

Overview of Soil Management

From an agricultural perspective, healthy soil means a soil that sustains or enhances productivity, ensures profits and is sustained for future generations. A broader perspective may include its ability to maintain or enhance biodiversity, nutrient cycling and biomass production. In today's world, all soil functions—regulating water, filtering pollutants, sustaining plant and animal life, cycling nutrients and supporting structures—are important.

Erosion

The rate of soil loss through conventional agricultural practices and natural geographical erosion raises concern about the agricultural system's capability to feed the global population and safeguard soil fertility and the soil itself.¹ An average of 10 times as much soil erodes from American agricultural fields as is replaced by natural soil formation.² This loss of soil affects productivity since surface soil contains most of the micro-organisms and plant nutrients required for good crop production. Soil erosion and runoff of chemicals used in agricultural production not only threaten the sustainability of agriculture, but also pollute water resources. The effect of run-off silt and nutrients is shown in dead zones in the Gulf of Mexico, Great Lakes and Chesapeake Bay. Conservation tillage, leaving crop residue on the surface of the field, has been utilized to some extent to counter this problem, but when accompanying weed control is accomplished by use of herbicides, ground water can become contaminated when these chemicals percolate through the soil.³ Research is needed to find the best combination of management practices to prevent soil erosion and enhance agricultural sustainability.

Factors Affecting Soil

The management of soils for agricultural purposes depends upon a number of factors including the inherent qualities of the soil (e.g., sand, clay, depth of organic material), climate/weather and surrounding landscape. Vegetative practices include cover crops, pasture planting, riparian buffers and windbreaks. Structural practices include grass waterways, manure storage structures, terraces and wetland restoration. Management practices include contour farming, crop rotation, nutrient management, integrated pest management and crop residue management. Many of these practices are consistent with both conventional and organic farming⁴ although organic farming allows no synthetic fertilizers, pesticides, or GMOs to be used in the operation for a three-year period prior to being designated as organic.

Best Management Practices

While specific recommendations vary from region to region, the best management practices identified by the Natural Resources Conservation Service (NRCS) of the USDA are promulgated through the various states by the soil conservation district staff and extension services of the universities of each state. The current emphasis of NRCS soil and water conservation plans⁵ is on disturbing the soil as little as possible (such as by no till practices) and crop diversity (as in rotating crops or incorporating new crops); however, the 2007 Census of Agriculture shows that only 25% of farms used some conservation methods and 18% practiced crop rotation.

Nutrient Management

Nutrient management is another aspect of farming practice that affects crop productivity and the environment. The Clean Water Act delegates water pollution cleanup management to the states and regions as part of their TMDL plans and agricultural runoff is a major focus of most of these plans. Agricultural pollution, both from manure and chemical fertilizers, is dealt with by a nutrient management plan particular to each individual farm operation.⁶ Depending upon the region, the plan is either mandatory or voluntary. The plans detail the source, rate, form, timing and placement of nutrients and require significant record keeping. The purpose of the plan is to supply essential nutrients for the particular crop in each field, promote efficient use of nutrients, help maintain or improve the physical, chemical and biological condition of the soil and minimize environmental degradation caused by excess nutrients in the environment.

Incentives

Research has shown that farmers who are better educated are more likely to adopt conservation practices, but cash incentives can also be effective.⁷ Current federal law incentivizes adoption of many best management practices, making them more affordable. Federal and state programs working together can cover up to 87.5%⁸ of the cost to implement many practices. But since 1996 when the Farm Bill exempted crop insurance subsidies from basic conservation requirements, the farm bills have provided a disincentive for conservation practices.⁹ This linkage is an issue currently under consideration in Congress as a new farm bill is debated. Addressing the farmland rental situation is another approach to increase implementation of best management practices. According to the 2007 Census of Agriculture 38% of the land farmed was rented which makes it challenging to justify, or qualify for, investment in projects to improve the land.

Sustainability

Research on improving land management practices and identifying the best combination of management practices to prevent soil erosion and enhance agricultural sustainability requires a strong link between researchers and farmers. Most research attempts to identify links among management practices, observable soil characteristics, nutrient cycling and productivity; it is

difficult for a single study to address all of these interrelationships. Areas for future study include defining the characteristics of a healthy soil's biological community and approaches to manage that biology, improving nutrient cycling by managing soil biology, and identifying low-cost remote monitoring techniques for soil quality. The ultimate purpose of research is to protect and improve long term agricultural productivity, water quality and habitats for all organisms, including people.

Recommended Readings

Izaak Walton League of America, "2012 Farm Bill Issue Briefs, II. Conservation Compliance and Crop Insurance," November 19, 2010, <http://www.iwla.org/index.php?ht=a/GetDocumentAction/i/11073>, accessed 8/29/13.

USDA, Natural Resources Conservation Service, "Soil Management / Management Principles," <http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/mgmt/>, accessed 12/4/13.

David R. Montgomery, "Is Agriculture Eroding Civilization's Foundation?" *CSA Today*, October 2007, <http://www.geosociety.org/gsatoday/archive/17/10/pdf/i1052-5173-17-10-4.pdf>, accessed 8/29/13.

¹ David R. Montgomery, "Is Agriculture Eroding Civilization's Foundation?" *CSA Today*, October 2007, <http://www.geosociety.org/gsatoday/archive/17/10/pdf/i1052-5173-17-10-4.pdf>, accessed 8/29/13.

² Nancy M. Trautmann, et al, Cornell Cooperative Extension, "Modern Agriculture: Its Effects on the Environment," psep.cce.cornell.edu/facts-slides-self/facts/mod-ag-grw85.aspx, accessed 8/29/13.

³ Ibid.

⁴ Jennifer Bromm, et al, "Saskatchewan Best Organic Management Practices: Farmers' Perspectives," Organic Research and Extension, Department of Plant Sciences, University of Saskatchewan, November 2008, <http://www.organiccentre.ca/Docs/BOMP%20Whole%20Dec%202008.pdf>, accessed 11/1/13.

⁵ USDA, Natural Resources Conservation Service, "Soil Quality / Soil Health Management," <http://soils.usda.gov/sqi/management/management.html>, accessed 8/29/13.

⁶ Northeast Recycling Council (NERC), "Comprehensive Nutrient Management Plan," http://www.nerc.org/documents/manure_management/comprehensive_nutrient_management.pdf, accessed 8/29/13.

⁷ Christine A. Ervin and David E. Ervin, "Factors Affecting the Use of Soil Conservation Practices: Hypotheses, Evidence, and Policy Implications," *Land Economics*, Vol. 58, No. 3, Aug., 1982, <http://www.jstor.org/stable/3145937>, accessed 8/29/13, cannot be accessed without a subscription.

⁸ MACS (Maryland Agricultural Cost Share) 2010 Annual Report, <http://cdm16064.contentdm.oclc.org/cdm/ref/collection/p266901coll7/id/3280>, accessed 12/4/13.

⁹ Izaak Walton League of America, "2012 Farm Bill Issue Briefs, II. Conservation Compliance and Crop Insurance," November 19, 2010, <http://www.iwla.org/index.php?ht=a/GetDocumentAction/i/11073>, accessed 8/29/13.