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Project Summary

Environmental Monitoring and Assessment Program Agricultural Lands Pilot Field Program Report—1993

This document provides a comprehensive report on the EMAP Agricultural Lands 1993 Pilot Field Program, which was conducted in Nebraska. Results of the pilot monitoring effort are presented on land use and cover, crop productivity, and soil quality (physical, chemical, and biological). Other aspects of the pilot study are also addressed including design and sampling, indicator evaluations, logistics, quality assurance and information management.

This Project Summary was developed by EPA's National Exposure Research Laboratory, Las Vegas, NV, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

The Environmental Monitoring and Assessment Program (EMAP) is being designed to help policy makers decide how to allocate limited resources among environmental problems. Many monitoring efforts are site- or problem-specific and do not allow assessment of condition over large regions with statistical confidence. EMAP will track the condition of our environment on a regional basis.

The mission of EMAP's Agricultural Lands Resource Group (ARG) is *to develop and implement a program that will, in the long term, monitor and assess the condition and extent of the nation's agricultural lands.* The specific objectives are to

- Estimate status and trends in condition.
- Estimate geographic coverage and extent.
- Seek stressor-condition associations.
- Provide summaries and assessments.

The ARG conducted its second Pilot Field Program in Nebraska in 1993. There were three major objectives: (1) test a suite of indicators in these categories: land use and cover, crop productivity, and soil quality; (2) compare the relative efficiency of two sampling designs; (3) develop and refine plans for key components of the monitoring program.

Nebraska was selected primarily because of the presence of both typical midwestern intensively cropped lands and western sparsely cropped lands. Addressing ecological condition in widely varying settings is crucial for developing a suite of indicators that can be used nationally.

EMAP uses probability sampling frames to choose sample sites, allowing statistically valid statements to be made for a region. Two different frames were used; 288 sites in Nebraska were chosen, all planted to annually harvested herbaceous crops (AHHCs). After the 1993 fall harvest, data were collected on crop yields, soil characteristics, and management. In addition, data on land use and cover were provided from the National Agricultural Statistics Service's June Agricultural Survey.

Land Use and Cover

AHHCs are planted on over 7.4 million ha in Nebraska, covering 37% of the state. Most are found in the extensively cultivated lands in eastern and southern Ne-

braska; western Nebraska is predominantly rangeland that is sparsely cropped. Corn is the most common crop (45% of cropland); soybeans are the second most common crop (14%).

Crop diversity was measured as the number of different crops in a given area and their relative abundance. In the extensively cropped lands, one third of the sample areas (260 ha each) contained four crops; in half the areas, a single crop (usually corn) accounted for more than 55% of the total cropped acreage. How diversity changes with time will be of interest: decreasing diversity would signal increasing vulnerability to pests and diseases.

Approximately 75% of all fields in Nebraska's extensively cropped lands are 16 ha or smaller; this differs from the usual impression of Nebraska as a state covered by large fields. Approximately 35% of the extensively cropped lands are covered by fields in this size range.

There are nearly 75,000 farm ponds in Nebraska, covering almost 58,000 ha. More than half are less than 0.3 ha in area. Water for livestock is the single largest use of farm ponds, followed by erosion and flood control.

Crop Productivity

Is cropland producing the yields we expect? We calculated the ratio of the yield reported for each sample field to the county average yield for that crop over the period 1980-1989 (irrigated fields compared to the average for irrigated fields; nonirrigated compared to nonirrigated). For the five predominant crops, 1993 was slightly better than average; soybeans did better than corn or sorghum.

Is cropland requiring increasing subsidies of nonrenewable inputs? We examined nitrogen use efficiency by calculating the quantity of nitrogen applied for each unit of harvested material. Not only soybeans (a legume) but also wheat shows more efficient use of applied nitrogen than the predominant crop, corn.

Are crops being managed for plant health? We examined crop rotation in three ways.

(1) Rotation plans. We estimate that nearly half of the AHHC land in Nebraska is not covered by any planned rotation; of the land in rotation, half the plans are two years in length. *(2) How long since the 1993 crop was grown in that field?* Over half the AHHC land had the same crop in 1993 as in 1992, and 72% of the corn acreage had been planted to corn in 1992. This is a substantial lack of rotation for a crop that occupies half of the AHHC acres in Nebraska. *(3) How many crops were grown in the past three years?* Forty-two percent of the AHHC land had the same crop every year out of three; corn again predominated.

Soil Quality

Surface soil samples were analyzed for a set of physical, chemical, and biological indicators. Median values for clay, organic carbon, and cation exchange capacity are lowest in northwestern and highest in eastern Nebraska; median pH values follow an opposite trend, with the highest in the northwest. An integrated rating showed better quality surface soils in eastern and southern Nebraska than in the northwest. This pattern corresponds to the trend in land use, with most cultivated land in the eastern part of the state.

A maturity index for free-living nematodes, which reflects the degree of stability of soil biota, showed that the relative health of the eastern and southern regions of Nebraska was similar, as did the Shannon index of trophic diversity. A maturity index for plant-parasitic nematodes showed healthier soils in the east, although its interpretation is controversial.

Soil pits were dug at 26 sites to examine subsurface indicators. Two methods for assessing soil quality, the Soil Rating for Plant Growth (SRPG) and the Soil Quality Report Card, underwent preliminary development using these data. Although different in their approaches, both provide ways of determining whether soils are meeting their potential. The SRPG will be best used for regional monitoring, whereas the Report Card will be more suitable for monitoring specific sites.

Future Directions

The ARG will continue to develop indicators for use in a national monitoring program. This includes further work on the indicators explored here, development of new indicators (we are testing an insect indicator in 1994), and consideration of pasture-livestock systems, windbreaks, and other components of the agricultural landscape. In addition, we will address cross-resource issues by working with other EMAP Resource Groups in the mid-Atlantic region in 1994-1997. We are also expanding our partnerships with other federal agencies, primarily USDA's National Agricultural Statistics Service and Natural Resources Conservation Service.

EMAP continues to play an important role in the national effort to base environmental policy decisions on sound scientific information. The monitoring and assessment techniques being developed by EMAP are intended to form the basis for any regional or national monitoring effort where determining the nature and scope of environmental problems is of interest.

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Susan E. Franson *is the EPA Project Officer (see below).*
The complete report, entitled "Environmental Monitoring and Assessment Program, Agricultural Lands Pilot Field Program Report—1993," (Order No. PB95-243069; Cost: $19.50, subject to change) will be available only from

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