SOIL/LAND QUALITY INDICATORS FOR ALBERTA

Several different approaches for developing soil/land quality indicators have been used in Alberta:

Land Productivity Indicator: The Land Productivity Indicator is the average annual yield of the six major crops grown in Alberta (Serecon Management Consulting Inc. 2000). An overall yield is determined by weighting the yields from different crops by average seeded area, which is determined for a specified period of time. The major advantage of this indicator is that it is easy to calculate. The major disadvantages are that only one goal (crop productivity) related to soil functions is considered, and the knowledge that crop yields are a product not just of soil properties, but also of climate, management, and landscape, has not been incorporated into this indicator. Improvement of this indicator might be possible by the use of algorithms to isolate the impact of soil properties on crop yields.

Land Suitability Rating System (LSRS): Pettapiece et al. (1998) estimated the change in soil quality for 15 ecodistricts in Alberta. The changes in soil quality were estimated from the change in LSRS ratings over 30 years, which were based on EPIC simulations of soil processes. This approach primarily reflects goals related to crop productivity, but it also provides direct estimates of the type and extent of soil degradation, which could be used to develop indicators for other goals related to soil functions. Further validation of this approach is necessary, particularly with regard to prediction of yields and soil degradation, possible importance of dynamic soil properties, and possible use of simpler models.

Agri-environmental indicators: The Canadian system of agri-environmental indicators is relevant to most goals for soil functions and has been applied to all agricultural lands in Alberta (McRae et al. 2000). Crop productivity is not dealt with directly, but indicators are provided for various aspects of land degradation that impact on crop productivity (e.g., risks of water erosion, wind erosion, soil compaction, salinization, and loss of soil organic carbon). Indicators for soil functions related to water quality require further development for use in Alberta; they have not been determined for any of the Prairie provinces.

Agri-environmental indicators are largely based on expected outcomes from management, climate, soil and landscape factors. Insufficient data and knowledge limit the usefulness of a number of the indicators, and all would benefit from further validation. These indicators are developed at spatial scales from ecodistrict to national, and are not valid for use at smaller spatial scales.

Soil monitoring indicators: Indicators based on periodic measurements of soil properties have been used to compare management practices (Karlen et al. 2001) and monitor changes in soil properties over time (Sparling and Schipper 2002). The soil quality monitoring study in Alberta is based on this approach, although indicators have not yet

been determined (Cannon 2001). The major advantages of this approach are that it is based on actual observations of soil properties and it aims to evaluate soil quality with respect to all soil functions.

The major disadvantages of this approach are its relatively high cost and the difficulty in relating measurements of soil properties to outcomes of soil functions. One reason for this difficulty is that goals for outcomes of soil functions are not formulated. Instead, indices based on soil properties are formulated (generally with insufficient validation) and compared among management systems or time periods. Another reason for this difficulty is that outcomes of soil functions are not simply determined by soil properties, but also depend on climate, landscape and management. This issue has been addressed by restricting the context in which soil property indicators are validated, or by restricting the indicators to soil properties that have a relatively consistent and significant effect on soil function outcomes (e.g., soil organic matter). These solutions are valid, but the value of the approach is considerably reduced.

An alternative solution would be to develop indicators based on the outcomes of soil functions using available information and appropriate models. A successful implementation of this approach would be of considerable benefit for validation of indicators based solely on soil survey and census data.