ALABAMA A&M AND AUBURN UNIVERSITIES

ANR-790-4.3.5

Soil Management To Protect Water Quality

Structural Measures For Soil Management

Structural measures for soil management and erosion or sediment control are designed primarily to control runoff water. They remove the excess water without allowing it to carry the soil away with it. This control of runoff water is accomplished by effectively reducing slopes and slope lengths, by increasing infiltration or settling of sediment, and by stabilizing waterways or other outlets that transport excess water.

Structural measures for soil management and erosion or sediment control include diversions, terraces, tile outlet water disposal systems, grassed waterways or outlets, lined waterways or outlets, improved surface drains, subsurface drains, grade stabilization structures, land smoothing or leveling, and debris or sediment basins.

Diversions

Diversions are ridges of soil or channels with a supporting ridge on the lower side. They are built across the land slope to allow interception and disposal of runoff at a selected location. They are used to break up long slopes, to move water away from active erosion sites, to direct water around barnyards or other sites, and to channel surface runoff to suitable outlet locations. Their primary purpose is to protect land or water below the structure. They often are used in combination with contour strip-cropping, grassed waterways, sediment filters, or other sod filters that can trap nutrients and fecal bacteria in the runoff water.

Terraces

Terraces are earthen embankments or ridges with a channel constructed across the slope. Their spacing depends on slope. Terraces have gentle grades, which allow them to intercept surface runoff and conduct it at low velocity to a stable outlet. These structures function much the same as diversions, except that terraces are usually constructed closer together, support less drainage area, are smaller than diversions, and are not usually vegetated. Essentially, they reduce erosion by shortening the length of the slope. The shorter the slope length, the less chance there is for runoff to build enough momentum to cause excessive erosion.

Terracing is more effective for erosion control than strip cropping and contouring because it divides the slope into discrete segments. Although there may be soil movement within terrace intervals, most of this material accumulates in the terrace channel or in basin areas. This measure is one of the most widely used practices to reduce erosion on cropland. With some types of terraces, more than 95 percent of the detached soil particles remain on the land.

Terraces also channel runoff safely away through outlets—either underground pipes, grassed waterways, or other stabilized outlets. Because they control the flow of water over long slopes, they prevent the formation of gullies and often allow more intensive row crop production on land that otherwise would erode excessively. High yields can be sustained for many years on fields where terraces have been constructed and maintained.

Tile Outlet Water Disposal Systems

These consist of terrace systems augmented with underground plastic pipe or tile water outlets. The pipe or tile is installed in natural drainageways on a gradient to allow for proper drainage. Small basins around outlets allow for most sediment to settle out.

Terrace systems, especially tile outlet systems, have the highest initial cost of all row crop conservation practices, and they require periodic maintenance. In addition, nutrient leaching to groundwater may be increased when this practice is used.

Grassed Waterway Or Outlet

A grassed waterway is a natural or constructed watercourse kept in grass and designed to carry water down slope without causing erosion. The sod slows

runoff and traps soil and nutrients carried in runoff waters from cropland or animal production areas. Grassed waterways serve as outlets for terraces, diversions, or other concentrations of water, but they don't take the place of erosion-control measures on adjoining slopes.

If waterways are used primarily as filter strips to remove sediment, they can quickly silt in and lose their effectiveness. To prevent this, crop residue management, contour buffer strips, or other methods should be used to control erosion in the fields that contribute the runoff water.

A stable outlet from the waterway is needed to prevent a gully from forming and growing in size with each storm. This may involve the construction of a water control structure, perhaps concrete-block spillways.

Lined Waterway Or Outlet

In some cases, because of land slope or other conditions, a waterway or outlet must be lined with an erosion-resistant material such as stones or even concrete. This structure is expensive but sometimes necessary to stabilize critically eroding areas, and it is generally used in combination with vegetative practices such as critical area planting.

Surface Drains

Ditches or channels may be constructed in relatively low-lying areas or flat fields next to streams to transport surface flow through a filter strip prior to its entering a stream. This practice has limited applicability because it has no erosion control benefit. In fact, these channels or ditches are not even vegetated. Their sole purpose is to facilitate the trapping of eroded sediment before it can enter a watercourse.

Subsurface Drains

Pipe or tile, usually plastic, may be installed underground to lower shallow groundwater tables or to handle seepage on side slopes or in drainageways. This practice can reduce surface runoff, allow for more efficient use of machinery around wet spots, and serve as a water outlet for other conservation measures in some cases. However, subsurface drainage has limited applicability because it may cause additional nitrate leaching and may be defined as illegal drainage of wetlands in the future.

Grade Stabilization Structures

These structures substantially reduce erosion and off-site sediment damage associated with channel and gully erosion. They are designed to reduce the erosion effects of sharp changes in elevation or to provide a stable area where the change in elevation takes place. They are commonly used in natural as well as artificial channels and may be used in conjunction with other surface water outlets.

Land Smoothing And Leveling

Designed to remove surface irregularities, this practice tends to reduce rill and gully erosion by spreading the flow of water over a larger drainage area. This allows for better control of surface runoff and is more effective when used in combination with other practices such as terraces.

Debris Or Sediment Control Basins

These basins consist of drainageways and embankments, dams, ridges, or channels constructed across the slope. Debris basins reduce the velocity of runoff water, allowing much of the sediment and associated nutrients to settle to the basin bottom. Sediment basins are effective in reducing sediment delivery from severe storms and in trapping small soil particles, but they do not control erosion at the source.

These structures are generally used where terraces cannot be installed and farmed with reasonable effort and where slope length and runoff rate or volume must be reduced. These shallow basins need a grassed overflow section and may require periodic removal of trapped sediment.

Conclusion

Structural measures usually have higher initial costs but lower annual costs than cropping and tillage practices. They require proper design and construction and have a degree of permanency. They may require some limited land use changes, but they are most likely to require changes in tillage or management techniques (like a row direction change, for example). Structural measures can be a very effective means of water quality improvement, and they may allow continuation of a more intense cropping practice than would be possible without them.

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This publication, supported in part by a grant from the Alabama Department of Environmental Management and the Tennessee Valley Authority, was prepared by James E. Hairston, *Extension Water Quality Scientist,* assisted by Leigh Stribling, *Technical Writer.*

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ALABAMA COOPERATIVE Extension SYSTEM

ANR-790-4.3.5

UPS, **New June 1995,** Water Quality 4.3.5