**Soil and change**

* Explain the causes of soil degradation. Discuss the environmental and socio-economic consequences of this process, together with management strategies.

Soil degradation:

**Soil degradation:** The physical loss (erosion) and the reduction in quality of topsoil associated with nutrient decline and contamination. Soil supports agriculture, wildlife, filters water and stores carbon.

Soil erosion includes:

* Erosion by wind and water
* Biological degradation (loss of humus and plant and animal life)
* Physical degradation (loss of structure, changes in permeability)
* Chemical degradation (acidification, fertility, salinization and toxicity)

In developed areas, soil degradation is largely a result of attitude adopted by commercial agriculture. In less developed countries, it usually results from population pressure, land shortages and lack of awareness.

* Water and wind erosion account for 80% of degradation (water 60%)
* Acidification may trigger the circulation of toxic metals
* 15% of earth’s land has been degraded

Causes of soil degradation:

 **Water and wind erosion:** The impact of water erosion is influenced by rainfall intensity, runoff, slope gradient and length and vegetation.

**Biological degradation:** Organic matter from plant and animal remains enters the soil to provide nutrients. Loss of organic matter may cause reduced stability and structure, increasing water erosion (runoff).

**Physical degradation:** Signs are soil crusting, sealing and compaction (from machines or animals). This can prevent infiltration of water.

**Chemical degradation:** Involves salinization, acidification, soil pollution and fertility decline. Acidity from acid rain may leach calcium. Salt levels affect root uptake and the death of vegetation. Soil toxicity from waste, pollution or contamination degrades.

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| **HUMAN CAUSES OF SOIL DEGRADATION** | **PHYSICAL CAUSES OF SOIL DEGRADATION** |
| * **Overgrazing:** Less vegetation makes the ground susceptible to wind and water erosion.
* **Over cultivation:** If you farm land to intensively and don't have fallow (not growing anything) periods then all the nutrients in the soil get used.
* **Deforestation:** The land will be receiving less nutrients and is more vulnerable to erosion because there is no interception and less stability of root systems.
* **Overpopulation:** Demand for agricultural products (crops and meat) is increasing causing more land to be deforested, over cultivated and overgrazed.
* **Fertilizer and Pesticide Use:** Local water sources become polluted; the ability of land to cultivate crops is reduced and is vulnerable to chemical degradation and wind and water erosion. Natural nutrients are taken away.
* **Industrial Pollution:** Chemicals, metals, acid rain and other pollutants leaked from industrial processes can chemical degrade soil.
* **Unsustainable Water Use (aquifer depletion, unsustainable irrigation):** Soil becomes arid.).
* **Conflict:** Biological and chemical weapons may degrade soil.
 | * **Rising Temperatures:** It is becoming hard for vegetation to grow thus reducing vegetation cover and increasing the risk of wind and water erosion.
* **Falling Rainfall:** Difficult for vegetation to grow.
* **Flash floods:** Erosion of topsoil, which leads to land degradation.
* **Wind:** Wind erosion is likely to increase.
* **Topography:** If land is relatively flat then it is much less vulnerable to water erosion, but maybe vulnerable to wind erosion. Hilly land is vulnerable to water erosion, but maybe protected more from wind erosion.
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Soil degradation can be calculated, taking into account, erosivity, erodibility, slope-length factor, crop management and soil conservation.

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| Factor | Description |
| Erosivity of soil  | Maximum erosivity occurs when the rainfall occurs as high-intensity storms. If such rain is received when the land has just been ploughed or full crop cover is not yet established, erosion will be greater than when falling on a full canopy. Minimum erosion happens when rainfall is gentle and fall onto frozen soil or land with natural vegetation or a full crop cover. |
| Erodibility  | The susceptibility of a soil to erosion. Depends upon infiltration capacity and the structural stability of soil. Soils with high infiltration capacity and high structural stability have lowest erodibility value. |
| Length-slope factor  | Slope strenght and steepness influence the movement and speed of water down the slope and so its ability to transport particles. The greater the slope the greater the erosivity; the longer the slope, the more water is received on the surface. |
| Crop management  | Established grass and forest provide the best protection against erosion. Of agricultural crops, those with the greatest foliage and thus greatest ground cover are optimal. Fallow land or crops that expose soil for long periods after planting or harvesting offer little protection. |
| Soil conservation | Soil conservation measure, such as contour ploughing and use of strips and terraces, can reduce erosion and slow runoff water. |

Environmental and socio-economic consequences:

**Desertification:** Fertile land turning into desert. As soil becomes more degraded, nutrients decrease and vegetation cannot be supported.

**Dust storms:** Soil becomes less stable and more vulnerable to wind erosion (Gobi Desert).

**Topsoil erosion:** Nutrient rich, humus layer reduces and causes more erosion.

**Reduced crop yields:** Failing crop yields can lead to famine, starvation and has economic impacts on local farmers.

**Conflict:** With the reduction of agricultural output and land, conflict may arise over resources.

**Increased use of chemicals:** Fertilizers may increase to compensate for the lack of natural nutrients, worsening the problem.

Solutions to soil degradation:

**Crop rotation and fallow periods:** The soil can regain fertility and nutrients.

**Terracing and contour ploughing:** Ploughing with shape and terracing reduces water erosion.

**Shelter belts (wind breaks):** Forests or hedges that protect farmland and reduce wind and water erosion.

**Reforestation and afforestation:** Trees make land more stable and fertile.

**Population control:** Decreases agricultural demand.

**Urban planning:** Reduces the need to deforest.

**Grazing quotas:** Limits in number of animals that graze.

**GM Crops:** Crops withstand poor conditions and increase yields.