**Erosion**

Soil erosion involves the breakdown, detachment, transport, and redistribution of soil particles by forces of water, wind, or gravity.  Soil erosion on cropland is of particular interest because of its on-site impacts on soil quality and crop productivity, and its off-site impacts on water quantity and quality, air quality, and biological activity. The economic impact of mitigating soil erosion significantly burdens the agri-business sector and the Nation as a whole.  Dust contributions to the atmosphere and delivery of sediment, nutrients, and chemicals to water resources are primary environmental concerns addressed by public policy makers and the stewards of our working lands.  Some types of erosion: wind, stream bank, rill and sheet, gully, coastal, beach.

**Soil degradation** is the decline in soil quality caused by its improper use, usually for agricultural, pastural, industrial or urban purposes. Soil degradation is a serious global environmental problem and may be exacerbated by climate change. It encompasses physical, chemical and biological deterioration. Examples of soil degradation include loss of organic matter, decline in soil fertility, decline in structural condition, erosion, adverse changes in salinity, acidity or alkalinity, and the effects of toxic chemicals, pollutants or excessive flooding.

**Types of Soil Degradation:**

**loss of topsoil by sheet erosion/surface wash**

Description: a decrease in depth of the topsoil layer (A horizon) due to more or less

uniform removal of soil material by run-off water / Possible causes: inappropriate land management especially in agriculture (insufficient soil cover, unobstructed flow of run-off water, deteriorating soil structure) leading to excessive surface run-off and sediment transport

**"terrain deformation" by gully and/or rill erosion or mass movements**

Description: an irregular displacement of soil material (by linear erosion or mass movements) causing clearly visible scars in the terrain / Possible causes: inappropriate land management in agriculture forestry or construction activities, allowing excessive amounts of run-off water to concentrate and flow unobstructed

**off-site effects of water erosion in up-stream areas**

Description: Three subtypes may be distinguished: sedimentation of reservoirs and waterways, flooding, and pollution of water bodies with eroded sediments

**loss of topsoil by wind action**

Description: a decrease in depth of the topsoil layer (A horizon) due to more or less uniform removal of soil material by the wind / Possible causes: insufficient protection by vegetation (or otherwise) of the soil against the wind; insufficient soil moisture; destruction of soil structure

**"terrain deformation"**

Description: an irregular displacement of soil material by wind action, causing deflation hollows, hummocks and dunes

**off site effects of wind erosion**

Description: covering of the terrain with wind borne soil particles from distant sources ("overblowing")

**fertility decline and reduced organic matter content**

Description: a net decrease of available nutrients and organic matter in the soil / Possible causes: a negative balance between output (through harvesting, burning, leaching, etc.) and input (through manure/fertilizers, returned crop residues, flooding) of nutrients and organic matter

**pollution**

Description: a distinction is made between "contamination", indicating the mere presence of an alien substance in the soil without significant negative effects, and "pollution", signifying soil degradation as a consequence of location, concentration and adverse biological or toxic effects of a substance. In this context only the latter is relevant. Both local source pollution (waste dumps, spills, factory sites, etc.) and diffuse or airborne pollution (atmospheric deposition of acidifying compounds and/or heavy metals) are considered under this category. / Possible causes: bio-industrial sources, dumping, spillage

**salinization/alkalization**

Description: a net increase of the salt content of the (top)soil leading to a productivity decline. / Possible causes: a distinction can be made between salinity problems due to intrusion of seawater (which may occur under all climate conditions: and inland salinization, caused by improper irrigation methods and/or evaporation of saline groundwater.

**Dystrification**

Description: the lowering of soil pH through the process of mobilizing or increasing acidic compounds in the soil. / Possible causes: draining of soils containing pyrite which will produce very acid sulphate soils ("cat-clays"). Planting of acidifying vegetation (e.g. fir) may also lower the soil pH.

**Eutrophication**

Description: An excess of certain soil nutrients, impairing plant growth / Possible causes: Imbalanced application of organic and chemical fertilizer resulting

in excess Nitrogen, Phosphorus; liming.

**compaction**

Description: deterioration of soil structure by trampling by cattle or the weight and/or frequent use of machinery / Possible causes: repeated use of heavy machinery, having a cumulative effect. Heavy grazing and overstocking may lead to compaction as well. Factors that influence compaction are ground pressure (by axle/wheel loads of the machinery used); frequency of the passage of heavy machinery; soil texture; soil moisture; climate.

**sealing and crusting**

Description: clogging of pores with fine soil material and development of a thin impervious layer at the soil surface obstructing the infiltration of rainwater / Possible causes: poor soil cover, allowing a maximum "splash" effect of raindrops; destruction of soil structure and low organic matter.

**waterlogging**

Description: effects of human induced hydromorphism (i.e. excluding paddy fields) / Possible causes: rising water table (e.g. due to construction of reservoirs/ irrigation) and/or increased flooding caused by higher peakflows.

**lowering of the soil surface**

Description: subsidence of organic soils, settling of soil / Possible causes: oxidation of peat and settling of soils in general due to lowering of the water table (see also Pa); solution of gypsum in the sub-soil (humaninduced?) or lowering of soil surface due to extraction of gas or water

**loss of productive function**

Description: soil (land) being taken out of production for non-bio-productive activities, but not the eventual "secondary" degrading effects of these activities. / Possible causes: urbanization and industrial activities; infrastructure; mining; quarrying, etc.

**aridification**

Description: decrease of average soil moisture content / Possible causes: lowering of groundwater tables for agricultural purposes or drinking water extraction; decreased soil cover and reduced organic matter content

(Source: G.W.J. van Lynden and L.R. Oldeman (1997): The ASSESSMENT of the STATUS of HUMAN-INDUCED SOIL DEGRADATION in SOUTH and SOUTHEAST ASIA. International Soil Reference and Information Centre, Wageningen. p. 5-7.)

**Erosion Factors**

**Soil erodibility factors (Kw) and (Kf)** quantify soil detachment by runoff and raindrop impact. These erodibility factors are indexes used to predict the long-term average soil loss from sheet and rill erosion under crop systems and conservation techniques. Factor Kw applies to the whole soil and factor Kf applies only to the fine-earth (less than 2.0 mm) fraction. Soil properties that are a part of determining the K factor: percent silt plus very fine sand, percent sand greater than 0.10 mm, organic matter content, soil structure, and saturated hydraulic conductivity. Soil erodibility factors Kw or Kf are used in the erosion prediction equations USLE and RUSLE. Soil properties that influence rainfall erosion are those that affect—

* 1. Infiltration rate, movement of water through the soil, and water storage capacity.
	2. Dispersion, detachability, abrasion, and mobility by rainfall and runoff.

Some of the most important properties are texture, organic matter content, structure size class, and the saturated hydraulic conductivity of the subsoil.

Classes.—Experimentally measured Kw factors vary from 0.02 (erodes very little) to 0.69 erodes more easily). For soil interpretations, the factors are grouped into 14 classes. The classes are identified by a representative class value as follows: 0.02, 0.05, 0.10, 0.15, 0.17, 0.20, 0.24, 0.28, 0.32, 0.37, 0.43, 0.49, 0.55, and 0.64.

**A wind erodibility group (WEG)** is a grouping of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to blowing. The wind erodibility index (I), used in the wind erosion equation, is assigned using the wind erodibility groups. There is a close correlation between soil blowing and the size and durability of surface clodiness, fragments, organic matter, and the calcareous reaction. The soil properties that are most important with respect to soil blowing are soil texture class, organic matter content, carbonates in the fine-earth fraction as determined by effervescence class, rock and pararock fragment content, and mineralogy. Soil moisture and the presence of frozen soil also influence soil blowing.

**618.95  Wind Erodibility Groups (WEG) and Index**

|  |  |  |  |
| --- | --- | --- | --- |
| **WEG 1,3,4,5,7** | **Properties of Soil Surface Layer** | **Dry Soil Aggregates More Than 0.84 mm (wt.%)** | **Wind Erodibility Index (I) (tons/ac/yr)** |
| 1 | Very fine sand, fine sand, sand or coarse sand2 | 12357 | 310250220180160 |
| 2 | Loamy very fine sand, loamy fine sand, loamy sand, and loamy coarse sand; very fine sandy loam and silt loam with 5 or less percent clay and 25 or less percent very fine sand; and sapric soil materials (as defined in [*Soil Taxonomy*](https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/class/taxonomy/?cid=nrcs142p2_053577)); except Folists. | 10 | 134 |
| 3 | Very fine sandy loam (but does not meet WEG criterion 2), fine sandy loam, sandy loam, and coarse sandy loam; noncalcareous silt loam that has greater than or equal to 20 to less than 50 percent very fine sand and greater than or equal to 5 to less than 12 percent clay. | 25 | 86 |
| 4 | Clay, silty clay, noncalcareous clay loam that has more than 35 percent clay and noncalcareous silty clay loam that has more than 35 percent clay; all of these do not have sesquic, parasesquic, ferritic, ferruginous, or kaolinitic mineralogy (high iron oxide content). | 25 | 86 |
| 4L | Calcareous6 loam, calcareous silt loam, calcareous silt, calcareous sandy clay, calcareous sandy clay loam, calcareous clay loam, and calcareous silty clay loam. | 25 | 86 |
| 5 | Noncalcareous loam that has less than 20 percent clay; noncalcareous silt loam with greater than or equal to 5 to less than 20 percent clay (but does not meet WEG criterion 3); noncalcareous sandy clay loam; noncalcareous sandy clay; and hemic soil materials (as defined in [*Soil Taxonomy*](https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/class/taxonomy/?cid=nrcs142p2_053577)). | 40 | 56 |
| 6 | Noncalcareous loam and silt loam that have greater than or equal to 20 percent clay; noncalcareous clay loam and noncalcareous silty clay loam that have less than or equal to 35 percent clay; silt loam that has parasesquic, ferritic, or kaolinitic mineralogy (high iron oxide content). | 45 | 48 |
| 7 | Noncalcareous silt; noncalcareous silty clay, noncalcareous silty clay loam, and noncalcareous clay that have sesquic, parasesquic, ferritic, ferruginous, or kaolinitic mineralogy (high content of iron oxide) and are Oxisols or Ultisols; and fibric soil materials (as defined in [*Soil Taxonomy*](https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/class/taxonomy/?cid=nrcs142p2_053577)). | 50 | 38 |
| 8 | Soils not susceptible to wind erosion due to rock and pararock fragments at the surface and/or wetness; and Folists. | -- | 0 |

The following footnotes are applied in the order listed:
1 For all WEGs except 1 and 2 (sands and loamy sand textures), if percent rock and pararock fragments (>2mm) by volume is 15-35, reduce “I” value by one group with more favorable rating. If percent rock and pararock fragments by volume is 35-60, reduce “I” value by two favorable groups except for sands and loamy sand textures which are reduced by one group with more favorable rating. If percent rock and pararock fragments is greater than 60, use “I” value of 0 for all textures except sands and loamy sand textures which are reduced by three groups with more favorable ratings. An example of more favorable “I” rating is next lower number: “I” factor of 160 to “I” factor of 134 or “I” factor of 86 to “I” factor of 56. The index values should correspond exactly to their wind erodibility group (e.g., “I” factor of 56 = WEG 5).
2 The “I” values for WEG 1 vary from 160 for coarse sands to 310 for very fine sands. Use an “I” of 220 as an average figure.
3 All material that meets criterion 3 in the required characteristics for andic soil properties as defined in the *Keys to Soil Taxonomy*, 11th edition. Such material is placed in WEG 2 regardless of the texture class of the fine-earth fraction.
4 All material that meets criterion 2, but not criterion 3, in the required characteristics for andic soil properties as defined in the *Keys to Soil Taxonomy*, 11th edition. Such material is placed in WEG 6, regardless of the texture class of the fine-earth fraction. The only exception to this is for Cryic Spodosols which have a medial substitute class and a MAAT < 4 degrees C.; these soils are placed in WEG 2.
5 For surface layers or horizons that do not meet the required characteristics for andic soil properties but do meet Vitrandic, Vitritorrandic, Vitrixerandic, and Ustivitrandic subgroup criteria (thickness criterion excluded) move one wind erodibility group (WEG) with a less favorable rating.
6 Calcareous is a strongly or violently effervescent reaction (class) of the fine-earth fraction to cold dilute (1N) HCL; a paper “Computing the Wind Erodible Fraction of Soils” by D. W. Fryear et.al (1994) in the Journal of Soil and Water Conservation 49 (2) 183-188 raises a yet unresolved question regarding the effect of carbonates on wind erosion.
7 For mineral soils with thin “’O” horizons, the WEG is based on the first mineral horizon.

**The “T factor”** is the soil loss tolerance (in tons per acre). It is defined as the maximum amount of erosion at which the quality of a soil as a medium for plant growth can be maintained. This quality of the soil to be maintained is threefold in focus. It includes maintaining the surface soil as a seedbed for plants, the atmosphere-soil interface to allow the entry of air and water into the soil and still protect the underlying soil from wind and water erosion, and the total soil volume as a reservoir for water and plant nutrients, which is preserved by minimizing soil loss. Erosion losses are estimated by USLE and RUSLE2. The classes of T factors are 1, 2, 3, 4, and 5. Soil loss tolerances commonly serve as objectives for conservation planning on farms. These objectives assist in the identification of cropping sequences and management systems that can maximize production and also sustain long-term productivity. T factors represent the goal for maximum annual soil loss.