Evaluation of the Agricultural Conservation Planning Framework

Final Project Report

May 2016

Project Methods

The project was funded by a one-year grant from the McKnight Foundation to the University of Minnesota Water Resources Center, May 2015 through April 2016, led by Les Everett, P.I., and Ann Lewandowski, Project Coordinator.

The project approach was to prepare staff of at least three watershed organizations in Minnesota to conduct a GIS-based watershed analysis to locate the most effective sites for installing specific conservation practices that would moderate stream flows and reduce sediment and nutrient delivery to streams. Those staff would then run the analyses in their watersheds, evaluate the GIS toolset, and use the output with landowners to help them site conservation practices.

Two, two-day trainings on the Agricultural Conservation Planning Framework (ACPF) GIS tool set were conducted at a computer teaching laboratory in Mankato, Minnesota in May and August, 2015. A total of 39 GIS-capable staff participated, from eight Minnesota Soil and Water Conservation Districts (SWCDs) and counties, plus state and federal agencies, universities, NGOs, and private consulting firms. The trainings were led by three ACPF development staff from USDA-Agricultural Research Service in Ames, Iowa. Local examples of how the ACPF results had been used with landowners for siting practices were given. An evaluation of the training was carried out via questionnaire and results were provided to the training team.

Contracts for conducting and evaluating the ACPF were implemented for Stearns SWCD, Whitewater Watershed Project, Greater Blue Earth River Basin Alliance, Waseca County, the Land Stewardship Project (Chippewa River Watershed), and Minnesota State University-Mankato. Their staff had all attended the training. They all conducted analyses of HUC-12 size watersheds. In the short time-frame, they had little opportunity to field verify the output, or use the maps in their planning and implementation activities. However, observations on field use of the output were obtained from two previous users of the ACPF. Observations on the use and utility of the ACPF were obtained through personal interviews and questionnaires.

Interview Results

Kudos: What did users like about the ACPF?

In general, users were happy with how easy it was to use the tools. Even when they knew how to hydro-condition DEMs and define watershed boundaries without ACPF, they generally preferred to do these tasks using ACPF tools because of their ease of use.

Users appreciated that the input databases were prepared for them, and all they had to add was the DEM.

At several points, users expressed appreciation for the flexibility of the tools so they could be used effectively to meet unique local needs.

Another value of the ACPF is that analyses are on a farm-field basis – which is typically how conservationists do their work. Users appreciated seeing slope and runoff risk mapped to farm-field boundaries so they could easily combine it with parcel data to identify landowners.

Time and expertise: Can LGUs run the ACPF?

Time

The ACPF is intended for analysis of subwatersheds of 10,000 to 30,000 acres – i.e., HUC-12 watersheds. Respondents took 2 to 10 days to generate ACPF output on a single watershed. The amount of time depended on the size of the watershed, the experience of the user, and most significantly, the complexity of the hydro-modification required to prepare the DEM and define stream networks. Hydro-modification is the most time consuming part of the process. In fact, once the stream networks have been defined, the tools for siting practices can be run in four to eight hours. Hydro-modification will go faster if a database of culvert locations is available or a layer of "cut lines" has already been developed for other purposes. The process will go slower in flat landscapes where the flow networks are driven by low-relief features such as roads and other man-made features.

Computer processing time is generally fairly rapid – several minutes at most for the more complex tools. But this assumes that users are following the guidance to use 3 meter instead of 1 meter resolution DEMs, and converting vertical (z) units from decimal meters to integer centimeters. Using 1 m DEMs substantially increases processing time without improving the usefulness of the output.

Expertise

Running the ACPF tools requires moderate proficiency in ArcGIS; knowledge of local topography, hydrology, and land use; and understanding of how conservation practices are implemented. A few individuals may have all those skills, but more commonly, the ACPF is run by a GIS technician in close consultation with one or more local field experts.

More specifically, users require intermediate knowledge of ArcMap Advanced 10.2 or higher, and should be comfortable with geodatabase naming and storage, editing procedures, geoprocessing tools, and multiple data formats. Users should have enough experience to do basic spatial troubleshooting.

Soil and Water Conservation staff, or other field technicians with knowledge of the local landscape and conservation practices are needed (1) to check the hydro-modification linework, stream network, and perennial stream designations; and (2) to choose appropriate thresholds

for conservation practices and interpret results. Some training is important to understand the tool options and choose the appropriate options for local conditions.

Note that hydro-modification and identifying perennial streams were the most time consuming tasks, they require local expertise, and have substantial impact on the accuracy of the output.

Software

One of the most significant barriers to LGU use of the ACPF is the requirement for an ArcGIS Advanced version 10.2 or higher, with a license for Spatial Analyst extension. The limited functionality of the basic license without Spatial Analyst extension prevents users from identifying the stream networks and running the buffer tool. In Minnesota, NRCS offices have advanced licenses, but, anecdotally, most SWCD and county GIS offices do not.

Some have suggested that ACPF analyses could be done at regional offices to get around this software constraint. However, local knowledge of landscapes and land use are important to correct hydro-modification, setting of input parameters, and interpreting results. Local conservationists also benefit from being able to run scenarios flexibly, as needed.

Training: What guidance and support do users need?

Users mentioned several topics that were addressed in their training that they wanted to emphasize to other new users:

- Prevent excessive processing time by preparing input DEMs correctly; i.e., use 3m DEM and convert vertical (z) units from decimal meters to integer centimeters.
- Choose appropriate area thresholds for Peuker-Douglas.
- Use best practices for hydro-modification and defining stream networks. Avoid over-editing the DEM. Consider overlaying a fishnet on the area to systematically work through the watershed.
- Hierarchical naming conventions and file paths are important; use them systematically.
- Plan how to accommodate new information such as
    - Land use and management changes,
    - Existing practices,
    - Improved hydro-modification,
    - Updated cropland data layers.
- Keep in mind that the tools (e.g. WASCOB tool) are meant for general siting, not precise design.

A few topics could be enhanced in the existing training:

- Provide guidance on ways to prioritize practices.
    - How thresholds can be adjusted for some of the tools
    - Use the runoff risk table to prioritize WASCOBS, waterways, etc.
    - Combine with other prioritization techniques such as SPI, analyzing existing buffers, etc.
- Thoughtfully manage versions when you run alternative scenarios by adjusting input parameters. Best practices for eliminating data redundancy and duplication.
- Think about other layers that will be needed such as
    - aerial images and stream network layers to help hydro-modify the DEM.

        - one user used aerial images to code grassed waterways as in-field, road, etc.
    - existing conservation practices
    - Minnesota's restorable wetlands map
    - local information on ditching and drainage to aid hydro-conditioning
    - parcel data and feedlots to help with local prioritizing
- How to export to a KML file for easy display in Google Earth
- Compare different options for identifying water storage and detention
    - WASCOB tool
    - treatment wetland tool
    - filling pits
    - others?
- For accurate results, it is important to edit drain tile tables to ensure fields are correctly identified as having tile, not having tile, or non-ag.
- What are the recommended ways to deal with urbanized areas within a watershed?

Some of the suggestions related to user support beyond training:

- Need a user guide for decision-making boards and for landowners/farmers
- Could use basic step-by-step videos (e.g. like the LiDAR videos)

Enhancements: What functions would LGUs like to see in the ACPF?

Support use of basic license

As mentioned above, the cost of the advanced ArcGIS license is a significant barrier to local use of the ACPF. It would help tremendously to provide alternative ways to achieve some ACPF functions using a Basic License.

Support prioritization

The ACPF is designed for identifying opportunities, not for prioritizing projects. Still, local staff need information about which sites are more or less critical to treat. The tools for siting practices are valuable to local work flow, but even more important is the ability to identify problem areas. The ACPF could be improved to support prioritization needs by (a) further highlighting critical problem areas, and (b) highlighting the most important sites for specific practices.

The ACPF effectively highlights critical areas with the erosion risk tool. These maps are some of the most useful to local staff. Users also asked for a tool to calculate and display Stream Power Index (SPI). One person was looking for a map identifying sensitive lands, e.g., lands prone to flood, steep slopes, proximity to water, and land capability classes.

Regarding specific practices, users can highlight higher impact sites by adjusting input values, and by combining results with data from runoff risk analysis. These functions should be featured in the user manual.

Track inputs

Another request from users was for an easy way to track the input choices made while using the tools that could be pulled up as an easy-to-read metadata table.

Work with individuals

Users noted that most of their work is done with individual landowners, not at the watershed scale. Would there be a way to run some of the tools for a single landowner, allowing users to bypass some of the hydro-modification, and efficiently respond to a landowner who "walks in the door", but who is not in a watershed that has been analyzed.

Additional practices

When asked about additional practices, users were mostly content with the current selection: waterways and sediment basins are the most common practices that users need to site. Requested additional tools included:

- Terraces,
- Defining lakesheds,
- Saturated buffers,
- Prairie strips, and other components of perennial systems. I.e., in addition to corn-soybean-based practices, look at practices that support other agronomic systems.

Impact of practices

The holy grail of conservation targeting is to be able to model how many practices are needed and where to achieve the desired pollutant reduction. Users would appreciate any tool that helps them show landowners the range of possible water quality impacts of various scenarios, to illustrate the magnitude of change that is possible.

Other

- Given the amount of time required, users asked for any means to streamline the processes for hydro-modification and defining stream networks.
- Can the fields database be modified to reflect changes in farm-field boundaries?
- Could the conversion of the DEM to integers be automated?
- Allow users to set criteria and parameters for multiple tools, then run those continuously during non-work hours.
- Make it easier to run multiple scenarios. For example, give users the option to overwrite the first version.
- Users wanted to be able to see where others had completed hydro-modification or had completed ACPF analyses.
- No one identified programing bugs that needed to be fixed.
- Include Stream Power Index (SPI) as an output of ACPF

ACPF in context: How does the ACPF relate to other planning tools?

Local conservationists have a large toolbox of models available for conservation planning. Their continual challenge is deciding which model to use for which purpose, and how to balance resources between modeling and planning, on the one hand, and relationship-building and practice implementation, on the other. Users would like better guidance about which models to use when, and how to integrate them.

Here are some of the tools that Minnesota conservationists use for sub-watershed planning.

NRCS Engineering Tools

The NRCS tools are used for field scale practice design, while the ACPF is used for siting practices across a watershed.

Although the ACPF watershed delineation function was preferred by users, the NRCS tools have the advantage of working within a basic ArcGIS license.

PTMApp

The PTMApp is a RUSLE-based model identifying priority contributing areas, locating potential sites for conservation practices at the scale of field-sized catchments, and estimating water quality impacts at the selected watershed outlet. Estimates of water quality impacts are based on reduction ratios for practices, estimated sheet and rill erosion, sediment delivery ratios, and nutrient delivery based on land-use and decay factors. Sediment mobilized by concentrated flows (gullies, ravines, stream channels) is not estimated. PTMApp development and deployment are supported by the Minnesota Board of Water and Soil Resources.

ACPF requires less time to set up the input data and much less computing time to run the tools, provides more precise siting of practices, but does not estimate changes in sediment and nutrient delivery from practice implementation. Both PTMApp and ACPF require hydro-modified DEMs. Several watersheds are currently using both PTMApp and ACPF, which will allow a side-by-side comparison of the outputs.

MDA-PMZ tools

These spreadsheets are a complementary set of tools for in-field analysis and documentation.

HSPF-SAM, SWAT, and other models

Other watershed models are important for planning, but provide outputs at a coarser scale than ACPF, or are not accessible to local users.

ACPF in context: How do LGUs use ACPF output?

1. Primarily, conservationists use ACPF output maps to prepare for conversations with individual landowners or as discussion items during those conversations. One group already has a packet of maps they take on all field visits (aerial imagery, soils, stream network, and SPI). They plan to add ACPF output to that packet.
2. One user plans to use the water storage tool to help target new CREP money.
3. ACPF output will be particularly valuable for planning and justifying grant proposals. It can be used to help quantify the number of opportunities for a practice.
4. Users discussed ways to present maps without making landowners feel targeted or pushed. E.g. “This map is wrong; we need your input to fix it.” or “these are some opportunities to choose from”. Landowners vary in their response to maps; some are threatened, while others come in asking to learn about conservation opportunities. One conservationist prefers not to show the maps, but rather to look at the maps ahead of the visit and then walk with the landowner to areas of the field where there are opportunities for practices.
5. By helping them understand watershed scale needs and opportunities, the ACPF maps encourage conservationists to do more outreach to high-impact sites. It gets them thinking about ways to target and engage landowners.
6. The runoff risk map is particularly useful for identifying high-priority areas.

7. One user asked if the buffer tool will be irrelevant now that everyone is required to have buffers. They were looking for more guidance in how to use the buffer tool to design buffers.

Project Products and Future Activity

This report will be distributed to ACPF developers and trainers. A shorter report was written for and will be distributed to local government staff who are considering use of the ACPF.

Work continues to enhance the ACPF and training support. The WRC will soon add an online map to the North Central Region Water Network website that will show where the ACPF toolset has been applied. Find this at http://northcentralwater.org/acpf/

Two new projects led by the University of Minnesota WRC with Purdue University and the University of Wisconsin will provide training across the Midwest. The first project is funded by the Natural Resources Conservation Service through the Agricultural Research Service. The multistate team will enhance the technical support materials and deliver technical training workshops and videos in 2016 and 2017. The second project is funded by an EPA training grant and will run for 4 years beginning in the summer of 2016. The team will examine how users are using ACPF output, develop guidance for effective use of the framework, and deliver training and support materials.

Staff at the USDA ARS National Laboratory for Agriculture and the Environment (NLAE) in Ames Iowa continue to enhance the functionality of the ACPF toolset, including expanding the input datasets to additional regions of the Midwest. Publications and current information can be found at http://northcentralwater.org/acpf/

Project Collaborators

Ann Lewandowski (Project Coordinator)

Les Everett (Project PI)

Jessica Nelson (ACPF background and technical support)

Joel Nelson (ACPF technical support)

Mark Tomer, Sarah Porter, and David James (Instructors)

Staff of the following organizations provided observations on use of the ACPF:

- Minnesota State University-Mankato, Water Resources Center
- Whitewater River Watershed Project
- Stearns Soil and Water Conservation District
- Waseca County
- Greater Blue Earth River Basin Alliance
- Land Stewardship Project
- Minnesota Department of Agriculture, Root River Watershed Project