How To Slow a 175-Tons-a-Second Landslide

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Spring runoff on a plowed field in Wisconsin carries away precious topsoil along with nutrients and pesticides. (F.M. Stone, SCS, WIS-1501)

Every second 175 tons of soil are eroded from U.S. non-Federal lands. Approximately 5.5 billion tons of soil erodes from U.S. non-Federal lands each year with two-thirds of this erosion coming from agricultural land, primarily cropland. Water erosion accounts for 65 percent and wind erosion for 35 percent

What Is Water Erosion?

The process begins with a single raindrop. The force of rainfall detaches soil particles. As rainfall intensifies, the soil surface becomes saturated, causing runoff of excess water, detached soil, and nutrients and pesticides that have adhered to the soil particles.

The type of soil and vegetative cover influence the rate of erosion as does the length and steepness of slope. Sometimes soil travels just a few inches—at other times to the bottom of the hillside. Over time, soil can travel hundreds of miles down-

A Montana field with no protection from wind erosion literally blows away. (Merle B. Brunsvoid, SCS, Mont-183)

There once was a reservoir in the center of this area. Land adjacent to the reservoir was converted from pasture to row crops, and within 5 years the structure completely silted in. (Tim McCabe, SCS, IA-2873) stream from its site of detachment.

What Is Wind Erosion?

Wind erosion occurs when the force of the wind on dry soil overcomes its gravitational pull. This happens when the wind is blowing at approximately 13 miles per hour or more measured 1 foot about the soil surface. Detachment depends on many factors including soil type, roughness of the soil surface, wind speed, and vegetative cover. As with water erosion, transport of windblown soil, with its attached nutrients and pesticides, can occur over long distances and affect the environment far from the original detachment site. The potential for wind erosion is largely due to the tremendous soil-carrying capacity of the air. For example, the air above the Mississippi River basin has been estimated to contain 1,000 times the soil-carrying capacity of the river itself.[1]

Where Does the Soil Go?

When soil particles are being transported, their size and weight are factors in determining where eroded soil and accompanying agricultural chemicals end up. Larger, heavier particles tend to travel closer to the ground in the case of wind erosion, and settle out quicker in the case of water erosion. Smaller, lighter particles, however, will travel farther distances as they are more easily lifted into the air or suspended in water.

[1]R. Neil Sampson, *Farmland or Wasteland*, Emmaus, Pa., Rodale Press, 1981, 422 p.

If effects of erosion are considered offsite when they leave a field, then the first places for deposition of soil particles are fence lines and roadside ditches and culverts. Windblown soil also may enter farmhouses and other agricultural facilities.

Later, soil reaches creeks, streams, lakes, towns, and cities. Eventually, some soil particles end up in larger rivers and lakes and finally the oceans. Soil, nutrients, and pesticides eroded by water in Iowa or Minnesota can end up in the Mississippi Delta. Erosion by wind in the Great Plains can affect the Great Lakes or East Coast.

What Harm Is Done?

Water Erosion Damages. Runoff water can contain pollutants such as sediment, nutrients, and pesticides. Each of these can limit the ways in which the water can be used safely. Sediment fills reservoirs, blocks navigation channels, interferes with water conveyance systems, affects aquatic life, and degrades recreation resources. Nutrients from chemical fertilizer and manure promote the premature aging of lakes and estuaries and affect recreation, municipal and industrial water supplies, and commercial fishing. Pesticides affect aquatic plant and animal life, reduce recreation opportunities, and possibly endanger human health.

Wind Erosion Damages. Windblown soil and accompanying pollutants can cause a variety of damages to households, businesses, public services, and the environment.

Annual Costs of Water Erosion

Category	Damage ($ million)	Regions Most Affected
Freshwater recreation	1,889	Corn Belt, Northeast, Pacific
Marine fishing	544	Pacific, Northeast
Water storage facilities	1,097	Mountain, Pacific
Navigation	680	Delta States
Commercial fisheries	409	Pacific, Northeast
Flood damage	888	Pacific, Delta States
Drainage ditches	214	Corn Belt, Northern Plains
Irrigation systems	107	Pacific, Mountain
Water use and treatment	1,231	Northeast, Appalachian, Lake States
Salinity	28	Mountain, Pacific
Biological	No Estimate	
Total	7,087	Pacific, Northeast, Corn Belt

Sources: Economic Research Service and Conservation Foundation

Drifting soil destroys fences, fills water conveyance facilities, and causes traffic and health hazards. Blowing soil also causes damages to buildings, machinery, and wildlife. In addition, smaller soil particles, those most subject to wind erosion, have a large total surface area which allows more nutrients and pesticides to adhere to them. Windblown particles contain twice the nutrient concentration as their parent material. Therefore, the detrimental effects of windblown soil on water quality are intensified as the "nutrified" particles settle into our Nation's waterways.

How Much Does It Cost Us?

Water Erosion. Here are a few estimates of the offsite costs of soil erosion.

Damages to freshwater recreation, water use and treatment, and water storage facilities account for 60 percent of estimated offsite costs from water induced soil erosion. Regionally, the Corn Belt, Pacific, and Northeast States suffer nearly one half the damages. Total damages are estimated at $7 billion per year, (excluding biological impacts, which while being significant, have not been measured). This translates into an average cost of $120 a year for every family in the country.

Wind Erosion. The offsite effects of wind erosion are even more difficult to measure than offsite effects of water erosion. ERS cost estimates range from $3 to $7 billion a year for the western United States where most wind erosion occurs. These costs do not include long-term health costs caused by dust particles, costs resulting from automobile accidents, long-term costs of damages to exterior surfaces, or impacts on water quality.

The annual offsite costs from wind erosion are an additional $55–$120 for each U.S. family bringing each U.S. family's total offsite erosion cost to $175–$240 annually. For the farm family, these costs are in addition to the onsite erosion losses ranging from lost production to increased production costs.

What Can Be Done?

Offsite effects can be minimized by controlling either the detachment or transport phase of the soil erosion process, and through careful chemical management.

Controlling Detachment of Soil. One way to protect the soil surface from the elements is by growing sod-based crops and crops with a high degree of vegetative cover. A crop with a large proportion of vegetative cover, and thus a large amount of residue, will not protect the soil if that residue is plowed under. Conservation tillage practices that leave residues on the soil surface reduce detachment and therefore control erosion.

Controlling detachment in the range areas of the West involves, among other things, grazing intermittently or rotating livestock from one range to another. These practices allow the grasses to be maintained and maximize soil protection. Range seeding and prescribed burning also help maintain proper stands.

Controlling Transport of Soil. For water erosion, runoff reduction and containment is essential for minimizing offsite costs. Conservation tillage decreases soil loss by slowing water runoff. The surface residues tend to puddle the rainfall, allowing more time for infiltration into the ground. Planting row crops on the contour, rather than up and down the hill, also increases the infiltration period by holding water between the rows.

On steeper slopes, water disposal systems which usually include terraces and grassed waterways or tile, hold runoff water and channel it out of the field with a minimum of erosion. Sediment basins and farm ponds hold runoff water as well, and allow for settling of soil particles, nutrients, and pesticides.

Wind erosion can be reduced by maintaining surface roughness which reduces wind speed at ground level. Conservation tillage accomplishes this with crop residues on the ground. Strip cropping and planting of windbreaks are practices which reduce wind speed, too.

Chemical Management. Applying fertilizer and pesticides only as needed, at times when runoff is minimal, maximizes the positive onsite effects and decreases negative offsite chemical effects. A study by the Iowa Agricultural Experiment Station suggests Iowa farmers could cut their commercial fertilizer usage one-half or more and still maintain yields by using nitrogen-fixing crops like alfalfa and by properly applying animal manure.

This New Jersey coastal plain pond suffered from heavy water-weed growth due to siltation and excessive runoff containing fertilizers. Various governmental agencies combined efforts to improve drainage of the 600 by 1,500 foot pond. (Clarence Deland, SCS, NJ-40,498)

What Will the Future Bring?

Public awareness of the adverse offsite effects of soil erosion is increasing. Research is ongoing at the Federal and State levels to aid farmers in their attempts to control soil erosion. Computer models simulate erosion runoff, predict sediment yields, pinpoint specific areas in need of treatment, and evaluate potential water quality problems. Special equipment and techniques monitor soil erosion including field dust samplers to analyze airborne soil and measuring sediment deposition rates using radioactive Cesium 137, both developed by the Agricultural Research Service.

With the development of more sophistication in monitoring and predicting offsite effects of soil erosion, conservation systems can be used as efficiently as possible on areas that contribute most to offsite damages. Further knowledge and continued implementation of conservation is needed to reduce the offsite costs of erosion, for which we all pay.