
<td>36</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td>Softener</td>
<td>24</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Chlorination</td>
<td>21</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Cistern</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>City water supply</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>LNID water supply</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

Reducing the risk of waterborne disease requires the regular testing and monitoring of drinking water in rural homes, even if it is monitored by the municipal waterworks facilities or other government agencies. However, this practice was not fully supported by this study’s findings. In fact, fewer than half of the respondents (45%) reported that they were engaged in annual water monitoring. Only 26% said that they tested their drinking water supply more than once per year. Despite the call for frequent water monitoring in rural locales, a large proportion (72%) indicated that they had not tested their water in the past five years or, in some cases, had not tested their water at all. Of those who had tested their water, it was tested by: private laboratory (45%), local health centre (24%), local Alberta Agriculture Centre (14%), County of Lethbridge (4%), personal testing (4%), and unknown (9%).

This investigation is one of the first to explore the relationship between drinking water supply and human health among Alberta cattle feedlot operators and family members. It is evident that study respondents are concerned about water quality and its impact on their health and well being.

It is clear that household water treatment technologies were regarded as the most popular method for ensuring a safe and clean drinking water supply. Among the types of
water treatment technologies utilized at home, the filter system was more common than RO and UV treatment systems. Furthermore, the findings demonstrate that many believe that the area has an abundance of clean water. One explanation is that most of the respondents use some type of home water treatment technology to purify their drinking water supply, even though only a quarter of respondents followed the provincial guidelines for water quality testing. Moreover, none spoke about testing and monitoring their home water treatment devices.

**CONCLUSION**

Study findings suggest a need for public health policy development related to water supply management (e.g., regular water quality monitoring and regular home water treatment maintenance) and sustainability in rural areas. Also, it suggests that awareness and education programs pertaining to the use of home treatment technologies would be a good first step. Research demonstrates that in several rural areas in Canada, people have been sold water treatment equipment systems that do not work properly. Moreover, safety has been identified as an issue for those who do not know whether or not their water supply sources are safe for specific uses (e.g., human consumption).16

Although there are many effective and expensive devices designed to treat municipal water sources, effective and affordable home water treatment systems for rural areas are limited. This identified public health concern deserves attention in light of waterborne disease outbreaks, and the associated personal, economic, societal, and public health costs. Hence, the current challenge will be to build on the findings of this study and continue to develop new information through further scientific study focused on water quality, water treatment systems, and water-related health issues facing this population.

Finally, from a practical perspective, Regional Health Authorities need to become increasingly proactive in regular rural water testing and monitoring. As a health promoting measure, collaboration in the development of national legislation governing water treatment devices in Canada is recommended. This action supports the mandate of Alberta Government’s Water for Life strategy, contributing to improved access to a safe and secure water supply and basic sanitation for all Canadians.

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**REFERENCES**


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