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Urbana, Illinois

July, 1982

Issued in furtherance of Cooperative Extension Work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. WILLIAM R. OSCHWALD, Director, Cooperative Extension Service, University of Illinois at Urbana-Champaign.

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Terrace Systems in Illinois: Questions and Answers

Soil erosion is a major problem on many farms in Illinois. The loss of topsoil gradually reduces the productivity of the land until a profit can no longer be realized with row-crop agriculture. The uncontrolled runoff of water also leads to other problems such as waterlogging of low areas and reduction of crop yields because of poor drainage. Eroded upland soils, on the other hand, may become drouthy because the remaining subsoil has less water-holding capacity than the topsoil that has been lost. Furthermore, because the infiltration rate of the subsoil is low, water runs off rapidly and has little opportunity to infiltrate into the root zone for later use by crops. Properly constructed terraces can help solve both erosion and drainage problems. This circular answers some questions that are often raised about what terraces do, how they are constructed, and when they should be used.

What are terraces?

Terraces are earth embankments, channels or combinations of embankments and channels constructed across a field slope. As shown in Figure 1, they reduce erosion by shortening the length of the slope. They also provide water management by conducting the runoff water safely to a stable outlet. Water that collects on long slopes gains velocity, thereby increasing the potential for sheet, rill, and gully erosion. Erosion can be reduced by using terraces to decrease the length of the slope and thus reduce the velocity of the water. For example, the soil loss from one acre of land with a 4 percent slope 100 feet in length will be about one-half of the amount lost from an acre with a 4 percent slope 300 feet in length.
What are the purposes of terraces?

A well-planned terrace system can achieve three objectives: (1) control erosion, (2) manage runoff water, and (3) be convenient to farm. Since terraces control the flow of water over long slopes, they permit a broader range of planting choices and often allow more intensive use of row crops on sloping land that otherwise would erode excessively. The use of terraces also permits greater choice and variation in crop sequences.

How much do terraces cost?

The costs of terraces include not only the construction of the terraces themselves but also the construction of outlets of either the underground or grassed waterway types.

Since the cost of installing terraces is significant, financial assistance is often necessary. The Agricultural Stabilization and Conservation Service (ASCS) may provide incentive payments to offset some of your terrace construction costs. Your county ASCS office can provide information about the availability of funds.

Contractors differ in the way they charge for terrace construction. They usually charge some minimum fee for a small project. Before selecting a contractor, visit terrace systems that he has previously installed. Knowing the costs of other recently installed systems will help you in your financial planning.

Where can I go for assistance?

If you decide to install terraces, you will need technical help, a qualified land improvement contractor, and perhaps financial assistance.

Technical help is necessary to develop an overall plan for your farm and to determine the proper type and spacing of terraces and the type of outlet system needed. Assistance is available from your local Soil and Water Conservation District office and your county Extension adviser.

Although you can use various types of earth-moving equipment to construct a terrace system yourself, a skilled earth-moving contractor is more likely to be able to build terraces that will save your soil and fit your farming operation. The directory of the Illinois Land Improvement Contractors Association is a good source of information about competent contractors who have had experience in your county.

What kinds of terraces are used?

Terraces are often described by the way they dispose of runoff water (Figure 2). If the runoff is channeled in the terrace to a grassed waterway, the terrace is referred to as a gradient terrace with a grassed waterway outlet. To improve the farmability and reduce the amount of land needed for grassed waterways, the runoff water can be channeled to a storage section of the terrace where it is held temporarily and released slowly through a surface inlet and underground conduit. Terraces of this type are referred to as gradient terraces with underground outlet or parallel-tile-outlet (PTO) terraces. The two main advantages of using an underground tile outlet system are that it promotes parallel alignment and reduces the need for grassed waterways. A combination of these two methods of discharging runoff may be used to make your terrace system more effective and farmable.

Sometimes terraces are described by the shape of their ridge cross section. Three commonly used terrace cross sections are shown in Figure 3. The first of these is the broad-base type. All slopes on this type of terrace are designed to be farmed. The exact slopes used on the terrace ridge are determined by your equipment needs. For best farmability, the terrace spacing and the length of the front slope must be a multiple of your equipment’s width. On steeper land, however, constructing a farmable back slope requires moving a large amount of earth, thus increasing the cost.

The grassed-back-slope type of terrace, in which the back slope is graded to a steep pitch and grassed, is often used in such situations. With grassed-back-slope terraces the soil for the terrace ridge is taken from the downhill side, resulting in a benching effect and a flattening of a portion of the slope to be farmed.
Figure 2. Two outlet methods for a gradient terrace.

Figure 3. Terrace cross sections.

BROAD-BASE TERRACES

Front slope

Terrace spacing and farming interval

Back slope

Channel

Ridge

Ground line

Cut slope

GRASSED-BACK-SLOPE TERRACES

Front slope

Terrace spacing

Farming interval

Channel

Ridge

Ground line

Cut slope

Grassed back slope

NARROW-BASE TERRACES

*Grassed front slope

Terrace spacing

Farming interval

Channel

Ridge

Ground line

Cut slope

Grassed back slope

* Slopes 2:1 or flatter
The narrow-base type also reduces the amount of earth that must be moved to construct the terrace. The entire ridge is grassed instead of just the back slope. Since the ridge is narrow, however, only a small area of the field is removed from production. With terraces having a narrow-base cross section, the length of the front slope is not a factor in farmability, but with all three of the above cross sections, the spacing must be adjusted so that the farmed intervals match the equipment width.

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Will the cross sections of terraces be dangerous to farm?

With grassed-back-slope terraces the steep portion of the terrace ridge is maintained in grass and not farmed. Accidents have occurred, however, when unskilled drivers have lost control of their tractors. Certainly the experience and skill of the operators is a factor that should be considered if you select the grassed-back-slope cross section.

With broad-base terraces all of the protected land is farmed; no land is taken out of production.

To gain this advantage each surface of the terrace must be farmed. It is also important that your farm equipment can be used safely on the slopes of the terrace cross sections. Terrace can be designed with flatter cross sections. This flattening is done by moving more earth during construction, however, which adds to the cost. For example, consider a field with a slope of 4 percent, as shown in Figure 4. As the steepest slope in a typical terrace cross section was reduced from 17 percent to 10 percent, the amount of earth moved and the cost per foot of the terrace was increased by 50 percent. It is obviously important that you know the slope limitations of your equipment and that you inform your technical adviser and contractor so that they can help you plan a terrace system that is safe and farmable.

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Are all terraces difficult to farm?

Terraces that are planned, designed, and constructed properly will in many cases improve the farmability of your land. Although reducing erosion and managing runoff water are the primary
objectives of a terrace system, farmability is also a key consideration. Terraces constructed many years ago were often hard to farm because they had many sharp turns and odd areas. Very little consideration was given to improving terrace alignment, and as a result terracing was not fully accepted. Modern terraces are designed to match farm equipment dimensions and are therefore more farmable. Experience has shown that minor cuts and fills can significantly improve terrace systems.

To be farmable, a terrace system should have the following characteristics:

1. The terraces should be parallel wherever possible with few (if any) point rows.
2. They should be parallel or perpendicular to field boundaries wherever possible.
3. They should have gentle, circular turns with minimum curvature.
4. The spacing and cross sections should be designed to fit the farm’s equipment. Terrace spacing should be planned so that the farming intervals are multiples of the width of present equipment and also, if possible, suitable for future equipment.
5. The terraces should be spaced as far apart as possible. To do so may require changing tillage practices or crop rotations between the terraces. For example, with continuous high-residue crops such as corn it may be possible to increase the terrace spacing by changing from conventional fall plowing to a management system that involves conservation tillage. It is important that the management system selected be continued during the life of the terraces.
6. The terraces should be designed so that roads provide access to all parts of a field. Field boundaries and ridges are ideal locations for roads.

How do the soil type and field slope influence decisions about terraces?

If your farm’s topsoil is shallow with short, irregular slopes, you should probably not install terraces. Instead, erosion should be controlled by other means such as conversion to perennial vegetation or an intensive conservation tillage system.

If your topsoil is shallow and you have long slopes, terracing can be an effective way to permit continued intensive cropping and at the same time save the remaining topsoil. During construction, the topsoil should be stockpiled until the terraces are completed. It should then be spread over the constructed area, especially where the subsoil has been exposed. The use of narrow-base terraces may be especially suitable for such situations because they involve less soil disturbance.

Broad-base terraces are best used on long, uniform, gentle slopes up to 5 or 6 percent. They have the advantage that it is possible to farm all of the land being protected, especially if underground outlets are used. Because the entire terrace cross section can be farmed, it is important to work out problems of farmability in more detail than with terraces having other types of cross sections. Be sure not to select a terrace shape with slopes that are too steep for your equipment.

On slopes of 6 to 15 percent, consider grassed-back-slope terraces. These terraces make it possible to stabilize the slopes. The steep back slope must be maintained in sod.

Can my present conventional terrace system be improved?

A conventional contour terrace system is one that follows the natural topography of the land. Most were planned many years ago for small equipment. To be easily farmed with modern equipment, they must be modified.

Many conventional terrace systems can be improved by using a combination of outlets (of the grassed waterway or tile type) and by using variable grades in the channels. Sometimes the earth in the old terraces can be used in the construction of new terraces. Reusing the earth will help to smooth the field and make the terraces more effective and farmable.

When should terraces be used with other erosion-reducing practices?

With long slopes it becomes increasingly difficult to reduce erosion using only management practices such as conservation tillage. Therefore, where slopes are long and uniform, installing terraces is an effective way of controlling water and reducing
soil loss. Terraces, more than any other soil conservation practice, permit you to manage water as well as soil.

Where gullies have developed on long slopes, diverting the runoff water from the gully by means of a terrace system may be an excellent control method. On these same slopes, terrace systems also provide a means for continuing intensive row-crop farming on productive land.

In many instances, an upstream land treatment system that includes terraces can be installed instead of a very expensive downstream structure to control a gully head. A properly designed terrace system not only controls the downstream gully erosion but also controls sheet and rill erosion on the upstream slopes of the watershed. In many instances, the total cost of the terrace system will be less than the cost of the structure.

In the vicinity of lakes, where excessive sediment is a potential problem, a well-designed terrace system on the watershed area will reduce movement of soil and prevent large amounts of sediment from entering the lakes. Terraces with underground outlets will limit annual sediment loss to 1/2 ton per acre or less.

Terrace systems will often improve the topography of the land surface for better farmability, complementing other methods of erosion control.

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How effective are terraces in controlling sheet and rill erosion as compared to other conservation practices?

When you consider the various combinations of conservation to use in limiting erosion to the soil loss tolerance limits 1 or less, compare terraces with other erosion control methods such as contouring, strip cropping, conservation tillage practices, and cropping sequences. Here is an example of such a comparison:

A soil on a central Illinois farm has a soil loss tolerance of 5 tons per acre per year and a soil

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1 The soil loss tolerance limit is the maximum amount of erosion that can occur without damaging land productivity.
erodibility factor\(^2\) of 0.32. Slopes vary from 4 percent to 6 percent but are predominantly 6 percent. The operator wants to compare the effects of various conservation systems and rotation intensities on the soil erosion rate.

Comparisons are made in Table 1 showing effects of various combinations of practices on a 400-foot, 16 percent slope.

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**Will the inlet pipes for underground outlets be an obstruction to my equipment?**

It is relatively simple to reduce the obstruction caused by the inlets. First, it is important that the distance from the ridge to the intake riser in the channel be properly selected so that your equipment can make a specific number of passes (usually one or two). Second, with narrow-base terraces the inlet may be placed close to the grassed ridge, where it will be less apt to interfere with equipment travel. Third, installing a removable connection between the inlet and underground outlet near the ground surface makes the inlet easy to remove before planting and easier to repair if it is damaged by equipment. Fourth, to reduce the potential for damaging the main lines, it is advisable to locate the tile inlet on a short branch connected to the main tile, as shown in Figure 5. This arrangement also makes it easier to repair any damage.

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**Can I install the entire terrace system at one time?**

Yes, but it may not always be practical. First, the cost of a large system may exceed the resources you have available for investment in a single year. ASCS incentive payments also have an annual limit. Therefore, it may be best to develop an overall plan first but then install the terraces by segments.

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\(^2\) The soil erodibility factor reflects the fact that different soil types erode at different rates because of physical characteristics such as soil texture, structure, organic matter content, and soil depth. An erodibility factor of 0.32 indicates a soil that is moderately erosive. Soils generally range from 0.5 (high erodibility) to 0.1 (low).
If an underground outlet or grassed waterway is used, it is often advisable to establish the major part of the outlet system during the season before the terraces are constructed. Where a waterway is to be used, the grass should be established during the year before construction so that it will be adequately established when the terrace is completed. If an underground outlet is used, it also should be installed a year before construction so that the backfill will have time to settle before the terrace embankment is constructed, thus reducing the danger of a failure in the settled zone.

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**What must I do to maintain the terraces?**

For terraces to function properly, their capacity to hold or channel water must be maintained. Sediment deposited in the terrace channel should be removed periodically to minimize the danger of overtopping. Sediment deposited near the intake of an underground outlet system and soil banked up around the intake during tillage operations should be redistributed so that the intake is always located at the lowest point of the terrace storage section. Generally, such maintenance can be performed with farm equipment.

Trash that collects in and around intakes increases the time that water will stand in the terrace storage section, which may result in terrace failure and damaged crops. You will need to clean and repair intakes after each storm and repair promptly any damage done by farm machinery.

The terrace ridge height is critical to maintaining adequate capacity and protecting lower terraces. Consequently, damage to the terrace ridge should be repaired quickly.

Rodent holes in terrace ridges are sometimes a problem, particularly in grassed ridges. Regular inspection and repair is necessary to prevent small holes from increasing in size and causing the ridge to fail. Grassed terrace slopes should be mowed periodically, and the growth of brush should be controlled to avoid attracting rodents.

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**Should I consider other phases of a soil and water conservation management plan when planning the terrace system?**

By all means, yes! Remember that a terrace system will be a long-term permanent improvement involving both soil and water management. It should fit into your plans not only for your cropping system but for such considerations as tile drainage. It is important that you consider all of your alternatives together so that you can conserve your soil and water resources as you maintain or increase productivity.