Chapter 35

Human Influence on Soils/Soil Erosion

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Human influence on soils: 2015 Question 17
Discuss the impact of human activity on soil.

[80 marks]

What You Need To Do:
- Name three human activities that affect soils.
- Name two examples where these processes occur.
- Explain how each of the three activities are interrelated.
- Refer to positive and/or negative impacts.

Answer

A

Overgrazing*

Overgrazing occurs when farmers stock too many animals such as sheep, cattle or goats on their land. This damages the soil surface and increases the rate of soil erosion. Animals eat the vegetation cover and their hooves dig into the soil in wet areas or compact it into a hard surface in dry regions. This prevents grass growth and prevents water from percolating into the soil. Dry soils are eroded by the wind very easily. Once the soil has been trampled and stripped of plants, its structure is damaged and its ability to hold water and nutrients is reduced. Soil structure is important because plant roots and water are found in the spaces between the soil peds. Peds are the small grains which are held together by humus and water. Peds have different shapes. Rounded peds give the soil a crumb structure. A crumb structure is best for soil aeration, water content and fertility. Overgrazing can change the structure to a platy structure or destroy the structure completely. As a result it can be easily eroded by wind and rain and pasture growth is also reduced.

Too many animals on the land will eat all the plants and strip the soil of its protective vegetation cover. Plants, roots and branches protect soil from wind and rain. Soils that are exposed become drier and are more easily blown or washed away.

This situation had happened in many places around the world such as the Sahel region of Africa where population growth has led to an increase in the numbers of cattle and goats grazed on already dry land. It also occurred in County Mayo in Ireland during the 1990s when EU farm subsidies encouraged farmers to overstock their land with too many sheep. The fragile boglands of West Mayo were soon severely eroded.

Over-cropping*

Over-cropping occurs when the land is under continuous cultivation and not allowed to rest (lie fallow) in between crops. The effect of over-cropping on soils is to reduce its water content and fertility. Infertile soils are more easily eroded by wind and rain. As nutrients are removed its structure is damaged as well. Over-cropped soils become dry and very dusty because the humus content has been reduced. Humus is important for

improving the texture and structure of the soil and for keeping it moist. In the Sahel region of Africa, over-cropping and overgrazing often occur together as a result of population increase. More people on the land leads to greater numbers of farmers who keep animals and grow crops. There is also less land to go around so whatever amount of land is available is under stress to produce food for the increased population. Intensive cultivation of land in the soya plantations of South America can also lead to over-cropping. Here the soil is fertilised but the application of chemical fertilisers does not benefit the land as much as applying manure from animal waste. Therefore, over time the soil structure is damaged and erosion increases. The effect of over-cropping can be reduced by the addition of organic matter (cattle dung) to the soil and through irrigation. Leaving soils uncultivated (fallow) and planting 'green fertiliser' ground-cover plants such as clover, improves soil fertility and texture.

Conservation has a positive impact on soils*

Soil conservation protects soil from erosion by wind and water and protects the soil from harmful farming practices such as over-irrigation, over-grazing and over-cropping. Soil conservation has positive effects on soil characteristics.

The main methods of soil conservation include contour ploughing, terraces, windbreaks and stone walls. In contour ploughing farmers plough around hillsides rather than uphill and downhill. This prevents soil erosion and increases water content and humus content by reducing the loss of soil downhill. Contour ploughing is used in Europe and North America.

Terraces are steps cut into steep ground. They are used to cultivate crops such as rice. Terraces slow the run-off of water downhill and increase the water content of soil. Terraces also prevent the loss of clay particles that would be carried away in run-off, thus increasing soil fertility on sloping land. Terraces are used in mountainous regions such as India.

Windbreaks prevent soil erosion by the wind. Bands of trees or tall crops are planted around the edges of fields. This increases the depth of soil in windy exposed regions. In Africa soil protected by windbreaks is 20% more productive than unprotected soil.

Irrigation can lead to salinisation of soils. In salinisation, water evaporates from soil, leaving crusty layers of salt on the surface. This affects the soil pH and kills micro-organisms in the soil, reducing humus production and preventing seed germination. Better land-use management can improve soils that have been degraded by salinisation. Growing salt-tolerant plants will remove salt from the soil. Improving drainage and flushing the soil with water are common methods to reduce salinisation.

Soil structure regulates water content and seepage through the soil. It helps to control the passage of nutrients from soil to plant. Soil structure also affects the ability of plant roots to grow in the soil and the presence of micro-organisms. Farming practices such as over-cropping and over-grazing as well as desertification can damage soil structure so conserving soil structure is important for farmers. Soil structure is best conserved by adding humus to the soil. Humus helps the development of a crumb structure.

Soil pH is affected by human activities that acidify soils such as burning fossil fuels in cars and power stations, leading to acid rain. Acidified soils are less productive and lose their structure. Farmers conserve soils affected by acidification by adding powdered lime to the soil, e.g. Norway and Sweden.

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Soil Characteristics: 2013 Question 16
Examine how desertification and conservation have impacted on soil characteristics. **[80 marks]**

What You Need To Do:
- Name and explain the general soil characteristics that are affected by desertification and conservation.
- Explain how desertification affects each soil characteristic.
- Explain how conservation affects each soil characteristic.

Answer

A

General soil characteristics*

All soils are classed according to their soil characteristics. These are: colour, structure texture, water content, humus content and soil pH.

Soils have a variety of colours, from black to orange. The water content, parent rock and other processes acting on the soil, such as laterisiation or humification, affect soil colour.

Soil structure describes how soil grains are stuck together in small lumps – called peds – by water and humus. Soil structure can be blocky, platy or crumb/granular. The spaces between the peds, called pores, hold air and water. Plants grow best in a crumb-structured soil.

Soil texture describes how the soil feels in the hand. Soil textures may be silt, clay, sand or loam. The size of the soil grains affects texture. Clay particles are too small to be visible to the eye, so clay soils feel like playdough. Clay soils contain 40-100% clay particles. They are cold and become waterlogged easily.

Sandy soils contain over 85% sand grains that are up to 2 mm in size. Sandy soil feels gritty to touch and does not hold water easily.

Silty soil feels powdery to touch and contains silt particles that are barely visible to the eye.

Loam soils contain an equal mix of sand, silt and clay. They are well-drained, fertile soils. They feel slightly gritty to touch.

All soils contain water in the pore spaces. Climate and human activity such as irrigation affects water content.

Humus content is the amount of humus in soils. Humus is a sticky black gel formed when fungi and bacteria in the soil become organic dead matter. Humus adds nutrients to the soil and helps prevent soil erosion by sticking the soil grains together. It also gives soil a dark colour.

The acidity or alkalinity of soil is known as its pH. Humus and parent rock affect the pH of soils. Acid soils tend to form on acid rocks like granite. Alkaline soils tend to form on alkaline rocks such as limestone. Most soil is slightly acidic or slightly alkaline. Human activity also affects soil pH, e.g. farmers add lime to neutralise acid soils.

How desertification affects soil characteristics*

Desertification is the spread of desert conditions into new areas. Desertified soils are dry, dusty and lack humus. Their fertility is reduced and they are quickly eroded.

Africa is the continent most at risk from desertification although Southern Europe, especially Southern Spain, is also at risk. Desertification often occurs as a result of a combination of drought, overcropping, overgrazing and deforestation. High population growth in countries such as Sudan contributes to desertification due to the increased demand for food and fuel. Drought conditions increase the chance of desertification occurring when the soil is already stressed by overcropping and overgrazing. In Sahelian countries such as Chad and Niger, cotton and cashew nuts are grown as cash crops on huge plantations as part of economic reforms (structural adjustment programmes) in return for debt relief. People are removed from their land to make way for the plantations and must make a living on poor land at the edge of the plantations.

This land is over-grazed and over-cropped and trees are cut down for fuel and building materials. This further deprives the soil of valuable nutrients leading to increased soil erosion in the region during drought.

The introduction of solar cookers in the Sahel could reduce the need for timber as a fuel. Trees are then planted which can help slow desertification and erosion in the region.

How conservation affects soil characteristics*

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