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# TERRACING FARM LANDS IN TEXAS

BY

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## FOREWORD.

A fertile soil is necessary for a prosperous agriculture.

The greatest loss of fertility on Texas farm lands is caused by erosion, or washing of the soil.

Soil erosion usually takes place so gradually that it is not noticed until it has carried away much of the fertility of the field.

Terracing is the most effective means of preventing soil erosion.

It is not intended that this bulletin shall be an exhaustive treatise on soil erosion or terracing, but rather to call the attention of Texas farmers to the value of terracing, and to give information on how to survey and construct terraces.

T. O. WALTON

Director.

## CONTENTS.

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	Page
Soil Conservation .....	5
Extent of Area Needing Terracing .....	5
Moisture Conservation .....	6
Cost of Terracing .....	8
Broad Base Terraces .....	8
Preliminary Survey of Farm .....	9
Land Preparation Before Terracing .....	11
Starting Point for First Terrace .....	11
Instruments for Running Terrace Lines .....	12
Homemade Level Outfits .....	12
Adjusting the Telescope Level .....	15
Running the Terrace Line .....	16
Terracing Table .....	18
Length of Terrace .....	19
Fall Along Terrace .....	19
Marking Terrace Line With Plow .....	19
Running Terrace Line Across Gullies .....	20
Spacing of Terraces .....	20
Building the Terraces .....	21
The "V" Drag .....	22
Size of Terrace .....	25
Damming the Gullies .....	25
Terrace Outlets .....	26
Maintenance of Terraces .....	27
Cultivation of Terraced Fields .....	28

CONTENTS

Page	
5	Soil Conservation .....
5	Extent of Area Needing Terracing .....
5	Moisture Conservation .....
8	Cost of Terracing .....
8	Broad Base Terraces .....
9	Preliminary Survey of Farm .....
11	Land Preparation Before Terracing .....
11	Starting Point for First Terrace .....
12	Instruments for Running Terrace Lines .....
12	Homemade Level Outfits .....
15	Adjusting the Telescope Level .....
15	Running the Terrace Line .....
18	Terracing Table .....
19	Length of Terrace .....
19	Fall Along Terrace .....
19	Marking Terrace Line With Plow .....
20	Running Terrace Line Across Gullies .....
20	Spacing of Terraces .....
21	Building the Terraces .....
22	The "V" Drag .....
25	Size of Terrace .....
25	Damming the Gullies .....
26	Terrace Outlets .....
27	Maintenance of Terraces .....
28	Cultivation of Terraced Fields .....

# TERRACING FARM LANDS IN TEXAS

M. R. BENTLEY,

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The conservation of the soils of the hillsides and slopes of Texas farm lands is one of our most important problems. The rebuilding of the worn-out, and washed lands is rapidly becoming a problem of more and more extent. Nearly all of the cultivated hilly lands of Texas are subject to damaging erosion.

Erosion may do damage in more ways than one. The most noticeable effect of erosion is the cutting of gullies in the fields. Erosion may take a layer of the soil evenly from the surface of the field. This is known as sheet washing. Erosion may separate and carry away the humus, or vegetable matter, from the soil. It sometimes covers good bottom land with sand. The silt and sand from the hillsides frequently settle in the natural drainage ditches of the bottom lands causing them to overflow, and making necessary the artificial drainage of such lands. Washing frequently destroys the stand of a young growing crop. Washing may cause the loss of manure or commercial fertilizer that has been placed on the land.

Terracing will check erosion, and therefore, prevent to a great extent all these damaging effects of it.

## EXTENT OF AREA NEEDING TERRACING.

In Figure 1, the shaded portion shows the extent of the area most affected by erosion. This area comprises about 100,000,000 acres, of which probably 40,000,000 acres would be benefitted by terracing. Probably as much as 20,000,000 acres are badly in need of terracing.

The Gulf Coast and the Plains sections are level so that terracing is not needed to prevent erosion.

In southwest Texas some of the country being mountainous and much of it being used for grazing purposes only, and also on account of the light rainfall, there is not likely to be any need for much terracing there in the near future.





FIG. 2. Sheet washing and gullying has practically ruined part of this field. The soil is devoid of humus or other water holding material and bakes so hard that most of the rainfall is lost as run-off.

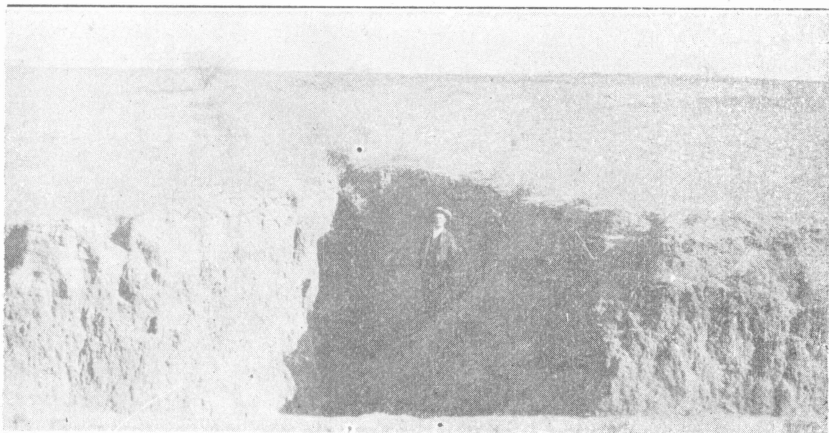


FIG. 3. Gullying of the waterfall type shows how the water undermines the surface soil when it is more resistant to washing than the soil below. Soil saving dams of concrete, lumber, or tile, will often control such ditches economically.

The conservation of moisture by terracing and contouring of rows would be worth millions of dollars to Texas annually. This should receive special attention in that part of Texas where moisture is the limiting factor in crop production.

#### COST OF TERRACING.

The cost of terracing ranges from about one to eight or ten dollars per acre depending largely on how steep the hillside is, and how badly it is gullied. The terracing of the slightly sloping fields that are not badly gullied is the cheapest. On account of the proportionately high cost of damming the gullies in a badly washed field, it will pay well to terrace the field before it begins to wash.

The average cost per acre for terracing as determined from a large number of fields is about \$2.25 per acre.

The cost of contouring the rows on the comparatively level fields for the purpose of conserving the rainfall, is practically nothing, since the only extra work required is the surveying of a few guide rows.



FIG. 4. One of the four large ditches in a 30 acre field. After the field was terraced only one ditch was left.

#### BROAD BASE TERRACES.

Various kinds of terraces have been used in different sections of the country, but to avoid confusion only one type will be discussed here. The variations of this type of terrace to adapt it to different soils and slopes will be considered.



The broad base terrace, as it is generally known, consists of a ridge from 16 to 24 feet wide at the base, built across, or around, the slope. The height of the ridge above the waterway along the upper side of the terrace should be from 14 to 24 inches. We usually expect to be able to work over, and grow a crop on the broad base terrace.

These ridges are placed at such intervals on the hillside that water starting down the slope by the steepest route will be checked before it begins to gather volume enough to wash. When the water comes to the terrace ridge it is carried along the waterway at such a low velocity that it does not wash the soil, and so that much of the silt and vegetable matter in the water will be deposited. The terraces should have outlets at natural waterways or ditches so that during excessive rainfall the water may flow out the ends of the terraces rather than to break over the ridges.

The old practice of building terrace ridges from 4 to 8 feet wide must be corrected. These narrow ridges cannot be satisfactorily cultivated and usually grow nothing but weeds, which gives a bad impression of terracing.

The broad base terraces will permit modern implements to be used over them, and will usually grow the best crop in the field.

#### PRELIMINARY SURVEY OF FARM.

The first thing that should be done in terracing a field is to consider its drainage with relation to surrounding fields. Often the absence of any definite plan for terracing the whole farm makes trouble as the work progresses. Sometimes the work first done must be changed.

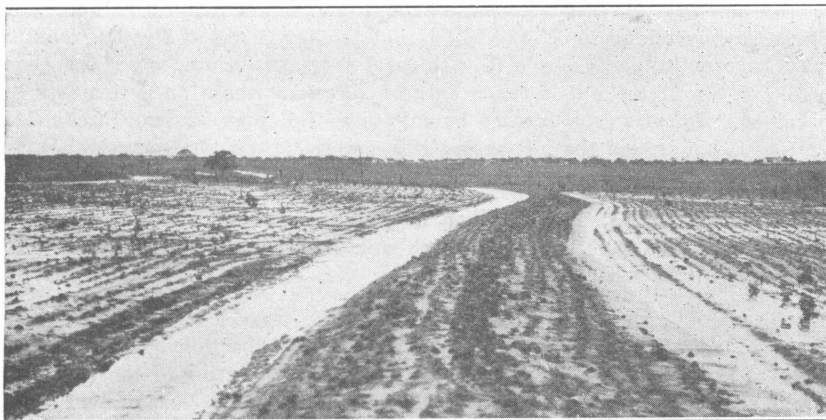


FIG. 5. Terrace carrying water in a broad stream at low velocity.

The terrace outlets should be selected with the view to their handling the water from all the fields. Plans should be made to eliminate as many outlets as possible after the erosion had been brought under control. The water coming from surrounding unterraced land must be considered. If it can be diverted, this should be done by means of a levee, or a ditch. If there are not sufficient natural waterways across the farm to serve as outlets it will be necessary to cut ditches for the purpose. Outlet ditches should run along the fences wherever possible, as they will cause less inconvenience there than if run through the fields.

The changes that are likely to be made in the fields should be kept in mind. For instance, terraces are frequently emptied into woodland that may be later put in cultivation, or the same may be true of pasture land. The terraces and outlets should be planned so that the opening of new fields will not make necessary the changing of terraces already built.

The roads about over the farm should be considered. Sometimes it is best to carry the water each way from such a road. Again it may be that a road-side ditch will form a good outlet ditch. It may be necessary to change the road so it will run on the top of a terrace. If some such arrangement cannot be made, a culvert may have to be put in, or the terrace built very strong where the road crosses over it.

Terraces usually cannot be run satisfactorily through an orchard. Orchard land should be terraced before the trees are set out.

If the land to be terraced is stumpy, the stumps can be removed from the land to be occupied by the terrace, after the terrace line has been run.

Occasionally a field will have a rather high knoll or hill in the middle of it with no outlet ditch running high enough up the hill to form an emptying place for the terraces. If the hill is not too large and the soil porous, it may be practicable to circle it with level terraces, located close together, until the top of the hill is taken care of, down to where an outlet may be obtained. Sometimes a terrace having some fall may be run once and a half or twice around the hill before it is emptied. Again it may be best to cut an outlet ditch up one side of the hill, to empty the terraces into.

Extreme care should be taken in selecting outlets in soils where the ditches wash and cave badly. In such soils the terraces should be emptied on to grass land wherever possible.

The public roads are used a great deal for terrace outlets, and unless the road is damaged thereby, there should be no objection to the practice. If there is danger of injury to the road, from the diverting of the water off the field to it, the outlet ditches should be run inside the land owner's field.



FIG. 6. A terrace through a pecan grove. Note the trees on the terrace line.

#### LAND PREPARATION BEFORE TERRACING.

The land is usually in the best shape for terracing in the fall after the crops have been gathered and before the breaking is started.

If the terraces are built before the land has been broken, the spaces between terraces may then be taken as separate lands. The dead furrow will then run in the same general direction as the terraces and be a benefit in handling the water. It is extremely difficult to terrace after the field is listed. Lister furrows should never be run over terraces. The lands between the terraces may be listed after the terraces are built.

If Johnson grass or Bermuda grass is to be eradicated from a field, it is best to do it before it is terraced, as terraces will interfere somewhat.

It seldom gets too dry to terrace, if the ground can be loosened at all, and as a rule it is better to terrace the black lands and clay lands when they are dry.

If the gullies are to be plowed in, or filled to make them easier to cross it is probably best to do this after the terraces and dams are finished, otherwise a rain might carry out large quantities of the loose soil from the gullies.

#### STARTING POINT FOR FIRST TERRACE.

There is usually some special feature in a field that will determine the place for running the first terrace line. It may be that some large gullies

head at about the same elevation on the hill. Then the first terrace might be run so as to pass just above the gullies. If there is an orchard, a garden, a barnyard, or a rocky knoll that is to be avoided by the terrace lines, a line may be run just above or below such obstruction. Other terraces will then be spaced each way from this one. If it is desirable to have a terrace empty at a certain place the terrace may be started there. It is not essential that the top terrace be surveyed first, but it should always be built first. Another important thing is to get the top terrace high enough up the hill. There should be no more vertical fall in the drainage area above the top terrace than there is between terraces. The top terrace is the important one, for the reason that if it breaks usually all the rest will break at the same point.

Frequently after running the first terrace line it is advisable to go back and change the starting point and run the line again to get it at a more desirable place. This is especially true of fields having only a slight, but irregular slope. A little care in selecting the starting place and a few trial runs will often help in getting a neat job of terracing.

#### INSTRUMENTS FOR RUNNING TERRACE LINES.

The instrument used for running terrace lines need not be extremely accurate, but it is especially important that some kind of an instrument be used on every terrace. A few terraces have been run by guess, or the "natural eye," but they are frequently worse than nothing. Again some use an instrument, and then do not follow the line run by it because it does not look right. Another mistake, that fortunately does not occur often, is to run one line with an instrument, and then to parallel the other terraces with this by means of measuring out an equal distance from it at intervals along it, making the so-called "parallel terraces."

The point is that each and every terrace line should be run by some kind of a fairly accurate instrument, and then the lines followed pretty closely by the terrace.

The instrument most commonly used now is the telescope farm level. It is to be recommended because it is not extremely delicate, is easily adjusted and operated, and is not expensive. Its particular advantage over any home-made level is the greater speed and ease with which lines may be run by it.

#### HOME-MADE LEVEL OUTFITS.

For the reason that there are some sections where telescope levels are not numerous, and where a home-made instrument may prevent a failure, space will be given to describe two common types of home-made levels.

The plumb-bob level is the cheapest, since it requires only three pieces

of board to make it. It is made by nailing three pieces of light lumber together in the shape of an "A". The legs should be of equal length. Ten to twelve feet is a good length for them. The plumb bod is suspended from the top of the "A". The position of the plumb bob string when the legs are on level ground may be determined as follows: Place the legs on two pegs and make a temporary mark on the horizontal board at the string. Then reverse the legs on the pegs and make the second temporary mark. Now when the plumb bob string hangs half way between these marks the feet of the outfit will be level. To run a line having a certain fall with this outfit, a block three-fourths inch or one inch in thickness may be tacked on the bottom of one of the legs. The thickness for the block depends on the amount of fall desired over a distance equal to the spread of the legs. Now when the plumb bob line hangs on the center mark on the horizontal board, the leg having a block on it will be on ground  $\frac{3}{4}$  inch or 1 inch lower than the other leg. This outfit works about like the outfit with which a carpenter's level is used, but does not operate well in the wind.

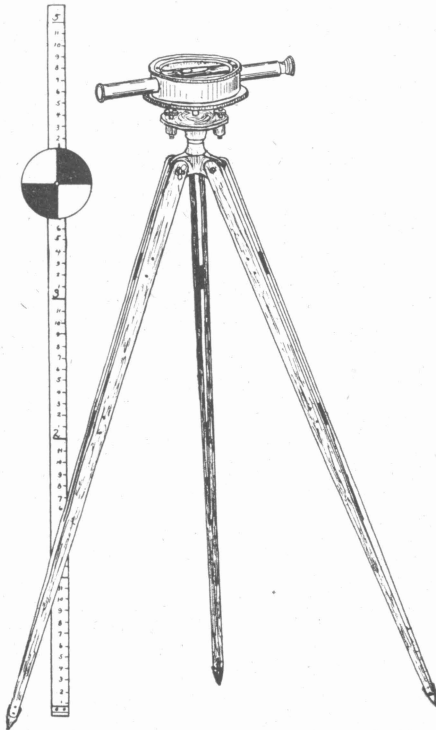


FIG. 7. One of the inexpensive telescope levels suitable for surveying terrace lines.

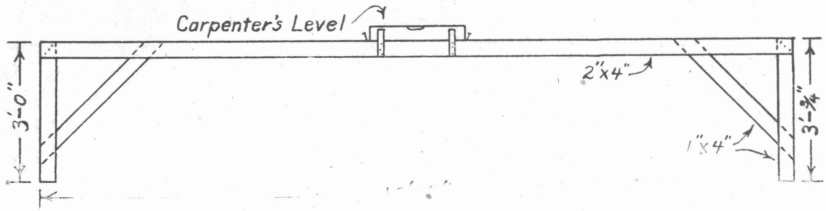


FIG. 8. Outfit for surveying terrace lines using a carpenter's level.

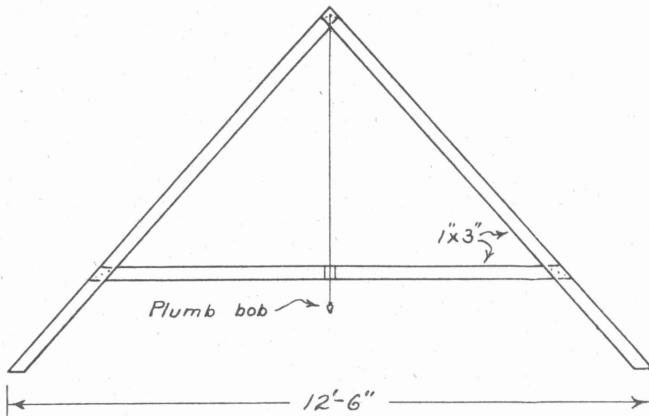


FIG. 9. Outfit for surveying terrace lines using a plumb bob.

The home-made level, using a carpenter's level, is made by nailing two legs of 1"x4", each three feet long to a 16 foot, 1"x4", and then placing a carpenter's level on top of the 16 foot board. If desired, the board may be more or less than 16 feet in length. The legs should be braced to the horizontal board. This outfit should be tested by setting the legs on two pegs, and then reversing the legs on the pegs. If the bubble tube shows the outfit level in one position and not level when reversed, cut a little off of the leg that shows to be the longer, and drive down the peg under the other leg, and repeat the test. After the outfit has been adjusted, a block  $\frac{3}{4}$ -inch or 1 inch in thickness, according to the fall that is desired, may be nailed on the bottom of one of the legs to give the fall along the terrace line.

To use either of the home-made levels, set it down at some point where the terrace is to run, with the long leg in the direction it is desired that the

water shall flow. Now move one leg around until the outfit shows to be level. Next carry the outfit forward and place the hind leg exactly where the front leg was, and then move the front leg around until the outfit shows to be level again. Then move forward as before, always being careful that the hind leg is set down to the same level as the front leg was. Every second or third point located should be marked so that the line can be followed by the plow. Always see that the long leg is kept toward the direction the water is to flow.

### ADJUSTING THE TELESCOPE LEVEL.

Since it is impossible to do satisfactory work with a level that is not in adjustment, the necessary adjustments for the telescope farm level will be described before its use is discussed. Every one who uses a level should know how to test it and if necessary, adjust it, for any instrument is likely to get out of adjustment while being carried about.

The adjustment of the bubble tube should be tested first. The object of this adjustment is to make the bubble tube perpendicular to the vertical axis, or in other words, to adjust the bubble tube so that the bubble will remain at the center of the tube when the telescope is pointing in any direction.

First by means of the thumb screws make the instrument approximately level, then put the telescope over a pair of thumb screws and level exactly. Now turn the telescope half way around, or 180 degrees, on its vertical axis. If the bubble remains in the middle of the tube, no adjustment is necessary. Should the bubble change its position when turned 180 degrees, one end of the bubble tube must be raised or lowered by means of the adjusting screws, and then the test repeated. The test and adjustment should be repeated until the bubble remains in the center of the tube while the telescope is turned 180 degrees.

The second test is to see if the telescope tube is parallel with the bubble tube. This test may be made easiest by the use of a pond of still water. The pond should be at least two or three hundred feet long. Set up, and level up, the instrument near the edge of the water. Then within a few feet of the level drive a peg down in the edge of the water until the top of it is flush with the surface of the water. Place the rod on this peg and then sight through the telescope and set the target. The target is clamped at this reading. Next another peg is driven down till the top of it is flush with the surface of the water, at some point several hundred feet from the instrument. The rod is then placed on this peg and the target is sighted through the telescope. If the crosshair in the telescope does not strike the target just as it did when the first reading was taken, the telescope must be adjusted. By means of the adjusting screws the telescope tube is raised or

lowered until it strikes the center of the target. The instrument will then be adjusted for use.

**Another Method of Testing Line of Sight.** Where there is not a pond convenient, the telescope tube may be made parallel with the bubble tube, by the two peg method.

Set two pegs firmly in the ground about 300 or 400 feet apart. The pegs should be at points of about the same elevation. Call these pegs A and B. Now set up the level exactly half-way between these two pegs. After carefully leveling the instrument, take a reading on the rod set on peg A. Then set the rod on peg B and take a reading. The difference in these readings will be the true difference in elevation of pegs A. and B, even though the telescope tube is out of adjustment. Suppose the rod reading at A is 3 feet and the reading at B is 5 feet, then peg A is 2 feet higher than peg B.

The instrument is next set up and leveled within a few feet of A or B. Suppose it is set up at A. The rod is set on peg A, and a reading taken. Suppose this reading is  $4\frac{1}{2}$  feet. Now we already know that B is 2 feet lower than A. Therefore when the rod is set on peg B, with the instrument still carefully leveled near peg A, the reading on the rod should be  $4\frac{1}{2}$  feet plus 2 feet, or  $6\frac{1}{2}$  feet.

If the horizontal crosshair does not coincide with the target when it is placed at  $6\frac{1}{2}$  feet, the level is out of adjustment. The target is clamped on the rod at  $6\frac{1}{2}$  feet, and the telescope tube is adjusted up or down, as the case may be, until the horizontal crosshair cuts the middle of the target.

The instrument should then be in adjustment and ready for use.

### RUNNING THE TERRACE LINE.

The instrument should be set up near where the terrace line is to run, the object being to get a position where the rodman will be in view, and to get within the range of the rod. The rodman holds the rod at some point on the terrace line. Sight through the telescope and have the rodman move the target up or down until the center of the target coincides with the horizontal crosshair in the telescope. The rodman now steps off 50 feet, and to run the terrace down hill, moves the target up two inches, if a fall of four inches per 100 feet is desired. The man at the instrument then moves the rodman up or down the hill until the target again coincides with the horizontal crosshair of the telescope. The rodman should be careful to keep his distance of 50 feet from the former stake as he moves about finding the location for the next point. The rodman again moves his target two inches and steps off 50 feet and locates the third point, and so on.



If the rodman is moving away from the terrace outlet, or up grade, he will move his target down at each station.

If more fall is desired he will move his target a little further for each 50 feet, or if the terrace is to run level for a little ways he will not move the target at all.

It may be advisable to put the stakes closer than 50 feet apart, in which case the target is moved a proportionately less distance. On smooth hillsides the stakes may be placed a little more than 50 feet apart.

After the rodman locates the line for several hundred feet from the instrument, it will be necessary to move the instrument up closer. Sights over 250 yards long should be avoided as they are not accurate. In moving the instrument the rodman remains at his last location until the instrument man has again set up and taken another sight on the rod at this station. The target is brought into line with the telescope crosshair by moving it on the rod, while remaining at the stake. After getting the target set from the new position of the instrument, the rodman moves his target a certain number of inches and locates new points on the terrace line as before.

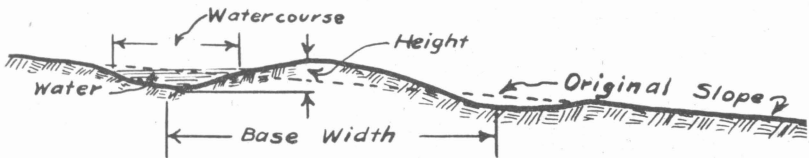


FIG. 10. Cross section of a terrace to show how dimensions are taken.

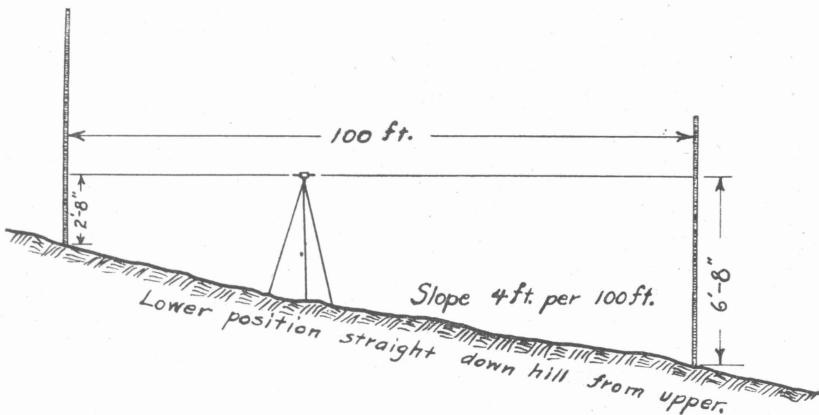


FIG. 11. Showing how slope of land is measured to obtain a value to use in top line of figures in the "terracing table." Slope is measured straight up and down the hill, and should be taken where it will be an average, if the hillside slope varies throughout the length of the terrace.

### TERRACING TABLE.

The terracing table gives suggested size, fall, spacing, etc., for terraces according to slope of land.

Slope of land in feet per 100 feet .....	1	2	3	4	5	6	7	8	9	10	11	12
Vertical fall between terraces in feet .....	2	2½	3	3½	4	4½	5	5½	6	6½	7	7½
Distance between terraces in feet .....	200	125	100	88	80	75	71	69	67	65	64	63
Fall per 100 feet along terrace .....	0"-3"	1"-4"	1"-4" for loose sandy soils. 3"-5" for heavy soils.					3"-5" for loose sandy soils. 4"-6" for heavy soils.				
Base width of terrace first year .....	22'	22'	20'	20'	20'	20'	20'	18'	18'	18'	16'	16'
Height of ridge while dirt is loose .....	16"	18"	18"	18"	20"	20"	20"	22"	22"	22"	24"	24"
Linear feet of terrace per acre .....	218'	348'	436'	495'	544'	581'	614'	631'	650'	670'	681'	691'
Acres terraced per day with 6 mules on V-drag and 2 mules on plow..	8-12	5½-8	4-6	3½-5½	3½-5	3½-4½	3-4½	3-4	2½-4	2½-3½	2½-3½	2½-3

NOTE: The use of the above "Table" will be simplified by referring to Figure 11 which shows how to measure the slope of land to apply in the first line of figures in "Table."

Reference to Figure 10 may also help in using the "Table."

The terraces are usually spaced according to the vertical drop between them. To locate the second terrace a certain number of feet below the first, a reading is taken with the rod on the first terrace, then the desired drop is added to this reading and the target moved up accordingly. The rodman then goes down the hill from this point in the direction of the steepest slope and locates a point where the target coincides with the horizontal crosshair. This gives a starting point for the second terrace.

### LENGTH OF TERRACE.

Short terraces are easier maintained than long ones and it is therefore best to keep the terraces as short as is practicable without making the outlet ditches too numerous. It is best to keep the terrace length, over which the water is carried in one direction, under 1200 feet. If the water is carried each way from the middle of the terrace this would make a length of 2400 feet. Sometimes it is advisable on a large smooth field to carry the water much further than this to reach a suitable outlet. Terraces may be made longer safely where the slope of the hillside is not great, and where the terraces are not too crooked, or the field badly gullied. Terraces have been built to satisfactorily carry the water as much as 3000 feet.

### FALL ALONG TERRACE.

The proper fall to give along the terrace will depend on the ability of the soil to absorb water, and on the slope of the hillside. Sandy soils except those underlaid with a tight subsoil should have less fall than the black lands or clay lands with the same slope. Short terraces, or medium length terraces on sandy soil, or terraces on slightly sloping fields built for moisture conservation, may run on a level. Six inches fall per 100 feet should be a maximum. Four or five inches per 100 feet is a good fall for most of the black lands. In fact when in doubt about the proper fall, 4 inches per 100 feet will not be far wrong. The "terracing table" will give some suggestions on this point.

Sometimes it is desirable with a long terrace to use a variable fall. The use of a variable fall will sometimes assist in running a terrace in a more desirable location. In using a variable fall the outlet end of the terrace should always have more fall than the upper end. A terrace with a variable fall might have a few hundred feet at its upper end run level, then a section with a fall of 2 inches per 100 feet, then a section with 3 inches fall per 100 feet, and so on.

### MARKING TERRACE LINE WITH PLOW.

When establishing a terrace line it is always best to set stakes as the points in the line are located by the rodman. Before these stakes are

knocked down or lost, the line should be run out with a plow. It is not best to discard stakes and follow the rodman with the plow.

The line of stakes will frequently form a very crooked or jagged line. These short, sharp bends should not be made by the line run with the plow.

On land with a medium slope the plow may miss some of the stakes by several feet. Rather than to have sharp bends in the terrace, it is better to smooth them out and make a little extra fill in the terrace embankment. These sharp bends can best be worked out if the person driving the plow, or the one walking ahead of the plow team, can see several stakes ahead as he moves along.

#### RUNNING TERRACE LINE ACROSS GULLIES.

The rodman in locating points in the terrace line should avoid setting the rod in gullies, or on high ridges or knolls. In running a line across a badly gullied field, unless the gullies are very broad, it is good practice to set one or more stakes on each ridge between gullies, and no stakes in or near the gullies. When this is done it is intended that the terrace ridge will be built straight across the gullies and that the necessary dams will be built in the gullies. Where the gully or depression is broad—50 feet or more—it is usually undesirable to run the terrace ridge straight across it. In this case the terrace is usually curved up into the draw so that the fill will not need to be so great. If the land owner is willing to make the heavy fills the terraces might run straight across the broad draws or depressions.

#### SPACING OF TERRACES.

Terraces should not be spaced too far apart, and yet there is no rule for the exact distance they should be. Suggestions are given in the "ter-



FIG. 12. Terrace lines marked by furrows. The meandering of terrace lines is due to the irregularity of the slope of the hillside.

racing table." If the terraces are too far apart there will be washing between them, and there will also be danger of them breaking from having too much watershed. If the terraces are too close together it makes the terracing more expensive per acre than necessary. On a large percent of the hilly lands of Texas needing terracing, the proper spacing will be from 3 to 5 feet vertical drop, which should make the terraces from 70 to 100 feet apart. The steeper the hill and the easier the soil washes the closer the terraces should be. The spacing may be quite different in the same field on account of the variations in the slope. In using the "table" for finding suggested spacing, the average slope of the land throughout the length of the terrace should be used as a basis.

In placing terraces on slightly sloping land for conserving moisture only, they may be spaced 200 to 300 feet apart if desired, although closer spacing would give a better distribution of the water.

### BUILDING THE TERRACES.

Although any of the terrace lines may be laid off first, it is important that the top terrace be built first. Each terrace should be completed before work is started on the next terrace below. If this is not done a rain may come and carry away one of the lower terraces because it is not protected by completed terraces above it.

Terraces are built with various implements. Sometimes they are built with a plow alone by simply backfurfrowing a land several times. Frequently a wooden "V" drag is used with the plow. Other implements used are steel ditchers, road graders, and fresnos, or slip scrapers.

In using the plow and "V" drag, a strip about 6 feet wide is plowed first, throwing the furrows together. Then each furrow as it is turned by the plow is pushed up with the "V" drag. After a strip about 20 feet wide has been plowed and pushed up, the plow is started again near the center of the ridge and the plowing and dragging is repeated until the terrace has the proper size. Sometimes the strip in the center of 4 or 5 feet width is not plowed but left solid. The first round with the plow is made around this narrow strip, and the "V" drag follows the plow from the start.

If the hillside is rather steep it is best to use the "V" drag mostly on the upper side of the terrace pushing the dirt down hill. This is easily done if the "V" drag is made reversible. The steel ditcher is used very much in the same way as the "V" drag. Sometimes it works best when not preceded by the plow, but allowing it to cut its own way. Most steel ditchers are made reversible so that they may be used entirely on the upper side of the terrace if desired.

Terraces are sometimes built almost entirely with a fresno. In using the fresno a strip of land about 24 feet wide is first backfurfrowed with a

plow. The dirt at the outer edges of this strip is then picked up with the fresno and dumped in the center of the strip.

It is not necessary to give all the details of the different methods of building terraces, since nearly anyone can build a ridge if he knows the kind and size of ridge he should have. Experience in building terraces will help in getting the most out of the implements and power used. For instance, the proper place to stand on a "V" drag, or steel ditcher, so as to get the dirt moved fastest with the least power, is learned by experience. It should be remembered that terrace building requires the moving of a considerable amount of dirt which requires power and time, and one should not expect to get a terrace built in 4 or 5 rounds with any implement.

One should be sure that the top terraces are well built, for not only does the safety of the lower terraces depend on them but it is the first few terraces at the top of the hill that really stop a large per cent of the erosion of the entire hillside. If only a limited amount of time can be spent terracing, it will be much better to build the two top terraces well than to half build four terraces.

#### THE "V" DRAG.

The "V" drag is used a great deal for terrace building. It is not expensive and is easily made. The wings should be made of 2"x12" hard pine lumber with one side planed.

The spread of the wings should not be too great or the dirt will not slip along the pushing wing. A little more spread may be given for sandy land than for clay land.

The outside edges of the wings should be shod with light strips of steel, such as old buggy tires.

It is well to make each side of this drag alike so that it may be used with either side up. This is necessary if it is to be used on the upper side of the terrace only.

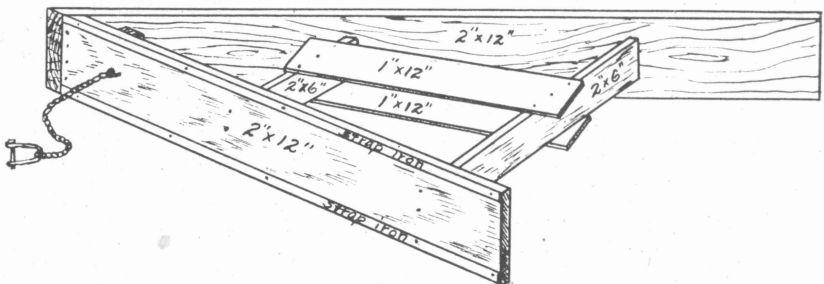


FIG. 13. Reversible "V" Drag, showing another method of making hitch. Otherwise this drag is the same as in Fig. 14.

## DIMENSIONS FOR HOME-MADE V-DRAG.

	Number of Horses or Mules				
	2	3	4	6	8
Length of Short Wing . . . . .	4½'	5'	6½'	7'	8'
Length of Long Wing . . . . .	8'	9'	11½'	12½'	14'
Size of Material for Wings . . .	2"x8"	2"x10"	2"x12"	2"x12"	2"x12"
Spread between Wings for black land (33 degrees) . . . .	2½'	3'	3½'	4'	4' 4"
Spread between Wings for sandy land 3-5 of length of short wing (37 degrees) . . . .	2½'	3'	3' 11"	4' 6"	4' 10"

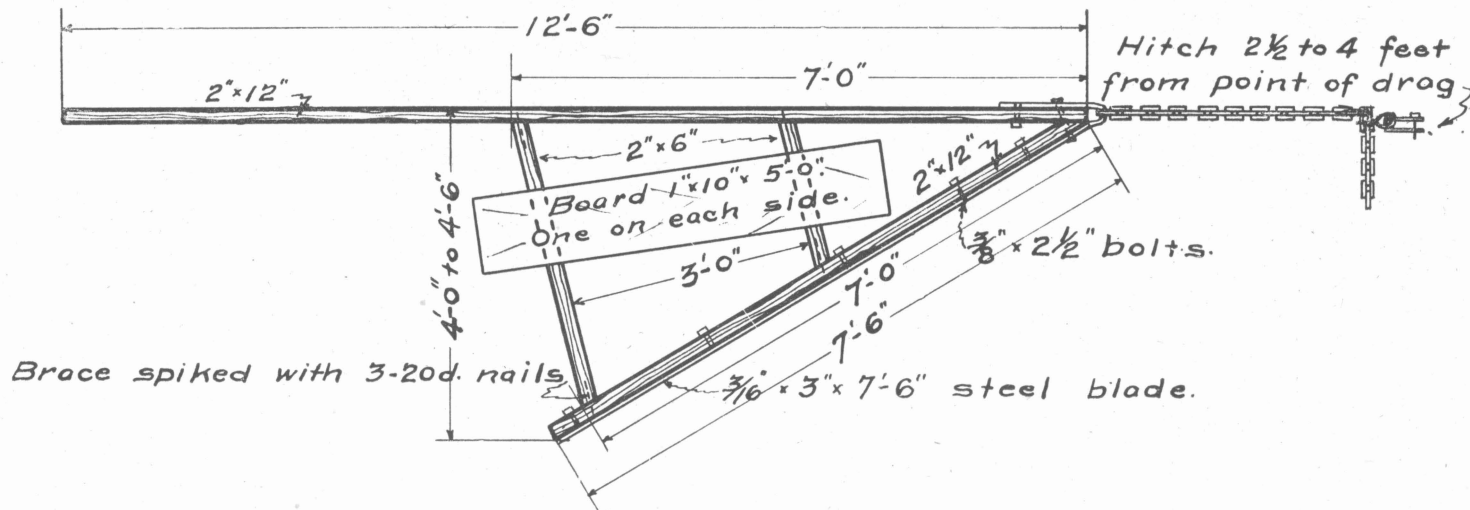


FIG. 14. The home-made "V" drag for terracing.

#### MATERIAL FOR V-DRAG.

- 1 pc. 2"x12"x20' (for wings, planed on one side).
- 1 pc. 2"x6"x8' (rough for braces).
- 1 pc. 1"x10"x10' (rough to stand on).
- 1 pc. steel 3" to 4"x3-16x7½' (for cutting edge of the short wing).
- 1 pc. iron 2"x¼"x2'6" (for making hitch to chain).

- 7 bolts ⅜"x2½".
- 1 bolt ¼"x5".
- 1 lb. 20d nails.
- 1 log chain and 6 horse evener.



### SIZE OF TERRACE.

Terraces should be built broad so they will have strength to hold flood waters, and also so they may be cultivated and worked over. The height should be great enough that they will not be overtopped by dashing rains. A terrace with a base width of 20 feet and with the top of the ridge 18 inches higher than the waterway is considered a good terrace. To get such a terrace requires the moving of a considerable amount of dirt, but it will give better satisfaction than a small terrace and will be cheaper in the end.

On very steep slopes it is sometimes not economical to build a terrace 20 feet wide, but they should have plenty of height and should be broad enough to permit the planting of a crop on them.

A terrace with a base width of 8 or 10 feet may be used on grass land that is used for grazing only. The only advantage of the narrow terrace here is that it is cheaper to construct.



FIG. 15. Building the terrace ridge. The plow is followed by the drag.

Any terrace should have a broad, flat waterway when first built. This is easiest obtained by moving the dirt mostly down hill from the upper side of the terrace.

### DAMMING THE GULLIES.

The weakest point in a terrace is nearly always where it crosses a gully. For this reason considerable attention should be given to the

building of the dams in the gullies. The dam should be much higher, than the terrace ridge on either side of it, when it is first built, as it will settle. About 25 per cent should be allowed for settling.

The dirt for building the dams can best be taken from the waterway above the terrace on either side of the gully. The enlarging of this waterway will aid in getting the water out of the ponds formed by the dams. This is also a place where the soil removed will eventually be replaced by other soil.

A fresno is better than a slip scraper for building these dams as it will move the dirt faster and is easier on the man handling it.

### TERRACE OUTLETS.

Terraces frequently fail because they are not properly opened into the outlet ditch. If the terrace is to be emptied through a fence into a ditch outside the field, it is not sufficient to spade a narrow trench from the terrace waterway to the ditch. This outlet should be from 6 to 8 feet wide.

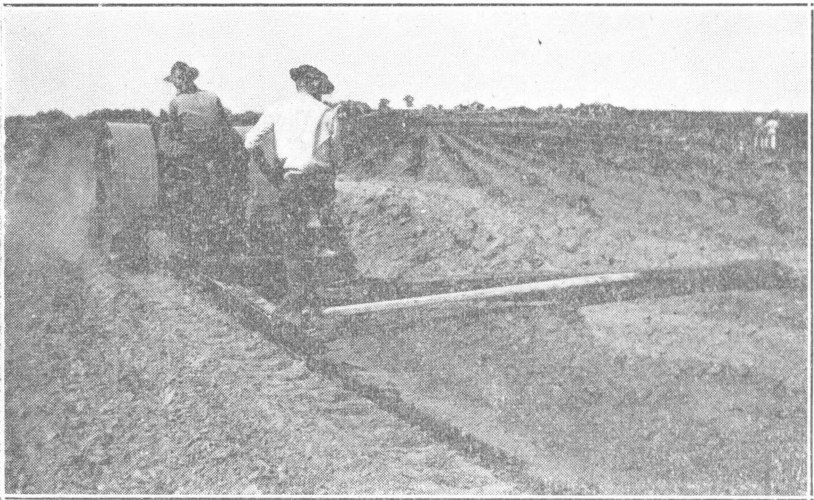


FIG. 16. Steel ditcher with wooden board extension wing. This extension makes it possible to push dirt to the center of a broad ridge while the tractor runs on solid ground.

It need not be deep and as a rule should be no deeper than the terrace waterway. A broad, shallow, outlet instead of a narrow one will frequently prevent a ditch from eating back into the field. Should this outlet begin to wash a ditch back into the field, sometimes a few scrapers of dirt properly placed in the outlet will stop the trouble. However, in some soils,

especially some of the black land soils, this eating back of the terrace outlets is not so easily controlled.

The fact that a terrace outlet caves back and forms a ditch does not always indicate that the terrace has too much fall over the last few hundred feet of its length. Such washing back from a ditch may occur in certain soils even though the terrace is run level.

The handling of terrace outlets and ditches in such soils requires considerable careful work, and those who have problems of this kind are requested to write to the Extension Service, A. and M. College, for Farm and Home Hint No. 300, and Farmers' Bulletin No. 1234.

### MAINTENANCE OF TERRACES.

If terraces are built large in the beginning, their maintenance is an easy job. About all they will need will be a backfurfrowing once a year, and possibly the removal of a few sand bars or silt bars from the waterway with a scraper or fresno.

It is very important that attention be given to the terraces, while they are new, after or during heavy rains. A man with a shovel can often patch a few breaks very easily if the work is done as soon as it is needed. Often a little work at the right time will save serious washing and gullying.

In breaking a terraced field it is well to take a plow land between the terraces. By starting the lands on top of the terraces they will be raised

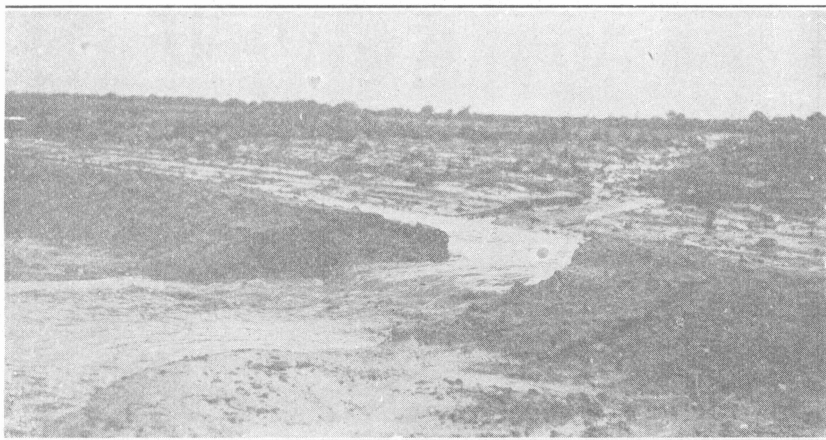


FIG. 17. The break in this terrace, caused by an insufficient outlet, occurred 20 feet from the outlet after the water had been carried 1200 feet. The two foot outlet through a hog-wire fence should have been 8 to 10 feet wide.

slightly each plowing, and there will also be a dead furrow formed half way between the terraces, which will aid in checking the water.

Some difficulty is experienced in keeping up terraces in blow sand. They should be built high, even though they are not so broad, and then sowed in some crop that will catch the sand on the terrace, thereby building it higher. Any small grain, or grass that will grow well and will not be a pest, may be used.

There is some trouble with dry weather cracks, and with gophers, making leaks through terrace ridges, which if not located and stopped at once will make bad breaks. The cultivation of the terraces will help prevent the cracks from making trouble, and the killing out of the gophers will prevent further trouble from that source.

#### CULTIVATION OF TERRACED FIELDS.

Many use the excuse for not terracing, that terracing makes the cultivation of the field so difficult. In some cases it makes the cultivation a

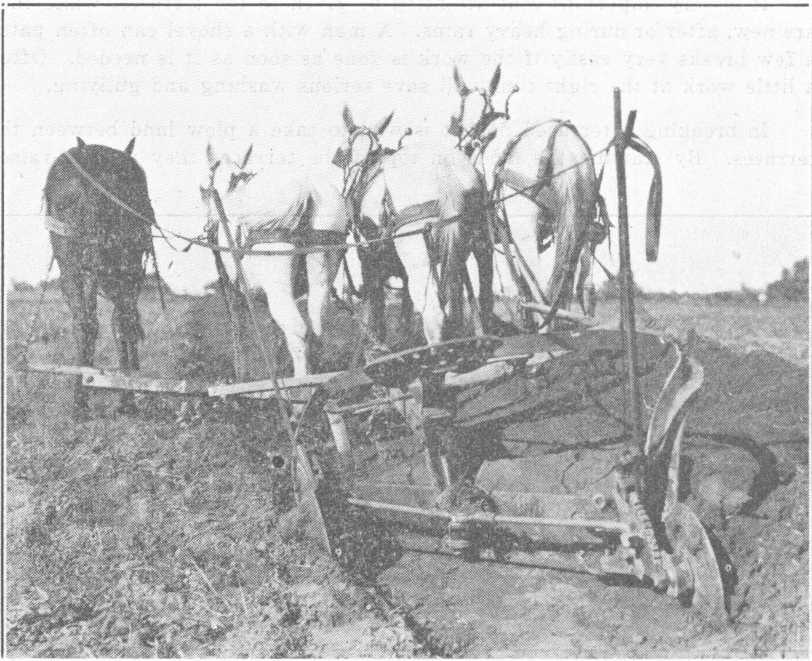


FIG. 18. Handy implement for terrace building, also very useful for maintaining terraces. It is reversible so that it may be used on one side of the terrace only, if desired.

little more tedious, but it is work that pays well. Terracing should not cause much trouble with a sowed crop, if the terraces are built broad so that implements can work over them.

If the field has an excessive slope it may be advisable to terrace it and then sow it in some kind of grass and use it for grazing only. Sometimes it is best to sow the terrace ridges in some annual grass or sorghum, and then plant any other desired crop between them.

The best way to run the crop rows for conserving the soil and moisture and for protecting the terrace ridges, is parallel with the terraces. To run the rows parallel with the terraces, a row should be placed down the middle of the terrace ridge. On each side of this row other rows are planted at regular intervals until they reach points about midway to the next terraces. Then a row is planted on top of the next terrace and rows run parallel with it until they meet with the rows which parallel the other terrace. This will leave some places where short rows must be put in to cover all the territory between the terraces. These point rows are what many farmers try to avoid. If attention is given to placing the point rows in pairs as much as possible, some extra driving may be saved in cultivating.

Sometimes the rows are started on top a terrace and run one after another to the next terrace, where a new guide row is laid-off on this terrace. This method will make the point rows at the terrace, which is not desirable. It is better to have them midway between terraces.

One way of running all the rows in the field parallel, is to use one of the central terraces as a guide row and then parallel all rows with it. Most of the terraces will be crossed by a few of the rows, but at a small angle.

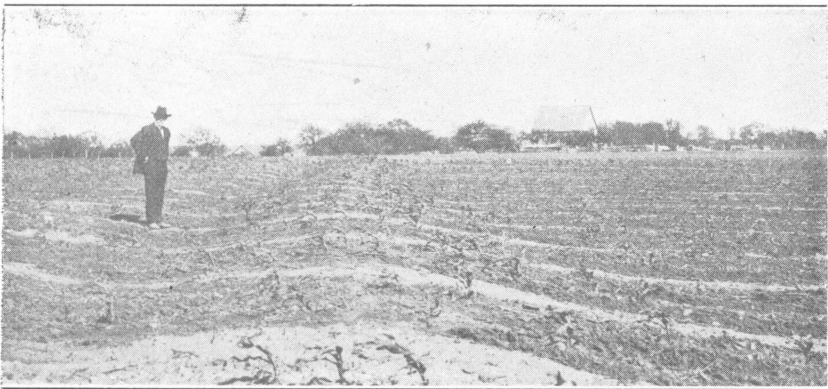


FIG. 19. Corn rows crossing terraces. If the slope exceeds 2 1-2 feet per 100 feet, this system is usually unsuccessful.

On farms that slope no more than 2 or 3 feet per 100 feet, the rows are frequently run perfectly straight, going over the terraces in any direction they may happen to hit them. This would give disastrous results on steep slopes. The crop rows should not run up and down a steep slope either with or without terracing.

There are several means of assisting terraces in controlling erosion. Deep plowing will help the land absorb much of the water that would run over the surface. The addition of humus or vegetable matter to the soil will cause it to absorb moisture more rapidly. Cover crops will check the water and hold the soil.

Terracing should be considered as the important factor in checking erosion, and as the first step toward rebuilding, or retaining, a fertile soil on the sloping lands of Texas.