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Erosion Control Methods

Best Farming Practices for Erosion Control

Select appropriate land use

Land management decisions should consider the potential for erosion under different practices, especially on land that is marginal for annual crop production. Areas at high risk for erosion due to steep slopes or erodible soils may be better suited for forage production or grazing. Steeply sloped lands under cultivation can be converted to permanent cover to minimize erosion. Wooded areas with poor soils and steep slopes can be left in their natural state and managed profitably as woodlots. Alternative land uses can conserve the soil and have environmental benefits, while remaining profitable to the farm operation.

Maintain organic matter

Soil organic matter is very important for good crop production and for reducing soil erosion. Organic matter is made up of dead plant material. During decomposition, this material releases nutrients for plants. Organic matter also improves soil structure and tilth. Organic matter and microorganisms cement individual soil particles into larger aggregates. Soils high in organic matter have large, stable aggregates, which resist erosion. A soil with stable aggregates also has more large pore spaces to hold water. With this increased moisture-holding ability, there is less ponding in fields, and less runoff and erosion.

To maintain soil quality and fertility, new additions of plant material must equal the rate of organic matter decomposition and nutrient use by plants. Conventional tillage and fallowing practices increase soil temperature as well as mix and aerate the soil, causing faster organic matter decomposition. The result has been a long-term decline in soil organic matter in tilled land. Rotations, which include forages, return more residues to the soil and increase fertility. Manure applications and legume plowdown are also good sources of organic matter and nutrients.

Maintain crop residue cover

One of the best ways to reduce erosion is to protect the soil surface with a cover of growing plants or crop residue. Surface cover cushions the impact of raindrops so soil particles are not as easily dislodged and moved. It also slows the flow of water, giving the soil time to absorb more water and thereby reducing runoff and erosion. Crop residue traps snow and reduces evaporation for higher soil moisture, which can improve crop yields, especially in a dry year. Conservation tillage systems that leave most of the crop residue on the surface will reduce erosion and may have other benefits, such as lower equipment operating and labor costs.

Strip cropping

Strip cropping is another option for protecting the soil from water erosion. This practice involves planting alternating strips of row crops with a cereal or forage. Combining conservation tillage with strip cropping will increase the width of the strips required.

Reduce tillage

Conventional tillage buries the protective crop residue cover and disturbs the soil. Raindrops and running water easily detach the loose soil particles. These factors lead to increased runoff and erosion. Research shows that switching to reduced or zero tillage systems is needed to protect soils on steeper and longer slopes from erosion. Reduced and minimum tillage systems leave a good crop residue cover to prevent erosion and conserve soil moisture. These systems also save time and energy. Costs are usually similar to or lower than those for conventional tillage systems.

Tillage is reduced by replacing some tillage operations for weed control with herbicide applications, or by using alternative tillage equipment that helps maintain a good residue cover.

Direct seeding and zero tillage systems save time and typically have lower operating costs than conventional tillage systems.

Use direct seeding for pasture conversion

Direct seeding is a good option for converting hay or pasture land to annual crop production. It produces crop yields similar to those from conventionally plowed systems, and also prevents soil erosion and moisture loss. In conventional systems, intense operations such as plowing, heavy disking and cultivations are used. They are costly and time consuming, and expose soil to erosion.

Annual crops such as barley, oats and peas can be direct seeded into pasture sod after the pasture vegetation has been killed by glyphosate herbicides. Fall spraying is usually preferred over spring spraying for better annual crop yields, weed/pasture plant control, and moisture conservation.

Terracing

Water erosion over long, wide slopes without well-developed channels can be controlled with terracing. A channel and berm with up to 3’ difference in elevation are constructed across the slope to intercept runoff and carry it safely off the field. The material excavated to create the channel is used to build the berm. A survey is essential to find the best terrace location on the slope and to maintain proper grade for drainage. The project should be staked before construction to guide the equipment operators. Heavy-duty road construction equipment, such as a motor scraper, is needed to construct terraces.

Terraces are practical only when crop returns from the land are high enough to justify construction costs. Tillage and residue management options should be evaluated before considering terraces.

Stream and Ditch Protection

Ditch and stream banks are often a significant source of sediment in water. Unprotected banks will continue to erode. High stream flows, cattle, and machinery can accelerate bank erosion. Concentrated flows entering a watercourse can cause rill or gully erosion. Stream banks and ditches are usually stabilized with one or more of the following: drop pipes, rock chutes, buffer strips, tile outlet protection, or header tile. Livestock should be restricted from all watercourses; many fencing options are available. Bridges, culverts or

low-level crossings are some of the options available to move livestock and machinery safely.

Tile Drainage

Tile drainage systems can also be an effective means of reducing surface runoff. By maintaining the water table at a constant, desired level, the soil surface will remain in a drier condition to more effectively accept water without eroding. Tile drainage systems complement surface water control measures such as grassed waterways, water and sediment control basins, terracing and water inlet systems.

Tile drainage outlets should be protected from erosion at the point where tile systems enter ditches and streams. Proper installation of rock riprap or other erosion-resistant materials will ensure that tile water is safely discharged into watercourses.

Windbreaks and Shelterbelts

Often additional protection from the wind is necessary when there is not enough residue to hold soil in place. Windbreaks and shelterbelts can provide that protection by slowing down wind speeds near the ground. Windbreaks usually have five or fewer rows and shelterbelts have six or more rows.

Fragile Land Retirement

Occasionally, the erosion cannot be controlled on a field or part of a field. The erosion may be too extreme or the field has some other limitation making it unprofitable or unsustainable to farm. Fragile land could include areas along creeks, lakes and wetlands that may be subject to flooding or other land that is subject to severe erosion. This land should be retired from production to pasture or woods.

Erosion Control for Waterways, Drainage Ditches, and Creeks

Introduction

A number of structures can be used to control a concentrated flow that is causing a gully rill. These structures will require less maintenance if combined with minimum till or no-till farming practices. When surface water concentrates, rills develop. If these rills are not addressed with appropriate control practices, a gully may result.

Grassed waterways

Gully erosion can often be controlled with a grassed waterway. A grassed waterway is a wide, shallow grassed channel that can carry a large volume of water quickly down slops of less than 5%. Grassed waterways need to be wide enough to carry peak runoff events from snowmelt and rainstorms (up to ten cubic feet of water per second). The size of the waterway depends on the size of the area to be drained. A typical grassed waterway cross-section is saucer-shaped with a nearly flat-bottomed channel, a bottom width of 10’ and channel depth of at least 18”. Side slopes usually rise about 3’ for every 30’ of horizontal distance. The waterway should follow the natural drainage path if possible.

The vegetative cover must be well established to handle high flows without erosion. Initial establishment of the vegetation can be a problem. A fast-growing cover crop, such as oats, provides initial, temporary protection for the waterway until the grass cover is established. Steeper portions of the waterway which are very susceptible to erosion can be protected by bio-degradable erosion control mats until the grass is established.

Commercially available mats are made from straw, jute or aspen wood shavings. A well-built and maintained grassed waterway is very durable and erosion-resistant. Regular mowing and fertilization should be used to maintain the waterway. Waterways can be used as a source of hay crops. Weeds and brush must be controlled for the waterway to remain effective.

Control basins

Water and sediment control basins, or channel terraces, can achieve the same objective as grassed waterways. They are used to pond surface water from small upland areas (less than 50 acres) for short periods of time (less than 24 hours), and direct these flows into subsurface tile systems. These structures effectively reduce the peak flows of surface runoff and control rill and gully erosion.

Buffer strips

Buffer strips along the banks of drainage ditches and streams stabilize the banks by preventing slumping and washouts as well as subsequent siltation. The buffer strips should be maintained with grass cover. Ditch or stream banks should have proper side slopes based on the soil type and be permanently vegetated. Properly installed and maintained buffer strips and vegetated banks will reduce maintenance costs for ditch cleaning.

Concentrated flows of surface water must be directed to protected points along the ditch bank where they may enter the watercourse. Drop structures such as rock chute spillways or drop pipe inlets will safely convey this water to the ditch or stream bottom.

Lined channels

Lined channels are a means of dropping water to lower elevations along steeper (5-10%) parts of a waterway. Those portions of the waterway are precisely shaped and carefully lined with heavy-duty erosion control matting, a type of geotextile product. The lining is covered with a layer of soil and seeded to grass for lined channels. The resulting channel is highly resistant to erosion for waterways that only carry water occasionally.

Chute spillways

Chute spillways are similar to lined channels except the lining is covered with rock riprap, gabion mattresses, revetment mats, or interlocking or cable-connected concrete blocks. The resulting channel is highly resistant to erosion for occasional to continuous flows at moderate to high rates. They are suitable for slopes up to 25%. The structure must be monitored and repaired regularly to assure the structural integrity of the liner and heavy materials. An inflexible channel lining such as poured concrete does not have the ability to move with the base material shifts caused by settling, frost heaving or possible erosion. Thus, concrete is not recommended as a waterway lining. The velocity of water exiting this structure may be excessive, causing further erosion problems downstream. A deceleration device such as large rock riprap or hydraulic jumps may be required.

Grade Control Structures

Grade control structures are a type of drop structure that reduces waterway grade by providing vertical drops up to 3 feet at selected locations along the channel.

There are two main types of grade control structures used: (a) the gabion basket type; and (b) the wood log type. These structures should always be backed with a filter cloth material to prevent soil from washing through and causing failure.

Drop structures

Drop structures are constructed along waterways to drop water at high gradients (>25%) to lower elevations without causing erosion. They are constructed of concrete, wood, metal or rock. Drop structures are the most costly but occasionally the most appropriate form of erosion control at specific locations along a waterway.

Surface Water Inlet and Buried Tile Line

A surface water inlet such as a catch basin or perforated riser pipe connected to an underground tile line will remove run-off water from small watersheds.

Most gully gradients are acceptable with this system. A clay berm should be constructed slightly downstream of the surface inlet to pond the water and allow the surface inlet to operate at full capacity. When the topography of the land is suitable, a larger berm may be constructed that will pond water for periods up to 24 hours. This storage will fill up with water during peak flow periods and empty after the peak flow is over.

The different drop pipe inlets have flow capacities that are dependent upon the structure sizes. More than one drop pipe inlet system may be used at one gully site to carry the design flow. If flood storage is used, it is important to have an emergency spillway to convey water down the berm if expected flow rates are exceeded; otherwise, failure of the berm may occur.

Proper installation of the drop pipe inlet is important to ensure that a future failure does not happen. Anti-seepage collars should be installed on all horizontal pipes to prevent water from channeling along the outside of the pipe. It is imperative the clay berm has been adequately compacted around the drop pipe.

The construction a floodwater storage system for smaller watersheds (or water and sediment control basin) results in a significantly reduced outlet tile size. Watershed areas up to 50 acres can feasibly be designed using a floodwater storage system. Proper design of this system is critical since failure could cause dramatic erosion problems.

Slow release drop structure

A slow release drop structure is an inexpensive and effective measure to control gully erosion. An earth berm is constructed upstream from the gully. Runoff water is held back temporarily by the berm. The water drains slowly through a small diameter plastic pipe (3 to 8 inch diameter), which runs under the berm and down the slope, and outlets at the bottom. A durable, high-density polyethylene pipe is recommended. The small pipe can be held in place on the slope where needed with steel pins. This structure can only be used where there is an area with enough storage capacity upstream of the gully. The flooded area is fully drained within two days to prevent crop damage. In fact, the temporary back flooding benefits the crop by increasing soil moisture.

Drop Pipe Structure

This structure consists of a vertical pipe fabricated to a horizontal pipe. The horizontal pipe is installed at approximately 1% grade to the outlet.

Although this type of drop pipe can handle elevation differences up to 10 feet it is preferable to limit the drop height to 5 feet for safety construction reasons.

High-Drop Inlet Structure

The high-drop inlet is similar to the drop pipe structure except that the vertical pipe is about 5 feet high and the horizontal pipe follows the surface of the gully once it intercepts with the gully face.

This structure is used for steep gully drops greater than 5 feet in height.

Sloped Pipe Structure

The sloped pipe structure consists of one component, a sloped pipe. This type of structure may be used when drops exceed 5 feet.

Combination Structures

If a channel slope is variable, any combination of the above practices can be used.

Maintenance

Any waterway stabilization system needs regular attention to check and repair weak areas before failure occurs. A checklist should be followed:

1. Any bare or eroded area should be repaired immediately.
2. Obstructions or potential obstructions in the flow area should be removed.
3. Any settling or shifting should be repaired.
4. All grassed areas should be mowed twice per year.
5. The inlet for the control system should be cleared of snow and ice before the spring peak flows.
6. All berms should be checked regularly for signs of failure and remedial measures taken.

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