

AGRICULTURAL WATER MANAGEMENT VIA THE WEB: THE GEORGIA FARMER PORTAL

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Abstract. Since the middle 1980s the state of Georgia has required that all water withdrawals totaling more than 100,000 gallons per be registered with the Department of Natural Resources. These permits are divided into categories as to the type of use such as municipal, industrial, or agricultural. In 2004, the Georgia State Legislature required that all 21,000 agricultural water withdrawal permits be metered with the intention of monitoring use by annual meter readings. The potential to have metered annual use is an excellent opportunity for regional analyses of agricultural water use. However, an economical means of collecting the statewide “value-added” data behind the water use is paramount for any meaningful analysis to take place. The Georgia Farmer Portal is that mechanism. Using an interactive web-based platform, farmers can catalog events such as rainfall, crop type, planting/harvest dates, irrigation information or most any other variable pertaining to water use. Incorporating the latest aerial imagery available in conjunction with an extensive GIS database, farmers can manage their information via visible, geographic locations such as meter locations or individual fields providing a total picture of irrigation and crop practices through out the year. The data can be presented to the farmer in terms of their yield and water use in comparison to averages in a pre-determined area such as county, basin or state. Reports can be generated on the basis of crop, soil type, tillage system, seed type and others. The Georgia Farmer Portal also collects valuable information that can provide local, regional, and state irrigation and crop data on common geographic divisions necessary for informed policy decisions. The information collected can further be applied to the documentation of “reasonable use” for individual farmers and in support of interstate issues relating to water allocation.

INTRODUCTION

During the 2003 legislative session, the Georgia legislature established a mandate for the metering of agricultural water use. During 2005 and 2006, with financial assistance provided by the U.S. Department of Agriculture

and the State of Georgia, the Georgia Water Policy and Planning Center (hereafter, Center) initiated a data collection program designed to develop a data set that would allow for meaningful analysis of water use data generated by the metering program and provide information that farmers might find useful in their efforts to improve the management of water resources used for irrigation. Data collected by the Center for these purposes required a series of field visits to a small subset of cooperating farmers for the purpose of obtaining farm- and field-specific information: soil types, source of water (ground or surface, and if surface, whether or not the source was a perennial stream or a non-perennial stream or pond), rainfall during cropping season, crops planted and harvested (by acreage and field), and yields.

Over the past year, attention was focused on a means by which the largest number of farmers possible could become directly involved with the reporting of raw data for research purposes, and by which substantive information could be immediately relayed back to farmers. The means developed for this purpose was the on-line-accessible Farmer Portal. Unveiled in March 2006, the Portal utilizes the latest in interactive web technology to establish a link between researchers and the largest, and perhaps most unknown, group of water users in the state, agriculture. A demonstration version of the Portal has been established, wherein hypothetical data can be entered and results displayed, which is used for the descriptions of the Portal given in this report. The reader can access the on-line demonstration of the Portal for a hands-on appreciation of how the Portal works by visiting the Georgia Water Policy Center website

<http://www.h2opolicycenter.org>.

TECHNICAL DESCRIPTION

Computer Configurations

The Farmer Portal is a composite software and data arrangement that resides in and is operated by a minimum of two computers. The first computer provides a connection to the internet and has access to the World Wide Web

(WWW). Security measures are applied to this computer to prevent attacks from the WWW. Farmer Portal data is not stored on this computer; however the components necessary to create the user interface are.

The web server software, Microsoft's Internet Information Server (IIS), handles all communication between the computers of individual users and the WWW. It was important that all applicable updates and patches were installed on both the operating system and IIS before introduction to the WWW. IIS interprets Hypertext Markup Language (HTML) directly from a website and sends it to clients upon request. However, IIS does not understand additional non-HTML code such as JAVA or BASIC often found in more advanced websites such as the Farmer Portal. To compensate for this shortcoming, New Atlanta ServletExec is utilized to interpret non-HTML code to IIS.

The first computer also houses ESRI ArcIMS, the software that provides internet mapping services (IMS). ArcIMS offers mapping functions necessary for area definition and objection selection, which are evident when a user logs on. The operating system is also directly responsible for presenting maps of the user's individual area, and allows for selection of irrigated areas prior to data entry.

The second computer houses the Farmer Portal database along with necessary software to perform database functions. This computer is placed behind a firewall with sufficient security to prevent unauthorized access from the WWW. A two-computer design is necessary for security and traffic capacity. The Portal database created with this system contains private information, and is protected behind a firewall that can only be accessed by specific ports and systems. All other components are simply there to serve the database and thus require less protection on a separate computer. The basic premise for the two-computer configuration is that such a design will facilitate participation through quicker service given the large number of clients that may service the Portal. When a database is publicly available and has the potential to grow extremely large, ESRI recommends that IIS and IMS function from the same computer while the database managing software resides on a separate server. The Portal was designed with the anticipation of handling traffic from over 25,000 agricultural withdrawal permit holders.

Website

The user interface of the Farmer Portal is a composite software and programming package. The actual web pages are written in HTML with applets from JAVA and .NET. The data entry is managed through four generic steps: database design and management, programming of web forms where data are entered, software that links the form information to the database, and software that acts as the Relational Data Base Management System (RDBMS). The concise presentation of web forms prompts a user to

enter textual data such as account information, rainfall, and irrigation, which are all saved in the database.

The interface also includes a map to aid in the location and selection of irrigated areas through the function of IMS. IMS is visually appealing and automatically enables only the functions needed for given maps. In order for ArcIMS to function properly, access to in-house geographic data allows specific portions of geodatabases to be extracted using a Spatial Data Engine (SDE).

Database

The core of the Farmer Portal Database consists of 10 tables (Table 1), each encompassing a specific theme; key components include a user, meter, water source, field, crop, and water use. Much of the data entry is required only once, while other factors may be updated more frequently based on annual, monthly or even daily events.

The database was designed to store more frequent data entry in annual divisions. These core tables are populated by two methods. The first method is direct entry by users via web forms. The second method is geographic analysis, which automatically fills data entries such as county, quadrangle, or hydrologic unit based upon an object's geographic location. Location analysis often references external sources from various Georgia and national database programs, as seen in Table 2. Each of the database tables are linked by a meter serial number or unique field code. These tables allow an operator, or producer, to have an individual account for their meters. From there, a

Table 1. Core data tables in the Farmer Portal Database.

Name	Description
Operator	Contact information and user identification
Location	Location and descriptive data of each ag meter
Water Source	Location and descriptive data of water sources
Use	Total acres, number of fields, irrigation systems, and units of measure per meter
Field Description	Individual field acres, soils, and corresponding meter(s)
Irrigation System	Irrigation hardware and conservation measures
Cropping Information	Annual crops, plant date, harvest date, tillage, and yields
Irrigation Schedule	Date and amount of individual irrigation events
Rainfall Record	Date and amount of individual rainfall events
Annual Irrigation	Annual meter reading, install date, and current condition of meter site

source location is linked to each meter serial number of unique field identifier. The meter serial also provides a link to annual water use and wetted acreage sums. Additionally, a unique field ID number connects each irrigated area with annual crops.

The Portal database is served by Microsoft SQL Server 2005 Enterprise Edition on the same secure computer. The SQL server manages all commands from the Portal user interface and applies the commands to the database. Tasks include saving entered data to appropriate tables and fields or locating values previously entered. Complex queries involving conditional statements that range across multiple tables in the database such as average water use for a given geographical area by crop can also be utilized. The SQL Server manages these tasks through table links while maintaining the integrity and consistency of the database. Entries from web forms are sent directly to the database by accessing the SQL Server.

Data used by the IMS are in a geodatabase format. This type of format allows all features of the geographic data to be stored as individual records while simultaneously permitting multiple themes in a single database. The geodatabase design mimics the format of many RDBMS. It offers known methods for creating and maintaining tabular data that are associated with the geographic data. Unfortunately, RDBMS does not understand spatial data, although it can manipulate it using standard core operations. RDBMS can not perform geographic type queries and therefore requires an interpreter such as the SDE. When the user moves to a location in IMS, the software sends a request to the SDE. Since the SDE holds the supporting geodatabases, it in turn provides requested information back to IMS. Since a geodatabase contains a mosaic of all possible data over all possible areas of the project, the SDE takes the current geographic location from the IMS viewer and extracts only the data needed from the geodatabase. The data is converted to a JPEG format for rapid internet transfer. In addition, the SDE takes requests from the IMS viewer and forwards them to the SQL Server. SQL Server processes the request and sends the query results back to SDE. The Farmer Portal

Table 2. Additional data sources

Database		Source	Data Used
TIGER		US Census Bureau	County, Zip Code
National Database	Hydrologic	US Geological Survey	Hydrologic Unit Code
SSURGO		USDA-NRCS	Soil Texture
Georgia Transportation	DLG-F	Georgia DOT	Roads
River Reach 3 base	Data-	US Geological Survey	Streams

uses ESRI's ArcSDE and resides on the computer behind the firewall.

Software

The following software is being utilized in the operation of the Farmer Portal:

- Microsoft Internet Information Service
- Microsoft Structured Query Language Server 2005 Enterprise Edition
- New Atlanta ServletExec
- ESRI ArcIMS
- ESRI ArcSDE

DISCUSSION/APPLICATION

The strategy behind development of the Farmer Portal was to provide end users, i.e. farmers, a useful management tool while simultaneously creating a vehicle to collect the "value-added" information needed to make annual water use numbers meaningful for policy analysis. With this in mind, the home page provides farmers with free access to real-time, user specific commodity prices and weather conditions, useful links to government and commodity organizations as well as agricultural news and information. From the home page, farmers can login to their existing account or create a username and password if they are first-time users. Once the initial account set-up is complete, users can build their farming operation into the Portal by adding individual fields. Farmers are presented a default image based on location data entered during account set-up. From there, they have the ability to pan and zoom to specific locations and claim fields with one or two clicks. Although each field is assigned a unique number in the Center's database, the Portal allows users to personalize areas consistent with existing management such as "Home Place" or "North 40."

For each field, the farmer is asked to provide the following information: whether or not the field was irrigated during the current year; type of pump; whether his system is a towable; whether or not there is an end gun shut off installed on the system; crops harvested from the identified field, yield for each crop, seasonal total rainfall received during the time between planting and harvesting of each crop, water used (acre inches) for irrigation of each crop, meter reading if applicable, harvest date, seed type, type of tillage, yield and others. This information is then used to generate real-time reports in which the farmer can compare their operation to those with similar characteristics. Further, it is precisely this information that is of critical importance to policy research by providing the connection between water use and the economy supported at the individual, regional and state level.