

Title: Comparison of Spatially and Conventionally Managed Farms - A Research, Education and Demonstration Project

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Abstract

The goal of this project is to improve our understanding of the economic and environmental factors important to farmers who adopt geospatial technologies to produce agricultural crops in North Dakota. This is the first year of a three-year project comparing 160 acres of spatially managed land on each of ten farms with conventionally managed land on each farm. The technologies used include: 1) geospatial records of crop inputs, expenses, yields and returns; 2) remote sensing of crops using infrared aerial photography and Landsat satellite imagery; 3) global positioning system (GPS) crop yield monitoring; 4) variable rate crop inputs; and 5) real-time GPS/GIS with handheld computers.

The program uses a consultation team of business representatives, conservation workers and North Dakota State University (NDSU) extension specialists to develop geospatial management recommendations.

Fields are evaluated for yields, costs, returns, profits and the environmental factors of potential surface and groundwater contamination from pesticides.

Paper Body

Project Description

Introduction

The primary goal of the Comparison of Spatially and Conventionally Managed Farms Program is to improve our understanding of the economic and environmental factors important to farmers who adopt geospatial technologies to produce agricultural crops. This interdisciplinary research, extension and education project compares at least 160 acres on each of ten farms enrolled in the ND Farm Business Management Education Program that adopt geospatial technologies with other farms currently enrolled in the Farm Business Management Education Program. The program compares the farms for three years, 2005-07. The geospatial technologies included are: 1) geospatial records of crop inputs, expenses, yields and returns; 2) remote sensing of crops using infrared aerial photography and Landsat satellite imagery; 3) global positioning system (GPS) crop yield monitoring; 4) variable rate crop inputs; and 5) real-time GPS/GIS with handheld computers.

The program uses a consultation team of business representatives, conservation workers and North Dakota State University (NDSU) extension specialists to work with the

participating farmers to develop geospatial management recommendations from available data and information. The consultation team includes representatives of the farmers' farm business management education program, financial institutions and crop input businesses, an NDSU county extension agent, agronomist, and geospatial specialist. Additional NDSU extension specialists are available for consultation with the program as warranted by varying local conditions.

This program provides a copy of Spatial Management Systems₁ (SMS) software to each of the participating farms, the extension agronomist and farm business management instructors. SMS is a geospatial information systems (GIS) computer program designed for farmers by Ag Leader Technology. The farmers also receive a handheld computer with GIS software with an attached GPS unit. The participating farmers provide their own desktop or laptop computer to use the spatial management software. The farmer-participants use recommended variable rate input applications on the designated fields, either using their own variable rate application equipment or through variable rate applications available from commercial applicators. They harvest the designated fields with a combine equipped with a yield monitor.

This program includes geospatial technology educational programming for the participating farmers and be available to the consultation team members. The program provides training on the geospatial management software (Spatial Management Systems), GPS application equipment, remote sensing technologies and potential economic and environmental impacts of spatial management.

The economic measures considered in the project include the regular economic factors evaluated in the ND Farm Business Management Education Program annual reports on their participating farms, including whole farm and enterprise reports of yields, costs, returns and profits.

The environmental factors evaluated by the project include an evaluation of potential surface and groundwater contamination of each field based on reported pesticide uses by the participating farmers. The results of the water resources potential contamination report will be compared to the potential contamination likely from normal whole-field management. Potential water resource contamination will be evaluated using the Assessments Systems for Groundwater Contamination from Agricultural Pesticide Use in North Dakota.

Rationale and Significance

This Comparison of Spatially and Conventionally Managed Farms Program will deliver science-based knowledge to farmers, allowing them to make informed practical decisions about adopting spatial management practices for their farming operations. This project will incorporate university specialists, professional conservationists and financial and farm management experts to systematically evaluate economic and environmental

implications of adopting spatial management systems for crop production. The spatial management software (SMS) employed in this program will allow users to incorporate remote sensing data, soil and fertility data, annual and multi-year crop yield data, economic data and GIS capabilities when deciding whether or not to use spatial management on specific fields and farms.

In order to provide realistic geospatial technology learning experiences for youth, this program will work with the extension youth faculty to develop youth technology teams in Carrington and Dickinson. The youth will learn how to use the GIS software and handheld computers with attached GPS units. The youth tech teams will provide technical support in such ways as geo-referencing aerial images, demonstrating uses of the handheld computers with background images and real-time GPS, and assisting participants with using the GIS software.

Approach

A. Description and Sequence of Activities.

Each of the farmer-participants in this project are enrolled in at least the second year of the ND Farm Management Education Program. North Dakota farm business management instructors select the farmer-participants in this program. The NDSU Ag & Biosystems extension geospatial and machinery specialists provide sixteen hours of training to the participants on the spatial management software (SMS) program and use of the handheld computers and associated software during the first year of the program, and additional one-day updates during successive years of the program. The extension geospatial and machinery specialist are also available for individual consultation throughout the project.

The NDSU extension geospatial specialist provides green and NDVI layers of Landsat imagery taken during the growing season of each geospatially managed field in the participants' farms for initial use in delineating management zones. During each growing season, the geospatial specialist acquires 1-meter resolution infrared and multi-spectral aerial photography and Landsat imagery for each of the participating farmers' fields. The growers receive copies of the aerial photography on the same day it is acquired to use in crop and field evaluation.

The participating farmers collect combine yield data with corresponding GPS location data for all participating fields. After each growing season, the geospatial specialist will assist the farmers to analyze the yield data and correlate it with the other digital layers available for each field.

The program consultation team members meet periodically as needed to evaluate remotely sensed data and to assist the growers with management recommendations. The consultation team members receive copies of the aerial photography and satellite imagery.

The consultation team will also meet annually, between growing seasons, to evaluate progress for each participant and assist with management recommendations.

The participating farmers actively participate in their local Farm Business Management Education Program, including supplying the required financial information to the farm management instructor. The farm business management instructor will provide annual comparative economic analyses between the spatially and conventionally managed fields. This annual report will include the regular analyses factors supplied by the ND Farm Business Management Education Program. Typical reports can be viewed at <http://www.ndfarmmanagement.com>.

The geospatial extension specialist will evaluate each field for potential surface and groundwater contamination based on reported pesticide uses of the participating farmers. The results of the water resources potential contamination report will be compared to the potential contamination likely from conventionally whole-field management regimes. Examples of potential contamination of groundwater from pesticide use can be viewed at <http://www.ageng.ndsu.nodak.edu/pest>.

B. Expected Outcomes.

Annual reports comparing the economic factors between spatially and conventionally managed fields in North Dakota.

Annual evaluations comparing potential contamination of ground and surface water between spatially and conventionally managed fields in North Dakota

C. Analysis – Assessment – Evaluation

The primary economic evaluation will be the three annual reports comparing the economic indicators of the spatially managed farms in the program to the conventionally managed farms across North Dakota. The report will compare the two groups for total farm assets, growth of farm assets, total farm liabilities, net worth change, cash farm expenses and receipts, net farm income, and crop yields, costs and returns.

Environmental impacts will be evaluated annually as described in the description of activities section of this proposal.

D. Individual Expectations

1. NDSU Ag and Biosystems Engineering Department
 - a. Provide project coordination.
 - b. Provide training in SMS software, GPs applications and handheld computers.

- c. Provide aerial photography and satellite imagery of the spatially managed fields.
2. Agronomists
 - a. Provide crop management advice
3. Farm management instructors
 - a. Select participating farmers.
 - b. Assist farmers' with spatial recordkeeping system.
4. Farmers
 - a. Spatially manage a minimum of 160 acres.
 - b. Spatially manage the selected fields.
 - c. Harvest each selected field using a yield monitor with a GPS unit.
 - d. Use variable rate applications on the selected fields.
5. County extension agents
 - a. Coordinate the youth tech team in their community. Select participating farmers.

References to Project Description

1. Ag Leader Technology. Advanced Spatial Management System (SMS). Ag Leader Technology, Inc. 2202 South Riverside Drive, Ames, IA
2. Zimmerman, Steve. "ND Farm and Ranch Business Management Education Association Reports." 2003. <http://www.ndfarmmanagement.com/Reports.htm>.
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