Soil Conservation

ARTICLE CONTENTS: Effect of Land Use and Management

Soil conservation is a combination of all methods of management and land use that safeguard the soil against depletion or deterioration by natural or man-induced factors. It most often attempts to ensure that SOIL does not erode and wash into streams and lakes or blow away in the wind, but it also involves the protection of the soil from damage by machinery (eg, compaction) or by detrimental changes to its chemistry (eg, acidification or salinization).

Importance of Soil Conservation

Most people know that they need clean air and clean water to stay healthy. Fewer people realize that their well-being also depends on the health of the soil. Soil supports the growth of most of our food and fibre, so its productivity is a major factor in the economies of Canada and other nations.

But soil also has a much broader, global role. Soil acts as a filter, cleaning air and water. It exchanges gases with the atmosphere and thus influences the global CLIMATE. Soil receives organic wastes and recycles their nutrients back to plants; it also holds and breaks down some toxic wastes. Because soil plays such a key role in world health, economics and environmental stability, we must conserve it and use it in a sustainable manner.

Soil Erosion

Erosion caused in this case by an intense thunderstorm squall lifting the soil from the fields (photo by Arjen Verkaik, Skyart Productions).

Effect of Land Use and Management
Causes of Declining Soil Quality

The inherent or natural quality of a soil is determined by the geological materials and soil-forming processes (such as chemical and physical WEATHERING) that combine to produce it. The characteristics

of a natural soil can be changed by human activities, including land use and farming practices. In agriculture and forestry, decline of inherent soil quality can occur because of EROSION, loss of soil organic matter, compaction, desertification and other degrading processes.

Soil Conservation Practices

Soil conservation practices are commonly used in forestry during harvesting and replanting operations. The quality of agricultural soils can also be maintained (conserved) or even improved by using soil conservation practices. Examples of these practices include adding organic material (eg, manure) and inorganic amendments (eg, LIMESTONE), using conservation tillage (reduced tillage or no-tillage systems), reducing the amount and frequency of use of summer fallow, rotating CROPS and growing LEGUMES (eg, clover).

The type of farming activity that takes place on an area of land, be it pasture or cultivation of forage or fibre crops, cereals, oilseeds, berry fruits or vegetables, depends on the type of soil, the climate and whether crops are grown under natural rainfall or IRRIGATION. The more any land use disturbs the land's natural ecology, the greater its effect on soil quality.

On pasture lands, agricultural management practices include restricting the density of animal stocking, using rotational grazing (resting fields after they have been grazed), controlling weeds, and protecting vegetation and banks along water courses. On cultivated lands, soil management practices include crop selection and rotation, choice of tillage methods (leaving crop residues on the surface or plowing them into the soil), controlling the traffic patterns of tractors and machinery, determining rates of FERTILIZERS and other soil amendments to apply, controlling pests and managing water.

Crops that provide high-density and year-round ground cover offer greater protection against soil erosion than row-cropping or cropping systems that include extensive use of cultivated fallow. Minimizing the amount of tillage used for weed control or seedbed preparation reduces the breakdown of soil structure (the arrangement of soil particles into granules or clods), and keeps more plant residues on the soil surface compared to more intensive tillage. This helps maintain soil tilth and control soil erosion.

Reducing the rate of oxidation of soil organic matter can contribute to increasing the amount of carbon stored in the soil, which is an important factor in reducing the greenhouse gas effect (the accumulation of carbon dioxide and other gases in the atmosphere). Soil management that returns plant nutrients to the soil at the rate of their removal by crops will help maintain soil fertility. Reduced use of PESTICIDES on erosion-prone soils, or use of pesticides accompanied by effective soil conservation measures, reduces the risk of contaminated sediments getting into surface water.

Acceptance of Soil Conservation Practices

Soil conservation practices have been increasingly adopted on Canadian farms since the 1980s. In 1996, the area managed by no-till practices accounted for approximately 16% of cropland. This area has since increased to approximately 46%. Soil-conserving tillage practices (conservation tillage and no-till combined) now represent over 72% of Canadian cropland. Nationally, the amount of farmland under summer fallow, which had decreased by more than half between 1981 and 2001, has further decreased by 25%. Agriculture and Agri-Food Canada (AAFC) has developed a series of Agri-Environmental Indicators for use in tracking the trends relating to soil conservation and environmental sustainability. AAFC reported on the trends in these indicators for the period 1981 to 2006 (the most recent period for which statistical information is available) in *Environmental Sustainability of Canadian Agriculture: Agri-Environmental Indicator Report Series - Report #3* in 2010. Trends in all the soil-quality indicators showed considerable improvement between 1981 and 2006. The majority of the cultivated land in Canada is in the very low risk class for erosion. Canadian cropland has gone from a net source to a net sink of CO_2 gas due to increased carbon sequestration and increasing levels of soil organic matter. Moreover, the share of land at risk of salinization has also decreased over this period. This general improvement does not apply to all soils, however, and there remain significant areas of farmland at risk of degradation. Nevertheless, the AAFC provided evidence that the health of our agricultural soils can indeed be maintained and even improved with the right care.

From this data, three general trends have emerged. First, conservation-oriented farming practices are required to maintain soil health, particularly in areas of intensive cropping and where soils are marginal for agriculture. Secondly, soil health can be maintained or is improved in regions where land use and management practices have been tailored to address soil resource and climatic influences that may combine to produce local problems of soil degradation. Finally, declines in soil health occur rapidly, often most dramatically in the first 10 years following conversion of undisturbed land to agriculture, but improvements to soil quality take place slowly and at greater cost than maintaining a good soil in top condition.

Atlantic Canada

None of the four Atlantic provinces is well-endowed with highly productive soils. The soils tend to be inherently weakly structured and many are acidic. The intensive production of potatoes and vegetable crops has further reduced organic matter levels, damaged soil structure, and led to severe soil erosion on sloping land.

Soil conservation practices are being adopted by farmers to control these problems. Terraces are becoming common in the potato-growing areas of New Brunswick; these are channels constructed across slopes at regular intervals. The terraces reduce the length of the slopes, which reduces the accumulation of runoff water. They carry off this water to the edge of the field. They also result in farmers planting the crop rows across the slope instead of up and down the slope, further reducing erosion of the soil by runoff.

Other soil conservation practices include crop rotations in which potatoes are grown alternately with cereal grains (eg, barley) and clover. Grassed waterways are also used in areas where water naturally concentrates, reducing the risk of erosion cutting channels (gullies) into the soil. Soil acidity is often increased by the use of the large amounts of fertilizer needed for the potato crop in this region. To control soil acidity, farmers apply ground limestone to the soil, and then mix it in with tillage implements.

About 80% of the cultivated soils of Atlantic Canada have a high risk of soil erosion by water if they are left unprotected by soil conservation practices. In 2006, New Brunswick had the lowest share of cropland at very low risk of erosion. This province has a significant proportion of land under potato production and soils that are prone to erosion. The risk of water erosion has not changed significantly in this province over the 1981 to 2006 period, as there has been little change in the types and areas of crops grown and only limited increased adoption of conservation and no-till tillage practices. The erosion risk in Nova Scotia and Prince Edward Island declined over the 1981 to 2001 period due to increased adoption of conservation tillage in both provinces and, to a lesser extent in Prince Edward Island, increased area of forages that are less erosion-prone than row crops.

Soil conservation is practiced across Canada to preserve our farmland and forests for future generations, and to maximize the benefits to the air and water obtained from these lands. A great deal of progress has been made in recent years towards increasing the area on which soil conservation practices are being applied. However, more is needed because it is essential to the future of all Canadians that our ability to produce food and fibre for ourselves and for export be sustained, and that we continue to enjoy clean air and water.