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G85-750 Terrace Systems for Nebraska

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Dickey, Elbert C.; Hamer, Tom; Hay, DeLynn; and Jasa, Paul J., "G85-750 Terrace Systems for Nebraska" (1985). *Historical Materials from University of Nebraska-Lincoln Extension*. 1343.

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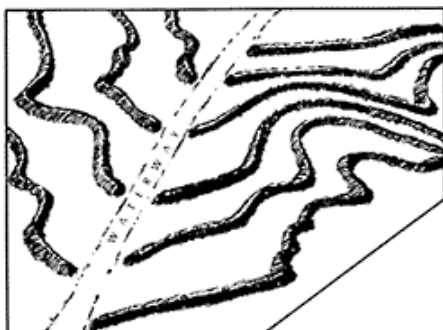


Terrace Systems for Nebraska

This NebGuide describes how different terrace shapes and systems can be used to reduce soil erosion losses on sloping fields.

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Loss of valuable topsoil to erosion prompted Nebraska farmers to build terraces as early as the 1920's. Current estimates indicate that water erodes as much as 140 million tons of soil annually from Nebraska's fields.

Figure 1. Contour terrace system.

Many options are available to reduce soil erosion losses. Terraces can reduce the soil loss by 50 percent or more. Contour farming can also reduce erosion by about 40 percent. When these two practices are combined, as is usually recommended, soil losses are reduced by about 80

percent of that occurring from a non-terraced, sloping field farmed up-and-down hill.

Terraces are constructed across a slope and form a series of channels and earthen embankments. They reduce soil erosion by breaking a long slope into several short sections. This reduces the speed of runoff water, which reduces the amount of soil that can be transported. Runoff collected in the terrace channel can be stored for infiltration into the soil or diverted safely from the field in an erosion-resistant grassed waterway or an underground outlet.



Figure 2. Parallel terrace system.

Initially, terraces were built following the land contour because it was the simplest, most economical construction method available (*Figure 1*). Contour terraces generally have a constant grade or slope within the channel, which minimizes the amount of soil that has to be moved during construction. However, contour terraces are generally not parallel to one another, and thus may be difficult to farm because of sharp curves and odd-shaped areas, which may cause "point" rows. The farmability of contour terraces became a major concern as tillage equipment became

larger. The development of earthmoving equipment enabled larger cuts and fills to be made, which allowed for the straightening and alignment of terraces. This improved terrace design increased farmability. Further advances in construction methods and equipment have made parallel terraces feasible (*Figure 2*). Parallel terraces are advantageous since point rows are, for the most part, eliminated, resulting in more efficient farming operations. A relatively new design concept is the use of variable channel slopes, which allows greater flexibility in the design and layout of parallel terrace systems, especially for non-uniform field slopes.

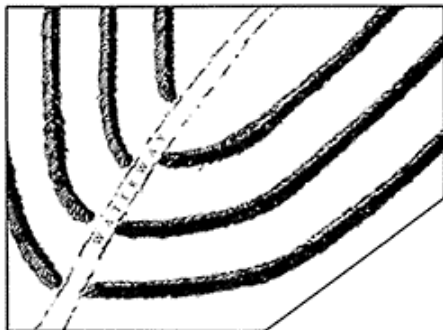


Figure 3. Terrace system parallel to field boundary.

Currently, parallel terraces are planned around the most naturally occurring contour existing in a field, whether it be around a hill or a field boundary (*Figure 3*). Since they usually cross high and low areas, parallel terraces are built using cuts and fills. This requires moving earth from the channel onto the ridge and along the length of the terrace to maintain proper channel grade and ridge height while crossing the slope. Because of this, parallel terraces are considerably more complex to design, lay out and build than contour terraces. Where extreme slope variations exist, non-parallel terraces may be more practical and cost-efficient.

Terrace Spacing

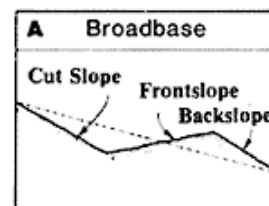
Selecting the proper terrace spacing is important for controlling erosion while maintaining farmability. When terraces are built closer together, erosion control is improved, but construction and maintenance costs become greater because the total length of terraces built increases. However, the greatest consideration when determining terrace spacing is farmability. When terrace spacings fit multiple equipment widths evenly, they are more farmable. Spacings of 120 feet accommodate most row spacings and equipment widths. The next best spacings are multiples of 60 feet. On existing terrace systems, the spacing should be considered when purchasing equipment to take advantage of improved farmability.

Terrace Shape

A variety of terrace shapes are currently used in Nebraska. The shape best suited to a particular field can be selected by considering the land slope, soil characteristics, topography, and tillage equipment requirements.

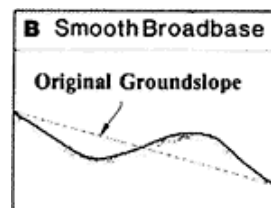
Broadbase

The most common terrace shape used in Nebraska, this terrace consists of three segments--a cut slope, a frontslope, and a backslope--which create a channel and ridge (*Figure 4a*). A variation is a wide, smooth terrace cross section, which is recommended for terraces that must be crossed with equipment (*Figure 4b*). Broadbase terraces are best suited on slopes that do not exceed 6 percent. A minimum terrace width of 40 to 45 feet is desirable, and some may be as wide as 60 feet to accommodate multiples of equipment width.



Steep Backslope or Grass Backslope (Pushup)

Slopes greater than 6 percent and deep soils are well suited to a grass backslope terrace. Soil is pushed up from the backside of the terrace instead of removed from the channel to build the steep backslope (*Figure 4c*). Because of this, the area between terraces is flatter than with other shapes, thus reducing the potential for erosion.



As the name implies, the backslope of this terrace shape is permanently grassed. To allow for small differences in terrace spacing, the terrace width can be adjusted by changing the backslope, thus eliminating point rows.

Narrowbase or Grass Ridge (Pushup)

Another terrace shape well suited to steeper slopes is the narrowbase or grass ridge terrace, which consists of a narrow embankment or ridge with permanently grassed front and backslopes (*Figure 4d*). The grass prevents erosion from breaking down the embankment.

An advantage of this shape, assuming underground outlets are used, is that the inlet for the underground outlet can be located in the grassed areas, which eliminates the need to farm around it. And, as the front slope of the narrow ridge terrace is not farmed, problems associated with matching equipment to the ridge width are also eliminated.

Flat Channel or Bench (Level Terrace)

Because of their water conservation potential, flat channel terraces are a good choice in areas that tend to be arid or semiarid, and that have less than 4 percent slopes. This terrace commonly consists of a cut slope, a flat channel and a ridge (*Figure 4e*). Channel size is important; it must be large enough to contain the runoff from the sloping land between terraces. Depending on the needed channel size, the flat section can have a width up to one half of the terrace interval spacing, allowing for water infiltration over a large area. The channels are often constructed with little or no slope for the greatest water conservation potential. As such, these terraces are often called level terraces.

Although flat channel terraces are more expensive to build and may require additional maintenance, the water they conserve can increase crop production in lower rainfall areas, such as western Nebraska. Potential for groundwater recharge in some areas may be another benefit.

Storage Embankment or Debris Basin

A storage embankment can be an important part of some terrace systems. The embankment creates a basin designed for temporary storage of runoff water. Generally, the basin is built large enough to contain the runoff from a once-in-10-years storm and the sediment accumulation for a 10-year period. Such an erosion control structure has a high sediment trap efficiency and can prevent runoff and soil from leaving the field, farm, or watershed.

Stored water is allowed to infiltrate into the soil, or to be released slowly, or both. With controlled release of the excess runoff, these structures also help prevent excessive downstream erosion. Sediment must be removed periodically from the storage area to maintain the needed capacity. Depending on the individual situation, the storage area and the embankment itself can be grassed or farmed. Suited to steeper slopes, storage embankments can often be built parallel to field boundaries so that farming operations can also be maintained parallel to the boundaries.

Combinations

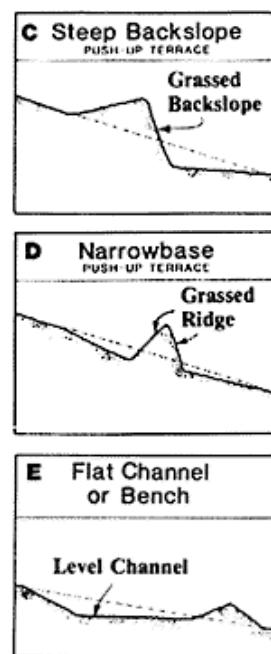
Some producers may find it advantageous to combine terrace shapes, especially in fields with large topography variations. For instance, a grassed backslope terrace may be used on the steeper portions, with broadbase terraces used on flatter areas. Combining shapes can help eliminate point rows, improve farmability and reduce installation and maintenance costs.

Outlets

For a terrace system to function properly, an outlet is necessary to remove excessive water runoff while preventing additional erosion. As with the terrace shapes, there are various types of outlets available.

Grassed Waterways

A grassed waterway is a natural or constructed channel that is generally 30 to 100 feet wide and about 1 1/2 to 3 feet deep. Grasses protect the waterway from erosion and provide a controlled depth and flow velocity for the runoff water. Waterways should be designed for the maximum runoff rate expected from a once-in-10-years storm.



Where possible, construct waterways in existing drainageways. In this case, only minimal grading may be required to obtain the desired waterway shape. Grasses such as brome or switchgrass, or mixtures with these, are often used to protect the waterway. These grasses are relatively inexpensive and readily available, and an adequate grass stand can be obtained in 1 or 2 years. Divert runoff from the waterway until the grass is established, and use care when applying herbicides to adjacent fields to prevent damage to the grass.

Grass waterways have the advantage of being simple and relatively low in cost to construct. A waterway can take some land out of production, but a return can be realized if the grass is harvested for hay or grazed. Removing deposits of sediment, filling in small gullies or eroded areas, and reshaping and reseeding as needed will maintain the waterway and minimize further erosion.

A naturally occurring grassed area, such as a pasture or a wooded draw, can often be used to convey runoff, provided there is an adequate grass stand and runoff water does not reach erosive velocities. Properly located and maintained, grassed or wooded draws can make effective and inexpensive outlets.

Underground Outlets

Underground outlets use buried drain lines, pipelines, or tile lines rather than a grassed waterway to convey water down the slope. Water enters the underground outlet through a riser or inlet. To help prevent downstream flooding, risers usually have orifice plates that control how fast water can leave the terrace channel. Depending on the crop grown, potential damage, and storm size, water may be stored in the terrace channel up to 48 hours. The terrace ridge or embankment must be constructed high enough to temporarily store the runoff from a once-in-10-years storm and to provide for some sediment accumulation. A relief section, where the embankment is a few inches lower than the rest of the terrace ridge, is often used to minimize damage when overtopping occurs from large storms.

Underground pipe or tile outlets allow greater flexibility in the design and layout of parallel terraces than grassed waterways. Underground outlets can also be used with other terrace systems and shapes. To take advantage of the natural storage created when terraces cross drainage ways, underground outlets are usually placed in these areas.

The riser or inlet to the underground outlet is generally located in the terrace channel (*Figure 5*). The riser has holes along its sides to allow water to enter the underground outlet. A pipe or tile line buried at least 2 feet deep conveys the stored water downslope to an outlet.

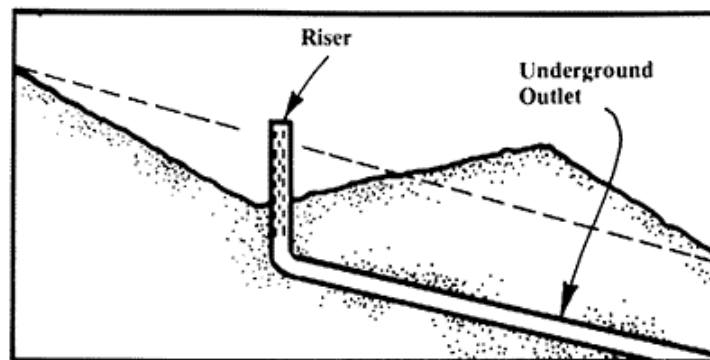


Figure 5. Terrace with underground outlet.

Unlike grassed waterways, underground outlets allow immediate use of the outlet system and take little land out of production. However, construction costs for terrace systems with underground outlets are usually higher than those having grassed waterways. Future changes in the terrace system are somewhat limited by the size of pipe or tile that was installed initially, and by the location of the installation.

Terrace Planning

Nearly every field can be adapted to a terrace system, but the expense of installing the terraces must be considered when deciding which terrace system, if any, is economically feasible. Highly productive land generally needs maximum protection because of concentrated land use. Depending on the amount of earth that must be moved, parallel terraces can cost two to three times more to construct than other terrace systems. However, when comparing the time spent in the field, non-parallel terraces can be more expensive over time. Improved farmability should be the goal of producers who intend to upgrade their present farm situation. As producers increase the size of farming operations, time becomes a major factor.

Properly planned, a terraced field will have less erosion while maintaining, or perhaps increasing, productivity. When planning, a producer should evaluate all of the fields on the farmstead to determine which ones would benefit the most from terracing. A complete farm plan should be developed for future expansion and upgrading, and should include travel lanes, terraces, fences, and water outlets so that unnecessary changes do not have to be made. Financing requirements, options, and priorities for these improvements should be determined. Terraces can be installed when economically feasible or as crop rotation permits.

Future equipment and farming needs must also be considered. Terrace spacing should fit many multiples of row spacings so equipment changes can be made without adversely affecting farmability. Decisions made should take into consideration short- and long-term goals to prepare for the future as well as for present needs.

Every farm must be evaluated individually. For technical information or assistance, contact local Soil Conservation Service or Natural Resources District personnel. Cost-sharing assistance is available in most situations from various state and federal agencies. A well thought-out plan ensures the development of a cost-effective system that is easy to farm. Once the system is installed, inspect it periodically, especially after heavy storms, to check for terrace embankment or outlet damage. Make repairs as soon as possible to keep the terrace system operating effectively.

File G750 under: SOIL RESOURCE MANAGEMENT

C-5, Conservation

Issued May 1985; 12,000 printed.

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Elbert C. Dickey, Director of Cooperative Extension, University of Nebraska, Institute of Agriculture and Natural Resources.

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