Foreword

The midwestern United States includes one of the largest areas of intensively cultivated agricultural cropland in the nation, with large amounts of soil tilled annually to continuous production of corn, soybeans, wheat, and other crops. Soil erosion by water and wind continues to be a major problem on these midwestern soils, especially when under intensive cropping, which is typical in this region. The National Soil Erosion–Soil Productivity Planning Committee (1981) concluded that, for many soils, soil erosion is occurring at a higher rate than formation, resulting in potentially irreversible losses in soil productivity. According to the *National Resources Inventory of 1982,* all cropland in the North Central Region of the United States had an overall soil erosion rate in excess of 5 tons/acre/year soil loss tolerance level (T-value), which was established as the maximum level of soil erosion that will permit a high level of crop production to be sustained economically and indefinitely.

The effect of soil erosion on productivity has been recognized as a major agricultural and natural resources issue since 1986 by the directors of the state agricultural experiment stations. A regional research project, North Central Regional Research Project NC-174, Soil Productivity and Erosion, was initiated in 1983 by 11 participating states in the North Central Region, with the objectives of strengthening the scientific foundation for describing the potential crop production of selected soils in the region, predicting changes in their production potential as soil erosion occurs, and evaluating the potential for extrapolating the information to other soils not studied.

From 1983 to 1992, the NC-174 project research identified and documented the effects of erosion on soil properties and corn and small grain yields under rain-fed conditions. Field experiments were established by all participating states using uniform procedures on soils with slight, moderate, and severe degrees of prior erosion, with data collected on soil properties, crop yields, and climatic parameters. Crop yields obtained on moderately or severely eroded soils were consistently lower than on comparable slightly eroded soils. Following the enlargement of the database on the selected soils, emphasis was placed on selection of management and restoration alternatives. Simulation models were used to identify and quantify the factors limiting crop productivity on these soils and, along with field testing, to evaluate those models for their usefulness in extrapolating these result to related soils.

This Midwest regional team of scientists from the 11 participating states has been instrumental in developing a multidisciplinary and scientifically sound understanding of the relationship between soil erosion and productivity. This research has evaluated practices including cropping systems, soil amendments, tillage, and water management, which can rehabilitate soils degraded by erosion. Factors most frequently limiting the productivity of eroded soils were (1) precipitation, (2) available water-holding capacity, and (3) topsoil depth. Conservation tillage, residue management, and the application of manures and municipal wastes have improved surface characteristics of eroded soils and minimized future erosion. These findings emphasize the critical importance of protecting soil against erosion, since reductions in topsoil depth and water-holding capacity are difficult to restore. Preliminary research by the NC-174 Committee scientists on restoration of eroded soils has shown that their surface properties can be improved; however, long periods of time are required when using commonly available management practices.

The relationship of soil erosion to crop productivity has been shown and clarified by this research. Soil erosion also has significant economic costs to society. In 1984, estimated monetary loss in the United States from soil erosion was $40 million per year due to loss of cropland productivity; other studies have estimated economic losses due to extra fertilizer costs to restore lost soil from erosion. In addition to productivity and economic losses, erosion can have major effects on the environment and soil quality — issues of increasing national and global concern in recent years. Sediment from soil erosion is one of the largest water pollutants in terms of volume and transports with it, in surface runoff, nutrients such as nitrogen and phosphorus and agricultural chemicals, pesticides, and animal wastes.

The National Research Council (1989) and the State Agricultural Experiment Station Committee on Organization and Policy (1990) both recognized the importance of research on soil erosion for the protection of the environment as well as productivity. Therefore, the objective of the NC-174 Regional Research Project — to determine the threshold soil property values, including available water-holding capacity, aggregation, bulk density, organic carbon, and infiltration, for restoration of soil productivity and quality of eroded soils — directly relates to the impacts of soil erosion on soil quality, water quality, and air quality. Because of this direct environmental as well as productivity and economic impact of soil erosion, the soil erosion scientists work closely with the researchers in soil quality and other environmental areas. Therefore, the NC-174 Regional Research Committee met and planned jointly with the NCR-59 Regional Research Committee on Soil Organic Matter and Soil Quality and jointly held a symposium on "Soil Quality and Soil Erosion Interaction," co-sponsored by the Soil and Water Conservation Society. Also, scientists from both groups contributed to a manual entitled *Methods for Assessing Soil Quality*, published by the Soil Science Society of America in 1996.

The research results and new knowledge being developed by these programs have been published in over 40 refereed publications from 1993 to 1997, as well as the symposium proceedings currently in press. These important investigations will continue to evaluate tillage, soil amendment, and water management effects on soil quality, water quality, air quality, and soil productivity and provide information

required for predictive models and determination of threshold soil property values. These data will provide users, practitioners, and policymakers with scientifically based information on the effects of soil erosion on soil productivity and environmental quality.

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