

## **Are USA Soil Erosion Rates Sustainable? By James J. Hoorman**

***“The nation that destroys its soil, destroys itself.” Franklin Delano Roosevelt***

Soil is a gift of life and the basis for modern civilization. The soil provides humans with food, fiber for clothes, shelter (wood, bricks, metals), foundation for our buildings, medicines, and a place to live and play. The Natural Resource Conservation Service (NRCS) started as the Soil Erosion Service in 1933 as a part of the United States Department of Agriculture (USDA) under the direction of Hammond Bennett. During the Dust Bowl days and the 1930's Depression Era, soil and wind erosion was a major problem with erosion rates of 30-50 tons of topsoil lost per acre per year. Blowing wind and water erosion were rampant throughout the country, displacing millions of tons of soil annually.

To reduce soil erosion, various conservation practices were utilized and implemented throughout the 20<sup>th</sup> century. In the 1980's, conservation tillage practices greatly reduced soil erosion to achieve soil erosion rates close to “T” values. "T" value is the soil loss tolerance assigned to each soil map unit, it is the average annual erosion rate (tons/acre/year) that can occur and still permit a high level of crop productivity to be sustained economically and indefinitely. For many soils, a T value of 4 to 5 tons of soil erosion loss per acre is common. To many people in the agriculture, it may appear that the war on soil erosion has been won. However, how close is the USA to achieving T and how sustainable is T?

The national USA average soil erosion rate for sheet, rill, and gully erosion is 7.6 Tons per Acre per Year (TAY). A ton of topsoil is difficult to imagine so converting 7.6 tons to pounds (@2,000 pounds per ton) equals 15,200 pounds of topsoil lost per acre per year. Some fields, especially hilly fields and highly erodible fields lose more soil while flatter fields lose less soil; but the national average is 7.6 TAY or 15,200 pounds topsoil lost per acre every single year. Some of the eroded soil stays on the landscape and just moves down the hill, while other topsoil moves with the wind to other distant locations or moves with the water to our streams and surface water bodies.

No matter where the soil moves, overall soil productivity declines because topsoil is the most productive part of the soil and is full of nutrients. Eroded hilltops are less productive and even lower land that receives the topsoil, already has its own topsoil. In some cases, subsoil is deposited on top of good topsoil, and makes both the eroded hilltop and the recipient of the eroded soil less productive. Sediment or eroded soil in water is highly enriched in soil organic matter and nutrients and causes water quality concerns. No one wants to drink dirty water, so the water needs to be treated and cleansed before it can be ingested. Nutrient rich water causes harmful algae blooms, is detrimental to aquatic organisms and fish populations, and reduces the enjoyment of recreational activities like swimming, boating, and fishing.

To put the 7.6 TAY or 15,200 pounds of top soil lost per year into perspective, consider the national USA average soybean yield which is close to 50 bushels per acre (51 bushel rounded

down for easy math). At 60 pounds per bushel, the USA average soybean yield is around 3,000 pounds per acre per year. What is the USA soil loss for every 1 pound of soybean produced? The USA soil loss is about 5# of topsoil lost for every 1# of soybean produced or 5:1 (15,200/3,000). Is that a sustainable level? The answer is obviously No!

Imagine harvesting a soybean field and dumping (by weight, not volume) 5 semi-loads of topsoil from that field into the river for every semi-load of soybean (by weight, not volume) produced on that field and for every soybean field in the USA. Of course, not all eroded soil ends up in water, but the concept is that the soil is moved to a different location and causes environmental harm to both the eroded land and/or to our water.

Similar values may be calculated for corn, which has a higher yield. The USA average corn yield is around 180 bushels per acre per year (178 bushels rounded up for easy math) and at 56 pounds per bushels equals an average production of 10,080 pounds of USA corn per acre per year. The soil loss ratio for every pound of corn produced is about 1.5:1 (15,200/10,080) or 1.5 pounds of topsoil lost by erosion for every 1 pound of corn produced. Again, imagine, that for every semi-load of corn produced, about 1.5 semi-loads (by weight, not volume) of topsoil is lost from that field. Is that sustainable. Again, the answer is NO!

State rates of soil erosion and varies because data is not available on gully erosion and only includes sheet, rill and wind erosion. As an example, the average Ohio rate of cropland soil erosion (wind, sheet, and rill) is 2.61 TAY or 5,220 pounds of topsoil lost per acre. The average soybean yield for Ohio is 52.5 bushels (3,150 pounds) per acre per year and for corn is 176 bushels (9,856 pounds) per acre per year. The Ohio soil loss ratio for soybeans (not counting gully erosion) is 1.67:1 or 1.67 pounds of topsoil lost for every 1 pound of soybean produced and for corn the ratio is 0.5:1 or .5 pounds of topsoil lost for every pound of corn produced. These numbers are much better than the national average but still not at a sustainable level.

What is a sustainable level of soil erosion? Ideally, the sustainable rate should be based on the natural rate of topsoil formation. Topsoil formation occurs when subsoil rock is broken down into sand, silt, and clay with additions of soil organic matter. On average, topsoil formation is around 0.5 TAY or 1,000 pounds per acre per year. To improve and gain topsoil, the rate of topsoil formation should be greater than the rate of topsoil lost annually. Ideally, a national soil loss rate of 100 to 300 pounds per acre would allow soils to regenerate at a more acceptable level than average T values (4-5 TAY).

For many farm producers, soil erosion is not something that can be easily seen and is not often a major concern. Fertilizer is used to keep crop yields producing decent crops, so a little topsoil loss seems manageable. What does the national soil loss rate of 7.6 TAY even look like? Consider a dime's thickness of soil eroded off an acre is equal to roughly 8.8 tons topsoil lost per acre per year or roughly 10 tons (TAY).

Another way to look at soil erosion is to calculate the loss of topsoil in inches per acre. How long does it take to lose 1 inch of topsoil? An inch of topsoil is roughly 160 tons spread across

one acre of land (based on 2 million pounds topsoil or 1000 tons in top 6 2/3 inches). At 7.6 TAY, it only takes 21 years to lose 1 inch of topsoil. A "T" value of 5 TAY takes 32 years to lose 1 inch of topsoil and a 4 TAY takes 40 years to lose an inch of topsoil.

The real question is how much has been lost already? In Iowa, it is estimated that an average of 6.75 inches of topsoil have been lost and in North Dakota about an average of 15 inches of topsoil has been lost. States with more hills, steeper slopes, and exposed soils will have higher rates of soil lost than states with flatter terrain and soils that are covered by natural vegetation and are less exposed. Soil erosion rates do vary quite significantly from state to state and there may be some variability in how state soil loss rates are calculated.

David Montgomery has studied past civilizations and their decline all over the world. Egypt and the Nile river were once the garden spot of the world. The Incas and the Aztecs in South America were once thriving agricultural communities and the center of civilization in the Americas. However, all major civilizations fail within 1,000 years if they do not take care of their soils. See FDR's quote at the beginning.

How long does the USA have before our nation runs out of topsoil and our civilization starts to decline? The answer is unknown. World estimates are about 50 to 100 years with major signs of agricultural decline already occurring. An estimated 9 billion people will need to be fed daily by the year 2050, so preserving the world's soil and the fertile USA soils should be a national priority. Will future generation bless us for the foresight to preserve our soils or curse us for wasting a national treasure? Soil feed us all (past, present, and future generations). To paraphrase an ancient Indian proverb, "Soil is not something any man inherits or owns, we just borrow it from our children!"

NRCS-USDA has four major soil health principles that should be followed on every acre of land to preserve our soils. The four major principles include 1) Minimize soil disturbance, 2) Maximize surface cover, 3) Maximize live roots, and 4) Increase biodiversity. For more information on how to preserve our nation's soil, see the following fact sheets:

#### **References:**

Ohio Agricultural Statistics, 2017.

National Resource Inventory Report, USDA-NRCS, 2015.

US Agricultural Census, 2012.

***"Essentially all life depends upon soil... There can be no life without soil and no soil without life, they evolved together." Charles Kellogg, USDA Year of Agriculture, 1938.***

***"Land, then, is not merely soil; it is a fountain of energy flowing through a circuit of soils, plants, and animals." Aldo Leopold, A Sandy County Almanac, 1949***