The principal cause of soil erosion by wind in the undeveloped countries was thought to be due to overgrazing of rangeland which led to desertification and soil deposition on unprotected cultivated soils. It was pointed out that areas generally most severely affected by desertification were those where desert encroachment occurred on the fringes of cultivated land. Consequently, it was felt that considerable attention should be given to the management aspects of protection and control of soil erosion by wind. The planned arid land study by FAO/UNEP to monitor changes in range vegetation and its effects on feeding capacity could provide useful information on the management aspects of soil erosion.

Recommendations

I. Assessment

A. Actual

Information regarding wind erosion areas related to wind velocity, duration and velocity variations with height as well as information on soil blown material distribution in the higher atmospheric layers be obtained from existing observation sites.

B. Potential

Standard criteria related to soil texture, climatic conditions, vegetative cover and topography be used for a global assessment of relative soil erosion by wind.

II. Action Programme

Experimentation and development of soil and vegetation management techniques for wind erosion control.

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8. Biological Degradation

by

G. Aubert

The modification of certain factors in an ecosystem, vegetation in particular, can result in changes in soil characteristics which constitute a virtual degradation since the productivity of the soil is reduced. This is especially true in areas where climatic conditions are extreme. These changes are usually a consequence of man's utilization of the land and the effects may or may not be reversible depending on the factor changed and what degree of degradation it has been permitted to reach.

The replacement of natural or permanent vegetation causes a profound modification of the bio-geochemical cycle of organic and inorganic soil constituents. The amount and type of organic matter deposited on the soil influences changes in biological activity, inorganic elements returned to the soil and the depth or extent of the extraction of mineral elements from the soil as a function of the varied root systems of different plants. Tillage of the soil is also a cause of profound modifications in the soil. The changes brought about as a result of these activities in soils are presented.

Organic matter losses modify the physical characteristics of the soil causing soil compaction, surface crusting and decreased cation exchange capacity and water permeability. There is also a loss of fertility which can be a function of denitrification or leaching,

increased acidity, the chemical fixation of nutrients into forms unavailable to plants, e.g. phosphate adsorption or precipitation, or chemical transformations into toxic compounds or elements, e.g. manganese and aluminum toxicity. Another soil constituent markedly affected is the microbial activity; there can be both quantitative and qualitative changes in the microbial population.

Increased instability of soil structure, compaction of top soil, soil crusting, decreased permeability and porosity, induration of subsoil and in Ferralsols the development of iron concretions or ironstone are the main modifications of the soil physical characteristics which may result from the losses of organic matter. Leaching of the clay fraction from the top soil and a relative coarsening of the texture are other forms of degradation.

Criteria are suggested for assessing the amount of degradation that has occurred. They are the organic matter content, pH and base saturation changes, soil profile characteristics, mainly compaction and microbial activity. The pH has established limits for crop growth. For the other criteria the limits are much more difficult to establish because their effects vary and interpretation are different in different ecological zones.

FAO should coordinate the identification of two types of zones : (1) those already strongly degraded but with different levels of resources required to reclaim them, and (2) those which are potentially degradable by a change in land use. In addition, they should promote further research on soil degradation processes and types of soil management adapted to particular ecological conditions.

Discussion

One form of biological degradation seldom considered is the total loss of nutrients from a country through the export of its agricultural products. While this was discussed and of concern there was no attempt to offer viable alternatives or consider the redistribution of nutrients within a country, even if there was no export of the agricultural product. There seemed no alternative to soil degradation by nutrient removal by crops except by fertilization. In most cases it could be considered a reversible form of degradation. Some forms of biological degradation were considered to be irreversible; the loss of organic matter and nutrients through soil erosion by wind was cited as an example of irreversible loss.

Much of the discussion was related to the reversibility of the various forms of soil degradation. There was particular emphasis on two points : how far could degradation be allowed to proceed before it was beyond reclamation and how could management prevent degradation or maintain the system at a new equilibrium level. While these were of concern it became clear from the discussion that little quantification of these problems could be achieved. One approach to the problem would be to assign some economic feasilibity and/or physical practicability to the reclamation or management at a new equilibrium level. It was also pointed out that frequently appropriate management of a situation can result in reversing the degradation that had occurred, provided it has not been allowed to proceed too far.

Since organic matter content and changes in the soil were considered of major importance in regulating the degree and reversibility of degradation some question arose as to how to monitor them. On-site monitoring and assessment could be achieved by actual measurement of organic matter loss or resultant changes in the soil. It was not clear how it would be possible to assess the potential for degradation or make a qualitative assessment of change or loss. It was also pointed out that changes in vegetative type is an important factor since it has an effect on the humus content and quality in the soil and that other FAO Divisions are preparing to monitor changes in vegetative cover in forests and rangelands.

There seemed to be general agreement that the criteria for assessing change and the conclusions reached regarding the change would vary depending upon the prevailing climatic conditions. The arid, temperate and tropical ecological zones were considered to be quite different in that regard.

Recommendations

I. Assessment

A. Actual

Identification of areas of soil degradation using biological, physical and chemical soil properties as criteria for determining the difficulty of controlling or ameliorating their effects.

B. Potential

Utilize climatic conditions, vegetative cover, management techniques and soil characteristics as criteria for identifying areas where there is the risk of soil degradation in different ecological zones.

II. Action Programme

Initiate, compile, further promote and coordinate long-term research studies on the ecological process and effects as influenced by man on soil, climate and vegetation to develop and promote the use of soil conservation practices in areas where actual soil degradation or the hazard is most severe.

9. Waste Disposal

by

R.I. Dideriksen

Land and water have been used for centuries to dispose of wastes. As human and animal populations increase and are concentrated into rather limited spaces the magnitude of the waste disposal problem increases dramatically and the capability of these traditional receivers of waste to recycle them becomes impaired. Also, the rate at which new substances are created, many of which are inert, toxic or radio-active, further complicates the waste disposal problem. In the past little attempt was made to salvage or recycle the wastes except for the traditional spreading of animal manure which virtually ceases when there is access to relatively low cost commercial fertilizers. Now, however, recycling of waste is increasing in importance as many resources become scarce. But recycling requires land for daily spreading or facilities for daily storing wastes until they can be spread. Even recycling can lead to soil, water, air or site degradation by heavy metals, pesticides, toxic elements, soluble salts and toxic gases. Pathogens are common in many wastes but most are generally rendered harmless in a relatively short period of time. In order to regulate the extent and intensity of pollution from waste disposal some countries have enacted legislation and established standards for assessing and monitoring pollution caused by wastes. In addition to monitoring, an identification of affected sites and areas where disposal may be permitted is also necessary. Some important soil properties that must be considered in evaluating soil suitability are: (1) texture, (2) permeability, (3) depth to watertable, (4) depth to bedrock, (5) flooding, (6) runoff, (7) available water capacity, (8) soil pH, (9) temperature regime and (10) moisture regime.