Laying Out and Maintaining Field Terraces

C. E. Ramser, USDA, 1924

Selected pages from Terracing Farm Lands.

See how growers marked a contour, laid out a graded terrace and kept runoff from cutting through the field.

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at the end of the terrace. Sometimes a protection for both the terrace channel and the ditch is built of concrete. Erosion is most active near the end of a terrace, where the largest flow of water occurs. For this reason the last 25 to 50 feet of the terrace should not be cultivated, and the terrace and terrace channel should be seeded to grass for protection against erosion. Where convenient the water from terraces is discharged at the edge of timberland.

Sometimes it is found necessary to use a natural draw in a field as a terrace outlet. Where this happens the draw should either be seeded to grass (see fig. 16) or some other means should be employed to prevent the erosion of a deep gully, such as the soil-saving dam. See Farmers' Bulletin 1234 (Gullies, How to Control and Reclaim Them) for description and discussion of the soil saving dam.

Where suitable outlets can not be found for a system of terraces it becomes necessary to construct a hillside ditch to carry off the water. It is better not to locate such a ditch directly down the slope. It should be large enough and should have sufficient fall to remove the water from all the terraces.

The problem of providing terrace outlets for systems of level terraces is not so difficult as for graded terraces, since much less erosion occurs from water that is discharged quite slowly at the ends of level terraces. On some soils that readily absorb a large percentage of the rainfall no provision need be made for terrace outlets. Figure 11 shows a plan of a field of level terraces in which the terraces completely encircle the top of the hill, there being no chance for escape of the water over the surface of the ground. In fields where tile drains are laid above level terraces the outlets consist of main tile drains laid down the slope to a drainage channel below.

LAYING OFF TERRACES.

In laying off a system of terraces it is first necessary to provide for suitable outlets. This, of course, especially applies to systems of graded terraces. Wherever possible outlets should be provided for at both ends of terraces. This divides the water of the field and gives each terrace less to handle. Short terraces are less liable to break than long ones, and are, therefore, more desirable.

Where a draw or depression occurs somewhere near the middle of the field it is desirable to begin the terraces in the draw, so as to avoid building a high embankment required for carrying the water across the draw. Of course, this practice depends upon the size of the draw and whether it is located so far from the middle of the field as to make one of the terraces unduly long. Sometimes it is found necessary to use such a draw as a terrace outlet where suitable outlets are not available at the border of the field.

The type of terrace best adapted for given conditions, the vertical distance between the terraces and the fall that they should have, are discussed in the foregoing pages.

It is always best to lay out the upper terrace in a field first. The starting point on the upper terrace should be obtained by measuring down the proper vertical distance from the top of the hill or field. If a terrace midway down the slope is laid out first, and a point from

which to start is selected at random without respect to the top of the hill, the chances are that the upper terrace will drain either too large or too small an area. When the upper terrace of a field is made to drain too large an area, which is a very common mistake in terracing the excessively large volume of drainage water generally breaks the upper terrace, and usually all the terraces below are broken in turn. If the upper part of a hill belongs to a neighboring farmer an effort should be made to induce him to terrace it. Otherwise it will be necessary to dig a hillside ditch along the upper side of the field to intercept the water draining from the neighboring farm above. In

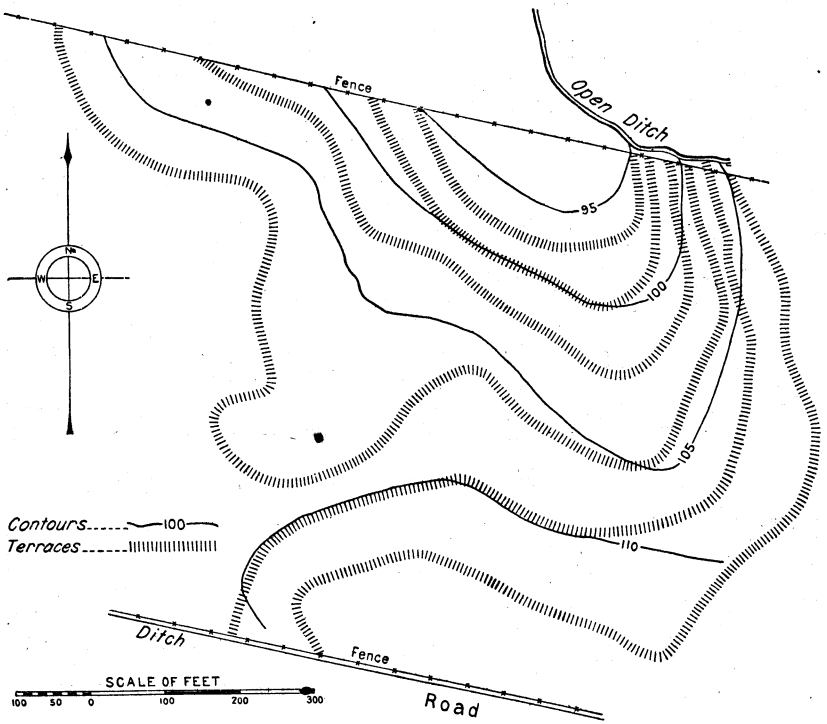

FIG. 17.—Field of broad-base graded-ridge terraces. Note the irregularities in the direction of the terrace lines due to changes in direction of the slopes of the field.

Figure 17 is shown a plan of the location of terraces in an actual terraced field. The irregularity in the direction of the terraces is due to changes in the direction of the slopes of the field. Where the slope of a field is uniform and with no changes in direction, the terraces are practically straight and lie in parallel lines.

A number of homemade instruments are used for laying off the terrace lines, such as the A frame with plumb bob or spirit level, but unless the work is done very carefully the results are generally poor. A cheap form of level, costing about $18 (see fig. 18), is widely used for laying off terraces. With this level in the hands of an experienced operator, very good results are obtained. The best results are obtained with an engineer's level.

In laying off a system of graded terraces, it is best to begin near the middle of the upper terrace. By beginning at the middle instead of at either end there is less variation in the vertical distance between the terraces. In fields where the terraces curve around a hill each terrace is generally much longer than the one immediately above. If the vertical distance between the terraces is laid off at the upper end, the terraces will be too far apart at the lower end owing to the greater amount of fall in the longer terrace. If the vertical distance is laid off at the middle of the terraces, the average distance between the terraces from the upper to the lower ends will be about right.

The field work required in laying off a system of graded terraces is as follows: Set the leveling instrument about half way between

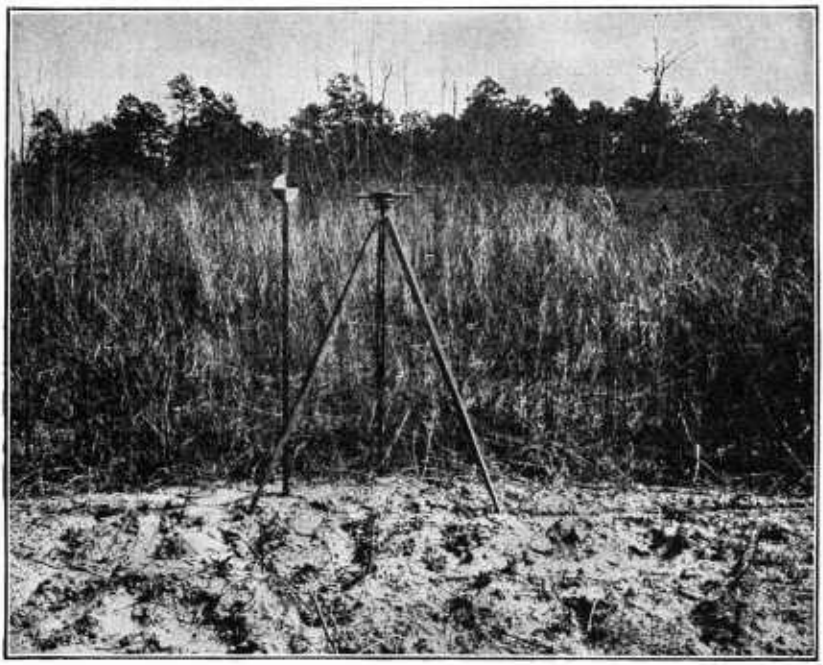

FIG. 18.—View showing level and rod widely used in laying off terraces.

the ends of the proposed terraces and high enough so that when it is level, the line of sight will pass over the highest point in the field. If, for instance, the average slope of the field is about 10 feet in 100 feet, then the drop betwen the terraces should be 4 feet as given in Table 2. To obtain a starting point on the first terrace, measure down a vertical distance of 4 feet from the highest point in the field. This is done by first reading the rod when set on the highest point and then finding a point below on the slope where the reading of the rod is 4 feet larger than the first reading. If the first reading is 1 foot the second reading should be 5 feet. Points on the proposed terraces may be located every 25, 33, 50, or 100 feet apart; the straighter the terrace the greater may be this distance. The distance should be either paced carefully or measured with a tape. A very common practice for average conditions is to establish points

33 feet apart or eleven 3-foot steps. If the terrace is given a uniform fall of 6 inches every 100 feet and is being laid out toward the outlet the target on the rod should be raised 2 inches every 11 steps, or 33 feet; if in the opposite direction, then the target should be lowered 2 inches each time. In pacing the distances the rodman should try to estimate as nearly as possible where the next point will be, and when directed up or down the hill by the levelman should try to keep the proper distance from the last point. In order to avoid mistakes the target should always be changed before starting to pace off the distance. If the field has been cultivated in ridges, the points should all be located by setting the rod either on top of the ridges or in the depressions between them. If, after the proper distance between points on the terrace line has been determined, it is found that the rod is too low when set in the depression between the ridges, and too high when set in the next depression above, then the proper location for the line of the terrace lies somewhere between the two positions of the rod. A man should follow the rodman and dig holes with a hoe or spade or set stakes at points on the proposed terrace lines. A plowman should follow immediately and lay out the first furrow. Care should be taken to see that no abrupt turns are made with the plow. All changes in direction should be made by smooth, regular curves. Where gullies or draws are crossed, stakes should be set on each side and the terrace run directly across.

Long sights with the level should be avoided. Much more accurate results are obtained where short sights are taken. When it becomes necessary to move the level so as to avoid taking long sights or in order to see around a hill, the rodman should remain at the last point located. When the level is set up at the new position, the rodman changes the target so that it coincides with the new line of sight of the level and the work proceeds as already described.

Where a variable fall for the terrace is used instead of a uniform fall, it should be taken from Table 3. For instance, if the land has a fall of about 10 feet in 100 feet and the proposed terrace is 1,200 feet long, the fall to give the terrace would be three-fourths inch per 100 feet for the first 300 feet, 1½ inches per 100 feet for the second, 3 inches per 100 feet for the third, and 6 inches per 100 feet for the fourth 300 feet.

The level terrace is much more simple to lay off than the graded terrace, since it is not necessary to measure distances along the terrace line, and the target on the rod is kept at the same position for all points on each terrace. Other points to be observed in laying off a system of level terraces are similar to those discussed for graded terraces.

BUILDING TERRACES.

The plow and the V-shaped drag are the most generally used implements for building terraces. In Figure 19 is shown a plan view of a terrace drag widely used in Texas. This drag is very easily built. In place of this drag, a steel ditcher or terracer is frequently used, a view of which is shown in Figure 20.

In terracing a field, the upper terrace should always be built first. If a lower terrace is built first and there is not time to build the upper before a rain comes, then the lower will be badly washed and broken

by the larger volume of water drained from all the land above. In building the terrace a backfurrow strip about four furrows wide is first thrown up as shown in Figure 21. The steel terracer or **V** drag drawn by four horses is then used to move the dirt toward the center of the strip and as high as possible. The plowing is then continued

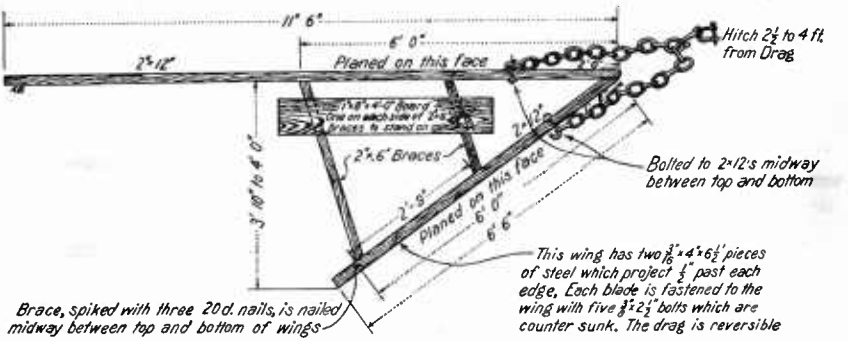

FIG. 19.—View of homemade wooden **V** drag used for throwing up terraces.

and the best results are obtained where each round with the plow is followed with the **V** drag. The short wing of the **V** drag is sometimes hinged so that the distance the soil is moved can be varied as the terrace grows wider. For the best results the weight of two men is required on the drag. They can shift their weight so as to raise or lower the end of the short wing as desired. The process of plow-

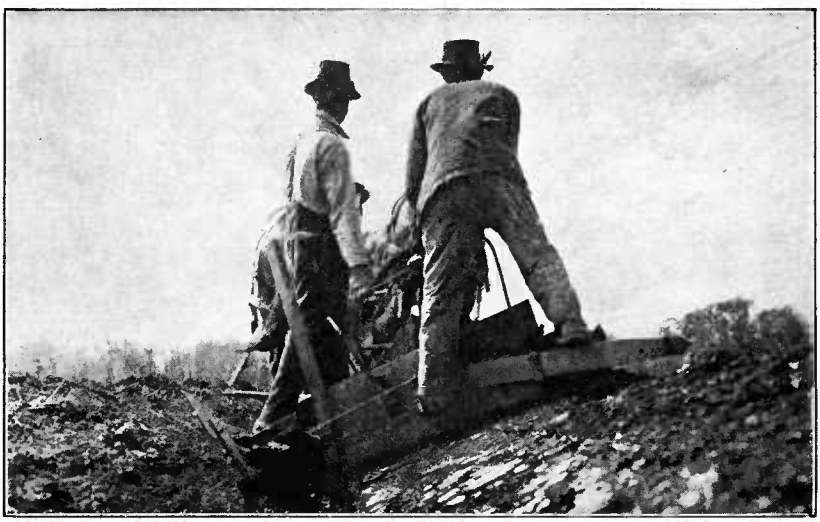

FIG. 20.—A steel ditcher and terracer. Four horses are generally used with this implement in terracing work.

ing and dragging is continued until the terrace is 15 to 20 feet wide. If the terrace is not high enough after it has settled, as found by testing the height in a number of places with a level, the plowing and dragging should be repeated. A view of a freshly built broad terrace is shown in Figure 22.

Terraces are sometimes built with a plow alone. Several plowings are required to throw up the terrace to the desired height. A large 16-inch plow with an extra large wing attached to the moldboard is used very successfully for throwing up high terrace embankments. The disk plow and the ordinary road grader are very effective implements for use in building terraces. Graded terraces on steep slopes are often built with a plow and slip scraper. A strip is backfurrowed with the plow, and the loose earth on the upper half of the strip is scraped up and dumped on the lower half. By this method the terrace is built up mostly from soil moved down from the upper side.

In order to finish up terraces properly, some work with the slip scraper is generally required. The top of the terrace should be tested with the level and rod to see that it conforms to the proper grade. Any low places detected should be filled with a shovel or scraper. All large embankments across draws and gullies should be built with the slip scraper, and it is necessary to build such embank-



FIG. 21.—The first step in building a terrace is to backfurrow a strip about four furrows wide.

ments considerably higher than the rest of the terrace to allow for settling the loose earth. Most breaks in terrace systems occur at crossings of gullies or draws, and it is therefore very important that a high, broad, substantial embankment be built across these places. In order to remove any water that collects above the terrace embankment across draws or gullies, a pole drain can be laid under the terrace down the middle of the gully. Such a drain is made by simply laying three poles together in the shape of a triangle. It will serve the purpose until the depression above the terrace is filled with silt and a drain is no longer required. This drain is particularly adapted for use with systems of graded terraces. Where level terraces are used, the tile drain shown in Figure 12 is recommended.

Any obstructions, such as rocks, stones, and stumps, that lie along the line of the terrace should be removed, since their presence might permit seepage and result in the failure of the terrace. In some parts of Texas the fields contain numerous large earth mounds generally

known as gas mounds. These mounds cause considerable difficulty in terracing fields. Where they lie along the lines of graded terraces, it becomes necessary to provide a passageway through them by means of the plow and scraper.

Where terraces are continued from one field to another across a fence row, it is necessary to build that portion of the terrace near the fence by hand labor, using the spade and shovel. It is very important that this portion of the terrace and channel be built the same size as the rest of the terrace, and considerable attention should be given later to see that the waterway is always kept open, so that the free flow of the water shall in no way be obstructed.

Narrow-base and bench terraces are built in the same manner as the broad-base terraces, but not so wide. The bench terrace is gradually developed by always plowing the soil down the hill with a reversible plow.

The old maxim, "What is worth doing at all is worth doing well," is especially applicable to terracing work. If one has not time to



FIG. 22.—View of a newly completed broad-base ridge terrace.

terrace all of a field properly, it is far better to terrace the upper part well than to attempt to terrace the whole field and do a poor job.

CARE AND CULTIVATION OF TERRACES.

Terraces require considerable care and attention, especially during the first year, before the loose soil has had time to become settled thoroughly. All apparently weak places should be visited after every heavy rain and any breaks should be repaired immediately with a shovel. It is best not to cultivate the terraces the first year, but to seed them to some kind of cover crop. (See fig. 23.)

It is advisable to run the crop rows parallel to the terraces, one row being planted on the top of the terrace. The cultivation of the top row tends to keep the top of the terrace at the proper height. Where the rows are run across the terraces, as is done commonly on moderate slopes, the top soil is moved down the side slopes by cultivation. As a result, the terraces are more liable to break, and much more maintenance work is required than where the rows are run parallel to the terraces.

All terraces that are cultivated should be plowed at least once a year, and the soil should be thrown to the center. In this way the height of the terrace is kept up, and the base may be broadened each year.

Steep land that washes badly between the terraces should not be cultivated. The terraces should first be well built and the entire field seeded to grass and used for pasture or meadow.

When it is found necessary to cross a farm road in terracing a field, the building of the terraces should be continued across without regard to the road. Where the terraces are as much as 20 feet broad, no provision need be made for passing traffic across them, but they

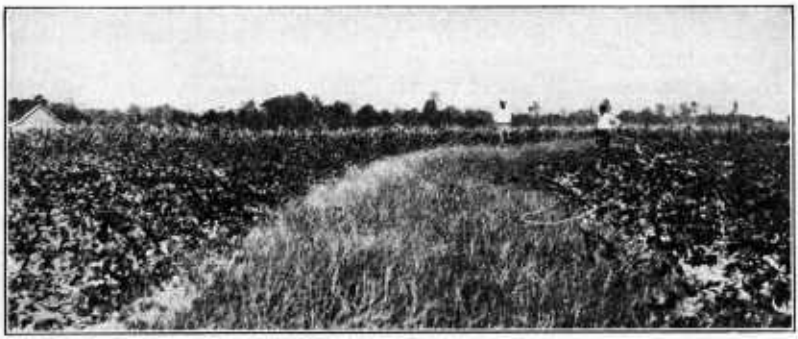

FIG. 23.—Newly built terrace seeded to cover crop to insure against breaking before the loose earth becomes thoroughly settled.

should be carefully maintained to prevent possible breaks. Where the terraces are not more than 10 feet broad, considerable inconvenience to traffic and injury to the terraces generally results where no provision for crossing is made. Sometimes the water is carried under the roadway by means of a culvert, but the principal objections to this are that the capacity of the waterway is greatly reduced, and the free flow of the water through the culvert is often obstructed by stalks or other trash washed from the field. A wooden bridge spanning the channel, so as not to reduce very much the cross sectional area of the waterway, makes a more desirable and satisfactory crossing.

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