

NASA APPLICATIONS PROJECT IN
MIAMI COUNTY, INDIANA

Progress Report - Grant NAGW-1472

April 12, 1989

Prepared by

R. Norberto Fernández
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Phillip J. Wyss
Chris J. Johannsen

with the assistance of

Miami County cooperators, Purdue University
investigators and graduate students, and D.R.T.S.

Laboratory for Applications of Remote Sensing

Purdue University



West Lafayette, Indiana 47907

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NASA Applications Project in Miami Co., Indiana.

PROGRESS REPORT

1. SITE SELECTION

The study site selection is intended to serve all of the different research areas within the project, i.e. soil conditions, soil management, etc. The primary study areas are located in Miami Co., Indiana (Figure 1). There are seven major soil associations or soils formed on similar landscapes in the county and over 38 soil series that have been mapped. The area extent of each of the seven soil associations is about equal. Four one-square-mile areas (sections) were randomly selected from each of the seven soil associations. Sections in the northern part of the County will be used for soil erosion studies, while sections located in the southern part will be used for crop compliance studies.

The selection process included the identification of all potential sites. A potential site was defined as a section that:

- a) has represented most or all soil types of a soil association for which it has been selected;
- b) shows large soil units;
- c) has different land cover types; and
- d) Cooperators have been identified.

A cooperator is a farmer that keeps good records of previous year's activities and is willing to participate in a project like this one providing information on land management. This was a critical point in the selection process.

During the selection process approximately 100 sections were originally considered based on a), b) and c) requirements. After cooperators were confirmed, half of the potential sites were discarded. Twenty-eight sites were randomly selected from the remaining sections (four one-square-mile sections were selected for each of the seven soil associations). Half of the sections will be used as training areas and the other half will be used as test sites. Figure 2 shows the location of the final 28 study sites.

Currently section 9, T28N, R5E is being used to develop and verify the data base before expanding it to the remaining 13 sections

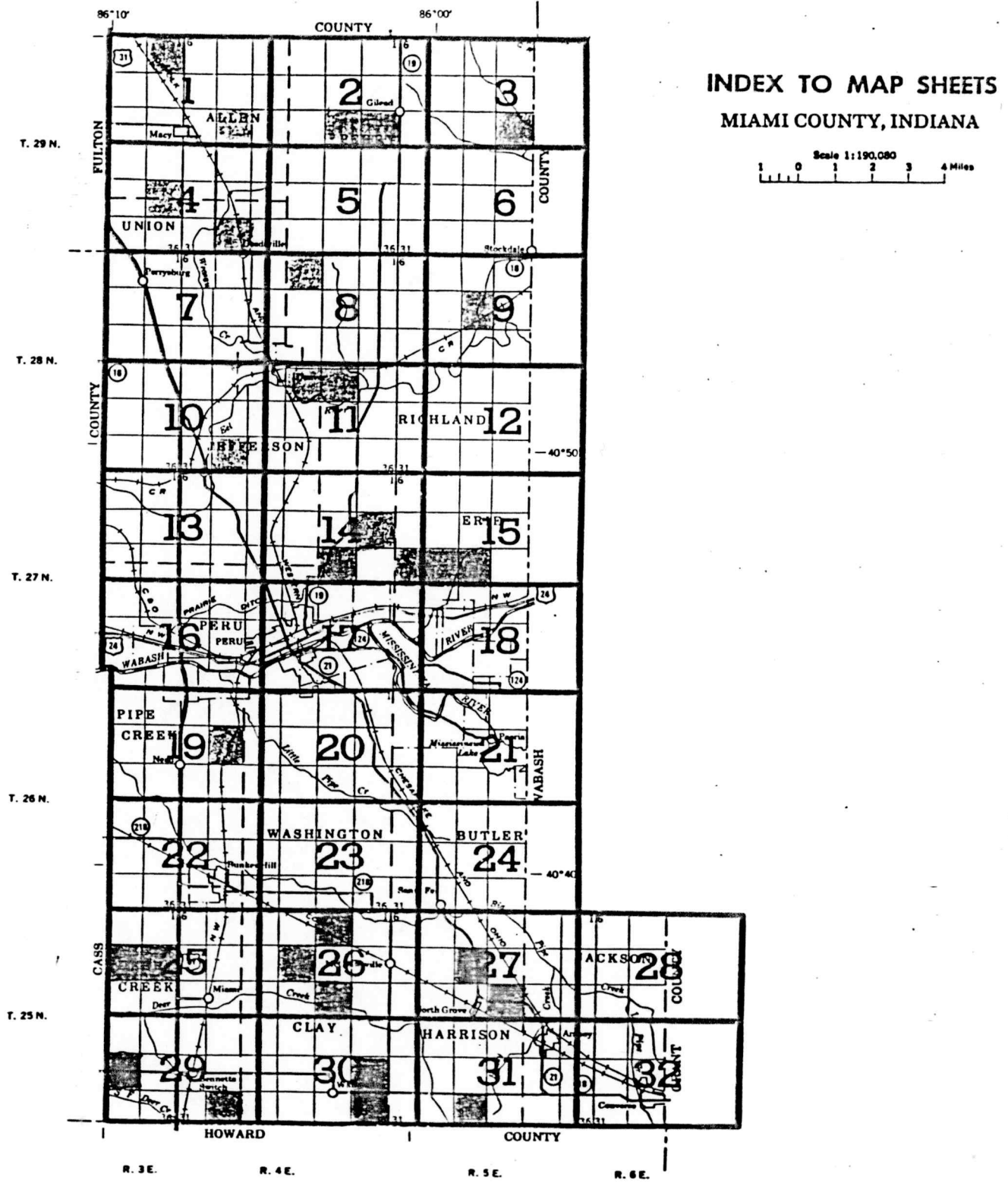


Figure 2 - Study Sites in Miami County

2. SOIL SAMPLING

Soil sampling has been conducted in section 9, T28N, R5E. It was selected because of its variability in soils and cover types; variable topography and presence of erosion problems. Surface and subsurface soil samples were obtained for the following listed in Table 1

Table 1 - Soils Sampled in Field Studies

Sample	Soil unit	Soil description
1	FsA	Fox silt loam, 0-2% slope
2	FsB	Fox silt loam, 2-6% slope
3	FzC3	Fox clay loam, 8-15% slope
4	OtA	Oshtemo sandy loam, 0-4% slope
5	OsB	Ormas-Oshtemo loamy sands, 2-8% slope
6	MsB	Morley silt loam, 2-6% slope
7	MtC3	Morley silty clay loam, 6-12% slope
8	MTD3	Morley silty clay loam, 15-25% slope, severely eroded

Figure 3 shows the location of the sample sites within section 9. This figure partially reproduces the soil map published by the Soil Conservation Service, for this particular section.

3. DATA ACQUISITION

3.1. Satellite Data:

Four Landsat scenes and one SPOT scene were requested in August 1988. None of the scenes have been received as of this date. The satellite data requested are listed in Table 2.

Table 2 - Requested Satellite Data

Sensor	Cloud cover	Date
Landsat-5 TM	10%	3-23-87
Landsat-5 TM	10%	7-29-87
Landsat-5 TM	30%	8-30-87
Landsat-5 TM	0%	4-26-88
SPOT	0%	11-6-87

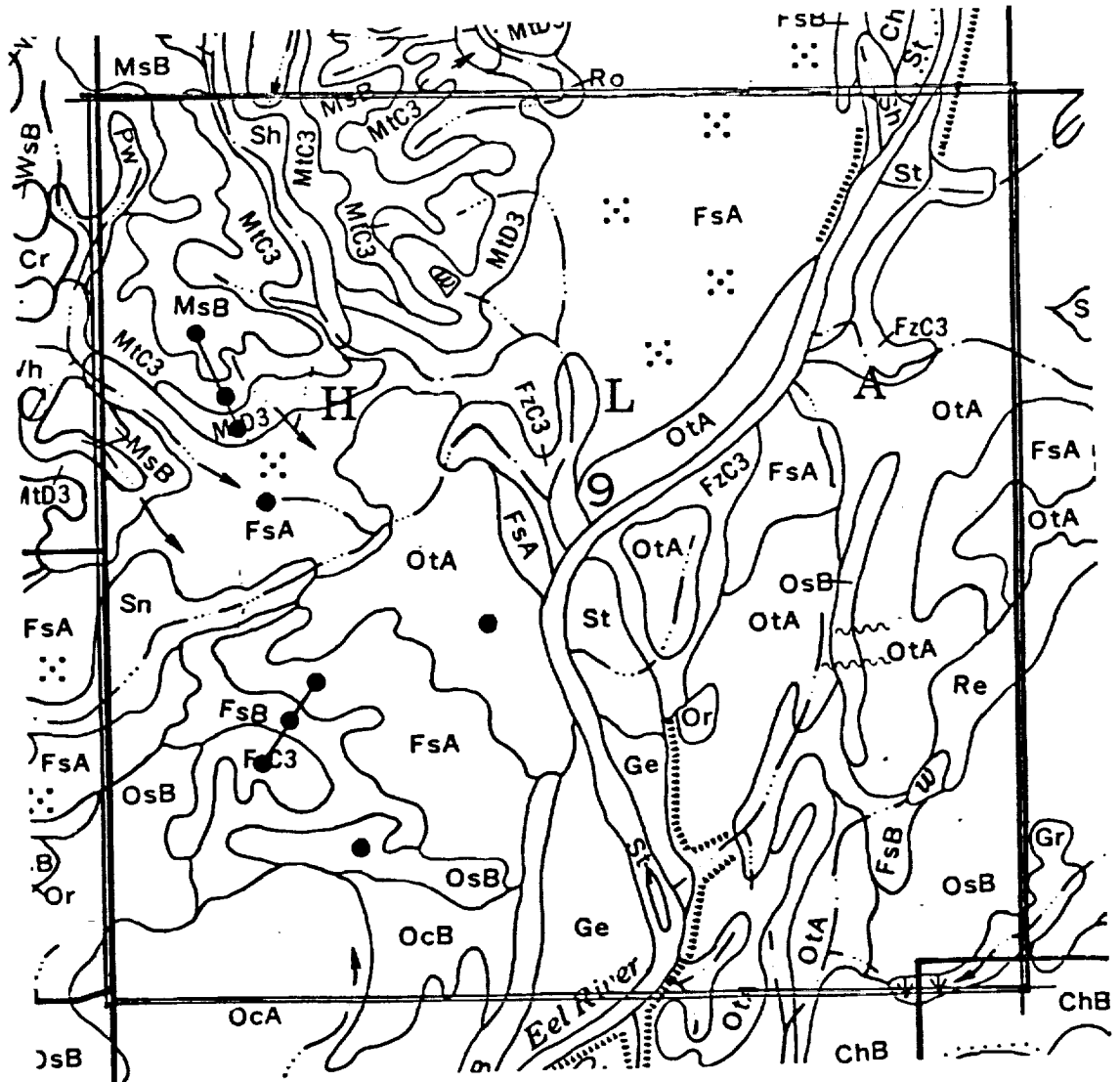


Figure 3 - Soil Map of Section 9 T28N, R5E

LARS has a Landsat-5 TM scene from November 15, 1982 over Miami Co. that is being used for training graduate students. This image has been geometrically corrected and registered to UTM coordinates obtained from USGS 7 $\frac{1}{2}$ ' Quads.

3.2. ASCS Records:

ASCS records for each section selected have been requested and obtained from the Miami Co. ASCS office.

3.3. Farm records:

A questionnaire to obtain ancillary information from cooperators' records on the field is being elaborated. This questionnaire will be sent to those farmers that have already accepted to provide such information. Part of the land management information to be obtained will include:

- a. Description of the tillage systems used.
- b. Cropping history (previous crop --1986, 1987, 1988 and approximate yield)
- c. Seasonal tillage operations: date of fall or spring tillage; date of planting.
- d. Precipitation records (during 1987): date of rainfall; amount of precipitation.

A photocopy of the letter sent by the County Extension Agent to the potential collaborators is shown in Appendix 1.

3.4. Land Ownerships Maps:

Land ownership plat maps are readily available from the County Surveyor's office in Miami Co. Copies of those maps for the sections under study have been obtained (enlarged, scale 1:5000). Figure 4 shows a digitized land ownership map for Section 9.

3.5. Soil maps:

Copies of the soil maps for the sections have been obtained from the local SCS office (scale 1:20,000).

3.6. Topographic maps:

Coverage for the entire County has been obtained from the Earth Science Information Center at Purdue University. Coverage includes 7 $\frac{1}{2}$ ' Quads at 1:24,000 scale.

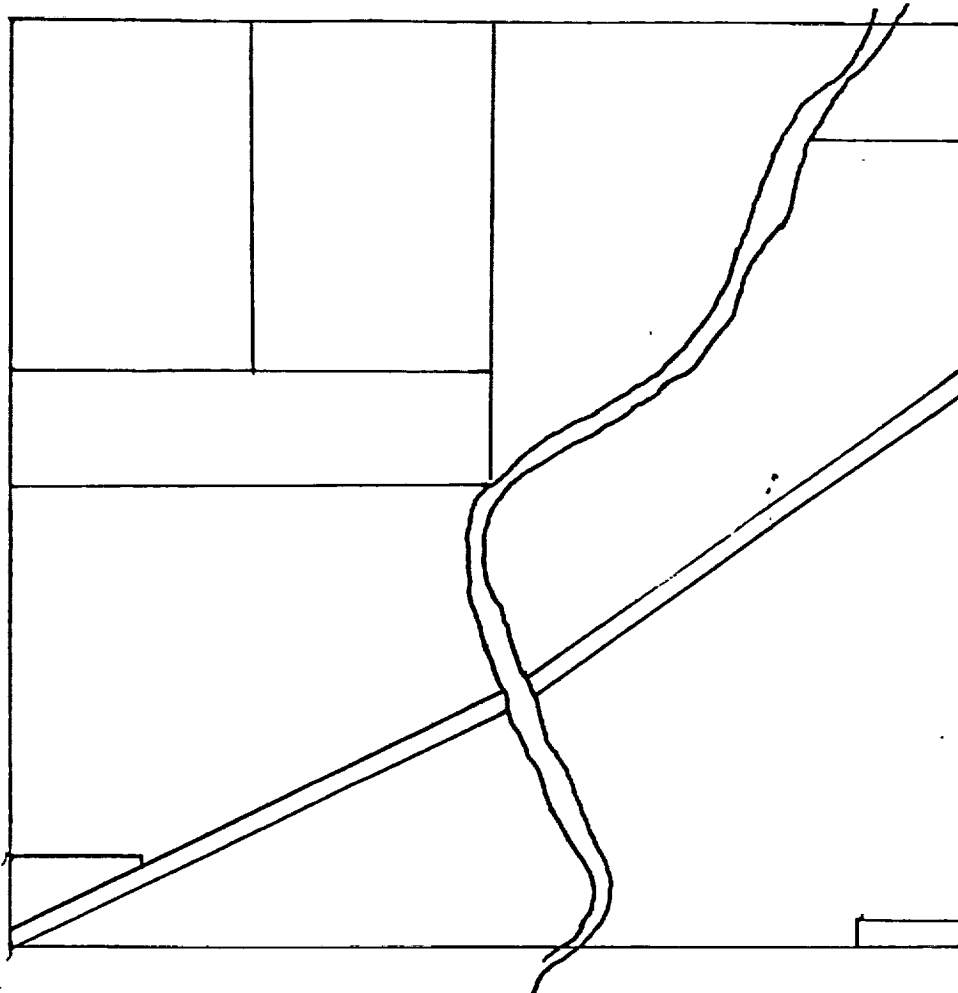


Figure 4 - Land Ownership in Section 9 T28N, R5E

3.7. Aerial Photography:

Copies of aerial 35mm color slides for each section under study have been obtained from the ASCS office. These photographs were acquired in April 1987 and are the ones used by ASCS to check planted and ACR acreages. It should be noted that the date these photographs were obtained coincide with one of the Landsat-5 TM scenes requested; this combination will allow a multistage, multispectral approach to land cover analysis over the study area.

3.8. Information Needed for the Different Research Areas:

The information needed for the study areas has been identified for each research project. This information is listed by project as:

A. Land Cover Assessment:

- Satellite data: Landsat-5 TM (4 dates); SPOT (1 date)
- Soil Map: from SCS (digitized)
- Land Ownership Map (digitized)
- Ancillary information: records from farmers;
- Soil productivity map
- Aerial photography.

B. Land Use:

- Aerial photography
- Satellite data
- Soil Map from SCS
- USGS topographic maps (1:250,000; road network)
- Drainage network

C. Soil Management:

- Satellite data
- Watershed boundaries
- Topographic maps
- ASCS records
- Farmers records
- Soil Maps (from SCS)
- Drainage network

D. Soil Erosion:

- Land use/land cover maps (derived from satellite data)
- Soil Maps (from SCS)
- Topographic maps
- Land ownership maps
- Drainage network
- Soil physical and chemical properties
- Soil spectral properties (Exotech 20C)
- SCS records
- Farmer records

4. SATELLITE DATA ANALYSIS

We have began analyzing the 1982 Landsat-5 TM data in order to get familiar with the land cover types present in the area. This data set is also used to train graduate students that will be involved in the project.

Most of the numerical analysis of satellite data will be performed with an ERDAS system (Earth Resource Data Analysis System). This decision has been made because the objective of this project is to develop a Geographic Information System able to interact with an image analysis system based on microcomputer. It is expected to use LARSYS when performing a classification of the entire County. The LARSYS software, operating on the campus IBM 3090 mainframe, provides the ability to analyze large amounts of data rapidly and efficiently.

Since the analysis of satellite data will be primarily done for land cover/land use, statistics will be generated from training areas representative of all different cover types present in the study area (supervised classification). The analysis will include utilization of aerial photography and farmer's records to check the spectral classes obtained from satellite data.

5. DIGITAL GEOGRAPHIC DATABASE DEVELOPMENT5.1. Introduction:

The design of the digital data base is the most important part of the geographic information system development. Several meetings have taken place among all parties involved in the project with the objective of identifying those variables to be included in the data base and to define different ways the data base would be accessed. The selection of variables still continues, since this is an iterative process.

We have acquired the pcARC/INFO system. This is a geographic information system with vector data structure and relational data base linking point and polygon topologies with physical attributes. This system is being utilized as another option for GIS development since it is microcomputer-based, commercially available, and compatible with the ERDAS system.

Table 3 - Source of Data for the Digital Data Base

DATA	SOURCE
LANDSAT -5-TM	EOSAT
SPOT	SPOT Corporation of America
Topography	USGS 7 1/2' Quads
Land Ownership	County Survey
Soils	SCS
Soil Productivity	Derived from soil maps
Drainage Network	Derived from topo maps, aerial photography, and field information
Watersheds	Derived from topo maps, aerial photos, and field information. It will include flow directions
Road Network	Digital linegraph US Geo Data

Digital Geographic Database Development
 NASA Applications Project in Miami Co. Indiana

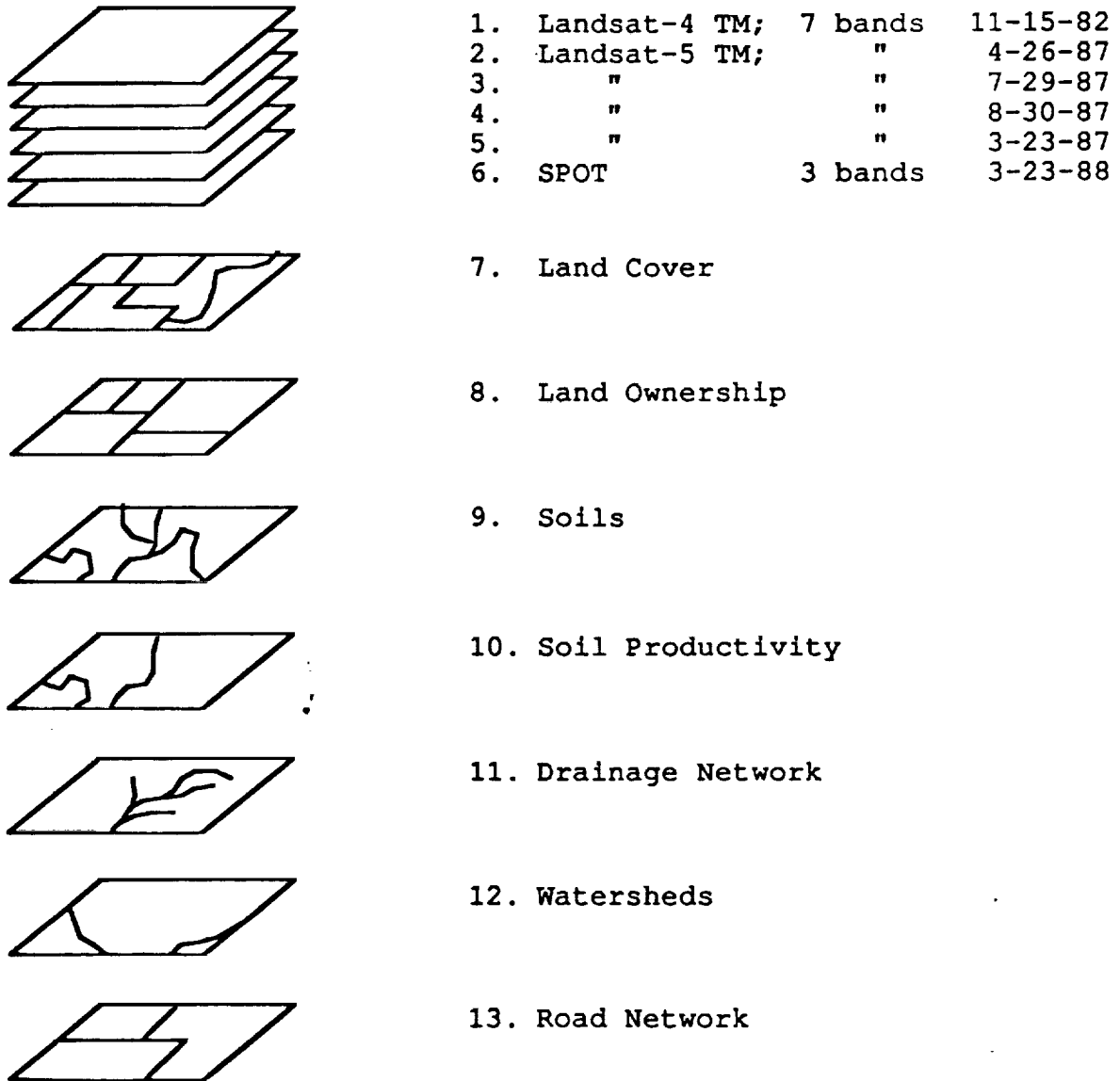


Figure 5 - Layers of GIS Information

Figure 5 shows the different layers of information to be included in the geographic information system. Table 3 lists the source of that information.

5.2. Variables to be Included in the Data Bases:

5.2.1 Land Ownership Data Base:

1. ID#: Identifies the farmer
2. Owners' name
3. Township
4. Range
5. Section
6. Quarter Section
7. Taxing Unit #
8. Individual parcel #
9. Acreage of each parcel defined in 8.

5.2.2. Land Cover Data Base:

It will be derived from satellite data and recoded to meet the classes defined under the tax assessment law.

1. Tillable Land:
 - 1.1. Cropland
 - 1.2. Pasture
 - 1.3. Cover Crops
2. Non-tillable land
3. Woodland
4. Other farmland:
 - 4.1. Buildings
 - 4.2. Water
5. Agricultural support land
6. Homesite
7. Flooding Class:

5.2.3. Crop Compliance Data Base:

1. Farm ID#
2. Ownership
3. Tenancy
4. ASCS Farm # and other numbers per tenant
5. Corn Base (ASCS)
6. Wheat Base (ASCS)
7. Set Aside Acreage
8. Land Quality
9. Tract #
10. Field #
11. Crop grown in each field
12. Acreage of crop grown in each field defined in 11.

5.2.4. Soils Data base:

The soils data base is the most extensive one and it will be divided in four different levels. Soil variables have been selected taking into account all the different research areas of this project (soil erosion, soil management, etc). For each variable listed there is also an example of the kind of descriptive information that will be included in the data base. The Fox silt loam is shown in this example:

Level 1a: General Information

<u>Variable</u>	<u>Explanation</u>
1. Map Unit Symbol:	FsA.
2. Soil Name:	Fox Silt Loam, 0-2% slope.
3. Soil Taxa:	fine-loamy over sandy, mixed, mesic Typic Hapludalf.
4. Soil Association:	Fox-Oshtemo
5. % of each soil:	(within the Soil Association) Fox 30%, 26% Oshtemo, 44% minor.
6. Terrain Information:	nearly level to strongly sloping, well drained, etc.
7. Soil Productivity factor:	0.77
8. Watershed #:	watershed in which the soil pedon is located.

Level 1b: Physical Properties:

The inclusion of these variables is intended, primarily, for soil erosion and soil management studies. and they will be added to the first level:

9. Depth of the soil layer: cm or inches
10. Permeability: in cm/hr or in/hr
11. Available water capacity: in cm/cm or in/in
12. Erosion factors K, T, L & S
13. Wind erodibility group: according to SCS
14. Soil Drainage classes

Level 2: Soil series description (Pedon site)

15. Location of the pedon site: It could be Lat & Long, or a description like the one in the soil survey: "...in cultivated field, 980 ft south and 15 ft east of the NW corner of Sec 29, T27N, R3E."
16. Physiography: the dominant landform of the area where the pedon is located. It will be divided in:
 - 16a. Regional Physiography: glaciated upland, lake plain, etc.
 - 16b. Local landform: moraine, kamefield, etc.
17. Geomorphic component: It is the specific part of the hillslope: summit, shoulder, backslope, etc.
18. Slope: It refers to the slope of the site where the pedon is located. It will be expressed in percentage and described by:
 - 18a: Shape
 - 18b: Aspect

Level 3: Horizon Description:

These variables refer to a description of each soil layer identified for each profile.

19. Horizon #
20. Horizon Symbol: **Ao.** (The symbols used will be the ones described in the Soil Taxonomy). This variable will include: Lithologic discontinuity, master horizon and horizon modifiers.
21. Horizon depth: in cm.
22. Soil Color, moist: according to Munsell Color System
23. Soil Color, dry: according to Munsell Color System
24. Soil Color from spectral reflectance, moist
25. Soil Color from spectral reflectance, dry
26. Mottles: defined by: Abundance, Size and Contrast.
27. Texture
28. Structure: defined by: Size, Type and Grade.
29. HCl Reaction
30. Lower Boundary: It will include any possible combination of topography and distinctness.
31. Stoniness Class
32. Consistence: It will include: Dry, Moist, Stickiness and Plasticity.

Level 4: Horizon Physicochemical data:

33. Pedon #
34. Organic Carbon; Organic Matter: in %
35. N (in %), P (in ppm), K (in ppm)
36. Iron (as Fed, in %): extracted: Dithionate, Citrate, Bicarbonate
37. pH
38. Extractable Bases
39. Exchange acidity
40. Cation Exchange Capacity
41. Laboratory sample ID
42. Laboratory ID
43. Particle Size