

9. Soils

9.1. INTRODUCTION

In arid and semi-arid regions of the world, the more serious environmental problems include salinization and alkalization of soils, and the leakage of certain plant nutrients, in particular nitrate-nitrogen, below the rooting zone. Salinization has reduced dramatically the area of productive land in irrigated regions of such countries as India and Pakistan. Recent studies have suggested that in the Great Plains region of North America also, there is reason for concern, with an increase of up to tenfold over the last fifty years, in the acreage of saline soils within areas of productive farm land. In Scandinavia, on the other hand, the problem is that of acidification of soils, reducing agricultural and forest yields (Sweden's Case Study, 1971). In the Laurentian Shield of North America, there is increasing concern that acidification may be occurring there also (e.g., Beamish and Harvey, 1972).

The rising popularity of disposing of urban and livestock wastes in agricultural soils has added a further dimension to environmental problems, in particular in semi-arid and arid regions of the world.

Improper or unwise land-use, leading to erosion, to accelerated leaching of nitrate-nitrogen, or to salinization of productive soils, has only recently been recognized as a serious environmental problem in semi-arid regions. An example is the high frequency of summer fallowing, typical of much of the Great Plains region of North America, the Middle East and many other regions of the world; summer fallowing was initially introduced as a means of conserving moisture, for weed control, and to regenerate soil fertility, particularly nitrogen. However, Rennie (1973) has suggested that the summer fallow tillage operations facilitate accelerated rates of decay of organic matter, are directly responsible for significant leakage of nitrate-nitrogen below the rooting zone, and indirectly have resulted in a comparatively rapid spread in soil salinity. These studies carried out in Western Canada, together with those reported from North Dakota, Nebraska, and also Israel led a joint FAO-IAEA panel of experts to conclude, "that studies involving the acquisition of more analytical data on nitrogen residues and their trends in soil and water are needed. These studies should be made in relation to soil environment, hydrological status, local agricultural practice, population density, waste disposal, etc. Priority should be given to arid or semi-arid zone agriculture where needs for intensive animal and plant production are associated with limited and precious water supplies."

Soil microbes are important sources or sinks for air pollutants. Grey and Jensen (1972) have found that bacteriogenic sulfur released by anaerobes in mud flats near Salt Lake City is a significant fraction of

the total regional sulfur emissions while other investigators have shown that soil microbes are significant sinks for trace gases such as CO, ethylene and NO₂. A useful set of papers on the effects of pollutants on microbial activity and the resulting soil degradation is to be found in the proceedings of a recent conference (Rosswall, 1973, pp. 457-479).

Soil is not a renewable resource in the same sense as air and water. There are, in fact, critical input limits (not yet well defined) for pollutants which, if exceeded, cause almost irreversible damage. There are also a number of land uses, some of which are listed above, that degrade the soil.

Because of the importance of maintaining or increasing world food production, and because of the almost irreversible processes involved in land degradation, soil monitoring and assessment must be given high priority. In the arid zones, a trained land-use officer can give a reproducible qualitative estimate of the degree of salinization of the soils. Quantitative field sampling and analytical assessment techniques for monitoring salt movements in soils have been used under field conditions in Western Canada and elsewhere; however, some modifications in methodology are required to meet specific physiographic and soil conditions in other regions prior to initiating a soil monitoring program

9.2. MONITORING PROGRAMS

Only a small GEMS Phase I program for soils is recommended, despite the evident importance of the medium.

Recommendation 29: It is recommended that intergovernmental agreement be sought on methodologies for monitoring pH, salinity, nitrates and phosphates of soils at remote stations (not under cultivation), intermediate stations (under cultivation) and impact stations (receptors of urban and animal wastes). When operational manuals have been written and approved, the program may contribute data to GEMS Phase I.

Member States are encouraged to undertake local supplementary Research and Development monitoring for mercury, lead, cadmium, DDT, PCB's, ammonia and soluble salts of the alkaline earth metals.

Recommendation 30: It is recommended that appropriate Specialized Agencies in cooperation with SCOPE be invited to propose long-term research programs into the methodologies of soil monitoring, particularly in impact areas.

9.3. COMPLEMENTARY MONITORING ACTIVITIES

Soil monitoring should be coordinated with atmospheric and vegetation or forest monitoring, so that pathways, sources and sinks of trace substances may be examined in an integrated way. In particular, productivity measurements should be made at the soil monitoring stations.