



62 JUN 1952

10

Erosion



1922-73 WUG - NSI

~~25907-10~~

82
24/6/52

controlled by

Terraces

J:1:41:5-7374

J:1:41:5-7374
J1
035312

State Soil Conservation Committee in Cooperation With the Soil Conservation Service, United States Department of Agriculture, and the Agricultural Experiment Station, the University of Wisconsin, Madison

(June, 1951)



CONCLUSIONS

1. Terraces are an essential part of the erosion control program in the Upper Mississippi Valley area. Strip cropping will give adequate erosion control only if slope lengths do not exceed 250 feet. Terraces are needed to reduce the length of slope.

2. Terracing, when supported by a good crop rotation and fertility program, is the best known means of controlling erosion on cultivated fields as the slope length is controlled. Soil losses were 6 times greater from an unterraced contoured area than from a terraced area when both were in a 3-year rotation, 5 times greater when in a 6-year rotation.

3. During a 14-year period, 11 storms caused 60% of the total soil loss from the unterraced area. To successfully control erosion, conservation practices must be used that will function effectively during these critical storms. Terraces offer the best means of regulating runoff and reducing erosion during critical storms.

4. Measurements have shown that an effective cross-sectional area of 8 square feet will provide sufficient channel capacity for graded field terraces in the Upper Mississippi Valley area. A channel grade of .2 to .5% is recommended.

5. Crop yields from a terraced area have been 7% greater than from an unterraced contoured area. Five years after terracing, corn yielded 12 bushels per acre more than on a similar field which was unterraced.

6. The two-way plow is well adapted for plowing terraced fields. Use of this type of plow allows one to control the location of dead furrows and back furrows.

Erosion controlled by **Terraces**

H. B. Atkinson¹ and Orville E. Hays²

TERRACES are needed in the erosion control program on farms in Wisconsin when slope length exceeds 250 feet and rotations used include corn and grain. Measurements at the La Crosse Soil Conservation Experiment Station³ have shown that terracing when used with a good crop rotation and fertility program is the best means of erosion control for cultivated fields.

Soil losses were six times greater from an unterraced contoured field than from a terraced field. Eleven critical storms over a 14-year period caused 60% of the total soil loss from an unterraced area. Terraces control erosion even during these critical, intense storms by reducing the length of slope of the field. Year-round protection is provided and one is not entirely dependent upon the dispersive action of vegetation to control runoff water.

Terracing allows a more flexible system of farm management. In contrast to strip cropping, the entire field can be farmed to a single crop. However, there must always be sufficient hay in the rotation to maintain a high organic matter content and a good physical structure in the soil to accomplish good erosion control even with terraces.

If it is desirable to pasture the hay or hog down the corn, fencing problems are simplified as compared with strip cropping. It is also possible to use a shorter rotation on terraced fields than on strip cropped areas. Terracing will give adequate control with one year less of hay in the rotation than strip cropping. Crop yields were 7% higher on terraced fields.

¹Formerly Hydraulic Engineer and ²Project Supervisor, Upper Mississippi Valley Soil Conservation Experiment Station, La Crosse, Wisconsin.

³A farm on which the Soil Conservation Service and the Wisconsin College of Agriculture conduct research in soil and water conservation. Appreciation and credit are acknowledged for technical assistance given by Noble Clark, H. J. Muckenhirn, and H. L. Ahlgren of the Wisconsin College of Agriculture.

A terrace system properly planned, constructed, and maintained becomes a permanent topographic feature of the field. It is, therefore, most important that due consideration be given to proper design and location of each terrace. Everything that can be done to make the field easier to farm with modern farm equipment should be incorporated into the design of the terrace systems. They should be made as straight as possible and as nearly parallel as field topography will permit, not only to facilitate farm machinery operations parallel to the terraces but to make it possible to maintain the terrace system under normal field conditions.

Normally the additional cutting and filling required to make terraces nearly parallel is not great, and any additional cost will be balanced by increased ease and efficiency in all farming operations.

A carefully planned water outlet will give satisfactory service. Its function is to safely carry from the field the water concentrated by terraces. The outlet should, therefore, be completed and ready to function before the terraces are constructed. Its location should be such that it will not be used as a cattle lane or a farm road.

Terrace outlets should be placed on the south and west sides of the field to facilitate drainage of the terraces during the spring thaw period. South and west facing slopes thaw first in the spring. Outlets on these slopes will be free of snow or ice when the major part of the thaw runoff occurs. Outlets should not be located near obstructions likely to cause heavy drifting of snow.

Grassed waterways can be used in the majority of cases as terrace outlets. If a natural water course cannot be used, it will be necessary to construct a channel. On good soils with slopes of less than 30% the channel can be seeded to a suitable grass mixture. This should be done at least one year prior to the construction of the terraces so that vegetation in the outlet will have sufficient growth and density to carry the runoff water when the terraces are constructed.

As the outlet is normally constructed on subsoil, most topsoil having been removed during construction, it is imperative that these channels receive a liberal application of manure, commercial fertilizer, and lime to obtain rapid growth and good density of cover. If protection is required within a relatively short time, the channel should be sodded.

Grass channels should be mowed or pastured so as to maintain a 3 to 4-inch height of vegetation in order to produce a dense

sod and to reduce rodent damage. Judgment should be used when pasturing sod channels to prevent the livestock from injuring the sod. Observations show that if sod channels are checked frequently and the necessary repairs made immediately, they will give excellent service.

If the productivity of the soil is such that it will not produce a dense sod or if the outlet slopes are over 30%, it will be necessary to use a lined channel. Channels constructed of tar rock, sheet metal, and creosoted wood have been under observation at the La Crosse Station since 1935. These outlets have been very satisfactory and have required very little maintenance since construction.

EXPERIMENTAL RESULTS

Three field areas were placed under measurement at the La Crosse Soil Conservation Experiment Station to determine the effectiveness of terracing, strip cropping, and contour cultivation as erosion control measures.

The physical characteristics of these areas are shown in Table 1. The strip cropped watershed was established in 1937 and consists of six 45-foot strips located on a 17% slope. Terraced field "A" consists of three terraces 1385 feet long with a 7-foot vertical interval on a land slope of 12%. These terraces were constructed in 1932. The unterraced, contour-cultivated watershed

Table 1—Physical Characteristics of Field Areas

Area	Type of Area	Acres	Aver. Land Slope (%)	Aver. Slope Length (Feet)	Length of Terrace (Feet)	Vert. Spacing (Feet)	Grade of Terrace Channel	Soil Type
A-4	Terraced	2.21	10	70	1385	7	1 to 6"	Fayette silt loam
A-5	Terraced	1.88	12	58½	1385	7	1 to 3"	Fayette silt loam
A-6	Terraced	1.63	13	54	1385	7	Level	Fayette and Dubuque silt loam
UCW	Contoured	2.25	15	420	-----	-----	-----	Upper ½— Fayette Lower ½— Dubuque
Cw	Strip Cropped	2.70	17	270	-----	-----	-----	Upper ½— Fayette Lower ½— Dubuque

was established at the same time and has an average slope of 15%. Both of these areas were farmed on the contour and planted to a single crop. Farming operations have been as nearly uniform on these areas as weather would permit.

Soil and Water Losses

Soil and water loss data are available from the terraced and the unterraced fields since 1933. These areas were cropped to a 3-year rotation of corn, grain, and hay through 1940. The cropping system on Terrace A-4 and the unterraced area was then changed to a 6-year rotation of corn, grain, and four years of hay. The strip cropped area was established in 1937. This watershed has been cropped to the above 6-year rotation.

Table 2—Average Annual Soil and Water Losses

Treatment	Three-Year Rotation 1935-1940		Six-Year Rotation 1941-1946	
	Runoff Inches	Soil Loss Tons/Acre	Runoff Inches	Soil Loss Tons/Acre
Strip cropped.....			1.05	3.77
Contoured.....	3.58	37.88	1.75	14.35
Terraced.....	4.27	6.36	2.15	2.80

The years of 1935 and 1936 accounted for the highest soil losses during the six-year period from 1935 to 1940 when the areas were in a 3-year rotation. In 1935, when both areas were in corn, the terraced land had a soil loss of 16.7 and the contoured area 92.6 tons per acre. In the following year, 1936, when these areas were in grain, the terraced area lost 13.1 and the contoured area 99.8 tons per acre. The rain of April 30-May 1, 1936, came just after the grain had been seeded. This one rain caused 36 tons of soil per acre to be washed from the contoured area.

The field was so severely damaged by sheet and gully erosion that it was necessary to reseed the lower two-thirds. The rain of May 22 occurred just after the reseeded grain was up and again caused a severe soil loss of 33 tons per acre from this watershed. These two rains occurring when grain areas are most vulnerable to erosion caused a total soil loss of 69 tons per acre, or nearly one-half inch of soil was removed.

The terraced area lost one-sixth as much soil as the contoured watershed when both areas were cropped to a 3-year rota-

tion of corn, grain and hay. The soil losses from the terraced area were 6.36 tons per acre, which is too high. For the period 1947-1950, this area was cropped to a 4-year rotation. The average annual losses were 0.7 ton of soil per acre and 1 inch of runoff. These results would indicate a 4-year rotation for a terraced 12% slope.

With a 6-year rotation which included four years of hay, soil losses were materially reduced as compared with losses from the 3-year rotation, but were greater than for the period planted to a 4-year rotation. The loss from the terrace for the 6-year rotation was 2.8 tons per acre.

A comparison of rotations covering different periods of years is not good. So much depends upon when the intense storms occur. If they occur early in the year before good vegetative cover is established losses will be high; if they occur later in the growing season when a good cover of corn or grain is established or when the area is in hay, the loss of soil will normally be quite low. However, the average annual losses from the 4-year rotation and the 6-year rotation were less than 3 tons per acre which is considered as the allowable annual loss for this soil.

Table 3—Effect of Terrace Channel Grade on Soil and Water Losses

Crop	Terrace A-4 1-6" Grade		Terrace A-5 1-3" Grade		Terrace A-6 Level	
	Runoff Inches	Soil Loss Tons/Acre	Runoff Inches	Soil Loss Tons/Acre	Runoff Inches	Soil Loss Tons/Acre
Corn.....	7.97	12.42	8.27	11.72	5.52	3.64
Grain.....	5.97	7.92	5.97	7.02	3.25	1.74
Hay.....	4.15	0.12	3.94	0.36	2.17	0.10

Soil losses from the contoured watershed were 14.35 tons per acre, still excessive even though there were four years of hay in the rotation. This indicates that erosion cannot be controlled on a long 15% slope, even with a long rotation including four years of hay, when planted on the contour without strip cropping or terracing.

Soil losses from the contoured area were five times greater than from the terraced area and 3.8 times higher than from the stripped cropped watershed. During a 14-year period, 60% of the total soil loss from the contoured watershed was caused by 9 storms. It is during these critical storms that contour cultivation

Table 4—Precipitation Intensity and Amount, and Soil and Water Losses in St

Date	Crop	Precipitation				Terrace A-4			Terrace	
		Amt. In.	Intensity, In./Hr.			Rate of Runoff	Total Runoff	Soil Loss	Rate of Runoff	Total Runoff
			5 min.	15 min.	30 min.					
7/5-6/34	Hay	2.63	7.92	5.72	3.26	2.54	1.70	2.10	0.76	1.03
7/5/35	Corn	1.84	2.88	2.76	2.30	2.02	1.22	7.81	1.39	1.03
8/5-6/35	Corn	2.55	3.84	3.36	2.62	2.45	1.70	3.16	2.01	1.77
4/30-5/1/36	Grain	1.81	2.76	2.00	1.34	1.27	0.74	5.08	0.98	0.93
5/22/36	Grain	1.47	4.80	2.56	0.94	2.07	0.82	5.17	2.14	0.82
6/19-20/37	Hay ¹	2.12	5.10	3.60	3.52	1.49	1.22	0.15	1.18	1.16
7/5/38	Corn ²	1.56	3.31	2.72	2.00	1.38	0.83	2.01	1.44	0.97
7/21/38	Corn	1.80	6.08	4.49	2.86	0.84	0.25	1.05	0.54	0.25
8/16/40	Hay ³	1.43	5.85	4.85	3.08	1.29	0.87	0	0.94	0.86
6/22/44	Corn ⁴	1.63	3.24	3.08	1.98	2.27	0.77	4.79	1.76	0.70
5/21-22/45	Grain ⁵	2.67	2.16	1.44	1.20	1.51	1.87	8.73	1.17	1.56

Rate of runoff—inches per hour; total runoff—inches; soil loss—tons per acre.

¹Strip sequence on strip cropped watershed—HHCGH (1937)

²Strip sequence on strip cropped watershed—HHCGH (1938)

³Strip sequence on strip cropped watershed—CHGHHG (1940)

⁴Strip sequence on strip cropped watershed—HHHGHC (1944); corn on Terrace A-4 and Cont

⁵Strip sequence on strip cropped watershed—HGHGHG (1945)

alone does not provide sufficient erosion control. It must be supplemented by either strip cropping or terracing, or both, to provide sufficient erosion control in rotations including a cultivated crop.

Terrace Grades

The three terraces in field "A" were constructed with variable grade channels. The channel grades (fall per 100 feet of channel) were as follows: A-4 from 1 to 6 inches, A-5 from 1 to 3 inches, A-6 level. These terraces were farmed in a 3-year rotation of corn, grain, and hay from 1935 to 1940.

Average annual soil and water losses are given in Table 3 for the 3 terraces. These terraces were in the same crop sequence.

Increasing the channel grade from 3 to 6 inches did not influence the amount of runoff but the soil loss was increased about one-half ton per acre per year. The six-inch channel would scour some when the area was planted to corn or grain. Soil and water

Causing High Rates of Runoff from Terraces and Watersheds—1934-1945

5	Terrace A-6			Contoured Watershed			Pasture Watershed			Strip Crop Watershed			
	Soil Loss	Rate of Runoff	Total Runoff	Soil Loss	Rate of Runoff	Total Runoff	Soil Loss	Rate of Runoff	Total Runoff	Soil Loss	Rate of Runoff	Total Runoff	Soil Loss
0.27	0.34	0.45	0.38	3.72	0.94	9.21	2.79	0.95	1.28				
6.49	0.75	0.75	1.56	4.59	1.10	44.29	0.12	0.04	0.01				
2.93	1.29	0.74	1.06	2.64	0.73	7.87	2.10	0.73	0.07				
4.84	0.33	0.48	1.13	5.79	0.72	35.96		0.01	0				
4.03	0.72	0.61	1.17	5.65	0.95	33.11		0.14	0				
0.25	0.58	0.72	0.16	4.14	1.16	4.14	2.26	0.51	0.03	2.93	0.72	2.29	
2.25	0.56	0.70	0.98	1.94	0.72	5.61	1.53	0.44	0.02	2.00	0.88	1.11	
0.97	0.21	0.18	0.37	5.70	0.69	3.27	1.85	0.36	0.01	5.51	0.83	1.62	
0.05	0.45	0.56	0	2.17	0.62	0.19	1.73	0.36		1.92	0.41	0.21	
0	0.80	0.46	0	6.04	1.12	30.99	0.62	0.09		2.11	0.45	8.04	
0	0.73	1.47	0	2.17	1.64	34.71	0.95	0.38		0.94	0.78	6.46	

ed Watershed follows 4 years of hay.

losses from the level terrace were materially less than from the terrace with a maximum grade of 3 inches. Runoff was reduced from 6.1 to 3.6 inches and soil loss from 6.4 to 1.8 tons per acre per year.

However, the disadvantages in tilling a level terrace make them impracticable on this soil type and similar soils that are not more permeable. The numerous ponds in the channel delayed farming operations in the spring of the year and damaged crops during the growing season. There was also excessive silting in the channel which increased the cost of terrace maintenance. On Fayette and similar soils, terrace channels should be designed with a minimum grade of 0.2' fall per hundred feet.

Critical Storms

Soil conservation practices must be designed to control erosion during intense rains if they are to be effective. The foregoing table (Table 4) includes data from 11 storms that occurred between



Terraces and strip cropping stopped gullies. The picture shows gully erosion in Area UCW. (Table 1.)

1934 and 1948. These are storms that caused the highest peak rates of runoff.

The peak rates of runoff, especially from the watersheds, are usually of very short duration, in many cases lasting only one or two minutes. Peak rates of runoff from the terraces are not as high as from the watersheds but are of much longer duration. It is interesting to note that these 11 storms caused over 60% of the total soil loss for the 14-year period, thus emphasizing the fact that a few rains of high intensity cause most of the total soil loss.

Cross-Sectional Areas of Terrace Channel Utilized During Critical Storms

Starting in 1935, depth stakes were installed in the terrace channels at 200-foot intervals. These consisted of one-inch-square stakes driven in the center of the terrace channel. Over the tops of these stakes were placed perforated sheet metal cylinders. These cylinders prevented rain from washing off the water marks.

In the following table are given the cross-sectional areas of the channel of Terrace A-4 that were utilized during three rains. The storms of August 5-6, 1935, and May 22, 1936, had the highest peak rates of runoff that have been recorded from corn and grain from this terrace. The rain of July 5, 1934, when the terrace was in hay, had a peak rate of runoff of 2.54 inches per hour.

Table 5—Terrace Channel Cross-Section Used During Three Critical Storms—1935-1937

Station	Depth of Flow in Channel	Height of Terrace Ridge	Maximum Capacity Channel	Capacity of Channel Utilized
	feet	feet	Sq. Ft.	Sq. Ft.
Storm of August 5-6, 1935; Crop—Corn Peak rate of runoff—2.45 inches/hour				
0+37-----	0.51	1.10	10.52	5.80
2+00-----	0.60	0.99	6.28	3.72
4+00-----	0.52	0.95	10.20	4.48
6+00-----	0.44	1.49	22.44	3.40
8+00-----	0.56	1.46	22.96	7.75
10+00-----	0.15	1.24	14.72	1.04
12+00-----	0.59	0.69	10.48	4.92
Storm of May 22, 1936; Crop—Grain Peak rate of runoff—2.07 inches/hour				
0+37-----	0.62	1.20	11.20	3.07
2+00-----	0.50	1.37	10.60	2.06
4+00-----	0.50	1.46	15.00	2.33
6+00-----	0.39	1.90	23.30	2.15
8+00-----	0.56	2.27	28.00	5.10
10+00-----		1.76		
12+00-----	0.36	1.26	12.02	2.98
Storm of June 19-20, 1937; Crop—Hay Peak rate of runoff—1.49 inches/hour				
0+37-----	0.79	1.09	9.04	5.40
2+00-----	0.84	1.27	10.04	4.80
4+00-----	0.84	1.42	13.48	6.40
6+00-----	0.81	1.79	23.04	5.04
8+00-----	0.98	1.35	28.40	7.75
10+00-----	0.71	1.58	17.60	4.68
12+00-----	0.87	1.06	10.64	7.80

This is the highest rate of runoff ever recorded from this terrace, however depth measurements are not available. The rain of June 19-20, 1937, produced a peak rate of 1.49 inches per hour which is the highest rate of runoff recorded from hay during the period the depth stakes were in use.

The cross-sectional area utilized during these rains varied a great deal within the length of the terrace. This terrace has a variable grade ranging from a 6" fall at the outlet to 1" fall per 100 feet in the upper 250 feet.

The largest cross-sectional area utilized was when the terrace was cropped to hay. An average of 6 square feet of cross-section was carrying runoff. The peak rate of runoff for this storm of June 19-20, 1937, was 1.49 inches per hour. Only 4.4 square feet of channel cross-section were utilized for a peak rate of runoff of 2.45 inches per hour when the area was in corn during the storm of August 5-6, 1935.

Table 6—Characteristics of Certain Rains Producing High Peak Rates of Runoff—1934-1937

Date	Precip. Amount Inches	10-Minute Intensity		15-Minute Intensity		30-Minute Intensity	
		Rate In./Hr.	Frequency Years	Rate In./Hr.	Frequency Years	Rate In./Hr.	Frequency Years
		7/5/34.....	2.63	6.66	48	5.72	48
8/5-6/35.....	2.55	3.60	—2	3.36	2	2.62	4
5/22/36.....	1.47	4.02	3	2.56	—2	0.94	—2
6/19-20/37.....	2.12	4.26	3½	3.60	+3	3.52	16

The largest channel capacity was required for hay even though the volume of runoff was less, because of the high retardance of standing hay to the flow of water in the terrace channel. An effective channel cross-section of 8 square feet will provide sufficient capacity for a terrace of this length (1385 feet) with a variable channel grade of 1" to 6" per 100 feet.

Effect of Terracing on Crop Yields

Since 1935, yield data have been obtained from terrace ridge, channel, inslope, and the undisturbed area of each terrace. This field was terraced in 1932. Yields are compared with those on the upper two-thirds of the unterraced area.

This portion of the watershed has a slope quite comparable to the terraced field. Both the terraced field and the unterraced watershed have been farmed on the contour and in the same rotation since 1932. Farming operations and cultural treatments have been the same on both areas.

These areas were farmed to a 3-year rotation of corn, grain, and hay from 1932 to 1940, and a 6-year rotation of corn, grain, and four years of hay from 1941 to 1945. Both areas were planted to the same crop during any one year.

The physical characteristics of the areas on which yield determinations were made and the average yields for the different crops are shown in the following table.

Table 7—Physical Characteristics and Crop Yields of Experimental Areas

Area	Percent Slope	Length of Slope—Feet	Area, Acres	Crop Yields*		
				Corn	Barley	Hay
Terrace A-4.....	10	70	2.206	53.2	20.8	1.60
Terrace A-5.....	12	58½	1.885	51.8	17.0	1.80
Terrace A-6.....	13	54	1.632	50.2	15.4	1.17
Upper 2/3 of Unterraced Watershed.....	12	215	1.676	49.9	14.6	1.18

*Average yields for period 1932-1940. Corn and grain yields—bushels per acre; hay yields—tons per acre.

The yields from the terraces were higher than from the unterraced area. Terrace A-6, with the level channel, had approximately the same yields as the unterraced area.



A terrace collecting runoff water which is flowing slowly to outlet.

The following table shows the annual yields obtained from the terraced field, from sections of the terraced field, and from the upper two-thirds of the unterraced cultivated field. The yields from the terraced field are based on averages of yields from the three terraces.

Table 8—Annual Crop Yields from Experimental Terraced Area vs. Unterraced Area

Year	Crop	"A" Terraces	Section of Terrace Area			Unterraced Area
			Undis- turbed	Ridge and Channel	Inslope	
Bushels per Acre						
1935	Corn.....	46.02	53.17	40.50	-----	54.92
1938	Corn.....	47.10	49.10	44.21	-----	35.62
1944	Corn.....	62.85	61.83	64.23	-----	59.30
1941*	Corn.....	40.16	34.90	47.76	-----	-----
1936	Barley.....	11.20	11.54	11.49	5.52	8.35
1939	Barley.....	24.95	27.32	26.18	9.72	20.81
1945	Oats.....	69.02	66.67	71.66	73.27	82.30
Tons per Acre						
1937	Hay.....	0.34	0.32	0.38	0.29	0.30
1940	Hay.....	2.42	2.30	2.73	2.10	2.07
1941*	Hay.....	3.81	4.02	3.38	-----	3.75

*1941: corn yields from terraces A-5 and A-6; hay yields from terrace A-4 and unterraced area.

The crop yields from the undisturbed part of the field were 1% higher than from the entire field for the 9-year period. The crop yields from that part of the field disturbed by the terracing operations, including the terrace ridge and channel, were 2.3% less than from the undisturbed part of the field that received protection from the terraces.

Summarizing the crop yields for the terraced and the unterraced fields shows that corn yields averaged 2 bushels per acre more in the terraced field. In 1935, three years after the terraces were built, the terraced field yielded 9 bushels less. However, in 1938 the yield was nearly 12 bushels more on the terraced area. Hay yielded 0.2 ton per acre more on the terraced than on the unterraced field. Longer rotations and improved fertility and cropping practices increased yields more on the terraced field where erosion was controlled.

Barley yields were quite low in 1936 because of severe rains which occurred just after the grain was seeded, resulting in poor

stands of grain and also in poor stands of hay in 1937. The only years in which yields were higher from the unterraced area than from the terraced area were 1935 and 1945. In summarizing the nine years of yield data, considering all crops, the crop yields were 7.2% higher from the terraced field than from the upper two-thirds of the unterraced area.

Terrace Maintenance and Farming Operations

The successful functioning of a terrace system largely depends upon whether it is properly maintained and farmed after construction. Terraces in themselves will not control erosion unless combined with suitable crop rotation and tillage practices.

New terraces may need additional maintenance during the first year. There may be some high places in the channel that will need cutting out, or there may be low places on the ridge that need filling. If repair work such as this is needed, it should be done without delay as an intense storm may wash out most of the ridge at a low point and cause severe field gullying.

The first two times that new terraces are plowed, a dead furrow should be left in the channel and a back furrow placed on the ridge. Terraces can be given their proper shape or cross-section by plowing. The width and shape of the channel can be controlled by the location of dead furrows in the channel. In all cases, the distance from the bottom of the channel to the top of the ridge should be at least ten feet.

The shape of the terrace ridge can be controlled by the location of the back furrow. If the terrace channel has sufficient capacity, then place the back furrow on the lower side of the ridge. This will make the ridge broader. The terrace ridge should be as broad and flat as possible and still maintain sufficient channel capacity. If this is done, there will be little difficulty in operating farm equipment parallel to the terraces. When it is necessary to increase the capacity of the terrace, a dead furrow should be left in the channel and a back furrow on the ridge.

It is realized that most terraces are plowed with the conventional one-way plow. Because of different shapes of terraced fields and terrace cross-sections it is difficult to establish a definite procedure for plowing fields with the one-way plow. The principle of developing the terrace channel by the proper location of the dead furrow and the shaping of the ridge by the location of the back furrow should be followed, however. The location of dead furrows and back furrows within the terrace interval should be varied so as to maintain as uniform a slope as possible.



The two-way plow being used to plow terraces. No dead furrows or back furrows are left between terraces to concentrate water.

The use of a two-way plow produces a uniform slope between terraces as plowing is started on the terrace ridge and all of the soil is turned up hill. This eliminates the necessity of any back furrows or dead furrows in the interval between the terraces. When back furrows or dead furrows are left in the interval between terraces, they collect runoff water. This concentration of water causes rilling on the lower half of the terrace interval. The use of a two-way plow is well adapted for plowing terraced fields. One can easily control the location of dead and back furrows by using a two-way plow.

Farming operations on the terraced field always have been parallel to the terraces. Channel maintenance has been by plowing. During the first 5-year period, a back furrow was made on the ridge and a dead furrow left in the channel every time the field was plowed to increase channel capacity. This practice resulted in a channel capacity larger than necessary.

Since 1937, a dead furrow is left in the channel and a back furrow on the ridge once in each cycle of the rotation, usually when plowing for grain. When plowing for corn, all the soil is turned up hill with a back furrow at the top of the field and a dead furrow at the bottom. This system of terrace maintenance has proved quite adequate to maintain ample channel capacity.