Effluent Irrigation: Saskatchewan Perspective

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Abstract

There is considerable potential for effluent irrigation in the Prairie provinces. Some jurisdictions view effluent irrigation as a means of wastewater disposal. Others view effluent as a resource for economic development (i.e. cash crop production, golf course irrigation, etc.). An understanding of the sustainability of such projects is of interest to effluent users and the general public.

A literature review conducted for the Irrigation Sustainability Component of the Canada-Saskatchewan Agriculture Green Plan Agreement (CSAGPA) indicates that a wide range in guidelines for effluent irrigation projects are used throughout the world. Monitoring data from two large effluent irrigation projects in Saskatchewan have shown that the soil biosystem will be altered with the application of sewage effluent. It should be sustainable, however, provided proper management practices are followed.

Introduction

Effluent irrigation has been practiced for centuries throughout the world (Shuval et al., 1986). It provides farmers with a nutrient enriched water supply and society with a reliable and inexpensive system for wastewater treatment and disposal (Feigin et al., 1991). Forage crops are often grown under sewage effluent irrigation projects in Western Canada. This is because of their long growing season, high evapotranspiration demand and removal of large quantities of nutrients from the biosystem. Because forages are not consumed directly by humans, the transfer of human disease is unlikely (Bole and Biederbeck, 1979). As the number of projects increase, there is a growing demand for effluent use on non-forage, food crops (Davies et al., 1988; Kirkham, 1986).

Effluent reuse is a well established practice in the Prairie region. Approximately 65 projects irrigating a total of 5700 ha (Alberta - 3050 ha; Saskatchewan - 2620 ha; Manitoba - 53 ha) have been established. These projects account for less than 5% of the total prairie effluent discharge (Pentland, 1993). Expansion of effluent reuse in the Prairie provinces could potentially irrigate 60,000 ha in Alberta, 20,000 ha in Saskatchewan and 35,000 ha in Manitoba. With appropriate design, this expanded effluent reuse could reduce or eliminate undesirable discharges to natural water ways.

In Saskatchewan, there are three major centers, Swift Current, Moose Jaw and Lloydminster (Northminster), and 28 smaller communities which conduct effluent irrigation (Cameron and Crosson, 1995). Some communities view effluent irrigation as a means of wastewater disposal while others view it as a resource to facilitate economic development. Understanding the environmental sustainability of such projects is critical to effluent users and the general public. Effluent irrigation for economic development purposes can only be considered where long term sustainability of the site is considered possible and where appropriate monitoring measures are incorporated to quantify changes to the ecosystem. Effluent irrigation for disposal purposes is generally considered to be the least environmentally damaging solution to a municipal disposal problem. Sustainability in these cases might be viewed as sustainability of the environment at large as opposed to sustainability of the disposal site. Predicting sustainability and establishing monitoring procedures are essential to allow regulatory agencies to evaluate the potential of any site or situation for effluent irrigation.

A project was initiated as part of the Irrigation Sustainability component of the Canada-Saskatchewan Agriculture Green Plan Agreement (CSAGPA), to evaluate the long term impact and sustainability of effluent irrigation practices in Saskatchewan. The objectives of this project were:
1. To review international literature and other information sources to determine effluent irrigation standards used in other jurisdictions.

2. To analyze existing monitoring data from the major effluent irrigation projects in Saskatchewan to determine or assist in predicting the sustainability of the present projects, and to assist in setting guidelines for future effluent irrigation projects.

**Literature Review**

A comprehensive literature review including a review of international criteria was completed (Cameron, 1996). Topics included a description of the alternative uses of wastewater including agricultural irrigation; a review of the history of effluent irrigation with emphasis on health risks; overcoming the health risks of wastewater use; types of sewage treatment; a review of wastewater reuse and standards used in other countries; general standards adopted by various jurisdictions in the United States and Western Canada; and site selection and monitoring guidelines used with effluent irrigation.

**Health Risks**

Health risks from the use of wastewater can include the spread of infectious diseases by bacteria (typhoid fever, dysentery, tetanus), virus infection (meningitis, hepatitis, respiratory diseases), worm infection (roundworm, whipworm, tapeworm) and other diseases. Health guidelines for irrigation with treated wastewater developed in California (Ongerth and Jopling, 1977) indicate that for agricultural reuse of effluent waters on food crops, wastewater must be disinfected, oxidized, coagulated, clarified and filtered. Total coliform counts cannot exceed a median value of 2.2/100 ml or a single sample value of 25/100 ml. Total coliforms must be monitored daily. Turbidity cannot exceed 2 NTU (nephelometric turbidity units) and must be monitored continuously. Less restrictive guidelines developed by Shuval et al. (1986), and adopted by most of the international agencies, indicate that effluent water reuse was relatively safe to use if it contained less than 1 helminth egg/L and less than 1000 fecal coliforms/100 ml.

Analyses of effluent from a secondary lagoon in western Canada for the major enteropathogenic bacteria, such as *Salmonella*, *Shigella* and *Staphylococcus*, were consistently negative, indicating this wastewater to be safe for crop irrigation (Biederbeck and Bole, 1979). Field and laboratory studies indicated that fecal bacteria were susceptible to pressure shock and could be killed by rapid pressure changes normally occurring during effluent pumping and spraying. Those bacteria surviving the application are sensitive to ultra-violet rays from bright sunlight and to desiccation from windy warm weather. These conditions are prevalent during western Canadian summers.

**Reuse Standards**

Effluent reuse standards vary around the world. For example, in Mexico and many South American countries untreated wastewater is used for irrigation of agricultural crops (Strauss and Blumenthal, 1990). Most of these countries do not have the resources or capital to maintain and/or construct new treatment facilities. Their wastewater is released with little or no treatment. They attempt to control the health risk associated with wastewater irrigation by controlling the crops grown. Mexico does not allow wastewater to be used to irrigate lettuce, cabbage, beets, coriander, radishes, carrots, spinach and parsley. Acceptable crops include maize, alfalfa, cereals, beans, chili and green tomatoes. Israel has very stringent water reuse requirements. Effluent water requires a high level of treatment (large soil-aquifer recharge systems with dewatering) before the water can be reused for irrigation of vegetables to be consumed raw (Shelef, 1990). Caution is urged in using groundwater recharge systems since the long term impact of pollution is unknown (Britton and Gerba, 1984; Quaghebeur et al., 1989; Thurman and Gerba, 1985). In Japan (Kubo and Sugiki, 1977) most of the reclaimed wastewater is used for nonpotable dual systems (toilet flushing, washing and cleansing and landscape irrigation).

**Irrigation Suitability**
The guidelines for acceptable salinity and minor element levels in effluent water irrigation follow those of normal irrigation waters (Ayers and Westcot, 1985). These guidelines take into account leaching fractions and sodium and salt tolerances of crops (Bernstein, 1964; Maas and Hoffman, 1977; Maas, 1984), boron toxicity (Eaton, 1944), trace elements (Page and Chang, 1984) and low EC-high SAR permeability hazards (Oster and Schroer, 1979; Rhoades, 1977; Suarez, 1982). Soluble salt levels are usually limited to less than 2000 mg/L. Most of the soluble salts added to the soil during irrigation eventually reach the shallow groundwater and increase the salt concentration in shallow domestic wells and springs. They will become part of the return flow of groundwater to local rivers and streams.

Management Guidelines

Waste management guideline development in Canada has paralleled that of the U.S. (Hrudey, 1992). In the early 1980s, Environment Canada provided support to develop guidelines for land application of treated wastewater and sludge (Black et al., 1984). Specific regulations and guidelines that govern wastewater reuse in agriculture are provincial jurisdiction. The Ministry of Environment, Land and Parks in British Columbia has an up to date set of regulations for wastewater reuse. They endorse Best Available Control Technology (BACT) and require an Environmental Impact Assessment with emphasis on groundwater pollution for new wastewater land application projects.

Site Selection/Monitoring Guidelines

Site selection guidelines for effluent irrigation vary from country to country and are determined by irrigation suitability. A detailed source of information on site characterization and evaluation was published by U.S. Environmental Protection Agency (1981). Site characteristics for three types of land treatment systems were compared. These were slow rate processes (sprinkler and other typical farm irrigation systems), rapid infiltration basins and overland flow. Information was provided on the design of systems, site characteristics, expected quality of the effluent water after land treatment and typical permeabilities and textural classes suitable for each land treatment process. A rating system can be useful to compare sites. Rating can be accomplished by weighting each of the site selection factors, and then calculating a numerical value which compares one site to another (U.S. EPA, 1981).

A monitoring program is necessary at a reclaimed water irrigation site to satisfy regulatory discharge requirements, and to provide timely information regarding the potential accumulation of constituents that may reach toxic concentrations or may threaten the pollution of adjacent natural resources (Thornton and Smith, 1987). The basic objective of a monitoring program is to evaluate short and long term effects of effluent irrigation at the project site.

Thornton and Smith (1987) proposed a sampling frequency for various parameters and components (plants, soils, groundwater, tailwater) at wastewater irrigation sites. They recommended both spring and fall sampling of soil and groundwater piezometers for analyses of nutrients and major ions. They also recommended that monitoring programs provide flexibility to ensure that monitoring frequency and parameters can be modified to correspond to changes in the objectives of the program or in response to new findings. Monitoring requirements will vary with the quality and quantity of the applied effluent water, the soil and physical characteristics of the project, cropping patterns, specific site characteristics and environmental concerns. In many situations, the monitoring criteria become issue specific to a given locality.

Analysis of Monitoring Data

Moose Jaw Site - 1981 to 1995
Details of the Moose Jaw monitoring data analysis were provided by Cameron (1997). The following provides a brief summary:

**Background.** The Moose Jaw Effluent Irrigation Project was initiated in 1982. The wastewater facility consists of a bar screen to remove large objects, a grit removal facility, six aerated treatment lagoons and two aerated storage lagoons (Cameron, 1997). At present, approximately 1194 ha of agricultural land is irrigated with treated wastewater. Currently 19 center pivots and gated pipe are utilized. Forage, cereal and oilseed crops are grown. In addition to effluent irrigation, a Rapid Infiltration Basin (RIB) is used to provide phosphorus reduction prior to discharge to the Moose Jaw River when irrigation demand is less than the effluent supply.

Several studies were conducted prior to and during the implementation stages of the project. A hydrogeological study identified both a shallow and a deep aquifer underlying the proposed irrigation site (Menely, 1975). Aquifer deterioration was predicted to occur from downward migration of the high nitrate concentration of the effluent leachate. A laboratory soil column study indicated that a 25% leaching application was required to prevent soil productivity reduction due to salinity buildup from the high soluble salt content of the effluent (deJong, 1976).

An environmental monitoring and management program was initiated prior to implementation of the project to evaluate concerns related to salinization of the surficial soils, contamination of the groundwater supply and of surficial drainage flows which discharge into the river (Parker and Caswell, 1989). Parameters monitored include: effluent flow and chemistry, groundwater (shallow and deep) level and chemistry, surface water (river and springs) chemistry, distribution of salts in the soil profile, soil heavy metal content and crop yield. This monitoring program provides an evaluation of drainage and fertilizer requirements, and the soil-plant system. In addition it includes maintenance of a technological database to determine environmental impacts of the effluent application.

**Salt Load.** The Moose Jaw effluent had an average EC (electrical conductivity) of 1.69 dS/m compared to 1.22 dS/m for the Moose Jaw River. The average TDS (total dissolved solids) level of the effluent is 1238 mg/L, approximately 31% higher than the average TDS (942 mg/L) of the Moose Jaw River. The effluent contained 10 times the concentration of NH$_4$-N and 6.6 times the concentration of NO$_3$-N found in the river water. Total and ortho-P levels in the effluent average >10 times those of the river water. DOC (dissolved organic carbon) levels were similar in both waters, but BOD (Biological Oxygen Demand) levels were 2.6 times higher in the effluent. Heavy metals and trace element concentrations were low in both the effluent and river water.

According to current soil-water compatibility guidelines, Moose Jaw River water is considered suitable for irrigation on clay or coarser soils while the effluent would be suitable for irrigation of clay loam or coarser soils (Saskatchewan Water Corporation, 1989). The moderate SAR (sodium adsorption ratio) levels of 3.1 and 4.0 for the river water and effluent, respectively, are not considered a problem.

Mass loading estimates of salt to the soil system, based on average effluent chemistry and application rates, indicate a total of 3700 kg salt/ha applied with the effluent annually. Crop removal is estimated at 5% of the total salts applied. Agronomically, the Moose Jaw effluent irrigation project will continue to be sustainable for crop production provided most of the added salts are leached from the root zone.

Average salt levels have increased significantly over time at most of the soil monitoring sites. On average soil EC levels have increased from 0.75 dS/m to 1.60 dS/m due to effluent irrigation. The increases are more apparent in the surface meter of soil than in the bottom depths. This is partially because the bottom depths had higher salt levels prior to irrigation hence increases in EC are more difficult to detect. These results suggest that soil salinity is equilibrating to the salinity of the irrigation water. They also suggest that the soil salinity may be approaching a stable chemical equilibrium that varies each year depending upon the amount of effluent applied relative to rainfall.

The surface soils of the Moose Jaw effluent irrigation site are predominantly loamy sand. There have been no reported problems related to permeability. This suggests that the SAR values are not high enough to cause a problem.
Groundwater Level. During the course of project development, a network of shallow monitoring wells were installed to follow water table trends. The majority of the shallow wells had water table levels below 1.2 m for most of the year. Some wells were within 0.2 m of the soil surface in the early years but showed a gradual decline over time. Each year a rapid increase in water level occurred when the irrigation first started, peaked in June and July and then decreased after irrigation. Base levels in the winter have always decreased to > 3 m depth.

Continuous well water recorders have been operated within the irrigated area since 1974 (7 years prior to irrigation) by the Saskatchewan Research Council (SRC). The water level in a shallow well has increased approximately 4 m since irrigation began in 1981. The water level is presently 2-3 m below ground level. The water level in a deep well has increased approximately 5 m since 1981. The trends for this well suggest there is a response to irrigation, but perhaps not as pronounced as that for the shallow well.

Water table levels in the wells at the fringe of the irrigated area followed a seasonal cycle with highest reading in the spring. Shallow ground water migration outward from the pivots is limited. Irrigation water not used by the crop tends to percolate downward and can contribute to the local and regional ground water flows in which lateral movement is more prevalent.

Areas with a high water table have had tile drainage installed. Approximately 132 ha or 11% of the irrigated area is now drained.

Groundwater Quality. Shallow ground water quality data from 1981 to 1989 indicated no effect on groundwater quality upstream from the irrigated area. Entry of effluent into the groundwater within the project area displayed increased concentrations of sodium, chloride, sulfate and bicarbonate. The deep aquifer appeared to be unaffected. In some domestic wells there were increasing concentrations of sodium and chloride, but not enough to limit the use of the water.

In 1996 it was noted that TDS levels in the regional (SRC) piezometers ranged from 378-3122 mg/L. On site domestic wells ranged from 799-3363 mg/L and perimeter domestic wells ranged from 304-3184 mg/L. NO$_3$-N levels varied from 0.03-33 mg/L in the groundwater samples. Phosphorus levels were low ranging from 0.07-0.44 mg/L.

Chloride levels in one of two springs monitored yearly indicated an increase since 1991 from 20-34 mg/L to 144-167 mg/L. Nitrate levels increased from 1 mg/l to 2 mg/L. Trends for cation/anion increases were not as apparent, although Ca, Cl and NO$_3$ levels may be increasing. TDS and anion/cation levels were higher in 1994 and 1995 than in previous years.

The average EC of the drainage effluent samples collected from 1984 to 1995 was approximately 2.40 dS/m. Mean annual EC levels ranged from a low of 1.86 dS/m in 1994 to a high of 3.25 dS/m in 1985. EC did not increase over time. Drainage water EC was lowest in the spring and highest during the irrigation season and fall. The chemical concentration of the tile drainage water depends upon the proportional amount of snowmelt, rainfall and effluent irrigation infiltrating the soil. The volume of flow from the drainage outlet is also important. Low flows have higher salt concentrations, and high flows lower salt concentrations.

Sodium concentration of the drainage water increased over time from initial lows of 100 mg/L to greater than 200 mg/L. Calcium and chloride did not show well defined trends.

Rapid Infiltration Basin (RIB) Data collected from the Moose Jaw RIB will be used to define long term trends under normal irrigation. During the first five years of operation approximately 48.2 m of effluent were applied to the RIB. On average, 0.3 m of effluent is applied annually to the large scale irrigation project. The five year RIB application of 48.2 m would be equivalent to 160 years of effluent irrigation.

Data collected from the RIB indicated that soluble ion levels of most salts increased in the drainage effluent by 7-10%, except Ca which increased by 44%. Under normal irrigation, soluble salt levels in
the leachate would be expected to be higher than those for the RIB because of evapotranspiration of the applied water by the crop. Outward migration of salts was detected in peizometers indicating that lateral migration of soluble ions is occurring.

Removal efficiencies for organic-N, ammonium-N and suspended solids ranged from 88-96%. Nitrate levels increased because of the conversion of organic-N and ammonium-N to nitrate. During 5 years of operation, the overall N removal efficiency for the RIB was 57%. In 1994 the N removal efficiency was only 33%.

The average total P concentrations have decreased from 5.2 to 1.1 mg/L by the RIB for an overall efficiency of 79%. Total P and ortho-P removal efficiencies have decreased annually from 90-96% in 1990 to 62-63% in 1994.

Results from the RIB support the fact that the soluble salts applied with the effluent water will eventually migrate back to the Moose Jaw River as return flow, or will percolate downward into deeper ground water. The RIB results provide strong evidence that the biological parameters (BOD, TOC (total organic carbon), organic-N, suspended solids, microorganisms, etc.) can be effectively reduced by over 90% using RIB treatment, and potentially more under normal irrigation. The RIB results indicate 67% removal of N, primarily by denitrification during flooding periods. Under normal irrigation, saturated soil conditions occur for a short duration. Denitrification would be less than in the RIB. Crop uptake of nitrogen would be higher however under normal irrigation than in the RIB where the soils are kept bare. Although difficult to predict, it is likely that effluent irrigation will increase nitrate concentrations in the ground water return flow.

Phosphorus removal efficiencies in the RIB decreased from 90% in year 1 to 60% in year five. This may not be applicable to normal irrigation. There are three reasons for this: the amount of water applied to the RIB in 5 years would be equivalent to 160 years of normal irrigation; crop uptake of P would reduce the amount adsorbed or precipitated in the soil; and P removal efficiencies are greatly improved when the effluent has a longer surface contact time with the soil, which is the case for normal irrigation. The results suggest that P removal from the effluent by the soil/plant ecosystem will be far more effective and sustainable than by the RIB.

Sustainability. It is difficult to relate long term sustainability of the Moose Jaw effluent irrigation project to ground water contamination with salts since this phenomenon happens in all irrigation projects. If sufficient contamination occurs to render domestic water sources unusable, then new wells can be drilled and/or other sources of water made available to compensate for the loss of the present domestic supply. Widespread contamination of the ground water with toxic levels of nitrate, infectious bacteria or viruses, or unknown toxic compounds carried in the effluent irrigation waters would limit the sustainability of an effluent project. There is no evidence that this type of contamination has occurred to date.

Sustainability of this project will depend upon its long term impact on the Moose Jaw River. There is no doubt that irrigation will increase salinity levels in the river, particularly in the section of the river near the irrigation project. Downstream impacts may be ameliorated by flows from other tributaries, from Thunder Creek and from storm sewer outlets. Increased salt levels in the Moose Jaw River may be acceptable, provided low phosphorus levels are maintained. Should future monitoring indicate that any toxic compounds dangerous to human health, or that any infectious microorganisms are contaminating the Moose Jaw River from effluent irrigation, then this approach to wastewater treatment will not be sustainable.

Swift Current Site - 1978 to 1995

The Swift Current site monitoring data is currently being compiled. Preliminary findings and data from other reports indicate the following:
**Background.** The Swift Current effluent irrigation project began in 1973 as a pilot project conducted by the Agriculture and Agri-Food Canada Research Station (Jame et al., 1984). The full scale project was initiated in 1978 utilizing a total of 338 ha. Effluent is supplied from a secondary lagoon to three center pivots, 11 laterals, two volume guns and three hand move sprinkler systems (Clifton Associates Ltd., 1993). Groundwater monitoring of wells and springs was initiated in 1976 by the City of Swift Current. Two wells monitor water quality in a deep bedrock aquifer. Eight water wells, four monitoring wells and one spring monitor water quality in shallow drift aquifers.

**Salt load.** The effluent has a high salt load with a mean EC of 2.6 dS/m (Jame et al., 1984). Preliminary results indicated a leaching fraction of 10-15% was required to ensure sufficient leaching to maintain salt content in the root zone below deleterious levels. After eight years of effluent irrigation, new steady state soil salinity profiles developed that approached the salinity of the effluent.

Soil salinity levels from 1978 to 1991 displayed variability among three sites (Clifton Associates Ltd., 1993). One site showed no change, one an increase and the third a decrease in soil EC.

**EM 38 survey.** Beginning in June of 1995 Sask Water has conducted an EM 38 survey of the irrigated lands in the project. These were completed using an EM 38 mounted on a sled and drawn across the landscape with a quad all terrain vehicle. The EM 38 is connected to a data logger with EM readings taken every 2.2 meters along the length of a survey line. Spacing between lines was generally 100 meters. The survey is conducted in both the vertical and horizontal dipole modes. Soil samples were taken for detailed salinity analysis and regressed with the EM 38 readings. Coloured plots of each of the areas were prepared. These are useful in recognizing potential problem areas and will be used in the future as a benchmark. EM 38 plots of these areas indicate that the soils have reached a background salinity level approaching that of the electrical conductivity of the effluent being applied.

**Groundwater quality.** Changes in the shallow groundwater quality of the drift aquifers from 1978 to 1991 displayed increases in chloride, hardness, sodium, sulfate, magnesium and total dissolved solids (Clifton Associates Ltd., 1993). Sulfate concentrations in the shallow groundwater were higher than that of the effluent indicating that sulfate was mobilized from the soil. Chloride concentrations began to increase in 1981, three years after irrigation began. Values as high as 414 mg/L were observed in one well indicating contamination by the effluent applications.

There has been no observed change in water quality for the deep bedrock aquifer.

Groundwater bacteriology has shown the presence of fecal coliforms greater than 30 MPN (most probable number) in the shallow wells. The method used to determine fecal coliforms has a detection limit of 30 MPN which is above the detection limit required by the Saskatchewan Environment and Public Safety Water Quality objectives. A more precise method of fecal coliform detection should be used in future monitoring.

The pilot project study conducted by the Agriculture and Agri-Food Canada Research Station at Swift Current indicated that fecal coliform bacteria die off rapidly as the soil surface dries between irrigations (Biederbeck and Bole, 1979). Greater than 90% of the fecal bacteria were retained within 2.5 cm of the soil surface and none penetrated below a depth of 30 cm. Contamination of groundwater should not be a problem.

**Northminster site - 1989-1993**

**Background.** The Northminster Effluent Irrigation Project is located approximately 11 kilometres north of Lloydminster and began operation in 1989. The project receives effluent from the City of Lloydminster’s effluent discharge line and stores the effluent in a reservoir. The effluent is pumped to ten individual parcels of land through pressurized pipe lines. One additional parcel receives effluent directly from the City’s discharge line. The effluent is used for forage and annual crops.
Conditions of Saskatchewan Environment and Resource Management's Sewage or Industrial Effluent Permit require Sask Water to undertake a variety of monitoring activities and submit a monitoring assessment report at the end of the permit period.

Domestic wells within a 2 kilometre radius of any of the irrigated parcels are monitored annually. Piezometers were installed at 58 sites on the project. Generally, two piezometers were located on each irrigated and adjacent parcel. Water levels are recorded and the piezometers sampled in the spring and fall of the year. Surface water was monitored at two sites on Big Gully Creek, one where the effluent reservoir coulee joins the creek, and the other six kilometres downstream from the reservoir.

Monitoring Results. Results of the 1993 domestic well samples showed no discernible impacts from the effluent irrigation. Chlorides and nitrates remained at background levels for all locations. The sampling schedule was decreased to once every three years for the 16 wells. Six piezometers have remained dry since installation and 17 have had insufficient water for consistent sampling. Piezometers located on or near two of the project quarter section irrigation systems have shown increased water levels, some very near the surface. Some piezometers that had shown an increase were destroyed and a number have been replaced. Water level measurements were suggested to be reduced to annual fall readings. Water quality analysis of samples from most of the piezometers has shown some nutrient content increase. It is not apparent if this is from the effluent supply or from fertilization. Major ion analysis of the piezometers has shown little change over background levels. Water quality samples have been reduced to one on farm and one off farm sample annually in the fall. Surface water quality sampling from Big Gully Creek was eliminated as little difference with background levels were noted.

Soil salinity and trace metal monitoring have shown that soil salinity of the irrigated lands has increased marginally. These increases were in sodium, chloride and sulphate. The effluent has an EC of 1.6 dS/m and an SAR of 3.3. It can be expected that the soils will achieve similar values in the near surface and that sodium will accumulate unless leached. Expected increases in EC and SAR have been observed on irrigated parcels. Abnormally low precipitation in recent years has limited leaching. Trace metal accumulation is negligible. Soil monitoring for both salinity and trace metals continues on the rotational schedule established. The operation and monitoring of this project have not been sufficiently long to build a reliable database. Management of the project must include a leaching fraction component, which based on current soil-water compatibility guidelines would be five percent. Under normal circumstances this will occur from post harvest rainfall and snowmelt infiltration.

Summary

A project was initiated as part of the Irrigation Sustainability component of the Canada-Saskatchewan Agriculture Green Plan Agreement (CSAGPA), to evaluate the long term impact and sustainability of effluent irrigation in Saskatchewan. Initial results from this study indicate that a wide range in guidelines are used for effluent irrigation projects throughout the world. Monitoring data from three large effluent irrigation projects in Saskatchewan indicate that the soil biosystem will be altered with the application of sewage effluent, but should be sustainable provided proper management practices are followed.

References


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