

# Deconstructing Precision Agriculture

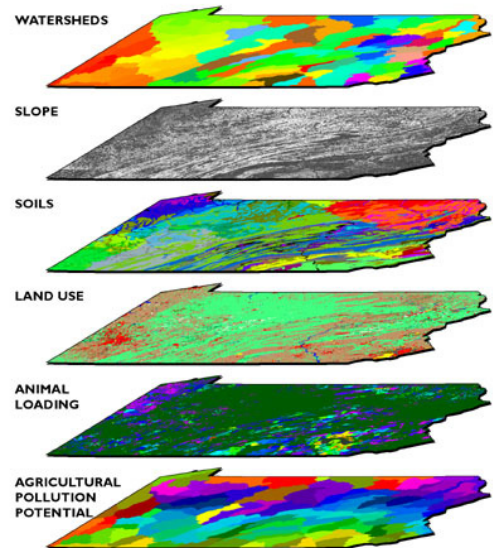
## Data, Computation, and Mapping: The invention of the Geographic Information System (GIS)

*“Data science is agronomy plus statistics plus software.”*

—Dave Gebhardt, WinField

The fundamental concept of precision agriculture is collecting data and making decisions based on that data. A geographic information system (GIS) system provides the analysis tools needed for precision farming. GIS builds on the study of geography by providing the means to organize, manage, and integrate the complex data that is collected in the study of the earth, its contents, and its processes. It also provides a framework for making this knowledge accessible to scientists, planners, decision makers, and the public.

Bringing geographic measurements together with powerful tools for visualization, analysis, and modeling, GIS technology has been implemented successfully in tens of thousands of easy-to-use applications and is increasingly being integrated into the planning, decision-making, and business processes of organizations. Today, geospatial data and technology represent major investments on the part of the U.S. federal government because nearly everything that happens in the public realm happens in the context of geography. Key organizations in the development of GIS include **US Bureau of the Census**, the **US Geological Survey**, and the **Harvard Laboratory for Computer Graphics and Spatial Analysis**.



Example GIS data map overlays.

The rise of the digital culture in the 1960s led to efforts to collect and synthesize data sets with geography. In 1965 the **US Bureau of the Budget** (now call the **Office of Management and Budget**) compiled an inventory of automatic data processing in the federal government, in which it noted the significant use of computers to handle land use and land title data. The **US Bureau of the Census** first demonstrated the use of GIS to map data gathered across the country, address by address. In the 1960 Census of Population and Housing, questionnaires were mailed to respondents and picked up from each household by an enumerator. In 1970, the plan was to use the **US Postal Service** for both sending and returning survey. This demanded geocoding capability and, subsequently, the development of an address-coding guide, such as ADMATCH.

In 1964 Howard T. Fisher formed the **Laboratory for Computer Graphics and Spatial Analysis** at the Harvard Graduate School of Design (LCGSA 1965–1991), where a number of important theoretical concepts in spatial data handling were developed. By 1970, the lab had distributed seminal software code and systems that served as sources for subsequent commercial development—to universities, research centers and corporations worldwide.

*Continued on reverse—*



Science and technology helps feed the world

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## Biographies

**Dr. Raj Khosla** is a Professor of Precision Agriculture at Colorado State University. In 2009, he was named the Colorado State University distinguished Monfort Professor. In 2012, he was selected as the Jefferson Science Fellow by the National Academy of Sciences and is currently working as the Senior Science Advisor in the Bureau East Asia Pacific, U.S. Department of State, Washington D.C. Prof. Khosla is the founder and Past President of the International Society of Precision Agriculture. He is also on the National Space-Based Positioning, Navigation, and Timing (PNT) Advisory Board.

**Del Unger** and his wife, Tammi, operate a 5,000-acre corn, soybean and wheat farm in southwestern Indiana near Carlisle. A Purdue University graduate, Unger began farming in 1983, taking over the operation from his father. Unger's two children are also part of the family business. In recognition of his many contributions to the agricultural community, Del has been named a Distinguished Ag Alumni by Purdue University.

**Dr. Dave Gebhardt** holds the position of Director, Agronomic Data and Technology for WinField, a Land O'Lakes company. Dave has spent over 20 years in the agriculture industry in various plant genetics, agronomy, and technology. Dave and his team are responsible for all data analysis and insight development from WinField's national Answer Plot® research program. They have developed and launched the R7® Tool, an innovative technology platform that delivers variable rate crop input management insights from satellite imagery and WinField's proprietary data. Dave is also responsible for overall development and delivery of precision ag technology and data management solutions for Land O'Lakes' farmer members.

**Dr. Shashi Shekhar**, a McKnight Distinguished University Professor at the University of Minnesota, is a leading scholar in the area of Geographic Information Systems (GIS). He co-edited an Encyclopedia of GIS and co-authored a textbook on Spatial Databases. He received the IEEE-CS Technical Achievement Award and was elected Fellows of the IEEE and the AAAS. Shashi is a member of the Computing Community Consortium (CCC) Council, and a co-Editor-in-Chief of Geo-Informatica journal. Earlier, he served on National Academies' committees (Mapping Sciences, GEOINT Workforce) and co-organized a CCC workshop titled "From GPS and Virtual Globes to Spatial Computing 2020" to catalyze community research visions.

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