II. Action Programmes

i. Promote long-term research on the application of waste water and solids that contain heavy metals to soils.

ii. Expand studies of salinity and waterlogging to include degraded areas resulting from waste water application from wells, mining operations, industry, agriculture and municipal sewage treatment plants.

B. ASSESSMENT OF SOIL DEGRADATION

1. Methodology for Evaluation of Soil Degradation

by

F. Fournier

Demographic expansion, industrialization and the need for maximum agricultural production have intensified the utilization of rural space in many regions of the world. When this utilization is irrational the soil is subjected to disastrous development and man sees the principal resource from which he draws his means of existence degraded. This paper deals with the methodologies of estimating soil degradation which falls into three categories : (1) erosion by water or wind, (2) changes in soil properties when man makes no effort to maintain its fertility, and (3) biological degradation. The result is that the useful life of the soil and biological activity in the soil are altered by the pollutants and poisons. Methods to assess soil erosion are discussed primarily since other forms of soil degradation have or will be covered in other papers.

The measurement of soil erosion by water calls for differing methods according to the phase of the phenomenon. In order to provide a complete and overall picture measurements are needed of detachment of transportable materials, soil loss and solid load transported in streams of various sizes. Measurement of detachment of transportable materials has not been widely practised in the field but has been researched mainly in the laboratory. Some crude field methods are available and one is described which could be used for an in situ evaluation of the magnitude of the phenomenon. Among the methods for the direct measurement of soil loss there are two in general use. One is the experimental plot method using an area of some hundreds of square metres which acts as a watershed; the plot must have a well defined environment with respect to slope, soil type, vegetation and soil condition. Various means of obtaining the data and the usefulness of the information on the influence of different variables are discussed. The methods can be used for a factorial analysis of erosion rather than an actual measurement.

The other method is to use a rainfall simulator which has the advantage of being portable and therefore can be used under more varied conditions over a shorter period of time. The significance of the data obtained remains the same as from fixed experimental plots but it allows a more thorough factorial analysis and above all a deeper knowledge of the influence of the various factors and conditions on soil erosion processes by water.

Measurements of solid load transported by water courses have been made throughout the world and have three common and characteristic problems : (1) unequal distribution in a cross-section of the stream; (2) difficulty in assessing stream bed load, and (3) the variation of turbidity with time. Ways to overcome these problems are discussed as well as the suitability of this method for assessing potential hazard of soil degradation by erosion.

It is evident that practically all phases of soil erosion by water can be evaluated but more research remains before precise measurements can be made. For potential hazards the characteristics of local erosion factors should be noted by referring to climatological, soil, geological, topographical and vegetation maps. All these assessments lead to a fuller understanding of soil erosion by water and the establishment of more effective erosion control and watershed management projects designed to maintain the natural environment at a desired level of productivity.

Discussion

Since most of the presentation centred on soil erosion by water the discussion also took that central theme. Two main problems were recognized: determination of the extent and intensity of actual degradation and determination of the potential hazard of degradation. It was stressed that in either case the use of soil classification information was extremely important. Much discussion concerned the close liaison between land evaluation, the relationship of an area to adjacent areas and soil degradation. A system of land use needs to be developed to reduce the time when land is bare since that is the condition most affecting soil losses. It was felt that the assessment of actual degradation should be done in practical terms of its effect on soil productivity, movement across the land, effect on other lands and the ability to reduce it. Potential hazards could be assessed more through influencing factors.

A distinction was made between various forms of assessment. There could be assessment of a process for use in simulation modelling, the level of limitation or degradation through surveys, monitoring or measurement, and potential hazard as measured by coefficients of aggressiveness of influencing factors. Satellite imagery might provide a tool for assessing the dynamic nature of soil degradation, possibly for both actual and potential degradation. Assessment of the potential hazard could be accomplished through the suggested evaluation of land-form, vegetative cover and slope.

The necessity of continuing research studies on erosion and sedimentation while at the same time mapping the areas affected was mentioned several times. The maps might provide a stimulus to governments to initiate their own action programmes for research and conservation. The usefulness of small watersheds was particularly stressed as a base for research and monitoring activities to predict losses and to extrapolate the data to other areas where information may be lacking. The use of mathematical simulation modelling was suggested as a means to integrate the data, extrapolate it and predict effects. The use of small plots for evaluating erosion losses was suggested but it was subsequently pointed out that there was a danger of singling out a factor on a small plot which might not correlate with the effect in the actual situation, e.g. there could be detachment but no transport of soil particles.

Recommendations

I. Assessment

A. Actual

Utilize data from small watersheds, experimental plots and rainfall simulators to measure soil erosion by water.

B. Potential

In large river basins, utilize sediment load, topography, climate and vegetation as criteria for an integrated evaluation of erosion by water.

II. Action Programmes

i. Provide for continuous studies of erosion and sedimentation through research on methods of measurement, and use pilot watersheds for the application and further development of simulation mathematical models to be used for prediction of erosion and extrapolation of data to other areas.

ii. In the development of soil degradation assessment, land suitability and types of land use should be taken into account.

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2. Meteorological Factors and Soil Degradation Processes

by

R.W. Gloyne

The main features of the paper are the relationships between meteorological processes and their consequential effects upon soils and land use. The paper is based on the current state of work of a WMO Working Group and is intended to facilitate the analysis of the problems presented and their solution against the background of readily available knowledge and technology as well as initiate consideration of the additional knowledge and effort required to achieve the stated aims of the meetings.

Climate and the shorter period phenomena defined as weather are dominant factors in soil formation and degradation through geological weathering, vegetative cover and as transporting agents. Water and wind are the elements of most importance in soil degradation situations with temperature as a mediating factor next in importance. However vegetation also plays a major role in influencing soil degradation as it involves all climatological elements.

The paper considers two aspects of meteorological data : the large scale events expressed in conventional measurements, e.g. annual rainfall, and which are generally available, and then the more precise information such as rainfall intensity which is less widely and readily available. The large scale factors associated with precipitation and soil moisture status of the soil are discussed indicating the types of soil degradation that would be influenced and the general level of precipitation at which the effects may occur. Large scale factors are also discussed for wind and temperature and indications of probable effects are given.

More precise information is required on the erosivity of rainfall, the erodability of the soil surface and certain wind parameters in order to study their effects on soil degradation. Most of this section is discussed in relation to soil erosion. Such information as raindrop energy, antecedent moisture and total rainfall since last tillage will be required for precise evaluations of soil erosion by water. Procurement of these data will necessitate the development of a much denser network of continuous rain recording instruments, techniques for spatial integration of point measurements and extrapolation methods for estimating intensity from cruder observational data. The precision of estimates that can be made will vary with several listed parameters.

Erodability of the soil surface is related to landscape geometry and surface roughness and to various aspects of vegetative cover, e.g. density and seasonal variation. The extent of influence will be a function of whether the agent of soil erosion is wind or water. For wind much more detailed information will be required to determine precisely its effects on soil erosion. Wind velocity, threshold wind speed, distribution of wind with height, turbulence and the interrelationship of surface geometry and wind speed and direction, are some of the parameters for which data is not widely or readily available.