Measuring the Adoption of Conservation Practices by U.S. Farmers in the Upper and Lower Chesapeake Bay Watersheds

Messer, Christina
U.S. Department of Agriculture, National Agricultural Statistics Service
1400 Independence Ave, SW
Washington, DC 20250
christina_messer@nass.usda.gov

Klapproth, Julia
U.S. Department of Agriculture, National Agricultural Statistics Service
1400 Independence Ave, SW
Washington, DC 20250
julia_klapproth@nass.usda.gov

Farrar, Martha
U.S. Department of Agriculture, National Agricultural Statistics Service
1400 Independence Ave, SW
Washington, DC 20250
Martha_farrar@nass.usda.gov

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ABSTRACT
The Conservation Effects Assessment Project (CEAP) was initiated by the United States Department of Agriculture (USDA) in 2003 as a multi-agency effort to quantify the environmental effects of conservation practices on agricultural lands. As part of this initiative, the National Agricultural Statistics Service (NASS) conducted interviews with farmers during the period 2003-2006, to obtain a baseline assessment of the extent of conservation practices in use on croplands. These data were used by the Natural Resources Conservation Service (NRCS) to model the impact of these practices on soil and water resources. Now, members of the agricultural community and others have identified the need for updated information, including changes in the types and number of conservation practices employed. A pilot study focusing on the Chesapeake Bay watershed has been proposed for 2011. This paper describes the survey design of the pilot project, highlights of findings from previous years, and proposed uses of survey results.

Introduction

The U.S. Farm Security and Rural Investment Act of 2002, commonly referred to as the 2002 Farm Bill, substantially increased funding for conservation programs. Nearly $20 billion was authorized to support implementation of conservation practices for the period 2003 – 2007, almost 80% above the level of funding in the 1996 Farm Bill (Zinn 2007). It was generally recognized that conservation practices provided benefits to landowners and to society at large, and numerous studies had quantified the effects of conservation practices at the farm field level (USDA 2011c). However, an understanding of the relationship between individual efforts on farms and cumulative effects at the landscape scale was lacking, as was accountability of how

society at large would benefit from the substantial increase in conservation funding (Mausbach 2004).

To provide a scientific-based measure at the national scale of the impact of the 2002 funding, the U.S. Department of Agriculture (USDA) initiated the Conservation Effects Assessment Project (CEAP), a multi-agency effort led by the Natural Resources Conservation Service (NRCS) and the Agricultural Research Service (ARS). Other cooperators include USDA's National Agricultural Statistics Service (NASS) and Farm Service Agency (FSA), Texas AgriLife Research of Texas A&M University, and the Iowa State University Center for Survey Statistics and Methodology (ISU-SSM).

The CEAP was designed to measure the benefits of conservation practices at the national level; to provide detailed, specific assessments in priority watersheds; to contribute to the development of regional watershed models for use in future assessments; to supplement national soil and water databases; and to be used in the development of performance measures for conservation programming. Separate CEAP assessments were designed for croplands, grazing lands, wetlands, and for wildlife. This paper will focus on the CEAP Cropland Assessment (Duriancik 2008).

CEAP Cropland Assessment

The CEAP Cropland Assessment has three specific goals: to quantify the effects of conservation practices currently present on cultivated croplands; to evaluate the need for additional conservation practices; and to estimate the gains that will be realized if additional practices are implemented. The CEAP Cropland Assessment uses a sampling and modeling approach, with four basic components. First, a set of statistically representative sample points of cultivated cropland areas is selected. Next, on-site interviews with farm operators are conducted at the selected points. Third, the data collected is incorporated into a field-scale model to simulate impacts at the field level. Finally, a landscape-scale model is used to assess off-site impacts (Duriancik 2008).

The CEAP Cropland Assessment sample is drawn from the NRCS National Resources Inventory (NRI) frame. The NRI is a permanent area-based sampling frame developed for use in studies of soil, water, and related resources. The NRI is linked to the NRCS Soil Survey Program, which provides information about soil characteristics and surrounding landscapes (Duriancik 2008).

The NRI frame includes all lands in the United States subdivided into segments of approximately one-half mile2 (approximately 160 acres) in size. One to three specific data collection points are located within each segment, for a total of about 300,000 segments and 800,000 sample points. Each year, approximately 72,000 segments are selected for inventory, with about 32,000 segments rotating in and out, and a core panel of 40,000 segments remaining in use. Inventory of the selected segments is completed through established Remote Sensing Laboratories using high-resolution satellite imagery and data provided by local NRCS Field Office records. The types of information recorded in the inventory includes land use, vegetative cover, soil information, erosion factors, agricultural practices (such as irrigation and cropping practices), conservation practices, wildlife habitat, and wetland classification (Nusser 1997, USDA 2009).

A subset of NRI points was selected for intensive data collection for the 2003 – 2006 CEAP Cropland Assessment. Points were selected from segments used for the 2002-2003 annual NRI surveys and classified by NRI as "cultivated cropland" or "land in Conservation Reserve Program (CRP)". Points were located throughout the 48 contiguous states. Data collection for 2003 and 2004 focused on developing baseline statistics. The 2003 sample was drawn from the 2002 Annual NRI segments and included 9,580 cropland points and 2,236 CRP points. The 2004 sample was drawn from the 2003 Annual NRI segments and included 10,148 cropland points and 2,268 CRP points. Data collection for 2005 and 2006 focused on more environmentally sensitive

areas and examined changes in conservation practices that occurred due to implementation of the 2002 Farm Bill. The 2005 sample included 7,489 cropland points and 3,893 CRP points. The 2006 sample included 6,032 cropland points and no CRP points. The 2005 and 2006 samples were drawn from the 2003 Annual NRI sample points and were reduced in size from 2004 due to funding constraints (Goebel 2009).

At these points, personal interviews were conducted with the farm operator to obtain detailed information on the previous three years of farming practices, including crops grown; irrigation; tillage practices; pesticide, fertilizer, and manure applications; erosion; proximity to streams and wetlands; and use of conservation practices (UDSA 2011b). The interview took approximately 64 minutes on average to complete, depending on the particular situation at the selected point. Interviews for more complex operations, for example, involving multiple crops, more complex tillage and irrigation regimes and extensive use of conservation practices took much longer. The longest interviews recorded were 94 to 138 minutes; the shortest interviews usually ranged from 29 to 48 minutes.

In addition to the operator report, the local NRCS soil conservationist completed a questionnaire for the selected point. This questionnaire was used to verify the operator's response, as well as to collect additional information. This included information on conservation practices that the producer employed in his formal, written conservation plan (Goebel 2009).

Researchers at the Texas AgriLife Research Station used the data collected from the on-site interviews and from NRCS field office records, along with the information maintained on the NRI frame to model the impacts of the farming practices. The information was entered into the Agricultural Policy Environmental Extender (APEX) model, the Hydrologic Unit Model of the United States (HUMUS), and the Soil and Water Assessment Tool (SWAT). The APEX model was used to provide a field level measure of reductions in the loss of sediment, pesticides, and nutrients from farm fields and to estimate changes in soil carbon as a measure of soil quality enhancement (Atwood 2010, Williams 2010). In-stream measures of water quality were generated using SWAT and HUMUS, which simulated the movement of water, sediment, pesticides, and nutrients from the land to receiving streams and further down the Bay, until they were ultimately discharged from the estuary (Santhi 2005). The models produced two scenarios for each NRI point – one which accounted for farming activities and conservation practices present on the field as recorded in the interview, and a second which assumes no conservation practices were present. The difference in the outputs was used as a measure of the impact of the practices (USDA 2011a).

Findings from the CEAP Cropland Assessment for the Chesapeake Bay Watershed

In March 2011, findings from the CEAP Cropland Assessment for the Chesapeake Bay Watershed were released. This was the second of a series of 14 regional reports which will be released from the Cropland Assessments conducted in 2003 – 2006.

The Chesapeake Bay lies along the east coast of the United States and is the nation's largest estuary. The watershed which drains into the Bay covers 68,500 square miles in parts of six states and the District of Columbia. Slightly less than 30% of the land in the Chesapeake Bay watershed is in agriculture – 18% of the land is grazing or hayland, and 10% is in cultivated cropland. Cropped acres in much of the region are considered vulnerable to loss of sediment, nitrogen, and phosphorus. For example, 60% of cropped acres are on slopes >2%, 44% of cropped acres are characterized as Highly Erodible Land (HEL), 46% of soils have high leaching potential, and 23% are prone to surface runoff (USDA 2011a).

The CEAP Cropland Assessment for the Chesapeake Bay Watershed showed that farmers substantially reduced runoff from farm fields through use of conservation practices. In fact, almost all (96%) of the acreage within this watershed had either structural or management practices, or both, to control erosion. Nearly half the cropland acres were protected by structural practices (for example, buffers or terraces), and reduced tillage was used on 88% of the cropland.

The models estimate that the use of these practices resulted in a 55% reduction in the amount of sediment discharged, a 42% reduction in nitrogen surface runoff, a 31% reduction in subsurface flow of nitrogen, and a reduction of 41% in phosphorus discharge (USDA 2011a).

The models also showed that further reductions in sediment and nutrient losses are possible from the implementation of additional practices. The model identified areas with the greatest need for additional conservation practices, including 810,000 acres (19%) that have a high level of need for treatment. Model simulation suggests that adoption of additional practices on these acres would further reduce sediment loss by 37%, surface runoff of nitrogen by 27%, loss of nitrogen through subsurface flows by 20%, and loss of phosphorus by 25%. In fact, targeting these acres for additional practices could reduce the sediment and nutrient losses per acre by over twice as much as treatment of other crop fields in the watershed (USDA 2011a).

Output from the models provides valuable information for planning of future conservation efforts. By creating a measure of environmental benefits, program managers may now more efficiently modify and implement existing programs and create new programs. One of the most valuable tools the model provides is the ability to identify areas where limited technical and financial resources will provide the greatest benefit. Finally, this initial CEAP Assessment will contribute to improvements in the models themselves.

Need for Additional Data

As researchers worked with the data from the 2003-2006 CEAP, they identified areas where improvements could be made in the models and in the types and manner of data collected. Additionally, support for and implementation of conservation practices by farm operators has continued, so that the current model falls far short of reporting actual conditions in 2011.

The 2008 Farm Bill provides additional funding for conservation, including $188 million dedicated to the region through the Chesapeake Bay Watershed Initiative (CBWI). This is in addition to funds available to producers in the area through other federal programs. In addition, many State governments, businesses (for example, poultry companies), and non-profit organizations in the Bay area have developed their own conservation programs, including technical assistance, cost-share funding, and land-retirement programs (USDA 2010). These programs have resulted in many thousands of additional acres protected by some form of conservation treatment. For example, in 2009 alone, funds made available through the 2008 Farm Bill were used in the Chesapeake Bay watershed to create nearly 3,400 acres of riparian buffers and 33,400 acres of upland wildlife habitat; fund 186 waste storage/composting systems; and enroll 154,000 acres in nutrient management systems, 24,000 acres in prescribed grazing systems, 9,200 acres in irrigation management systems, 100,200 acres in residue management systems, and 65,200 acres planted in cover crop. (USDA 2010)

Therefore, NRCS has proposed a new round of onsite data collection for an expanded CEAP study, beginning with a pilot study in the Chesapeake Bay watershed in 2011. Pending approval of funds, the pilot will extend to additional watersheds in 2012, and in following years, will broaden in scope to become an annual survey that will encompass all 48 contiguous States.

Lessons Learned

Sample size and design. The original CEAP was designed to collect and report data on a total watershed basis, which has provided a valuable measure for federal accounting. However, local jurisdictions and States also have need for the data, as this will allow for more efficient planning, monitoring, and allocation of funds. Therefore, the 2011 sample size and design for the Chesapeake Bay Watershed will be constructed to allow for reporting at the State level as well as the 4 major sub-basins of the Chesapeake Bay (Potomac River, Susquehanna River, Lower Chesapeake Bay, and Upper Chesapeake Bay).

Data collection. Overall, response rates for the 2003-2006 CEAP farmer interviews averaged around 75%. Approximately 15 – 18% of the operators refused to complete the questionnaire and 8 – 10% of the operators were never located during the survey timeframe. Addressing the issue of non-response is a challenge faced in all survey programs, and particularly when the interview can take longer than one hour. To help prepare enumerators for this challenge, NASS plans to conduct a comprehensive and intensive training for Field Office Staff and enumerators in a two-day training school. Refusal conversion will be addressed.

NASS will also employ the backing of our partners in the State Departments of Agriculture; in local Soil Conservation Districts and Farm Service Agencies, and farm groups to convey the meaning and importance of the new CEAP survey to the agriculture community.

Point location. Although nearly 75% of the questionnaires were completed during the farmer interviews, some were considered unusable. Approximately 7 – 9% of the points were considered "out-of-scope", because the land use at the point was not cultivated cropland (for example, pasture, hay, horticultural operation, orchard, or non-agricultural). Likewise, there were some problems identified as the modelers began to work with the data. For example, sometimes the historic data did not match the data reported by the respondent, appearing as if the enumerator had recorded data for the wrong field (USDA 2011a).

In the 2011 pilot study, NASS will test the use of computer assisted personal interviewing (CAPI) to help assure that the enumerator is at the correct location. Researchers at ISU-CSSM are working with NASS to develop an iPad application, whereby the enumerator prescreens the operator. The farmer will response to some basic questions (for example, crops planted, cropping practices, etc.), which will be transmitted back to a database for confirmation. If the answers given match the expected result, the interview will proceed.

In addition, NASS will make use of USDA Farm Service Agency (FSA) Common Land Units (CLUs) to help locate operators of the selected NRI points. FSA CLUs are GIS shapefiles which can be overlaid with the location of the NRI points, to potentially identify the FSA farm for that point. If the owner or operator of the farm has registered for government programs with the FSA within the past two years, this will be used to identify the potential current farm operator. NASS will compare the farm operator's name with names on their List of Farm Operators, to generate a phone number and mailing address, and to determine if the operator has been selected for other NASS surveys. While this method will not locate all farm operators, use of FSA CLUs is expected to save enumerative time and expenses.

Modifications to the survey questionnaire. A thorough review of the questionnaire is being conducted by NRCS, researchers at Texas AgriLife Research of Texas A&M University, and ISU-CSSM. The questionnaire will be refined based on their work with the data collected in the 2003 – 2006 CEAP interviews, and to address new data needs.

Conclusion

The CEAP Cropland Assessment conducted in the years 2003-2006 resulted in information which can be used to measure and guide policy in regard to public funding of conservation practices. Review of the data collection process shows some areas which can be improved upon, for example, a larger sample size, refinement of the questionnaire, and enumerator training. In addition, technological advances, such as use of the iPad for screening operations and the use of the FSA CLUs to identify operators allows for new processes to be incorporated, potentially reducing enumerative costs and error.

After the 2011 pilot survey is complete, NRCS, NASS, and their partners at ISU and Texas A&M will again review the questionnaire, the pre-screening process, and use of the FSA CLUs. Additional refinements will be made as needed, and a second larger pilot that includes additional

watersheds will be conducted in 2012. Findings from this pilot will guide the final product – annual surveys conducted nationwide beginning in 2013.

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