Applying GIS to Managing Crop Production Research (Paper #905)

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Submitted Abstract: The Potash & Phosphate Institute is implementing GIS in many ways within its organization including the management of its worldwide research efforts. PPI uses ArcGIS to map their research projects. Using ArcIMS and ArcSDE, PPI has begun to share their research maps via the internet adding efficiency to internal communications about projects and building exposure outside the Institute regarding the scope and detail of research projects. This presentation focuses on the end results and how they are used internally and with others, but it also tells the story of how PPI is adapting GIS technology into its business functions.

The Potash & Phosphate Institute (PPI), the Potash & Phosphate Institute of Canada (PPIC), and the Foundation for Agronomic Research (FAR) provide support and oversight to crop and soil management research throughout the world. Since 1980, FAR has supported over 1,000 research projects, and currently has approximately 100 projects in North America and 110 international projects on a variety of topics addressing local needs. Funding for these projects comes from a variety of sources, including industry contributions, government agency grants, and producer organizations. The research is done mostly by university research and Extension staff in cooperation with PPI and PPIC regional directors. Much of this research is conducted in the field, often on sites owned by farmer cooperators. The result is a widely geographically-dispersed research program, representing a wide range of soil and climatic environments. This creates both strengths and weaknesses in managing a research program. The primary weakness is the decentralized nature of the overall research program, but that is also in many ways a strength of the program, because it provides a wide diversity in results. Through the use of GIS, we can hopefully remove many of the coordinating problems of a dispersed program, and building on the positive aspects of a dispersed base.

At the simplest level, GIS allows us to visualize the geographic distribution of research sites. That is useful in recruiting sponsors who often are interested in the scope of impact of their contributions. It also helps us identify areas not being reached by our research program. We can then seek out partners to improve the coverage.

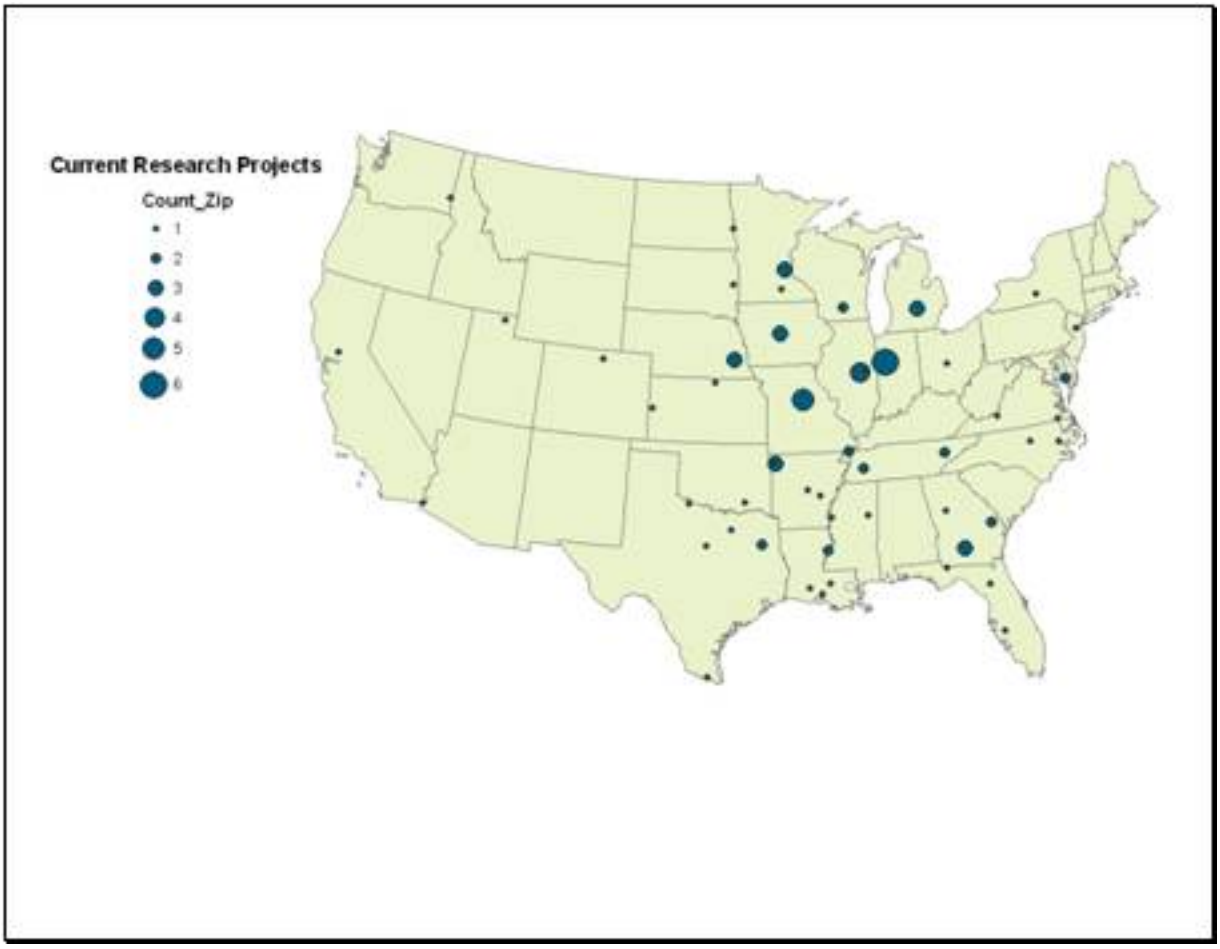

Figure 1. Distribution of current FAR research projects in the United States. Point locations represent the Zip Code of the researcher's base location. Size of the symbol represents the number of projects at the same location.

We are just building these capabilities and have many gaps to fill. But the process is helping identify the metadata needs that are often overlooked in research project records. This is especially critical for research that is done at locations other than the traditional university research farms. With the large number of projects and the over time, a cumulative GIS map of project locations would help us track our total program for both internal use and for communicating to our supporters and others. In talking to prospective supporters, matching our research demographics to their regions of interest would serves as a valuable "marketing" resource for attracting supporters for our research efforts. It would help us visually represent the scope of our program to them.

Many of the FAR projects are in programs for which we serve as coordinator/manager for several university contracts. These often involve sites in several states where researchers are working on related studies. We are building the GIS databases and supporting software to provide opportunities for these researchers to collaborate among one another and share databases. In some cases, this will allow them to build upon one another's work and facilitate communication among the projects. Some of these are testing specific products or practices for an individual company. Others are developing different parts of a management system or alternatives to system

components that are better suited to different areas of the country.

For the past several years FAR has coordinated site-specific management systems research for the United Soybean Board. Funding provided by the U. S. soybean producers supports these projects. Projects in 16 states across the Midwest, MidSouth, and Mid-Atlantic regions involve about 100 cooperators, as well as multiple co-sponsors, with many of the sites located on farmers fields. Most of the projects involve GIS databases and various examples of implementing GIS applications at the farm level. These projects are an excellent candidate for the use of ArcIMS, ArcSDE, and the other tools. Multiple users need access to the same databases and need to be sure they have the current data. Developing this system is a major challenge, but the potential efficiencies gained are very attractive.

The availability of the ArcGIS, ArcIMS, and ArcSDE tools provides some new dimensions upon which we can build a more useful and dynamic research management system. For example, linking the project location database with other GIS information would help identify research projects that represent certain soil types or have other defining characteristics. If a researcher studying the yield response of corn to potassium under no-till management on low organic matter soils, wanted to know what other projects we have sponsored on similar soil types over the years, we could scan the project database to identify the projects he might wish to review. Listings of publications and project reviews linked to the GIS could then provide an important review of previous results or could help identify potential collaborators in other geographic areas.

As the number of projects in our database increases, the GIS tools will become a critical resource for our program. With education as a dual mission, we use the research program to provide material that is developed into training programs on crop and soil management. The GIS database could locate research results most appropriate for the people for whom the training is being prepared helping improve the relevance to the audience and focusing the examples to their local area. As site-specific management systems are more widely implemented, such targeting of information will become even more critical.

Another aspect of GIS in research is implementing GIS tools to assist in conducting research, managing data, and analyzing results. We encourage our research cooperators to use GIS tools wherever appropriate in planning research and logging data. Special ArcView extensions have been developed as part of our research program. The Enhanced Farm Research Analyst (EFRA), for example, has been widely adopted by researchers at universities and in industry to assist in their design, implementation, and analysis of on-farm research plots. This program packages most of the tedious, repetitious tasks of dealing with plot design, data management, and data analysis, greatly reducing time commitments and providing better standardization of procedures among researchers.

We are building the capabilities of ArcIMS and ArcSDE into our program so that our databases will be available to all of our staff and to cooperators who are important to our program, hopefully improving efficiency in sharing information. GIS data sets, remote sensing imagery, and other project information are being shared among people involved in our research projects, so that all can work from the same databases and be assured that they have the most up-to-date files. We are just beginning to learn and appreciate the power of these tools in a distributed collaborator environment. As the resources on this site expand, its value will be further realized.

The soil-crop-environment-climate-management system is NOT uniform across the landscape and should not be treated uniformly. GIS tools help us understand, document, and manage the differences. They also help us find similarities that lead to better coordination of research and of management decisions. They help us identify which research results are most likely applicable to the local situation and thus avoid costly mistakes or duplication of research efforts. Future enhancements to the value of GIS as a research management tool depend upon selling researchers today on the importance of proper documentation of their research with GPS coordinates and GIS metadata so that the power of GIS can be better utilized in working with project results.

The implementation of GIS and the related services discussed here will help maintain PPI's position as a trusted source-of-choice for current, science-based crop and soil nutrient management information and educational tools. It will help us maintain our leadership role in helping farmers, input suppliers, and service provider evaluate and implement the best technology for assisting their role in providing adequate, high quality supplies of food, fiber, and energy to the world, and doing so in a way that is agronomically sound, economically sustainable, and environmentally responsible.

Future plans include expanding our use of ArcIMS and ArcSDE to provide our information services to others, enhancing our ability to influence and support management decisions on a wider scale. Building these resources into our education program will enable us to provide management decision tools to trainers and have them linked to dynamic databases so that the trainers can always have access to up-to-date files. Some of these tools may eventually be made available for farmers and their advisers.

Site-specific management of agricultural fields is critical to the sound application of science in production systems to make most efficient use of land, water, labor, and capital resources. Practices and input rates best suited for a given field…or area of a field…must be selected on the basis of good knowledge of the expected results. Fine-tuning management to the local conditions is the best way to make the right decision, and it requires the kind of detailed information and information analysis that GIS is designed to provide. Management decisions that can potentially impact the environment within the field as well as off-site must be made with the best available information that is specific to the site involved. GIS allows the databases to be analyzed and

aggregated at various scales as appropriate to the decision to be made. Most important, GIS tools allow a variety of levels of decision-making to work from the same basic databases. That helps ensure coordination of the decisions and may help us understand the interactions of decisions at the local, regional, and even global scales.

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