Beasley Lake, Mississippi

(An ARS Benchmark Research Watershed, one of 24 CEAP watershed projects.)

Characteristics

Beasley Lake watershed is located in Sunflower County, MS, and is part of the Big Sunflower River watershed (Hydrologic Unit Code 08030207) within the Yazoo River Basin. The Beasley Lake watershed has a total drainage area of approximately 850 ha (2,100 acres), and the surface area of the receiving oxbow lake is about 25 ha (62 acres) (Fig. B7). Beasley is an oxbow lake, a cutoff meander of the Big Sunflower River. The Sunflower River defines the northern part of the watershed boundary, and a large forested wetland (125 ha) is riparian to the eastern side of the lake. As may be expected adjacent to a meandering river with historical stream floodplain interaction, soil texture varies from sandy loam to heavy clay. Soil survey data show that Dundee (fine-silty, mixed, thermic Typic Endoaqualfs), Forestdale (fine, smectitic, thermic Typic Endoaqualfs), Dowling (very-fine, smectitic, thermic Vertic Epiaquepts) and Alligator (very-fine, smectitic, thermic Alic Dystraquerts) are major soil series represented. The difference in elevation from the top of the watershed boundary to the lake surface is about 5.5 m. From 1995 to 2001, 660 ha of the watershed were predominantly cropped with cotton (70% of cropped area), corn, and soybean. Under an October 2002 contract, 91 ha were removed from crop production and planted to hardwoods under CRP. From 2002 to present, soybean is the dominant crop on the remaining cropland. This watershed was part of the Mississippi Delta MSEA Project (MD-MSEA) (1994-2002), and background information on the MSEA Project relative to Beasley Lake is found in Locke (2004).

Environmental Impacts

1. Water Quality: Runoff contaminated with sediments, nutrients (P, NO_{3-}, NH_{4+}), and pesticides.
2. Fish and Wildlife Habitat: Receiving water body impacted by suspended sediments that suppressed primary and secondary productivity.
3. Soil Assessments: Changes in soil characteristics as practices are implemented.

Management Practices

1. Conservation tillage (NRCS codes 329A and 329B)
2. Grade Stabilization Structures (410), e.g., Slotted Board Risers, Slotted Pipes
3. Constructed Wetlands (656)
4. Riparian Forest Buffer (391)
5. Vegetated Barriers (601) e.g., Stiff Grass Hedges
6. Field Border (386) e.g., Grassed Buffers
7. Grassed Waterways (412)
8. Channel Vegetation (322)
9. Filter Strip (393)
10. Tree/Shrub Establishment (612)
11. Subsurface Drainage (606)

Research Objectives

The original hypothesis for the Beasley oxbow lake watershed (under MD-MSEA) was that implementation of physical structures such as Grade Stabilization Structures (410) combined with grassed field borders and filter strips would be sufficient to improve lake water quality. Studies determined that this was not the case. Therefore, the current hypothesis under CEAP is that additional innovative management practices will improve lake water quality and fishery productivity.

*General: A*ssess the effects of integrated BMPs on water quality and ecology.
Specific:
1. Monitor lake water quality to assess the effectiveness of BMPs to reduce contaminants and improve lake ecology.
2. Edge-of-field
a. Evaluate the efficiency of vegetative barriers, with and without subsurface tile drains, to reduce sediment and contaminant delivery through grade control pipes.
b. Evaluate effectiveness of constructed wetlands in mitigating contaminants associated with agricultural / CRP runoff.
c. Evaluate the results of CRP establishment and other BMPs on water quality, ecology, and soil characteristics.
d. Determine the mitigation potential of a vegetated drainage ditch carrying contaminated agricultural runoff.
3. Utilize models such as AnnAGNPS to assess the effects of management and water quality changes at the watershed scale.

Approaches

Lake Water and Runoff Water Quality: For water quality evaluations, lake water is sampled in three locations every two weeks. Samples are processed and evaluated for sediment, TOC, nutrients, and pesticides (Knight et al., 2001a; Cooper et al., 2003; Cullum et al., 2003; Smith and Cooper, 2004). Autologger sensors will be used to collect a temperature profile at a single site to determine time and duration of thermal stratification. Lake ecology will be assessed by collecting biological samples, assaying the bi-weekly lake water samples for plankton, microbiology, and enzymatic activities, and evaluating longer-term fisheries indicators, e.g., Knight et al., 2001b.

Runoff monitoring sites, some of which will be associated with BMPs, will be at selected points in close proximity to the lake. Automated equipment will collect surface water samples during rainfall and irrigation-induced runoff events. Samples will be analyzed for sediments, nutrients, and pesticides. Trapping efficiencies of BMPs for sediments and various agrichemicals will be determined by comparing concentrations at sampling sites with and without BMPs. Vegetative buffers, conservation tillage, and conversion of row cropland to CRP (e.g., cottonwood trees) will be studied. Instrumentation includes area-velocity flow logger/meters to provide a record of discharge hydrographs and composite samplers to provide flow-weighted water samples from storm runoff events.

Wetlands and Ditches: The hypothesis being tested is that wetland areas (Zablotowicz et al., 2001; Shankle et al., 2004) and vegetated drainage ditches (Moore et al., 2001) have the ability to improve the water quality of agricultural runoff via sediment entrapment and agrichemical (pesticide and nutrient) retention, degradation, and processing. Research will determine (a) type of vegetative material that can effectively trap contaminants in water; (b) trapping efficiencies; and (c) necessary drainage ditch length for contaminant mitigation. Vegetated ditch studies similar to that of Moore et al. (2001) will provide additional information on the contribution of these BMPs to water quality. A section of vegetated drainage ditch (e.g., 50 m) within the Beasley lake watershed will be analyzed for background concentrations of targeted pesticides in water, sediment, and plant samples. A simulated storm runoff event using pumped water will load pesticides into the ditch, and their fate and effects will be monitored over several months.

A small sediment basin and a two-cell constructed wetland were established in 2002 upstream of an inlet to Beasley Lake for trapping sediments and processing contaminants. Subdivisional cross-sections allow water, sediment, and plant samples to be collected across the entire wetland. Standpipes are used to maintain 30 to 40 cm of standing water in each cell**.** Instrumentation consists of a Doppler area-velocity flow logger/meter and an automated composite water sampler placed at the inlet and outlet of the constructed wetland. Grab samples of water will be collected at existing wetland transects to determine transport of agricultural contaminants and the effectiveness of wetland processing. Comparison between vegetated drainage ditches and constructed wetlands for agricultural runoff mitigation will be evaluated.

Edge-of-Field BMP Effects on Quality of Water Leaving the Field: The hypothesis to be tested is that improvement in edge-of-field water quality can be demonstrated via specific combinations of field management practices (Rebich, 2001; Rebich et al., 2001; Smith et al., 2002). Improvement in edge of field water quality will primarily be evaluation based on the reduction of sediments, since many of the contaminants of interest entering the streams are attached to these particles. Entrapment of contaminants in edge-of-field barriers may enhance their processing, thereby reducing further movement (Staddon et al., 2001). Grade control pipes, with and without such vegetated barriers immediately upslope, will be evaluated. Subsurface drains under the thalweg of some pipes with vegetative barriers will also be assessed. Flow-proportional composite samples will be collected based on measured velocity (acoustic Doppler) and depth in the pipes. To date, six pipes have been instrumented: two controls, two with vegetative barriers, and two with barriers and tiles. Instrumentation to quantify and sample water leaving the tiles will be installed in 2005. Runoff samples are being analyzed for sediment, nutrients, pesticides, and total organic carbon (TOC). Sediment concentrations will be determined by ultrafiltration (0.45µm), and suspended solids via laser diffraction. Pesticide analysis will be by gas chromatography with confirmation via gas chromatography/mass spectrometry using already developed methods (Bennett et al., 2000; Smith, 2001; Smith et al, 2001). Nutrient analysis (soluble NO_{3+}, $PO_{4\text{-}3}$, Cl_{-}) will be by ion chromatography. Flow-through colorimetry will be used for soluble NH_{4+} and total Kjeldahl N and total P. Analytical instrumentation will include state-of-the-science GC/MS, ion chromatography, ICP/MS, automated flow injection analyzer, automated laser scattering particle size distribution analyzer, and automated TOC analyzer. Withinfield management practices chosen by the cooperating farmers will affect the performance of these edge-of field BMPs. These management practices, which include crop rotation, conservation tillage, and cover crops, will be documented and their effects will provide needed comparisons for improved system performance assessments. Additional new research will be initiated using triplicate slotted-inlet pipe sites on both CRP and cropped land.

Soil Assessments: Approaches are still being developed for assessing changes in soil characteristics as influenced by management practice. Prior research in the Beasley watershed evaluated the spatial distribution of soil characteristics (Gaston et al., 2001) and their effects on herbicide dissipation (Locke et al., 2002) under conventional tillage cotton production. Parameters for assessing soil changes with conversion of land use

from row crop to CRP will be developed and soil evaluations will be made. Subwatersheds under CRP versus non-CRP areas will be surveyed and soil will be sampled in grids within these areas and characterized.
Previous work in Beasley Lake watershed demonstrated the effects of vegetative buffers on soil characteristics (Staddon et. al, 2001). Land owners within the watershed plan to establish quail habitat buffers around various fields. Soils in these buffer areas will be sampled and characterized prior to buffer establishment, followed by monitoring over time for any changes.

Modeling and Economic Assessments: Some modeling assessments have been made in similar watersheds (Yuan et al., 2002), and efforts in this area will develop over time.

Complementary CEAP Related Research Activities Within the Yazoo River Basin: There are three additional sites within the Yazoo River Basin (where Beasley Lake is located) where the WQERU is conducting research that directly relates to the assessment of conservation management practices. The topography and agriculture at these sites are highly representative of the Mississippi Delta landscape, and research results are completely compatible with conditions in Beasley Lake watershed. The three additional sites include:
1. Stoneville, MS: Small field scale (0.25 ha) replicated runoff plots for evaluating water quality as influenced by tillage, cover crop, and buffer strip.
2. DCDC: Field and vegetative ditch studies
3. Coldwater River watershed: Habitat ecology in river bendways
Additionally, WQERU has fostered assessment and success of conservation practices in upland source watersheds of the Yazoo Basin. Projects include variations of conservation tillage, tillage effects on shallow groundwater contamination potential, documentation and design options of water retention structures from field-sized devices to watershed lakes, and edge-of-field vegetation.

Selected references

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8. Zablotowicz, R.M., M.A. Locke, W.J. Staddon, M.W. Shankle, D.R. Shaw, and W.R. Kingery. 2001. Microbiological characteristics of a Mississippi Delta forested riparian zone. *In* The Mississippi Delta Management Systems Evaluation Areas project, 1995-1999. R.A. Rebich and S.S. Knight, eds. Mississippi Agricultural and Forestry Experiment Station Information Bulletin 377:218-222.

Collaborators and cooperating agencies and groups

1. Mississippi Dept Wildlife Fisheries and Parks: Lake re-stocking
2. Mississippi State University: Documentation of farmer practices
3. Arkansas State University: Assessment of vegetated ditch and wetland ecology
4. Delta Wildlife: Buffer establishment

Beasley Lake watershed, Sunflower County, Mississippi