SOIL EROSION BY WIND

Wind erosion processes (detachment, transportation and deposition) are similar to that of water erosion. However, soil movement by wind is different. The basic causes of wind erosion are:

- Loose, dry and finely divided soils
- Smooth and bare soil surface
- Strong wind
- Large field

Wind erosion can be eliminated or curtailed whenever:

(i) The soil is compacted, kept moist or made up of stable aggregates or clods large enough to resist the force of the wind

(ii) The soil surface is roughed or covered by vegetative residue

(iii) The wind velocity near the ground is somewhat reduced.

5.1 Types of Soil Movement

Saltation, surface creep, and suspension are the three types of soil movement which occur during wind erosion. While soil can be blown away at virtually any height, the majority (over 93%) of soil movement takes place at or below one meter.

Saltation: Soil particles move in a series of short leaps pr bounces. Saltation means 'to jump'. The jumping grains gain a great deal of energy, and may knock other grains into the air or bounce back themselves. The particles remain close to the ground as they bounce. The particles are often stopped by obstructions or reduced wind velocity. The major fraction of soil moved by the wind is through the process of saltation.

Surface creep: This is the rolling and sliding along the surface of the larger particles. Soil grains larger than 0.5 mm cannot be lifted. This causes them to roll and slide along the surface after coming into contact with saltating particles.

Suspension: This occurs when very fine dust particles are lifted into the wind. Soil particles less than 0.05 mm in diameter, such as, silt size and smaller are kept suspended by the turbulence of air currents. These particles only drop out of air if rain washes them or wind velocity reduces drastically. They can be thrown into the air through impact with other particles or by the wind itself.

5.2 Factors affecting wind erosion

Soil moisture: Wet soil does not blow because of the adhesion between water and soil particles. Dry winds generally lower soil moisture to below wilting point before wind erosion takes place.

Wind velocity: The rate of wind movement, especially gusts having greater than average velocity will influence wind erosion. Standard wind velocity is measured at a fixed height of 9 m above the ground.

Height: Velocity of even a steady wind increases dramatically above the ground surface. Wind velocity over a bare surface is zero at a height close to the surface below the tops of irregularities.

Wind turbulence: Wind strong enough to cause erosion is always turbulent, with eddies moving in all directions at a variety of velocities. Turbulence increases with increases in friction velocity, with increasing surface roughness, and with pronounced changes in surface temperature. Turbulence is important in keeping soil grains suspended in air.

Surface roughness: Wind velocity is less severe when the surface is rough. This can be achieved by tillage, ridging and/or mulching

Soil properties: Apart from soil water content, other soil properties which influence wind erosion are (i) stability of soil aggregates, (ii) size of erodible soil fractions. The presence of clay, organic matter and other cementing agents enhance aggregate stability

Vegetation: Vegetation or residue mulch especially those with rows running perpendicular to the prevailing wind direction reduce wind erosion. Wind velocity approaches zero near the soil surface in a vegetated area. In addition, plant roots bind the soil.

Length of exposed area: Soil drifting increases substantially with increasing length of the eroding strip

5.3 PREDICTING WIND EROSION

A wind erosion prediction equation (WEQ) has been in use since the late 1960s:

$E = f(ICKLV)$

The predicted wind erosion E is a function f of:

I = soil erodibility factor

C = climate factor

K = soil-ridge-roughness factor

L = with of field factor

V = vegetative cover factor

The WEQ involves the major factors that determine the severity of the erosion, but it also considers how these factors interact with each other. It is not possible to predict wind erosion by simply multiplying the factors as in USLE.

The soil erodibility factor I relates to the properties of the soil and the degree of the slope in question.

The soil-ridge-roughness factor K takes into consideration the cloddiness of the soil surface, vegetative cover V, and ridges on the soil surface

The climatic factor C involves wind velocity, soil temperature, and precipitation (which controls soil moisture)

The width of field factor L is the width of a field in the downwind direction. Naturally the width changes as the direction of the wind changes, so the prevailing wind direction is used.

The vegetative cover V relates not only to the degree of soil surface covered with residues, but to the nature of the cover-whether it is living or dead, still standing or flat on the ground.

5.4 WIND EROSION CONTROL

The factors of wind erosion give clues to methods of reducing it. Little can be done to change climate in an area, but it is possible to alter one or more of the other factors

Soil surface management: Tillage. To minimize wind erosion, the surface should be rough, in cloddy condition and with surface residues. Tillage should be carried out when the soil moisture is adequate.

Soil water management: Water conservation practices which reduce loss of water through evapotranspiration include weeding, conservation tillage, and reduction of runoff through surface roughness or terraces

Altering length of field: The length of eroding field can be altered by strip cropping or by installing wind breaks perpendicular to the direction of the prevailing wind.

Planting rows of shrubs or trees to serve as windbreaks or shelterbelts is effective in reducing wind erosion. Local recommendations for appropriate species should be followed with vegetative windbreaks. The distance protected by a windbreak may be 6 to 15 times the height of the barrier, with effectiveness decreasing with distance.

Vegetation management: Closely spaced crops are more effective than row crops. Alternating rows of crops such as cotton which is less-wind resistant with sorghum which is more resistant to wind is important. Residues should be left on the fields.

6.0 Cultivation and tillage – types of tillage

The type of tillage practiced can be evaluated by the amount of crop residue managed at the soil surface.

1. Conventional Tillage

- Utilizes the mouldboard plough + harrow

- Extensive field research has shown that conventional mouldboard plough systems leave only 1 to 5% of the soil covered with crop residues.
- The soil is left unprotected during the time of year when runoff and erosion pressures are greatest.

2. Conservation Tillage Practices

- System involves less tillage.
- At least 30% of the crop residue must be maintained on the soil surface.
- This system minimizes opportunity for erosion.

Types of Conservation Tillage Practices

a) **No-till or "No-tillage" –**This is a system whereby no primary tillage is done and a crop is planted directly into a seedbed . 50 to 75% of the land is left covered with residue.

b) **Mulch tillage –**The soil is prepared or tilled in such a way that the plant residues or other materials are left to cover the surface.

c) **Reduced tillage or minimum tillage –**This system consist of minimum soil manipulation necessary for crop production. Leaves between 15 to 25% soil cover.

d) **Contour tillage –**The tillage is done at right angles to the direction of the slope

e) **Contour strip cropping –**This is layout of crops in narrow strips in which the farming operations are performed approximately on the contour. Usually strips of grass and close-growing crops are alternated with those of cultivated crops.

f) **Strip cropping –**This is the practice of growing crops that require different types of tillage, such as row and sod in alternate strips along contours or across the prevailing direction of wind