

GIS Software

Geographic Information System Solutions for Food and Agriculture



Preserving the environment, managing assets, constant overproduction with low prices, changing government subsidies, biotechnology, and intense global competition are reasons agricultural professionals are using geographic information system (GIS) technology. With increased awareness of geospatial technologies and its role in society, agriculture has and must continue to embrace GIS to adapt to these changing circumstances.



ESRI is committed to seeing the benefits of GIS technology brought to the food and agriculture industries through successful implementation from the farm to agribusiness to the governing bodies that regulate and support the industry domestically and internationally.

The Role of GIS in Agriculture

Spatial analysis, the study of geographic features, and the relationships that exist between them can be applied to many areas of the agriculture industry. By better understanding how features within the landscape interact, decision makers can optimize operational efficiency and improve economic returns. Regardless of scale—whether at the farm field level analyzing crop yield information or across an entire country—GIS is becoming fully integrated and widely accepted for assisting government agencies to manage programs that support farmers and protect the environment.



ESRI Supports Agriculture and the Food Industry

ESRI manufactures the undisputed GIS platform of choice throughout the global agricultural community. Since geospatial technologies are relatively new to the food and agriculture industries, a need for standards exists. The ESRI® GIS open architecture and interoperable platforms comply to the vast majority of modern technology standards. For this reason, the growing ESRI food and agricultural community has the ArcGIS™ platform in common, letting society evolve standards for food and agriculture. It provides the user with the capability to integrate spatial and tabular data for improving the management of agricultural data sets. Its integrated approach, flexibility, consistency, scalability, and advanced analytical capabilities encourage multi-issue thinking and provide a method to gain additional returns on previous investments in both data and advanced technologies.



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ESRI GIS Solutions for Food and Agriculture



The ArcGIS software suite offers industry-leading GIS tools that provide scalability and performance for deployment for the farm desktop, multinational enterprise, and/or government.

L T U R E

GIS for Production Agriculture



ArcPad in the field



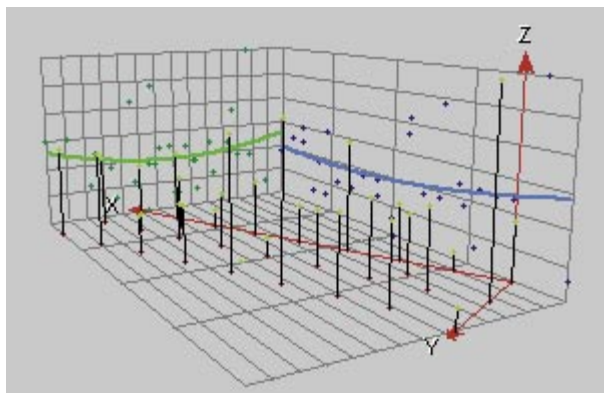
GIS offers farmers various data management opportunities to analyze ways to increase production, reduce input costs, and manage farmland efficiently. From handheld computer mapping in the field to the scientific analysis of production data at the farm manager's office, geography plays a part by tying together disparate data that was previously never brought into one computing environment for analysis.

Data Collection in the Field

Farmers have great insight into how to best manage a farm's assets. While never being able to replace such expert knowledge, technology is certainly able to assist in the planning and implementation of important decisions related to farm management. In order to make the best decision, farmers need to have the most information at hand, often in the field. Now, new technology in computing allows the farmer to take the power of GIS into the field. ArcPad™ software can be used on handheld computers in the field for the creation, visualization, and querying of data. Analyzing the data lets the farmer map relevant information such as crop stress from pest infestations, nutrient deficiencies, and water shortages.

Desktop Data Analysis and Interpretation Using ArcGIS

Comparing different layers of agronomic information simultaneously is often enough to identify relationships that exist between seemingly unrelated data types. An example would be the location of weeds within a field and historical crop rotation data. Applying sound or advanced geostatistical tools to the farm operator's geospatial data results in optimum yields and lowest crop input investment. Identifying this spatial relationship supports better decision making for improved management or field treatments using variable rate technology (i.e., only applying field inputs where necessary), saving costs and reducing environmental impact.



Statistical soil sampling

Agriculture GIS Application in the Field

- Combining agronomic and economic data sets
- Field data interpolation
- Decision support for farm management
- Farm asset allocation
- Field input reporting
- Regulatory compliance
- Subsidy claims



GIS for Agribusiness

ESRI offers a scalable enterprise GIS solution that delivers improved information distribution between departments within an organization using multiple software products. ArcGIS, ArcSDE™, ArcIMS®, and ArcLogistics™ Route are fully compatible and can be connected via a company network.

GIS-Based Asset Management for Agricultural Businesses

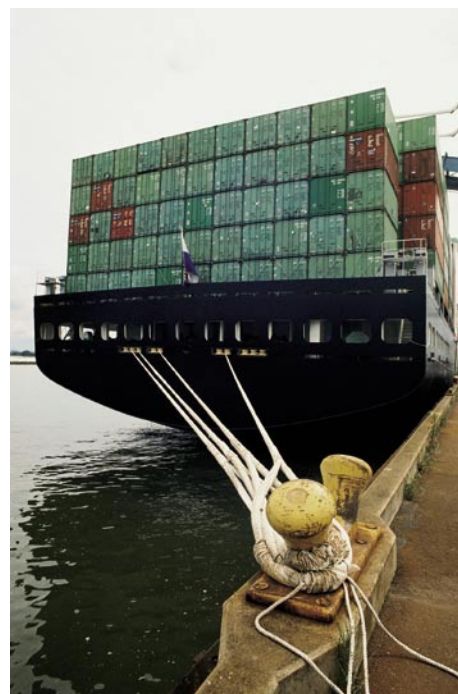
Crop input manufacturers use spatial demographics and market demand models based on existing sales information and factors of influence to predict future manufacturing and marketing requirements. An underlying principle of successful business is acquiring knowledge related to the whereabouts of assets and demands, analyzing this information, and using it to provide an optimized strategy to deliver where existing and future business opportunities are located.

Businesses that have implemented GIS are benefiting from increased supply chain efficiencies through linear network functionality. Reduced product storage times, better delivery routing and scheduling, and up-to-date asset management all work to release asset investments and return profits faster.

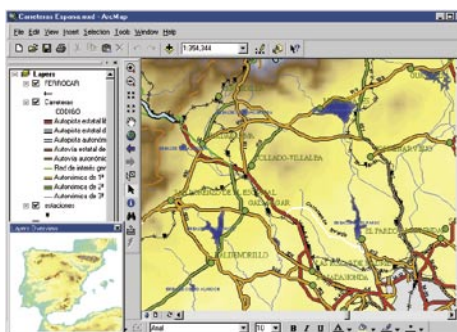
Using GIS in the Food, Feed, and Fiber Processing Industry

Out of necessity, processing companies manage their operations in fine detail by contracting farmers for delivery of specific quantities on specific dates. This management aims to reduce surplus processing assets or market demand that outstrips production capacity.

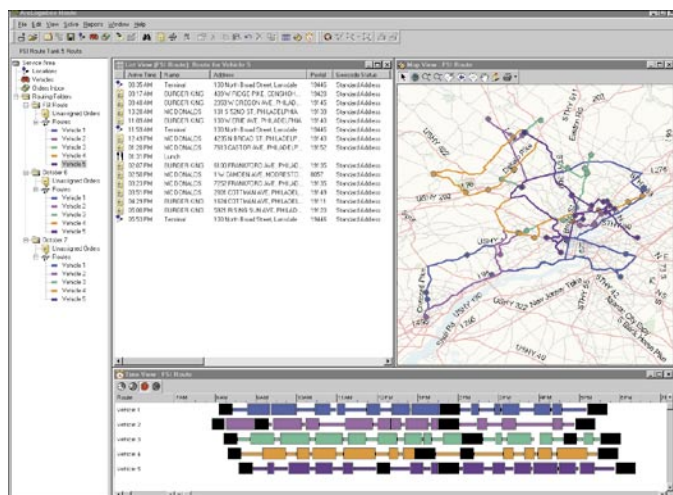
Business models that are built containing natural phenomenon, without consideration of variations outside of the control of normal production practices, are significantly at risk. The food industry is no exception and frequently suffers as a result of disease, climate, and drought. Understanding of these potential risks is based on statistical analysis of historical information in a spatial or location-specific context. The Geostatistical Analyst extension provides agribusinesses with the tools to calculate these risks and better forecast any eventualities when they do occur.



Asset location and network routing optimization



Product distribution network



ArcLogistics Route work order planning tool

Agribusiness GIS Applications

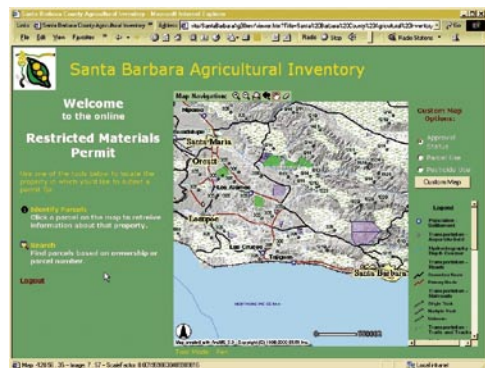
- Distribution, routing, and real-time inventory management
- Crop identity preserve
- Risk assessment for agricultural insurance premiums and measuring areas under claim
- Location-based, targeted marketing demographic campaigns
- Local and regional business development

Implementing GIS in Government

Federal, state, and local agricultural agencies have a broad responsibility to a wide range of seemingly disparate groups. All the way through the food supply chain from farmer to consumer, agricultural ministries and institutions collect, collate, manage, and disseminate information. These activities will increase with growing public awareness of farming practices and the resultant legislation. If there is a common theme in new efforts to better manage agriculture, it is communication, not only internally but also between government and consumer.

Regulatory Compliance Programs for Crop Nutrients, Pesticides, and Manure

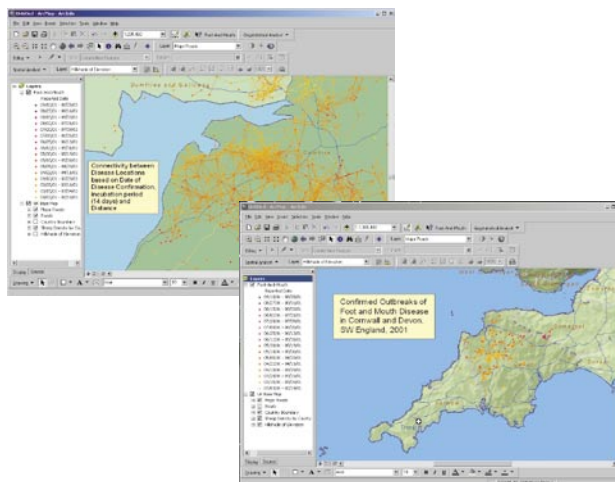
Crop inputs take many forms, but pesticides, manure, and phosphates are most hazardous to the environment. For this reason, state agricultural agencies must carefully manage and control pesticide applications to achieve an acceptable balance between the economic interests of the farming community and health concerns. Regulations on pesticide use vary from state to state, but all states require information to be collected and disseminated. Such information includes which, how much, and where pesticides have been applied. Since much of this information is tied to a discrete land parcel unit or field, it can be stored and accessed spatially. By storing this information, a GIS allows state officials to electronically manage initial permit application, monitor water quality, and control point source pollution events.



Disease Tracking, Pest Detection, Monitoring, and Control

Integrated pest management relies on accurate data related to the quantity and location of pests within a county. Using insect traps and field observations, government entomologists highlight areas where agricultural pests are apparent and recommend remedial measures. Whether on handheld units running ArcPad or the office desktop with ArcView®, GIS plays an important role in data collection, interpolation, and analysis. Using ArcIMS, government officials can send up-to-date information on pest locations, areas of potential risk, and recommendations for eradication. A public Web site allows users to obtain real-time informa-

tion, including maps of current pest outbreaks, that assists them in reducing disease contagion and its impacts.



Agricultural Subsidy Administrative Procedures Facilitated by GIS

Producers in many countries rely heavily upon subsidy payments to assist in maintaining viable commercial operations. Annual operational costs for such programs are huge, and methods to improve efficiency by even 1 percent can have improved economic benefits.

Subsidy claims have four distinct phases. The farmer first needs to be provided with the necessary information if the application is to be processed smoothly. Forms are then completed and submitted to the claims office. The claim is processed and verified, sometimes using satellite imagery but more often using field inspectors. Once the verification is complete, subsidy payments are released.

Web-enabled GIS facilitates this work order flow process. Government agencies can now reach an increasing group of agricultural subsidy claimants via the Web. Subsidy applications can be completed online using ArcGIS technology. Fields are often the land unit most associated with claims, and by using ArcIMS technologies, farmers will be able to locate their field on a map service and fill in the details directly online.

Agriculture Government Uses of GIS

- Rural development
- Food label licensing
- Agricultural census
- Food safety inspection and permitting
- Extension services
- Agricultural alternatives
- Property tax appraisal and collection

ArcGIS

Tools for Agriculture

ArcGIS is a family of software products that forms a complete geographic information system for the fully integrated land information agency or a stand-alone system for the individual farm. ArcGIS is built on open, recognized standards and fully integrates with IBM® DB2®, Informix®, SQL Server®, and Oracle® RDBMS. ArcView, ArcEditor™, and ArcInfo™ comprise the ArcGIS Desktop, while ArcSDE and ArcIMS make up the application services products.

ArcView

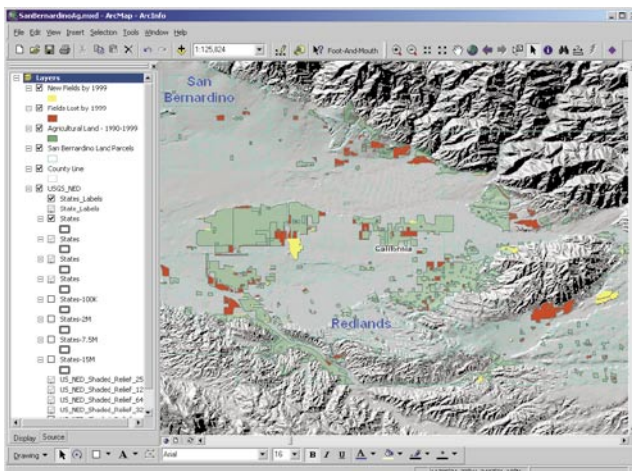
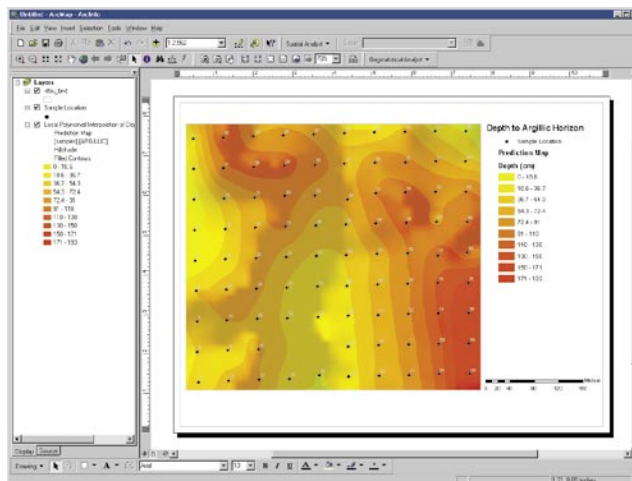
ArcView is an exceptional stand-alone desktop GIS product, as well as the entry point into ArcGIS, and provides core mapping and GIS functionality. ArcView provides geographic data visualization, query, and analysis of most factors affecting agriculture land and improvement value. Land use, soil, and flood maps are just some of the geographic data that can be combined with parcel maps in ArcView to establish, adjust, and defend values for an area.

ArcEditor

ArcEditor includes all the functionality of ArcView and adds the power to edit topologically integrated features in a geodatabase or coverage. Other functionality includes support for multiuser editing, versioning, custom feature classes, feature-linked annotation, and advanced data types and geometry such as survey measures and coordinates. ArcEditor, with its advanced, easy-to-use drafting tools, is the ideal solution for multiuser enterprises.

ArcInfo

ArcInfo is the complete GIS data creation, update, query, production, and analysis system. It includes all the functionality of ArcView and ArcEditor and adds advanced geoprocessing and polygon processing as well as the classic ArcInfo applications and capabilities, such as Arc, ArcPlot™, and ArcEdit™, that make ArcInfo the de facto standard for GIS. Land records agencies find ArcInfo to be the complete GIS for converting and adjusting data from other departments, as well as state and national agencies, into their information.



Agricultural land parcel changes in Southern California

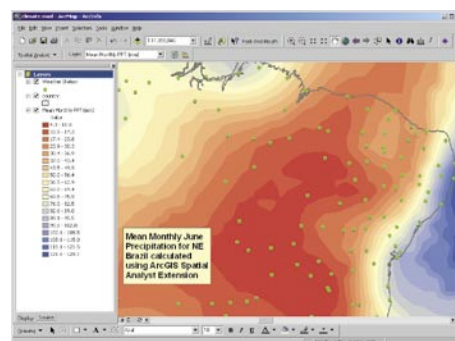
ArcGIS Desktop

ArcView	ArcEditor	ArcInfo
<ul style="list-style-type: none"> Data access Mapping Customization Spatial query Simple feature editing 	ArcView plus <ul style="list-style-type: none"> Multiuser geodatabase editing and data management 	ArcEditor plus <ul style="list-style-type: none"> Advanced geoprocessing Data conversion Workstation

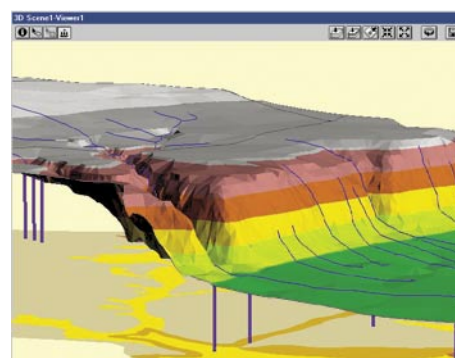
ArcGIS Extensions

The architecture of ArcGIS supports a series of extensions, which dramatically extends the functional capabilities of the ArcGIS Desktop products for agriculturists. One of the key features of the ArcGIS extensions is that they operate seamlessly with ArcGIS Desktop software. This significantly reduces training, operating, and acquisition costs.

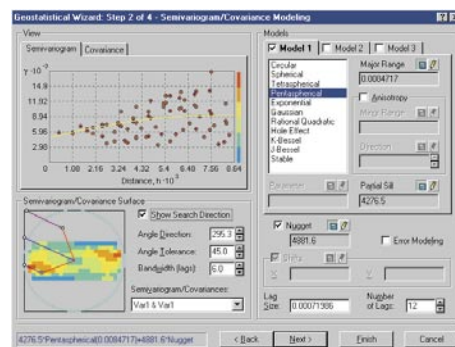
ArcGIS Spatial Analyst	Advanced spatial analysis using raster and vector data.
ArcGIS 3D Analyst™	Three-dimensional visualization, topographic analysis, and surface creation.
ArcGIS Geostatistical Analyst	Statistical tools for data exploration, modeling, and advanced surface generation.
ArcPress™ for ArcGIS	High-performance printing using a graphics metafile rasterizer that improves color output control and printing speed.
MrSID® Encoder for ArcGIS	Produce and mosaic MrSID images from input images up to 500 MB.
ArcGIS Survey Analyst	Direct utilization of survey measurement and coordinate data gathered by field survey instruments. Added Survey Analyst functionality allows survey measurement data to participate in the spatial adjustment of boundary data while maintaining the integrity of the original measurements.



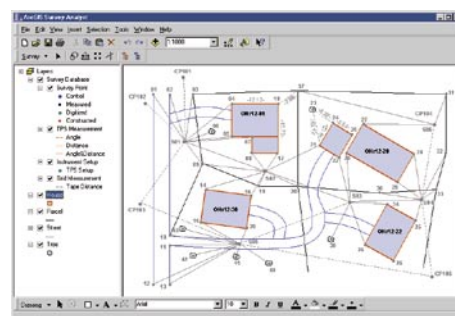
ArcGIS Spatial Analyst



ArcGIS 3D Analyst



ArcGIS Geostatistical Analyst



ArcGIS Survey Analyst

City of Tucson - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address http://www.tucsonaz.gov/land/ [Go] [Refresh] [Back] [Forward] [Home] [Stop] [Print] [F1] [F2] [F3] [F4] [F5] [F6] [F7] [F8] [F9] [F10] [F11] [F12] [F13] [F14] [F15] [F16] [F17] [F18] [F19] [F20] [F21] [F22] [F23] [F24] [F25] [F26] [F27] [F28] [F29] [F30] [F31] [F32] [F33] [F34] [F35] [F36] [F37] [F38] [F39] [F40] [F41] [F42] [F43] [F44] [F45] [F46] [F47] [F48] [F49] [F50] [F51] [F52] [F53] [F54] [F55] [F56] [F57] [F58] [F59] [F60] [F61] [F62] [F63] [F64] [F65] [F66] [F67] [F68] [F69] [F70] [F71] [F72] [F73] [F74] [F75] [F76] [F77] [F78] [F79] [F80] [F81] [F82] [F83] [F84] [F85] [F86] [F87] [F88] [F89] [F90] [F91] [F92] [F93] [F94] [F95] [F96] [F97] [F98] [F99] [F100] [F101] [F102] [F103] [F104] [F105] [F106] [F107] [F108] [F109] [F110] [F111] [F112] [F113] [F114] [F115] [F116] [F117] [F118] [F119] [F120] [F121] [F122] [F123] [F124] [F125] [F126] [F127] [F128] [F129] [F130] [F131] [F132] [F133] [F134] [F135] [F136] [F137] [F138] [F139] [F140] [F141] [F142] [F143] [F144] [F145] [F146] [F147] [F148] [F149] [F150] [F151] [F152] [F153] [F154] [F155] [F156] [F157] [F158] [F159] [F160] [F161] [F162] [F163] [F164] [F165] [F166] [F167] [F168] [F169] [F170] [F171] [F172] [F173] [F174] [F175] [F176] [F177] [F178] [F179] [F180] [F181] [F182] [F183] [F184] [F185] [F186] [F187] [F188] [F189] [F190] [F191] [F192] [F193] [F194] [F195] [F196] [F197] [F198] [F199] [F200] [F201] [F202] [F203] [F204] [F205] [F206] [F207] [F208] [F209] [F210] [F211] [F212] [F213] [F214] [F215] [F216] [F217] [F218] [F219] [F220] [F221] [F222] [F223] [F224] [F225] [F226] [F227] [F228] [F229] [F230] [F231] [F232] [F233] [F234] [F235] [F236] [F237] [F238] [F239] [F240] [F241] [F242] [F243] [F244] [F245] [F246] [F247] [F248] [F249] [F250] [F251] [F252] [F253] [F254] [F255] [F256] [F257] [F258] [F259] [F260] [F261] [F262] [F263] [F264] [F265] [F266] [F267] [F268] [F269] [F270] [F271] [F272] [F273] [F274] [F275] [F276] [F277] [F278] [F279] [F280] [F281] [F282] [F283] [F284] [F285] [F286] [F287] [F288] [F289] [F290] [F291] [F292] [F293] [F294] [F295] [F296] [F297] [F298] [F299] [F300] [F301] [F302] [F303] [F304] [F305] [F306] [F307] [F308] [F309] [F310] [F311] [F312] [F313] [F314] [F315] [F316] [F317] [F318] [F319] [F320] [F321] [F322] [F323] [F324] [F325] [F326] [F327] [F328] [F329] [F330] [F331] [F332] [F333] [F334] [F335] [F336] [F337] [F338] [F339] [F340] [F341] [F342] [F343] [F344] [F345] [F346] [F347] [F348] [F349] [F350] [F351] [F352] [F353] [F354] [F355] [F356] [F357] [F358] [F359] [F360] [F361] [F362] [F363] [F364] [F365] [F366] [F367] [F368] [F369] [F370] [F371] [F372] [F373] [F374] [F375] [F376] [F377] [F378] [F379] [F380] [F381] [F382] [F383] [F384] [F385] [F386] [F387] [F388] [F389] [F390] [F391] [F392] [F393] [F394] [F395] [F396] [F397] [F398] [F399] [F400] [F401] [F402] [F403] [F404] [F405] [F406] [F407] [F408] [F409] [F410] [F411] [F412] [F413] [F414] [F415] [F416] [F417] [F418] [F419] [F420] [F421] [F422] [F423] [F424] [F425] [F426] [F427] [F428] [F429] [F430] [F431] [F432] [F433] [F434] [F435] [F436] [F437] [F438] [F439] [F440] [F441] [F442] [F443] [F444] [F445] [F446] [F447] [F448] [F449] [F450] [F451] [F452] [F453] [F454] [F455] [F456] [F457] [F458] [F459] [F460] [F461] [F462] [F463] [F464] [F465] [F466] [F467] [F468] [F469] [F470] [F471] [F472] [F473] [F474] [F475] [F476] [F477] [F478] [F479] [F480] [F481] [F482] [F483] [F484] [F485] [F486] [F487] [F488] [F489] [F490] [F491] [F492] [F493] [F494] [F495] [F496] [F497] [F498] [F499] [F500] [F501] [F502] [F503] [F504] [F505] [F506] [F507] [F508] [F509] [F510] [F511] [F512] [F513] [F514] [F515] [F516] [F517] [F518] [F519] [F520] [F521] [F522] [F523] [F524] [F525] [F526] [F527] [F528] [F529] [F530] [F531] [F532] [F533] [F534] [F535] [F536] [F537] [F538] [F539] [F540] [F541] [F542] [F543] [F544] [F545] [F546] [F547] [F548] [F549] [F550] [F551] [F552] [F553] [F554] [F555] [F556] [F557] [F558] [F559] [F560] [F561] [F562] [F563] [F564] [F565] [F566] [F567] [F568] [F569] [F570] [F571] [F572] [F573] [F574] [F575] [F576] [F577] [F578] [F579] [F580] [F581] [F582] [F583] [F584] [F585] [F586] [F587] [F588] [F589] [F590] [F591] [F592] [F593] [F594] [F595] [F596] [F597] [F598] [F599] [F600] [F601] [F602] [F603] [F604] [F605] [F606] [F607] [F608] [F609] [F610] [F611] [F612] [F613] [F614] [F615] [F616] [F617] [F618] [F619] [F620] [F621] [F622] [F623] [F624] [F625] [F626] [F627] [F628] [F629] [F630] [F631] [F632] [F633] [F634] [F635] [F636] [F637] [F638] [F639] [F640] [F641] [F642] [F643] [F644] [F645] [F646] [F647] [F648] [F649] [F650] [F651] [F652] [F653] [F654] [F655] [F656] [F657] [F658] [F659] [F660] [F661] [F662] [F663] [F664] [F665] [F666] [F667] [F668] [F669] [F670] [F671] [F672] [F673] [F674] [F675] [F676] [F677] [F678] [F679] [F680] [F681] [F682] [F683] [F684] [F685] [F686]

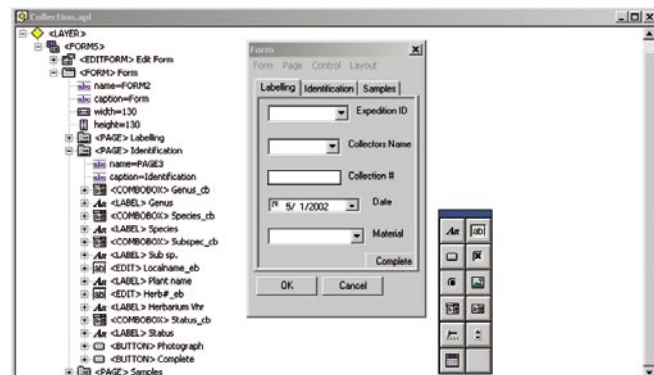
ArcSDE is the gateway for GIS data in an agriculture geospatial DBMS. ArcSDE enables an organization to move from the traditional approach of managing collections of geographic data files to an integrated environment in which all spatial data is modeled and managed as a continuous database in a DBMS. ArcSDE provides support for storing and managing all raster data formats supported by the ArcGIS Desktop applications. ArcSDE serves data directly to the ArcGIS Desktop products and through ArcIMS to a variety of lightweight Internet clients for both Internet and Intranet applications.

The screenshot shows the Microsoft Internet Explorer browser window. The address bar displays the URL: <http://www.surrey.gov.uk/molesey/Map.aspx?C=1&area=100>. The main content area shows a map of Molesey, Surrey, with various colored overlays representing different land use categories. A legend on the right side of the map lists the following categories:

- ☒ Roads
- ☒ Residential (BROADLY)
- ☐ Park
- ☐ Road
- ☐ Track
- ☒ Northern (GREENBELT)
- ☐ Sewer
- ☐ Canal
- ☐ Transport
- ☐ Utilities
- ☐ Industrial
- ☐ Flooded
- ☐ Waterways
- ☐ Unclassified

The map shows a mix of residential areas, roads, and green spaces. The bottom status bar indicates the coordinates 51.506, 239.505 and 51.505, 239.505, and the scale 1:2,237.

ArcPad software is a mobile GIS technology for field data collection and verification. ArcPad provides database access, mapping, GIS, and GPS integration to users in the field via handheld and mobile devices. The ability to take a portion of the agricultural geodatabase into the field, verify or edit the data, and then return the data to the geodatabase without additional processing is measurably increasing the efficiency of field consultants, farmers, and researchers.



Identify attributes with user-defined forms

How to Implement Your GIS

Data Requirements

Well-managed and documented databases are essential for successful GIS implementations. Data in mapped, image, and tabular form can be obtained from many sources. Agricultural departments may have the data already, find the data they need on the Internet, purchase data, or create their own data. Specific projects require specialized data that can be converted into a geographic format. Much data can be geocoded (i.e., given a locational value through an address, ZIP Code, or the like).

Data Format	Typical Information	Source
Raster	Digital elevation model, crop type classification, land use change analysis outputs	Satellite imagery and aerial photography, orthophotos
Vector	Roads, cadastre, cultural features, field boundaries	Free or commercially available from vendors and other agencies, in-house data captured through scanning maps or field GPS
Tabular	Pesticide application records, tax records	Existing databases, field verification, geocoding

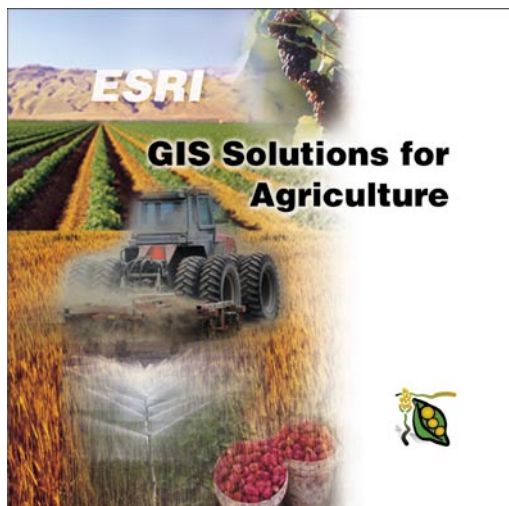
GIS can combine any or all data types. The value of a GIS is its ability to combine data visually and analytically.

Hardware

Advances in computer hardware technology mean new options for agricultural GIS. Which option you select depends on many factors including the scale of the GIS implementation, the budget allowed, and the technical ability of the staff that will administer it. Options range from mobile devices, desktop computers, and workstations to centralized servers.

Scale	Typical Hardware	Associated GIS Software	Typical Function
Mobile	Handheld PDA or laptop with Windows® or Windows CE	ArcPad	Field data collection, updating, and verification
Desktop	Windows NT®/XP/2000	ArcView, ArcGIS extensions	Data browsing, public and clerical access to GIS data
Workstation	Windows NT/XP/2000 with increased processing speed and disk capacity	ArcView, ArcEditor, ArcInfo, ArcGIS extensions	GIS analysis, geoprocessing, and database maintenance
Server	Windows or UNIX®, possibly with multiple CPUs	ArcSDE, ArcIMS	Shared database support and Internet map services

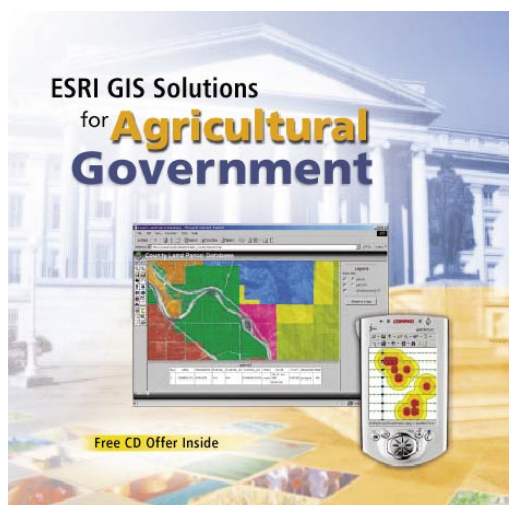
ESRI Resources Available to the Agriculture Industry



GIS Solutions for the Farm and Agribusiness

This CD shows you solutions using GIS for those who work in the agricultural industry. Whether you are a farmer, research analyst, or crop manager or own an agribusiness, you will learn how GIS optimizes your operations.

Request a copy online at http://gis.esri.com/emails/ag_cd.cfm.



ESRI GIS Solutions for the Government in Food and Agriculture

The new ESRI GIS Solutions for Agricultural Government CD-ROM provides ideas and examples of where GIS is currently or will be used in state and local agricultural government activities. In addition, the CD contains free evaluation software, digital data sets of the United States, video presentations of ESRI software, recommended software configurations, and explanations about how a GIS can be implemented within a state or local government office.

Request a copy online at http://gis.esri.com/emails/ag_gov_cd.cfm.

Training and Consulting

Planning is essential to creating a successful GIS facility, starting with an understanding of the GIS business objectives and requirements. ESRI supports implementing an agricultural GIS through its Virtual Campus course named *Planning for a GIS*. The first module of this course is free and may be found at <http://campus.esri.com>.

This Virtual Campus course was created by Roger Tomlinson, Ph.D., one of the world's most recognized authorities in GIS. This course lays out a proven planning methodology applicable for departmentwide or enterprisewide GIS projects.

ESRI Professional Services has more than 30 years of application development experience in creating a plan of implementation for government departments.

Web Site

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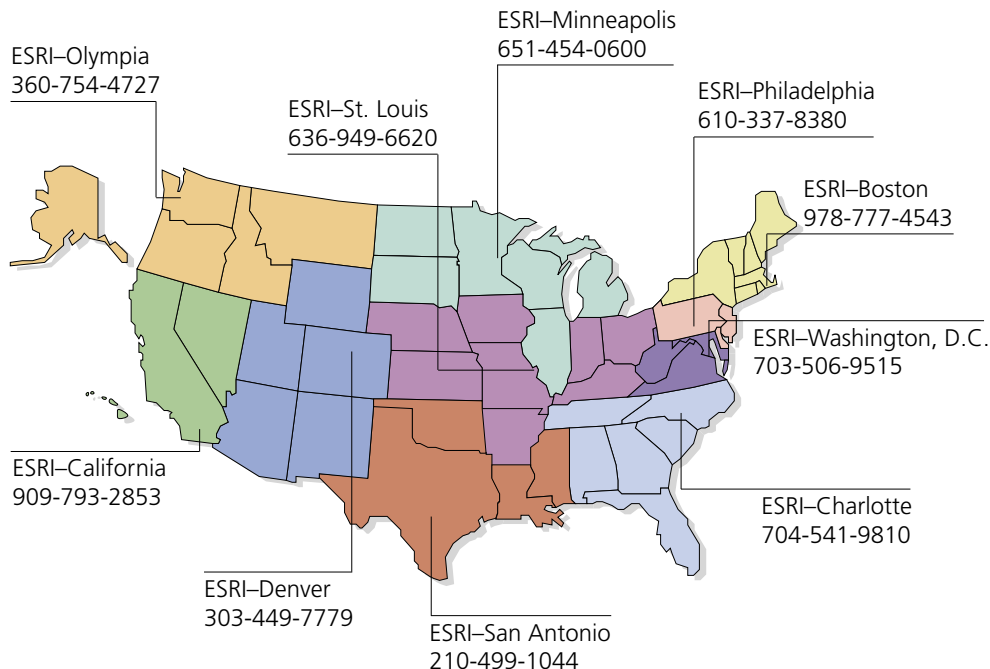
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