LARS Contract Report 093092

APPLYING REMOTE SENSING AND GIS TECHNIQUES IN SOLVING RURAL COUNTY INFORMATION NEEDS

Final Report - Grant NAGW-1472
July 1, 1988 - September 30, 1992

Prepared by

Chris J. Johannsen
R. Norberto Fernández
D. Fabián Lozano-García

with the assistance of

Miami County cooperators, Purdue University investigators and graduate students

Laboratory for Applications of Remote Sensing
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I. Introduction:

This project was designed to acquaint county government officials and their clientele with remote sensing and GIS products that contain information about land conditions and land use. Other users determined through the course of this project were federal agencies working at the county level, agricultural businesses and organizations such as rural fire departments, school systems and others in need of spatial information.

The specific project objectives were:

1) to investigate the feasibility of using remotely sensed data to identify and quantify specific land cover categories and conditions for purposes of tax assessment, cropland area measurements and land use evaluation,
2) to investigate the use of satellite remote sensing data as an aid in assessing soil management practices,
3) to evaluate the use of remotely sensed data to assess soil resources and conditions which affect productivity.

II. Users and Potential Users:

There are many users and potential users with which we came in contact during the accomplishment of this project. A listing of these users provides some insight to the overall need for information by many groups and organizations within a county. One should be aware that some of these users cooperate with one another to share data, information and resources while others compete for dollars, information and resources. There are many interactions and relationships at the county level that are not very obvious until one spends some time working with these groups.

Some of the organizations are mentioned several times in this listing since an attempt was made to show functional information groups and the interactions of these groups within a county.

County Government

County Assessor
County Agent
County Auditor
County Treasurer
County Surveyor
County Sheriff
County School System
County Highway Department

Federal Agencies at the County, Area, and/or State level

- Soil Conservation Service
- Agricultural Stabilization and Conservation Service
- Federal Crop Insurance Administration
- Farmers Home Administration
- Forest Service
- Economic Research Service
- National Agricultural Statistical Services

Agribusiness related to agricultural production

- Agricultural Finance
  - Full service banks
  - Production Credit Associations
  - Lending agencies - credit unions, banks, insurance companies
  - Supplier finance or credit organizations (i.e., machinery dealer, feed store, fertilizer dealer)
  - Government loan programs (short-, long-term, emergency) - Federal Land Bank, ASCS, Farmers Home Administration
  - Crop insurance companies
- Labor
  - Extended farm/business family labor
  - Full time hired labor
  - Seasonal labor
  - Tenants
- Land
  - Realtors
  - Federal Land Bank
  - Non-resident owners
  - Bank holdings
  - Individual owners
  - Estate lawyers
  - Corporations - both farm family and non-farm
  - Insurance companies
  - State/Federal owned lands
- Farm Equipment
  - Farm machinery dealers
  - Farm machinery manufacturers
  - Storage facilities
  - Parts suppliers
- Transportation
  - Trucking industry - Inter-state, intra-state, local
  - Rail industry
  - Shipping industry
  - Port authorities
  - Interstate commerce commissions
- Fertilizers and limestone
  - Limestone quarries
  - Fertilizer retailers - custom applicators
  - Fertilizer wholesalers - bulk, blending, liquid handlers
  - Fertilizer manufacturers
  - Fertilizer quality control agencies
  - Mining industries - Imported, domestic

- Pesticides
  - Pesticide wholesaler
  - Pesticide retailers - sales and custom applicators
  - Chemical manufacturers
  - Environmental protection agencies - state and federal
- Energy
  - Gasoline and diesel fuel industries
  - Natural gas industries
  - Electric power utilities
  - Energy suppliers to pesticide and fertilizer industries
  - Suppliers of alternative energy sources
- Seed
  - Seed dealers
  - Seed companies - non-farm operations including garden seeds
  - Plant breeding organizations
  - Certification agencies
- Management Services
  - Soil and plant testing labs
  - Professional farm managers
  - Farm planning services
  - Financial adviscrs
  - Legal Services

Industries for Ag Product Utilization/Marketing

- Storage
  - On the Farm
  - Commercial - local elevators, regional terminals
- Transportation
  - Trucking industry
  - Rail industry
  - Shipping
  - Barge companies
  - Port Authorities
  - Interstate commerce commissions
- Feed
  - Hog, beef, poultry, dairy cattle producers
  - Animal products processors
- Industrial Utilization
  - Wet milling
  - Dry milling
  - Distillers
  - Feed mills
- Export Market
  - Importers
  - Exporters
  - Government trade

Public Service Organizations

- Advisory Services
  - Farmer cooperatives
  - Farm publications
  - Broadcasting
  - Government - SCS, ASCS, FS
  - Agricultural weather services

Extension Services
Soil and water conservation districts
Conservations Technology Information Center

Education
Colleges and Universities
Trade schools
Extension Services
Vocational agricultural education

Policy
Local and Area planning commissions
State boards of tax commissioners
Economic Research Service
Government legislative bodies
Regulatory agencies
Program implementing agencies
Commodity groups - lobbying
Farm organizations

There are many potential uses and users of a county geographic information system (GIS) which indicates a need for remote sensing as an important tool in preparing databases of current land cover/land use information. A listing of the possible uses for such a system (developed with the Miami County Supervisors) is as follows:

LAND APPRAISAL FOR REASSESSMENT
- Land Ownership - current maps and ownership database
- Soils
- Land Use

EMERGENCY PREPAREDNESS
- 911 system with specific rural addresses
- Highway maintenance
  - Snow removal
  - Repair
  - Grading
- Flood
- Tornado
- Crime prevention and investigations

SCHOOL BUS ROUTING

WASTE DISPOSAL
- Routing for trash pickup
- Landfill sites
- Liquid waste disposal
- Hazardous waste sites

OWNERSHIP DATABASE
- One source for all offices
- Mailings for specific public meetings
- Commercial use

III. Project Impact on Users:

We had an opportunity to interact with many of the users that are listed in the previous section. Our many target users were the county government users. The impacts on this group were 1) the realization that new technology would assist them in accomplishing their duties, 2) the use of remote sensing data from satellites provides a view of their county which focuses on current natural and land resources, 3) geographic information systems can help them organize their maps, data bases and data collection procedures, 4) quality of data can be greatly improved, 5) they needed a long term plan to arrange for the resources to use this technology.

The project gave them a look at the future. They saw that computers for record keeping was only a small part of what could be accomplished. They saw that they could accomplish a large number of tasks with a County GIS such as:

Provide county ownership maps and records upon specific request
Adjust property data and information according to needs,
Monitor data and information on roads and bridges
Utilize an automated 911 emergency system for the County Sheriff, hospital ambulances, city and rural fire departments, school bus routes and similar purposes,
Map and keep records of chemical use for noxious weed control,
Map crime data
Assist with disaster coordination.

The costs of this technology was a hurdle that they needed to plan for if they were going to be able to take advantage of what they learned. In Miami County, a request was made of vendors/ consultants to supply plans for a county GIS along with cost figures. This led to four proposals which resulted in costs from $450,000 to over $750,000 to establish, with annual costs of about $100,000 to maintain. The costs were much higher than they anticipated. Meetings with the County Board resulted in a refusal of establishing a County GIS. The county government units are now developing further plans and approaches for reaching a goal of a County GIS.

An example of one of the problems facing a small rural county is that salaries of county officials are not very high. The need for hiring a "computer analyst/manager" meant an annual salary of about $40,000. This is about $10,000 higher than the highest paid county employee. Miami county is currently visiting with surrounding counties to determine if they could share the services of computer personnel and therefore share the salary costs.

Transfer of the Technology:

The state funded Universities in Indiana have formed a University GIS Alliance. The UGISA has sponsored annual Indiana GIS Conferences. The 1993 Conference will focus on local and county government uses/needs as a direct result of the project

accomplished in Miami County. The Association of County Officials and other organizations are cosponsoring this event. Workshops held in conjunction with the Conference will include the following topics:

Introduction to GIS
Management/Planning for GIS
Public Policy/Legislation for GIS
Common Data Base Structures
TIGER Applications
Sources of Data
Geopositioning systems (GPS)
GRASS software and applications

Copies of the land cover/land use classification maps were mounted and framed and are currently on display in the Miami County Courthouse as well as in the County Extension Office and Agricultural Stabilization and Conservation Service Office. These displays are a good form of awareness for the county users to visualize the benefits of satellite remote sensing.

There have been a significant number of technical reports, journal articles, proceedings papers, and abstracts prepared as a result of the work accomplished by this project. The following is a listing:

Zhuang, X., B.A. Engel, X. Xiong, and C.J. Johannsen. "Analysis of Classification Results of Remotely Sensed Data and Evaluation of Classification Algorithms." To be submitted to Photogrammetric Engineering & Remote Sensing.

Fernández, R.N. and M. Rusinkiewicz. "Conceptual Design of A Soil Database for a GIS." Submitted to the International Journal of Geographic Information Systems. Paper number 91-47.

R.N. Fernández, M. Rusinkiewicz, L.M. Silva, and C.J. Johannsen. "Design and Implementation of a Soil Geographic Database for Rural Planning and Management". Accepted for publication in the Journal of Soil & Water Conservation.

Johannsen, Chris J., R. Norberto Fernández and D. Fabián Lozano-García. 1992. "Applying Remote Sensing and GIS Techniques in Solving Rural County Information Needs." Final Report, September 1992. LARS Contract Report 093092. Laboratory for Applications of Remote Sensing, Purdue University, West Lafayette, IN.

Zhuang, X., D.F. Lozano-García, B.A. Engel, R.N. Fernández and C.J. Johannsen. 1992. "Optimization of Training Data Required for Neuro-Classification." Paper No. 1033. In Archives of the 17th Quadrennial International Congress for Photogrammetry and Remote Sensing, Aug. 2-14, 1992, Washington, D.C., U.S.A.

Henderson, T.L., M.F. Baumgardner, D.P. Franzmeier, D.E. Stott, and D.C. Coster. 1992. "High Dimensional Reflectance

Analysis of Soil Organic Matter." Soil Sci. Soc. Am. J., Vol. 56, No. 3, May-June 1992, pp. 865-872.

Zhuang, X., B.A. Engel, M.F. Baumgardner and P.H. Swain. 1991. "Improving Classification of Crop Residues Using Digital Land Ownership Data and Landsat TM Imagery." Photogrammetric Engineering & Remote Sensing, Vol.57, No. 11, November 1991, pp.1487-1492.

Fernández, R.N., D.F. Lozano-García, G. Deeds, C.J. Johannsen. 1991. "Accuracy Assessment of Map Coordinate Retrieval." Photogrammetric Engineering and Remote Sensing", Vol 57, No. 11, November 1991, pp.1447-1452.

Johannsen, Chris J., R. Norberto Fernández and D. Fabián Lozano-García. 1991. "NASA Applications Project in Miami County, Indiana." Progress Report, November 1991. LARS Contract Report 112091. Laboratory for Applications of Remote Sensing, Purdue University, West Lafayette, IN.

Zhuang, X., B.A. Engel, R.N. Fernández and C.J. Johannsen, "Neuro-Classification of Multi-type Landsat Thematic Mapper Data." In Proceedings of GIS/LIS '91, October 26-30, 1991. 10 pp.

Zhuang, Xin. 1990. "Determining Crop Residue Type and Class Using Satellite Acquired Data." (M.S. Thesis), Dept. of Agricultural Engineering, Purdue University, West Lafayette, In. December 1990, 129pp.

Johannsen, Chris J., R. Norberto Fernández, Fabián Lozano-García, and Jack Hart. 1990. "Applying Remote Sensing and GIS Techniques in Solving Rural County Information Needs," In Proceedings of Geographic Information System Conference, State of Indiana, University GIS Alliance, Indianapolis, In, November 15-16. pp. 143-150.

Johannsen, Chris J., R. Norberto Fernández and D. Fabián Lozano-García. 1990. "NASA Applications Project in Miami County, Indiana." Progress Report, June 1990. LARS Contract Report 012391. Laboratory for Applications of Remote Sensing, Purdue University, West Lafayette, IN.

Fernández, R.N. and M. Rusinkiewicz. 1990. "Database Design for GIS II. Implementation and Examples," American Society of Agronomy Abstracts, p. 291.

Johannsen, C.J., D.F. Lozano-García, R.N. Fernández and B. Engel. 1990. "Integrating Remote Sensing and GIS in Rural Environments," American Society of Agronomy Abstracts, p. 295.

Rusinkiewicz, M. and R.N. Fernández. 1990. "Database Design for GIS: I. Conceptual Design," American Society of Agronomy Abstracts, p. 302.

Henderson, T.L., M.F. Baumgardner, D.C. Coster, D.P. Franzmeier, and D.E. Stott. 1989. "Use of High-Dimensional Spectral Data to Evaluate Organic Matter-Reflectance Relationships in Soils," (M.S. Thesis), Dept. of Agronomy, Purdue University, West Lafayette, IN. December 1989, 153 pp. LARS Technical Report 013090.

Fernández, R.N., D.F. Lozano-García, P.J. Wyss and C.J. Johannsen. 1989. "GIS for Rural Information Needs in Miami

County, Indiana," American Society of Agronomy Abstracts, p. 14.
Fernández, R. Norberto, D. Fabián Lozano-García, Phillip J. Wyss and Chris J. Johannsen. 1989. "NASA Applications Project in Miami County, Indiana." Progress Report, April 12, 1989. LARS Contract Report 041289. Laboratory for Applications of Remote Sensing, Purdue University, West Lafayette, IN.

Value of the Project:

The accomplishments of this project are continuing since the Principal Investigator maintains contact with the Miami County users. These contacts are very important so as not to give the impression that no further help is available if the county is in a position to activate the GIS technology which this project has demonstrated. The County Extension Office serves as the conduit for transfer of questions, further explanations, information and details.

The value of the project in dollar terms is still to be realized. The upcoming GIS Conference will further the transfer of information learned in this project and should encourage many other counties to ask for assistance. The burden of this effort will be shared by the state-funded Universities within the state of Indiana. The potential for future GIS activities including the use of remote sensing data will likely be about $300,000 per county with annual outlays of over $100,000 after a county GIS has been established. The University GIS Alliance is predicting that over half of the Indiana Counties (47) will have GIS capabilities by the Year 2000.

If many of the potential users noted in Section II become involved in remote sensing and GIS activities, the costs factors will increase exponentially. This project has accomplished the feat of opening up a new frontier of data gathering, analysis, dissemination and utilization to a large spectrum of users.