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NASA Applications Project in Miami County, Indiana

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with the assistance of

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

Overview:
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. 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.

Accomplishments:
The research accomplished by this project was organized using scientific sampling procedures. Four sample sections (640 acres) were selected for each of the 7 soil association mapping units within Miami County. Additionally a 4 square mile area was selected when we realized that complexity of landowner within the county required land areas adjacent to one other for testing the landownership database. This prototype area was then used for refining and demonstrating GIS techniques.

Landowner/cooperator records were obtained from farmer cooperators with assistance from the County Extension Agent and the Agricultural Stabilization and Conservation Service. This information was used for assessing the accuracy of our satellite analysis since we used a modified supervised/unsupervised approach. Additionally, this information was useful in demonstrating the GIS capabilities. We performed digital classifications of four different Landsat TM and two SPOT scenes over the entire county for land cover/land use. All were used for temporal analysis in order to accurately identify different land cover types for specific uses.

We developed a large spatial database for ownership records and soil maps. These databases were used to generate reports and other data within the GIS environment. We implemented a database using soils data to provide information for soil erosion and soil management studies, and land appraisal for tax assessment at the local level on PC based computers.

We developed a model on agricultural land appraisal for Miami County to 1) comply with state and county regulations, 2) be accurate at the 90% level, 3) be efficient in data storage and handling and 4) have flexibility in display of information in map and tabular formats.

We demonstrated that point coordinate retrieval from stable-based USGS 7.5-minute series maps is acceptable for a rural GIS where collateral evidence is reliable. This was recently published in a paper in Photogrammetric Engineering and Remote Sensing.

It was determined that the commercial cooperator was making serious errors with the land appraisal work for the County. This led to the removal of this company from the project by the County. Because of the project, the County Officials have realized the value of a GIS. We are assisting the County in evaluating proposals for establishing a Miami County GIS.

Good communication with the county officials was developed from the beginning of the project. Regular meetings were held with the Miami County Cooperators to discuss results, problems and future activities.

Another measure of the success of the project is that 3 refereed papers were published in scientific journals and three papers have been submitted for publication. Additionally three poster papers and a presentation of the results from this project were presented at National meetings including the American Society of Agronomy, the Soil Science Science Society and Soil Conservation Service National Resource Inventory Workshop.

APPENDIX 1

Papers Published

Zhuang, X., B.A. Engel, R.N. Fernandez & C.J. Johannsen. 1991. Neuro-Classfication of Multi-type Landsat Thematic Mapper Data. GIS/LIS Proceedings. 102691

Fernandez, R.N., D.F. Lozano-Garcia, G. Deeds, & C.J. Johannsen. 1991. Accuracy Assessment of Map Coordinate Retrieval. Photogrammetric Engineering & Remote Sensing 57(11):1447-1452. 111191

Zhuang, X., B.A. Engel, M.F. Baumgardner, & P.H. Swain. 1991. Improving Classification of Crop Residues Using Digital Land Ownership Data and Landsat TM Imagery. Photogrammetric Engineering & Remote Sensing 57(11):1487-1492. 111291

Papers submitted for publication

Fernandez, R.N., M. Rusinkiewics, L. Morais da Silva, & C.J. Johannsen. 1992. Design and Implementation of a Land Ownership Database for a GIS/LIS at County Level. Submitted to Photogrammetric Engineering & Remote Sensing. 112191

Fernandez, R.N., D.F. Lozano-Garcia, & C.J. Johhansen. 1992. Integration of Remote Sensing and Geographical Information Systems for Agricultural Reassessment. To be submitted to Photogrammetric Engineering & Remote Sensing. 091191

Fernandez, R.N., M. Rusinkiewics, L. Morais da Silva, & C.J. Johannsen. 1992. Design and Implementation of a Soil Geographic Database for Rural Planning and Management. To be submitted to URISA Journal. 112291

APPENDIX 2

Abstracts

Agronomy Abstract
1989 Annual Meetings
October 15-20, 1989

GIS for Rural Information Needs in Miami Co., Indiana.

R.N. Fernandez, D.F. Lozano-Garcia, P.J. Wyss and C.J. Johannsen, LARS/Purdue University.

A Geographic Information System (GIS) is being developed by LARS/Purdue University, to investigate the feasibility of using this technology, in conjunction with remotely sensed data, to identify and quantify specific land cover categories for enhancing agricultural tax assessment, soil management and soil erosion; at County level. This methodology will be compared with a traditional manual approach that is currently used. The GIS includes several thematic maps such as land ownership, soil topography, stream network, and roads. These maps have very different scales and projections. The attributes for each map are being incorporated into a relational data base to allow overlays and queries upon specific requests. Land cover/land use maps will be derived from Landsat TM and SPOT data and incorporated into the data base. The GIS capabilities can be used to efficiently determine and update farmland tax categories, to model soil properties and conditions, to study soil erosion and deposition within watersheds.

Agronomy Abstract
1990 Annual Meetings
October 21-26, 1990

Database Design for GIS: I. Conceptual Design.

M. Rusinkiewicz and R.N. Fernandez, LARS/Purdue University.

A soil database has been designed as a part of a geographic information system (GIS). The objectives of the conceptual database design process were to satisfy the informational and processing requirements of the user, and to understand the interrelationships among data. The Enhanced Entity-Relationship (EER) model was used to create a conceptual schema, which reflects the semantics and the constraints of the database. Under the EER model, the real world is perceived as a collection of entities (described by attributes) and relationships among entities. Since the EER model is generic, the design phase is independent of the Database Management System (DBMS) used to implement the database. This approach is closer to the user's perception of data and applications, and allows interactive modifications during the design process.

Agronomy Abstract
1990 Annual Meetings
October 21-26, 1990

Database Design for GIS: II. Implementation and Examples.

R.N. Fernandez and M. Rusinkiewicz, LARS/Purdue University.

The physical design of a database involves the evaluation of implementation alternatives using the data model of the target Database Management System (DBMS). The results of the conceptual design of a soil database were mapped to the relational data model. The resulting database is free from update anomalies (i.e., each elementary fact can be updated independently of other elementary facts), while preserving all dependencies among attributes. The database was implemented using a microcomputer-based DBMS, and loaded with data provided by the Soil Conservation Service (Forms 5 and 6). This database will provide information for soil erosion and soil management studies, and land appraisal for tax assessment, at county level. To facilitate data retrieval, pre-defined queries have been developed to retrieve data based on various combinations of attributes. The results of queries can be presented as formatted reports, and linked to the cartographic database of a geographic information system.

Agronomy Abstract
1990 Annual Meetings
October 21-26, 1990

Integrating Remote Sensing and GIS in Rural Environments.

C.J. Johannsen, D.F. Lozano-Garcia, R.N. Fernandez and B. Engel, LARS/Purdue University.

The Laboratory for Applications of Remote Sensing (LARS) at Purdue University, is developing a geographic information system (GIS) for land use/land cover inventories, land appraisal for tax assessment, soil erosion, and soil management studies to be used in rural environments. SPOT satellites over Miami County, Indiana, were geometrically corrected satellites, registered to a base map, and classified for land use/land cover. Results were incorporated into the GIS. Other layers of information of this GIS are soils, land ownership, roads, surface hydrology, and contour lines. A model for land appraisal was implemented using the GIS and compared with a traditional, manual overlay procedure. The evaluation of this automated approach was based on accuracy of results and flexibility of the system.