(Photo by N.D. State Soil Conservation Service)

SOIL EROSION AS A POLLUTION AGENT

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A report submitted to the President in January, 1969, by the Secretary of Agriculture and the Director of the Office of Science and Technology entitled "Control of Agriculture-Related Pollution" (1) discussed eight pollutants of special concern. Sediments head the list of major agricultural pollutants, according to this report.

Sediments are defined as solid materials, both mineral and organic, that are being transported or have been moved from their original site by water, ice, air or gravity.

Sediments or soil particles that have been eroded from the land make up the bulk of the pollutants now found in surface waters across the United States. It has been estimated that some four billion tons of soil are moved from place each year by water. About one-fourth of this eroded soil reaches the major streams of the United States annually. In addition to soil losses due to water, large amounts of soil are removed from cropland and rangeland by wind. During the 1969-70 wind erosion season, the Soil Conservation Service reported (2) that 1,876,309 acres of the Great Plains area of the United States were damaged by wind erosion. Figures giving the amount of soil loss due to wind erosion are not available, but it is clear that this is also a source of sediments in rivers and lakes.

In North Dakota, the Soil Conservation Service has estimated the acreage of cropland susceptible to various rates of soil loss in each land capability class based on the 1967 Conservation Needs Inventory. Table 1 shows that in all land capability classes, 16,424,000 acres have a rate of soil loss of 0 to five tons per acre per year; 9,842,500 acres have a soil loss of six to 10 tons per acre per year, and 1,235,000 acres have a soil loss of 11 to 20 tons per acre per year. (3)

The Soil Conservation Service has set five tons of soil loss per year as the maximum acceptable rate of loss due to erosion. Rates higher than five tons are considered excessive and corrective measures should be applied. The data indicate that approximately 60 per cent of the cropland in North Dakota is adequately protected, but the amount of erosion on some of these lands could be decreased. Cropland not adequately protected should be of prime concern.

How does soil erosion affect overall environmental quality? Soil erosion is damaging many times over. First is the loss of cropland and decreased value of badly eroded soils. Once the soil is removed it cannot be replaced. Gullies cut across fields interfere with farming operations. Soil lost through erosion may reduce the soil profile water storage capacity and infiltration rate, adding to the erosion problem by concentrating water that re-

Table 1. Estimated Cropland Acres with 0 to 5, 6 to 10 and 11 to 20 Tons/Acre/Year Soil Loss Through Erosion.[1]

Land Capability Class	Rate of Soil Erosion[2] 0 to 5 T/A/Yr.	6 to 10 T/A/Yr.	11 to 20 T/A/Yr.
	Acres	Acres	Acres
1	25,100	—	—
2	12,015,300	6,335,800	10,900
3	3,320,000	2,622,800	721,700
4	428,400	401,000	248,700
5	48,100	—	—
6	564,200	471,700	248,800
7	22,700	10,800	4,900
8	200	400	—

[1]Wind and water erosion without adequate land treatment.
[2]A 5-ton soil loss per acre per year would require about 35 years to erode one inch of topsoil from an acre of land.

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sults in more rapid runoff and faster erosion. Excessive water runoff reduces the amount of water stored for crop production and increases possible flood hazards at lower levels in the watershed.

Secondly, degradation of the environment by sediments resulting from soil erosion continue at off-site locations. Some of the off-site damage resulting from sediments are listed in the report to the President. Deposition of eroded soil particles in lakes and reservoirs reduce water storage capacity. Flood-borne sediment deposited on productive flood plains may damage crops and, if coarse-textured, reduce the productivity of alluvial soils. Sediment deposits in stream channels reduce their capacity to convey water and sometimes impair drainage of adjacent lands. Drainage and irrigation ditches clogged with sediment do not function, and sediment removal is a costly item of maintenance. Wearing or abrasion of power turbines, pumping equipment, irrigation distribution systems and other structures is accelerated by sediment in water. Habitats of game fish are damaged by water-borne and water-deposited sediment, and people enjoy clear water for recreation purposes.

The impact of fluvial sediment on the national economy and on the quality of our environment is of tremendous significance. According to the report to the President, sediment damage, because of its many ramifications, has been estimated at more than $500 million annually. In addition, capital investments in treatment facilities are required for processing sediment-laden waters to make them suitable for municipal and industrial uses. Also, the value of soil resources lost by erosion is no doubt several times greater than the combined sediment damages.

Thirdly, soil erosion is also involved in eutrophication of lakes. Sediments resulting from water erosion are usually composed of clay particles or colloidal materials high in organic matter which carry adsorbed plant nutrients such as phosphorus and potash and organic compounds such as pesticides. Once in water, a portion of these nutrients become available for growth of algae and other aquatic plants. Nutrient levels with the exception of phosphorus, are usually high enough in surface waters to support plant life, and so the addition of relatively small amounts of phosphorus will often enhance plant growth and speed the natural process of lake "aging".

Almost all phosphorus originating from crop production practices found in surface waters must be the result of soil erosion and surface runoff. Research conducted at Morris, Minn., shows that the amount of phosphorus removed from a field in sediment is more than the amount of phosphorus found in the water carrying the sediment (Table 2) (4).

Table 2. Phosphorus Losses in Runoff Water and on Sediment Originating from Snowmelt and Rainfall. 2-year Average.

Cropping Treatment	Snowmelt		Rainfall	
	Water	Soil	Water	Soil
	— Lbs/A —			
Continuous fallow	0.02	0.02	0.02	0.28
Continuous corn	0	0	0.06	0.10
Rotation corn	0.04	0	0.02	0.04
Rotation oats	0	0	0	0.02
Rotation hay	0.20	0	0	0

Wadleigh reports (5) that available evidence indicates that algae will grow vigorously if the water contains 0.1 part per million of phosphorus. To completely inhibit algae growth, the level of phosphorus in water must be below 0.02 ppm. Phosphorus is moving into surface waters from farmland, but it is not known how important this source of phosphorus is in eutrophication of lakes. Natural drainage, domestic sewage, industrial wastes, feedlot wastes, etc., are potential sources of large amounts of phosphorus.

Soil erosion is a major agricultural-related pollution source. Although only 40 per cent of North Dakota's cropland is subject to excessive erosion losses, an intensified effort to reduce soil erosion will in turn reduce environmental pollution originating from agricultural production practices. Schmidt (6) summarized the effect of erosion control on pollution when he stated that, "Various types of land use or soil management can either reduce or increase erosion and its associated pollution load. Practices such as contour cultivation, strip-cropping, graded terraces, cover crops, mulch or reduced tillage, and crop rotations including grasses, can reduce erosion losses from agricultural watersheds from 25 to over 75 per cent of that from poor crop practices".

REFERENCES

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