Saline Soils in the Red River Valley

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Introduction

The Red River Valley of the North stretches over 315 miles from northeastern South Dakota through northwestern Minnesota and eastern North Dakota into southern Manitoba. The area is highly productive and nearly all is in dry land farms and ranches (Figure 1). An extensive network of drainage ditches installed in the late 1870s through the early 1900s, and continuously maintained, reduces the natural wetness of the soils and facilitates farming.

Salinity has been recognized as a major factor affecting crop production in the Red River Valley. Soil surveys have identified some of the salt-affected soils in the area. Portions of Richland and Grand Forks counties in North Dakota, Kittson county in Minnesota and southern Manitoba are the most seriously affected (Figure 2). The soil survey does not include areas with ditch-affected salinity (Figure 3). It is estimated that approximately 30,000 acres of ditch-affected salinity exists in the Valley.

Figure 1: Typical Landscape in the Red River Valley

Figure 2: Salt Affected Soils in the Red River Valley

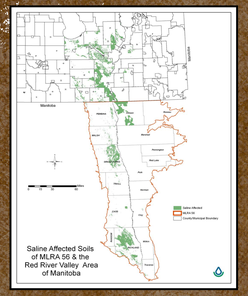
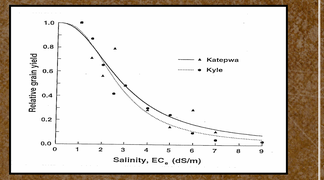


Figure 3: Ditch-Affect Salinity

Figure 4: Specific Wheat Variety Response to Salinity



Many of the saline areas in the Red River Valley are impacted with low or slight levels of salinity. Slight salinity has been called "**invisible**" salinity by Canadian researchers. These levels of salinity are not readily seen on the landscape but can impact production (Figure 4) and, without proper management, may lead to **increased levels** of salinity. A complete inventory of slightly saline soils does not exist for the Red River Valley. However, preliminary work has shown slightly saline soils to be potentially wide spread and associated with some of the most extensive soils in the area (Calciaquolls).

Figure 5 shows an example of an increase in salinity levels on a field basis. Wet dark areas shown on the left photograph in 1997 have salinized by 2006. The white areas in the right photograph are presently **lost for crop production**. Another factor affecting the management and evaluation of salt-affected soils in the Red River Valley is the large variability in saline levels associated with these soils. Figure 6 shows spatial variability in salinity levels for a field in Kittson County, Minnesota. Salinity levels change from very high to very low in a matter of meters. This **spatial variability**, coupled with **temporal variability**, complicates the management of saline areas.

Figure 5: Temporal Changes in Salinity

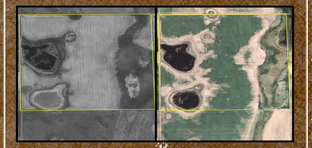
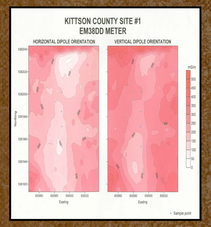


Figure 6: Spatial Changes in Salinity



Economic Impact

Using existing soil survey data and including potentially slightly saline soils and ditch affected salinity, it is estimated there are almost **2 million acres** of salt-affected soils in the Red River Valley (Table 1). Most of these soils are considered **Prime Farmland;** however, increases in salinity may exclude them from meeting Prime Farmland criteria.

Table 2 estimates the **economic impact** of salinity on the Red River Valley. It is estimated between $50 to 90 million are lost in production annually due to salinity ($50 million if all areas are in wheat and $90 million if the area is a mixture of wheat, beans, and beets). Salinity also causes a loss of production costs. A 5% loss in production costs on saline land equates to a negative economic impact between $10 and 20 million annually. There are also costs due to salinity related environmental impacts (water quality, infrastructure) and tax equalization.

Table 1: Estimated acres of salt affected soils

- Slight Salinity: 1.0 to 1.5 million acres
- Moderate and Strong Salinity: 225,000 to 300,000 acres
- Most of the area affected is PRIME FARMLAND

Table 2: Economic impact of salinity the Red River Valley

- Loss of production ~ $50 to 90 million annually
- Production costs (fuel, chemicals, labor, capital land, equipment, increased risk) ~ $10 to 20 million annually
- Environmental Cost (water quality, etc.) ~ unknown
- Tax Equalization Problems ~ unknown

The total direct economic impact is estimated between **$60 and 110 million dollars annually**. A figure on par with the value of approximately 10% of the total wheat crop in North Dakota.

The Red River Valley is one of the most viable and productive dryland agricultural regions in the world. It produces an abundance of crops and is the economic engine driving the region -- without the need for irrigation, energy to drive pumps, or major concerns about contamination of aquifers. Salinization of this area needs to be viewed over the long-term. What is salinization going to be like in 50 years, 150 years, or even 500 years? With this long range point of view, **salinization may be threatening this unique resource**. Salinization is a considerable problem in many parts of the world. Figure 7 shows salinization associated with the Aral Sea, in Kazakhstan. Although much warmer and drier then the Red River Valley, this image emphasizes the impact management practices can have on salinity and emphasizes the need to look at **salinization in the Red River Valley over the long term.**

Figure 7: Salinity Associated with the Aral Sea in Kazakhstan

Successful Approaches to Saline Management

Salinity is one area where we are **"Data Rich—Information Poor"**. Federal and university researchers have accumulated a large amount of data on salinity. Much is know about chemical and physical properties of saline soils and the best practices to manage salinity. However, we have not been able to implement a successful large-scale management program on the ground.

There have been many successful approaches to salinity management; unfortunately, they are not from the Red River Valley. Australia has become a leader and innovator in salinity management. Figure 8 is a cover photo from a four part ABC television documentary that was broadcast in Australia promoting saline soil management. Figure 9 is the cover of Australia's National Action Plan to address salinity. **Simply put, the Australians have recognized the impact of salinity on their economy and are implementing a program to address it.**

Figure 8: ABC Television Special in Australia

Figure 9: Australia's Action Plan to Address Salinity

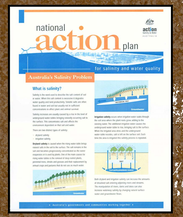


Figure 10 is the cover of a publication from **Alberta** promoting a **watershed approach to salinity management**. Although they deal primary with saline seeps and irrigation induced salinity, the watershed approach may have validity in the Red River Valley. Figure 11 is the cover of a newsletter from the **Salt Tolerance Testing Laboratory in Saskatchewan**. In the past, this group has promoted the management of saline soils, developed salt tolerant crop varieties, and worked closely with producers.

Montana has also established a very aggressive salinity management program. The **Montana Salinity Control Association** (Figure 12) is a state agency that is organized similar to soil conservation districts. This group has been successful in addressing salinity problems in northern and eastern Montana. They have a full time staff of four and have been active in over 1000 projects and 14 watershed level projects in the state. The **Montana Salinity Control Associa-**

Figure 10: Alberta's Watershed Approach to Salinity

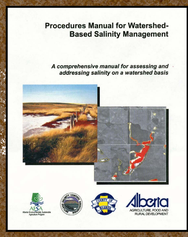


Figure 11: Saskatchewan's Salt Tolerance Newsletter

Figure 12: Newsletter from the Montana Salinity Control Association

Conclusion

Salinization needs to be viewed over the long term and is a serious threat to sustainable agriculture. Large areas of slightly saline soils in the Red River Valley have the potential to increase in salinity, threatening the long-term economic viability of the area's agricultural sector. Examples of large scale successful management programs are available from Australia, western Canada, and Montana. The Montana Salinity Control Association is a good example of a locally-led management program that may have applicability to the Red River Valley.