

CONSERVATION INNOVATION GRANT Final Progress Report

Grantee Name: Agren Inc.
Project Title: Integration of GIS, Expert System, and LiDAR Technologies for Conservation Planning in Iowa
Period Covered by Report: Feb 2009 – April 2009
Project End Date: July 2009 (one-year, no cost extension requested)

Summary of project activities

Objective 1: Define the scope of the conservation planning decision-support tool and establish evaluation criteria for the final product.

Agren, Inc. and Iowa Department of Natural Resources convened a two-day stakeholder meeting in October 2006 as a first step to developing an electronic decision-support tool to facilitate use of LiDAR, GIS, and expert system technologies. This meeting was an integral step to further develop, demonstrate, and evaluate the use of LiDAR for conservation planning in Iowa, as well as develop an electronic decision-support tool to facilitate use of this technology.

Stakeholders, including approximately 15 conservation planners, watershed specialists, farm managers, and others participated in the meeting. Participants were invited to assist in the software visioning process because they are potential users of the tool.

The key audience for the decision support tool is conservation planners serving multiple federal, state, or local offices throughout Iowa. NRCS soil conservation technicians and conservation planners, state and county-level watershed and environmental specialists, and technical service providers are all considered key users of the decision tool. These users will have some level of conservation planning experience and expertise. However, the tool must provide sufficient “direction” for planners who may have less than five years conservation planning experience. Many users will have little or no previous GIS experience, and there should not be a need for any user to undergo formal training to use the tool. Farmers are not considered a key user of the proposed tool.

The input from the Stakeholders is hereby summarized. Sample desirable features of the proposed tool include use of drop down boxes and other similar controls that eliminate the need for extensive typing. Relevant help information should be accessible through the main interface, rather than buried in help files. The tool should lead users through layout in a step-by-step process, similar to the geo-processing wizard used in ArcView applications. Furthermore, the interface should allow users to save and compare multiple layout scenarios. However, the decision tool should not be too automated, preventing users from interacting or overriding the tool’s recommendations. It also should not present the users with too many options, making it difficult to navigate.

The decision tool can improve planning efficiency for a number of conservation practices. The following five practices were listed as the priority practices for Iowa: 1) erosion control ponds; 2) terraces; 3) waterways; 4) contour buffer strips; or 5) wetlands.

A number of criteria will be used to evaluate the proposed decision tool in its final stages of development. The planning process should not take more time than it currently takes and should allow for an increased accuracy of the cost and layout. Cost estimates should be within 10 to 15 percent of the final design estimate. The accuracy of the layout should be logical and should never violate major design rules. Training requirements for users should be minimal, regardless of the user's previous experience with GIS. Finally, the tool should increase the value of the conservation planning experience for 95 percent of both conservation planners and their farmer clients.

Agren and Iowa DNR used this feedback to define the scope and attributes of the final decision-support tool and to prepare for an expert panel meeting.

Objective 2: Identify and evaluate existing technological resources that can be utilized as part of the decision-support tool.

In May 2007, a web conference was held with several staff members from the NRCS Application Development Team in Fort Collins. The group shared information on NRCS direction for future conservation planning applications and answered some questions Agren had regarding how to develop our application in a way that would be most compatible with NRCS applications in the future. Agren also requested representation from the group at the June expert panel meeting. NRCS declined the offer to send someone, but recommended a contractor from Synergetics, Inc. who worked closely with NRCS.

An expert panel (scientific review) meeting was held in Nebraska City, NE on June 2007. Participants included 15 subject matter experts representing the fields of GIS modeling, expert systems, conservation planning, state & federal government programming standards, etc. The purpose of this meeting was to define the technology architecture, programming standards, database platform, etc. of the decision tool. Recommendations were formed through two days of facilitated large and small discussion. This meeting was postponed from the original planned timeline of December 2006 to accommodate development of decision trees for each of the conservation practices. Originally, these had been planned to be developed after the expert panel meeting rather than prior to the meeting.

Objective 3: Develop a GIS-based expert system utilizing LiDAR technology for use as a decision-support tool for conservation planning.

Final recommendations from the expert panel meeting were used to define the technical requirements and other variables needed to develop a bid solicitation for GIS vendors. This solicitation was distributed to identified vendors in early August 2007. GIS Workshop in Lincoln, NE was selected as the subcontractor.

Decision trees (also referred to as use-case diagrams) were developed for each conservation practice (level and graded terraces and erosion control ponds). These charts diagram in great detail the processes that conservation technicians go through to layout each conservation practice.

The first conservation practice attempted was TerraceBuilder. Several large barriers were encountered which eventually led to the shelving of this tool. The largest barrier was that a tool that allows part of a terrace to parallel an upslope terrace and the rest of the terrace to follow the contour isn't possible given the current budget.

The first conservation planning tool completed was PondBuilder. PondBuilder is a tool used for ponds built via an earthen dam, not a pond built via excavation. The next conservation planning tool completed was BasinBuilder, otherwise known as a Water and Sediment Control Basin. The third tool, RCNCalculator, is imbedded within the interface of both the PondBuilder and BasinBuilder tools.

Objective 4: Serve and assess LiDAR data for use in the conservation planning decision-support tool.

Statewide LiDAR acquisition began in October 2006. Iowa DNR coordinated with other state partners to serve and distribute LiDAR data. The raw LiDAR data has been processed into the following products: first return DEM's, last return DEM's, bare Earth DEM's, two foot contour lines, and hillshade grids.

The DNR developed a LiDAR distribution portal through the University Of Northern Iowa. The UNI site is the primary location for public access to the data. The Iowa DNR processed 2 foot contour lines for all counties with a complete LiDAR data set. Both the 2 foot contour lines and the LiDAR data are being offered in a SDE format. Data can now be downloaded from the site (<http://www.geotree.uni.edu/LidarProject.aspx>) and derivative data sets are being shipped to UNI for distribution. Failover systems have been built at the DNR and DOT data centers.

Iowa DNR has completed their report on ground-truthing of the LiDAR elevation data. The vertical error of the data is less than 6 inches in elevation, making this data acceptable in the planning process. Several NRCS employees have indicated that the LiDAR elevation data is accurate enough to allow for conservation practice design (beyond the scope of this CIG) and will continue to evaluate it.

Objective 5: Implement and evaluate the use of the decision-support tool with conservation planners and farmers in four Iowa watersheds.

Pilot testing of the PondBuilder conservation planning tool took place in four counties: Union, Ringgold, Fayette, and Winneshiek. Pilot testing of BasinBuilder took place in two counties: Fayette and Winneshiek. Approximately 9 Soil Conservation Techs, 2 Engineering Techs, and 3 Engineers tested the tools.

The users of the PondBuilder program were very happy with the simplicity, accuracy, and time savings when planning a pond. One technician reported 120 estimates for pond sitings over the course of a year. In evaluating the tool, they either agreed or strongly agreed that the PondBuilder tool improved their effectiveness, efficiency, and accuracy in planning ponds. Most indicated that they could plan a pond with PondBuilder in less than 20 minutes.

In the final BasinBuilder Satisfaction Survey, the majority of respondents planned 1-4 basins with the tool. The group consisted of technicians with varying levels of experience in planning basins. In evaluating the tool, most respondents indicated that they could plan a basin with BasinBuilder in less than 20 minutes. In evaluating the final criteria BasinBuilder was expected to meet, the group unanimously indicated that the tool met the expectations.

Landowner's were very satisfied with the PondBuilder program. The majority had worked with the NRCS office in the past, but found that the working with the office and using the program provided a more valuable experience. One landowner stated that the PondBuilder program was a great help in visualizing how the pond would lay out in the field, and was helpful in communicating with field staff. Landowners also liked the fact that they could compare and contrast different options for a pond and that they could make a timely decision on whether or not to pursue building a pond.

Objective 6: Expand utility of the decision-support tool with statewide LiDAR coverage.

The State of Iowa was successful in securing funding to obtain state-wide LiDAR coverage. The contractors finished LiDAR data collection in the Spring of 2010. As of April 2010, all data and derivatives for 39 counties have been made available to the public. Data for the remaining counties should be served up by the end of the Summer 2010. This is allowing us to expand the utility of our conservation planning tools across the state.

Results

The ultimate result of the Conservation Innovation Grant is the development of the conservation planning tools; PondBuilder, BasinBuilder, and RCNCalculator. These tools allow conservation planners to provide quick and accurate estimates to landowners for ponds and water & sediment control basins. The RCNCalculator has been built into the other two tools but can be used to estimate the runoff curve number for other conservation practices.

The pilot users of the conservation planning tools state they can:

- Develop an estimate in less than 30 minutes
- Provide an estimate to a landowner that has an accuracy greater than 90% of as-built designs
- Give landowners numerous options for a structure at any given site
- Reduce the number of contract (EQIP, etc) revisions necessary because of the accuracy of the estimates
- Operate the tools with very little training

Potential for Transferability

The transferability of these conservation planning tools is somewhat limited to the counties/states that plan ponds with earthen dams and water & sediment control basins. Also, LiDAR is necessary to operate the tools.

Yet, even though the grant objectives have been completed, Agren continues to develop other conservation planning tools. Two tools are currently being developed; WetlandBuilder and SoilLossCalculator. In addition, the scope of work is currently being drafted for WaterwayBuilder. All three of these tools are being developed via non-federal funds.

The scale-up of the conservation planning tools is already taking place. Agren submitted and received an Iowa CIG to ramp up the number of counties accessing the tools. The State of Iowa, Division of Soil Conservation is partnering with Soil and Water Conservation Districts to fund the licensing of the tools throughout the state. These combined efforts will make the conservation planning tools currently developed and those being developed available to all 100 Districts through June 15, 2013.

Currently three other states are pursuing the licensing of conservation planning tools in portions of their states. An additional five states have shown an active interest in the tools but are awaiting acquisition of LiDAR data.

Long-range plans include the licensing of the tools to the private sector including engineers, TSP's etc. The private sector entities will need to determine if they meet state laws regarding Engineering license requirements.

Conclusion

Given the status of Federal and State budgets, it is not likely to expect more government staff in Field Offices. Therefore, it makes sense to use technology to increase staff efficiencies. The conservation planning tools, made possible through the availability of LiDAR, allow staff members to provide accurate cost estimates in a short amount of time.

The LiDAR technology opens up a lot of possibilities, both in conservation planning and in practice design. As with any elevation data, the functionality will depend on the quality. High quality resolution data combined with the conservation planning tools will allow the conservation planners to provide accurate information to landowners. As the resolution of the data declines, I would expect the accuracy of the tools to decrease. Low resolution data will likely diminish the usefulness of some conservation planning tools such as WetlandBuilder and WaterwayBuilder.

The overall goals and objectives of this project have been met through the implementation of this Conservation Innovation Grant. Even more exciting is that all of the work, effort, and financial investment is paying off as the Soil and Water Conservation Districts across Iowa acquire a license to the Conservation Planning Tools. And, as mentioned above, other states are also interested in licensing the tools. These efforts will greatly speed conservation planning efforts.