Assessment of Agricultural Best Management Practices in the Brushy Creek Watershed

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Overview and Objectives

Agricultural best management practices (BMP) can be defined as methods or a system of methods that are implemented for the reduction of non point source pollution in agricultural watersheds. There is much documentation to attest that these methods are of great value at the small watershed (field) scale, but there is little existing research of effectiveness at the medium or large watershed scale. Spatial scale has a great influence on the modeling of non point source pollution and BMPs. The small (field) scale approach has been successful in modeling the upstream-downstream effects of BMPs on small plots of land such as large farms or groups of small farms. The effects of BMPs at the medium watershed scale, such as that of a small tributary stream or at the large watershed scale, such as a 14-digit HUC watershed is still largely unknown. This research project will use water quality and statistical analysis along with geotechniques to assess the effects of BMPs in the large-scale (29,000-acre) Brushy Creek watershed.

Interest in the Study Area

The Brushy Creek watershed is located in the south central Kentucky counties of Lincoln, Pulaski, and Rockcastle (Figure 1) Buck Creek, one tributary of Brushy Creek, has been a focus area of interest for the Kentucky Chapter of the Nature Conservancy since it is home to more than 30 species of freshwater mussels (nine of which are endangered or of state concern), 77 species of fish, and one endangered bat species. The threats to this outstanding resource water are incompatible forestry practices, livestock production practices, crop production practices, invasive species, recreational vehicles, and unimproved creek crossings (The Nature Conservancy, 2005).

Buck Creek and its tributaries is a also a target area of interest for several federal and government programs that provide funding for agricultural best management practices. Buck Creek was a designated a United States Department of Agriculture (USDA) Environmental Quality Incentives Program (EQIP) priority area in 2001 and 2002. There has also been funding from the US Fish and Wildlife Service Partnership for Wildlife Program, Kentucky Division of Conservation's State Cost Share Program, and federal Farm Bill programs such as the Continuous Conservation Reserve Program (CRP).

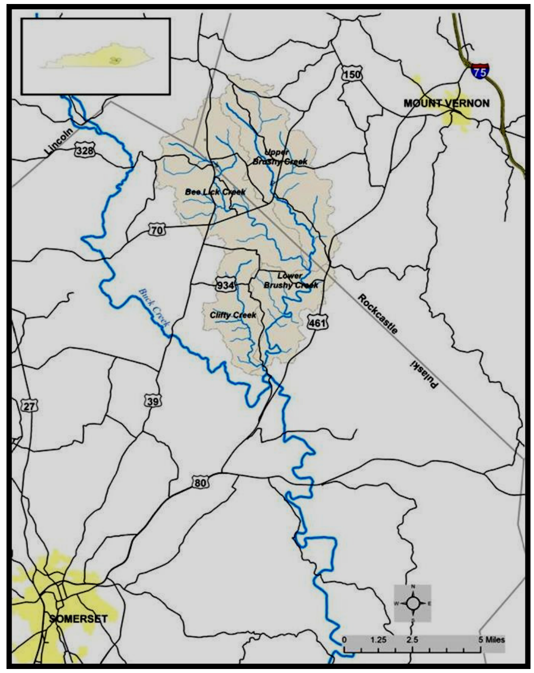

Figure 1– Location of Brushy Creek Watershed

The dominant agricultural activity in the Brushy Creek watershed is beef cattle production. So the majority of the more than $4 million that has been spent from these federal programs has been targeted at reducing nonpoint nutrient pollution from cattle operations. There are also significant amounts of hay and tobacco produced within the watershed. Row crops such as corn and soybeans represent a small percentage of the land usage in the watershed (Templeman, 2006).

Study

Water quality was monitored at 18 surface water and six groundwater sites throughout the Brushy Creek watershed on a monthly basis between May 2006 and April 2007(see Figure 2). Physical, chemical, and pathogenic parameters were examined at each of the sites.

In order to detect the possible effects of small clusters of BMPs and see the effects of BMPs at the watershed scale, the network is very dense. These sites were strategically placed above and below certain confluences of the creek in order to examine the differences in BMP implemented

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streams and non-BMP implemented streams. The groundwater sampling sites used for this project were cave streams, springs, and seeps. These are the most effective sampling sites in areas of significant karst development (Quinlan and Ewers, 1985). The focus was on approximately five sites that discharge directly into the headwaters of Brushy Creek. Access to sampling locations also played a significant role in designing the sampling network, as the majority of land in this watershed is privately owned. The monitored field measurements were dissolved oxygen, pH, water temperature, and specific conductance. Laboratory analysis were performed to find concentrations of Nitrogen Ammonia, Nitrogen, orthophosphate, total phosphorus, total coliform, and e.*coli*.

Figure 2– Ground and Surface Water Monitoring Locations and Locations of Proposed and Implemented BMPs

Results

The results suggest that Brushy Creek and its tributaries remain impaired by nutrient and bacteria loading. This suggests that the implemented BMPs, which are generally three to five years in age, are not yet affecting the water quality in this watershed.

Adopting/Non-Adopting Reach

Water quality from a subwatershed with a high rate of BMP adoption was compared with water quality from a subwatershed with a low rate. The results indicated no significant difference in water quality.

Upstream/Downstream comparison

In one subwatershed with a very high rate of BMP adoption, water quality upstream of the BMPs was compared with water quality downstream of the BMPs. The only difference was in total e.coli counts downstream of the BMPs, but the difference was not statistically significant. All other pathogens and water quality measure were equivalent, suggesting that the BMPs have no effect on water quality.

Effects of Karst

Because we suspected that the prevalence of karst may have had an effect on the effectiveness of the BMPs, water quality downstream of all BMPs were analyzed to determine whether or not the presence or absence of karst in the contributing watershed had any effect on water quality. The results indicated that while bacteria was significantly less in adopting watersheds during the winter months, bacteria concentrations were significantly higher during the spring season. This suggests that since the significant differences in water quality occurred during the period of heaviest precipitation for this area and that the quality of water from karst aquifers is often dependent on the level of groundwater flow, elevated levels of nutrients and bacteria may be discharged to surface waters during the spring season. This unpredictable nature of karst compounded by the lack of karst-specific BMPs in the watershed may degrade the effectiveness of currently implemented BMPs.

Conclusions

Overall, the implementation of BMPs throughout this watershed appears to have had little effect on overall water quality at the watershed scale. The study suggests that the two major hindrances of the effectiveness of BMPs are (a) the absence of karst as a consideration in national BMP prescription policies and practices; and (b) inconsistent adoption of BMPs by landowners. If water quality is to improve in the Brushy Creek watershed while still maintaining the economic viability of local cattle operations, best management prescriptions must be developed with consideration to the effects of karst in this region, and the majority of landowners must be encouraged to implement BMPs consistently throughout the watershed .

Biliography

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