



United States Department of Agriculture

Geographic Information System (GIS) INFORMATION SHEET

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What does Geographic Information System mean?

Geographic Information System (GIS) describes any automated system for spatially managing and analyzing geographic information.

In simplest terms, nearly everything on the face of the earth has a physical location, and by default everything has a spatial component. GIS is the managing and analyzing, of information about things that have a spatial component and/or creating a virtual display.

Most, but not all, geographic data has a projection, which is a mathematical attempt to place what is seen on a flat computer screen, or printed page, at the coordinates/location where it exists in the three dimensional world.

GIS is part of a larger field called Geographic Information Science, a more overarching, and academic field dealing with the totality of hardware, software, geospatial data, and their interactions.

What kinds of data can GIS use?

Generally speaking, GIS uses two types of spatial data: Vector and Raster.

Vector data is a coordinate-based data structure commonly used to represent point or linear map features. Each linear feature is represented as a list of ordered x, y coordinates. Attributes stored in a database are associated with the features. Vector data includes:

1. Point features (signs, tractors, grain silos, etc.)
2. Line features (roads, fences, sidewalks, etc.)
3. Polygon features (fields, wetlands, forests, etc.)

Raster data is data displayed as discrete picture elements (pixels). It is a cellular data structure composed of square rows and columns. Groups of cells represent features. The value of each cell determines the tonal value of the feature. Raster data can include aerial photography, scanned images, and any other information displayed and stored as pixels.

GIS can also store almost any kind of attribute data as part of the spatial feature. Attribute data is data that further describes spatial data. For example, a point feature may be a sign, but the attribute data could specify what type of sign it is: stop, yield, or speed limit. Attribute data is stored in an associated database, which can be extracted as a text file or tabular table. The real power of GIS is in accurate attribute data, along with accurate geometry.

For what purposes do people use GIS?

GIS can:

- Map the locations of things: Mapping locations assists users in finding geographic features, and in measuring distances or transportation routes between features. Visualizing locations and relationships between features, on a map, can assist in decision making.
- Find patterns: Observing the distribution of features on the map can reveal patterns assisting in analysis.
- Map densities: Mapping features may display their geographic concentration, but in areas with many features it may be difficult to determine which areas have a higher concentration than others. A density map displays measurements of the number of features, so that users can clearly see the distribution.
- Map quantities: Quantities are mapped to assist with study objectives, or to compare data in different places. This type of map can aid with decision making, because it gives an additional level of information beyond simply mapping the locations of features.
- Find what's inside something: Mapping quantities or densities in specific areas could help to monitor what's happening and to take specific action. For example, maybe within a particular city district, crime is higher than in other districts. This finding could lead police to increase patrols.
- Find what's near something: A GIS can create buffer zones and discover what's occurring within a set distance from a feature. This type of analysis is crucial to environmental planning.
- Map change: Mapping changes in a particular area can help to predict future conditions, decide on a course of action, or to evaluate the results of a previous decision. The historical imagery available at APFO can play a crucial role in this type of analysis because it can assist in locating change and mapping it. [Click here](#) to view an online map showing historical imagery available at APFO.

How do the Farm Service Agency (FSA) and the Aerial Photography Field Office (APFO) use GIS?

USDA FSA programs help agricultural producers purchase and operate farms, stabilize farm income, conserve land and water, and recover from the effects of disasters.

In order to determine producer benefits for most FSA program areas, staff must know the specific crop acreage or other land use information. Also, for many programs, producers agree to certain provisions on their land, such as conservation compliance.

GIS helps FSA staff to efficiently measure land features by using computer-generated maps in which the features have related databases (attribute tables) that store information about the land. This technology gives local offices tools to:

1. Help producers exercise sensible land stewardship;
2. Provide quicker, more accurate, information for decision-making purposes; and
3. Reduce the amount of time a producer must spend with local FSA staff to participate in USDA programs.

USDA-FSA-APFO helps manage 2 primary spatial datasets:

1. Aerial Imagery
2. Common Land Unit (CLU)

In FSA programs, aerial imagery, a raster dataset, is the base layer in GIS over which other data, such as CLU, and other vector datasets, are overlaid and digitized.

Depending on the purpose of the work, other data layers may also be added. The end product is a group of layers that represent real world features in the form of a map. GIS allows the user to access much more detailed information than is contained in a hard copy map with a color-coded legend; the attributes in GIS layers could be used to create an entire series of maps. Each GIS layer can store and display vast amounts of information, such as soil types, crops, land boundaries, place names, and populations.

No matter how vast the GIS database, it can be queried and organized to propagate efficient data management practices. A simple GIS query can locate one farm number from among thousands, in just seconds.

Further uses of GIS by USDA FSA relate to:

1. Farm Commodity and Conservation Programs
2. Farm Loan Programs
3. Emergency Preparedness
4. Compliance

What is a CLU used for?

The most critical component of GIS for FSA is the development and maintenance of the Common Land Unit (CLU) dataset. A CLU is the smallest land unit with a permanent closed boundary and land cover; in other words, a farm field. USDA FSA digitizes CLU into an enterprise database, and populates associated attribute data.

There are many uses for CLU, including but not limited to:

1. Providing a link between tabular farm records and a map or image of the land
2. Using GIS for acreage calculations
3. Replacing paper maps with digital images that can be easily updated
4. Drawing crop boundaries to better define or use with other data, such as:
 - a. Crop Patterns

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- b. Subdivisions
 - c. Conservation Plans
5. Creating a central database for land unit boundaries registered in USDA programs, and linking it to customers and other data.
6. Speeding up the process for implementing disaster payment and other specialized applications.

How do farmers benefit from GIS?

GIS technology can help agricultural producers improve production history and farm planning through precision agriculture. Producers can request hard or soft copies of USDA imagery, their own farm and field boundaries, and soils data to help them with:

1. Planning, such as determining crop planting strategies
2. Crop production, such as mapping and monitoring fertilizer and herbicide application.

Can I build my own GIS project?

Yes. All you need to get started is software and data.

Do I have to purchase GIS software?

No. Software with basic GIS functionality is free for download or is available in some cases as a web based application; more advanced GIS software does come with a substantial associated cost.

For more information on free GIS software and downloads, go to the following sites:

<http://software.geocomm.com/viewers/>
<http://spatialnews.geocomm.com/features/viewers/2002/>
<https://www.gislounge.com/free-gis-data-viewers/>

This list is provided for convenience; USDA-FSA-APFO does not support or endorse these products or services.

Do I have to purchase GIS data?

No. There is an abundance of free data available on the web. The key is having a clear objective in seeking data. The Geospatial Data Gateway, at: <https://gdg.sc.egov.usda.gov/> contains imagery and vector data available for public consumption. Many state governments also have their own clearinghouses. Be aware that access to the CLU dataset is restricted to authorized users. NAIP is available to the public in a web service. [Click here](#) to view a map showing access to public services.

Who do I contact for more information?

For APFO sales and product information, contact USDA-FSA-APFO at 2222 W 2300 S, Salt Lake City UT, 84119-2020, call 801-844-2922, or visit <http://www.apfo.usda.gov/>

1. For further information on GIS, contact GIS Specialists at APFO: Louise Mathews, 801-844-2934; or Zack Adkins, 801-844-2925.