Edwin A. Pearce

GULLY CONTROL

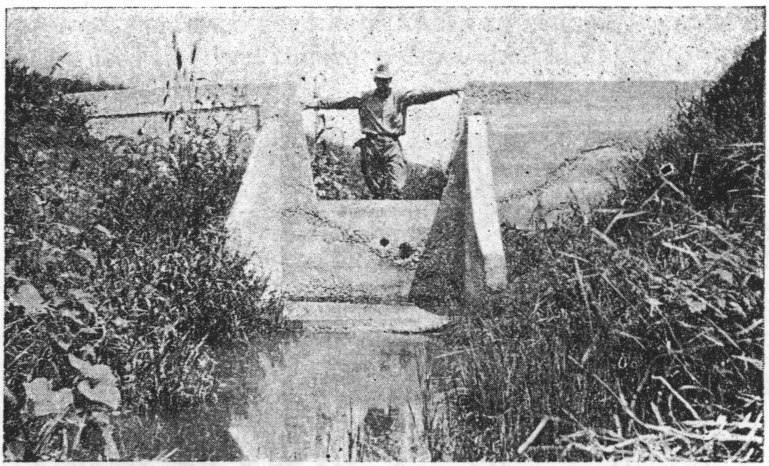

Fig 1—A big concrete spillway dam to control a large ditch.

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Gully Control

By M. R. BENTLEY, Extension Agricultural Engineer

The filling of gullies and the controlling of terrace outlet ditches on rough or rolling land often presents a difficult problem. In some soils, especially some of the black land soils, terrace outlets are extremely hard to control. There are several types of dams used for this purpose. The soil saving dam built of earth, the rock wall dam, the concrete dam and drop, and the wooden stop-plank dam are all good. The best of these to use depends somewhat on conditions. These dams and drops, however, should be used **only where an ordinary terrace cannot be used** to divert the water from the gully.

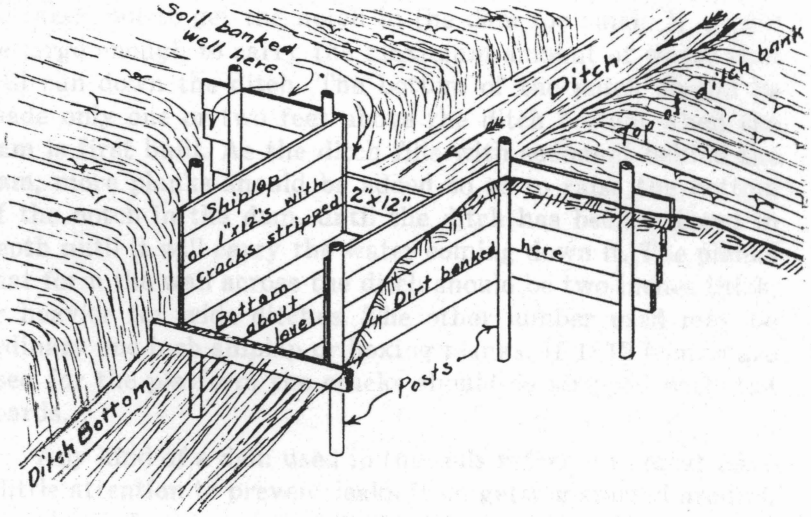


Fig. 2—Wooden Spillway Dam.

WOODEN SPILLWAY DAM

Dams or spillways made of lumber have been used successfully for several years in Texas for the purpose of controlling terrace outlet ditches. The wooden dam that is most popular now is made of posts and lumber. Posts that will not rot quickly should be used, and it is well to creosote the lumber used, to make it last longer. The size and shape of the dam will depend on the size of the ditch and the quantity of water running down it. It should be shaped so that it will fill up and reduce the size of the ditch. The wings of the dam should run into the banks of the ditch far enough to keep the water from leaking around them. This also serves to prevent the dam from being pushed out by the water pressure behind it. The dam should also be tied into the bottom of the ditch. Care should be taken not to get the notch in the dam too small. It should be large enough to carry the maximum amount of water that will run down the ditch. The bottom of the notch should be made only one or two feet above the ditch bottom when the dam is first built. As the ditch fills with sediment behind the dam, more planks should be added so as to raise the bottom of the notch in the dam, until the ditch has been reduced in depth until it will carry the water coming down it. The planks that form the wall across the ditch should be two inches thick, or heavier for wide ditches. The other lumber used may be ordinary one-inch shiplap or boxing planks. If 1x12 boards are used for the platform the cracks should be stripped with 1x4 boards.

Any kind of a dam used in the soils referred to must have a little attention to prevent leaks from getting started around, or under it. Leaks are most likely to be caused by the cracking of the soil around the dam during a long dry spell of weather. Troublesome leaks may be prevented to some extent by packing dirt on both sides of the wings and also to the top of the boards that the water pours over, on the upstream side of them, when the dam is first built.

CONCRETE SPILLWAY DAM

Where a drop is needed permanently in a ditch it may be cheaper to make it of concrete in the beginning. The size and shape of the concrete dam, as in the case of the wooden dam, will depend on the shape of the ditch and the quantity of water to be handled. It should be shaped so it will fill up and reduce the size of the ditch. The wings of the dam should run into the banks and bottom of the ditch far enough to keep the water from leaking around them. The bottom of the notch in the dam should be as high as the ditch bottom above the dam can be maintained, as the ditch will eventually fill to this height. Care should be taken not to get the notch too small or the bottom too high. The bottom of the notch had better be left too low as it can be filled in later if need be. There should be some small holes in the dam just below the notch, so that the water caught above the dam may run out slowly. The sloping concrete walls below the dam serve to brace it and also form a pocket into which the water may fall without washing the soil away.

A concrete wall about 4 or 5 inches high on the downstream edge of the concrete platform, made so that a shallow basin is formed, is said to decrease erosion in the ditch just below the structure.

On account of the permanence and rather high first cost of a concrete dam it will pay to figure out the design and reinforcing very carefully. There is such a wide variation in the requirements of a concrete dam for different ditches that no standard specification can well be given. The concrete mixture should be one part cement, two parts sand, four parts gravel or crushed stone. It should be reinforced with woven wire or steel rods, or both.

If good building rocks are convenient, a dam might be built of them in the same shape as the concrete one. It would be necessary to lay the rocks in cement mortar and to make the walls quite heavy.

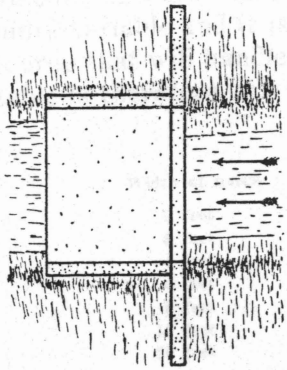


Fig. 3—Plan of Concrete Dam.

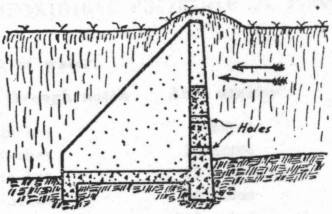


Fig. 4—Section of Concrete Dam.

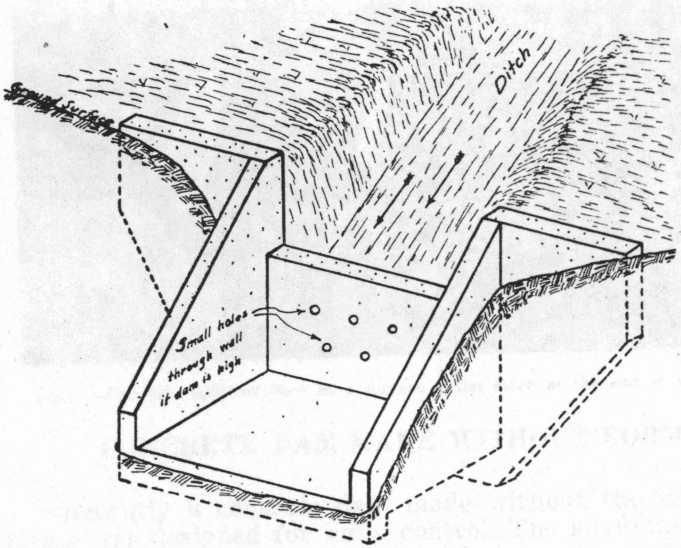


Fig. 5—Concrete Spillway Dam.

SIZE OF NOTCH IN SPILLWAY DAM

The notch in the dam should be large enough to carry the maximum amount of water coming down the ditch. The amount of water that will run from a given area of land is quite variable and it is difficult to give the size of opening in a drop that will handle the run-off from a field. The following table is therefore only an approximate estimate of sizes.

Width of notch	Depth of water running through notch	Area drained
2 feet	6 inches	5 acres
3 feet	8 inches	10 acres
4 feet	12 inches	25 acres
6 feet	18 inches	70 acres
8 feet	24 inches	140 acres
12 feet	24 inches	235 acres
20 feet	24 inches	375 acres

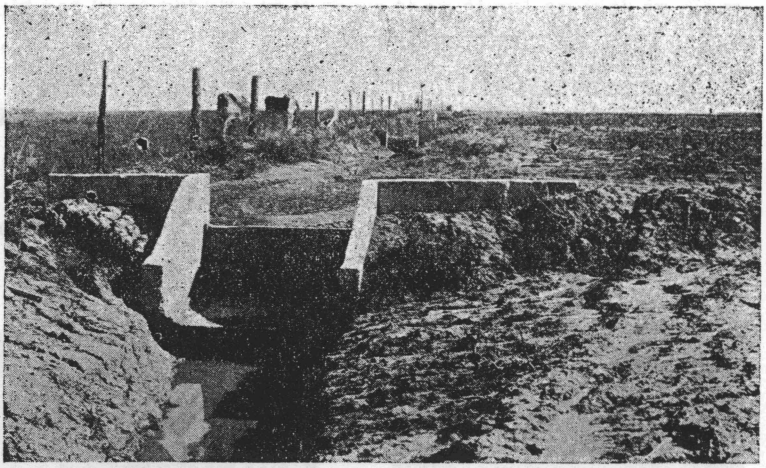


Fig. 6—Concrete spillway dam in a terrace outlet ditch at the end of a terrace.

CONCRETE DAM MADE WITHOUT FORMS

Recently a concrete dam made without the use of any forms was designed for gully control. The advantage of this dam over a concrete dam made with forms is the lower cost. This formless concrete dam will not likely stand up as well in soil that cracks as will the concrete dam heretofore described.

To install one of these dams the dirt is dug out to form a pocket in the ditch bottom where the water is to hit when it falls from the crest of the dam. The dirt removed is used to built a dirt dam in the ditch bottom just up the ditch from the pocket. The dirt dam forms the base of the crest over which the water runs. Trenches are dug into the ditch banks very much as if a concrete spillway of the type previously described was to be put in, except the trenches may be much narrower since they will be filled with concrete only and no space is wanted for forms. After the dirt has been dug out to make an excavation of the proper shape, wire hog fencing is spread over the dirt where the concrete is to be plastered. It is well to double the hog fencing at all points where the concrete may tend to crack. Concrete of a 1:2:3 mixture is plastered over the dirt to a thickness of three or four inches. The concrete may be placed a shovelful at a time and worked smooth with a plastering trowel. The stone or gravel used in the concrete should not have pebbles in it more than about an inch in diameter.

It is well to slope all dirt surfaces to be plastered as much as three inches for each twelve inches of vertical height.

The spacing of these dams where more than one are used and the width of the passage way for the water may be estimated according to suggestions made herein.

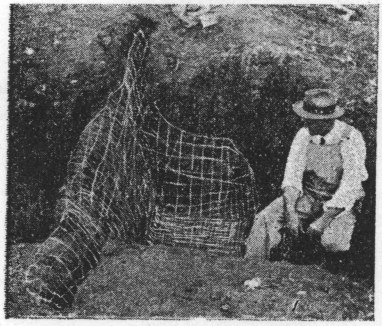


Fig. 7—Hog fencing in place ready for concrete plastering.

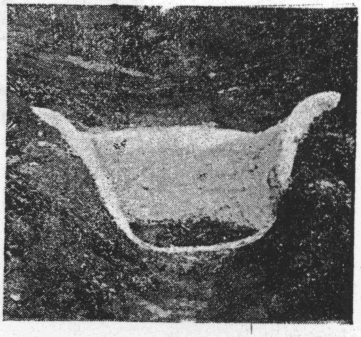


Fig. 8—Finished formless concrete spillway.

SPACING OF DAMS

The spacing of the dams in a gully where two or more are used, will depend on the fall of the gully, its depth, and the height to which each dam is built. It is well to build the dams close enough together so that there will not be too great a drop of the water at each dam. Usually 4 feet is as great a drop as should be used. The drop from the spill platform of a dam to the bottom of the notch of the next dam down the ditch, or rather to the place to which the notch will finally be raised, should not be more than six inches for each 100 feet between the dams.

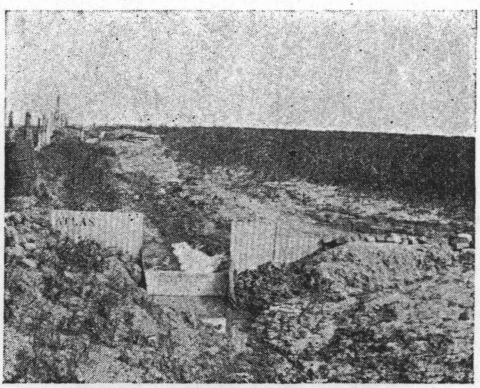


Fig. 9.—Sheet metal spillway dam at the end of a terrace. The interlocking strips of sheet iron are driven in the ground and then the apron is hooked into the notch.

LOOSE ROCK DAMS

Loose rock has not been considered a satisfactory material for controlling gullies in soils that crack and cave badly; however, the highway department of Texas is using loose rock quite successfully in roadside ditches in places where the soil washes easily. It appears that the success with loose rock may be attributed to the use of a plentiful amount, properly placed, and to regular inspection and immediate repair when it is needed. These dams frequently fail because the central part of the rock pile is higher than one end or the other, so that the water cuts into one bank or the other and makes a new gully. Another common failure is the cutting out of the soil just below the rock pile. This trouble can be remedied in two ways. Plenty of rocks should be used to make a sort of an apron to drop the water down by steps, and then the dams should be placed close enough together so that the ditch bottom from the bottom of one dam to the crest of the next one down the ditch, is practically level.

It is well to bank dirt against the upper side of the rock pile when it is first made, so that the water will not run under it.

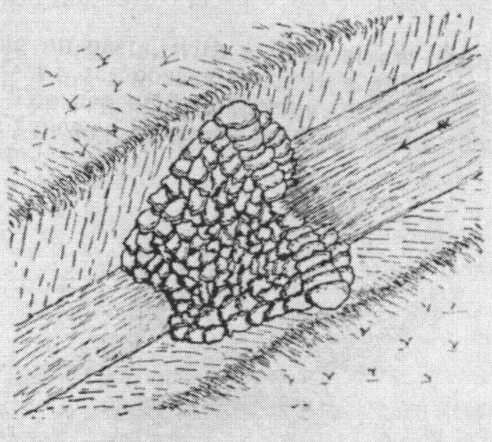


Fig. 10—Sketch showing how loose rocks are piled high against the banks of a gully to prevent water from cutting around the dam. Dirt should be banked against the upstream side of the dam to prevent the water from undermining it.

TEMPORARY CHECKS OF BRUSH OR WIRE

Dams made of stakes with brush and straw or similar materials, are very effective in controlling ditches in some soils, but are of little value in the soils that cave badly. Such materials may be well worth using at the heads of gullies where the water drops a considerable distance; even in the worst sort of caving ditches. When used in this way, these dams may prevent the ditch from getting longer while it is being filled by a dam of the spillway type.

Where brush is plentiful it is well worthwhile to use it freely as a temporary measure in filling gullies. In sandy or loam soils sometimes gullies may be filled by the use of brush, and then if sodded in grass may give no further trouble.

The same general principles should be followed in building dams of a temporary nature as is recommended for permanent dams. The crest of the dam should be left low in the middle and should be made high at the ditch banks. This tends to prevent the water from cutting around the obstruction. It is well to pile some straw or stalks and some dirt against the upstream side of the dam so as to prevent, as much as possible, the undermining of the material in the gully.

Considerable information is given on the use of brush, straw, wooden stakes, and logs for checking gullies in Farmers' Bulletin No. 1234.

Hog fencing on posts, with a little straw or brush used with it may effect a temporary check in a gully, even in soils easily washed. The use of hog fencing, or wire netting in a gully should be followed by grass sodding, or by some permanent type of dam.

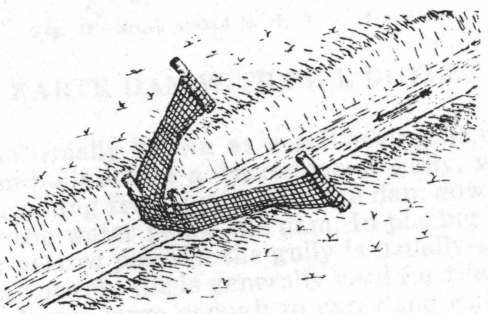
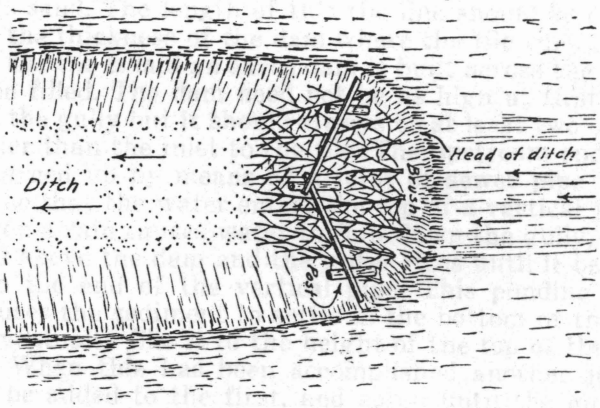


Fig. 11—Wire netting or hog fencing fastened to four posts to check the washing in a gully. Only a temporary control.



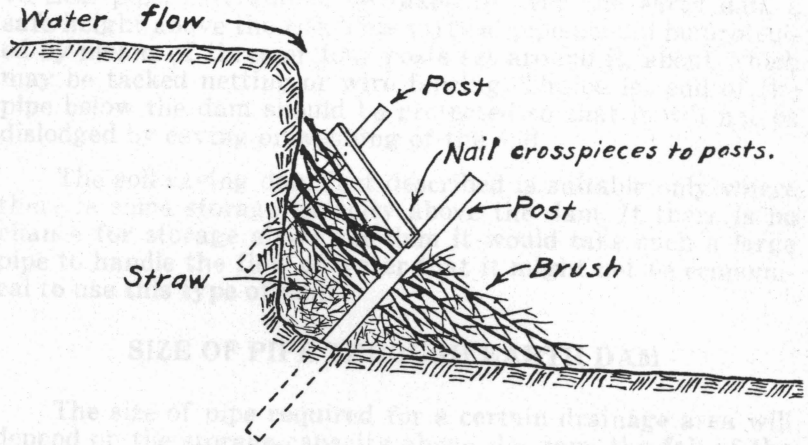


Fig. 12—Brush staked in the head of a gully.

EARTH DAM WITH PIPE OUTLET

The dam usually known as a soil-saving dam consists of an earth dam built across a depression or gully, with a line of tile or pipe running from just above the dam down under it so as to empty the water below the dam. In placing a soil saving dam, a deep narrow place in the gully is usually selected. Clay sewer tile or concrete tile is generally used for the pipe to place in the dam. A size large enough to carry the water should be selected. A line of this tile is laid with the joints cemented

with a cement mortar made of one part Portland cement and two parts sand. The length of this tile line should be as much as twice the thickness of the dam where the tile runs through it. After the tile is laid an earth dam is built across the depression to be filled. The dam need not be as high at first as the banks of the gully but it should always be at least two or three feet higher than the inlet to the tile. The upstream end of the pipe is turned up by means of a joint of sewer pipe for the purpose, so that the water enters the top of a vertical joint of pipe. When a rain causes water to flow down the gully, a pond is formed above the dam and the water rises until it begins to pour into the end of the vertical pipe. This ponding of the water causes the sediment to settle in the bottom of the gully until it eventually fills it to the height of the top of the vertical pipe. When this has been accomplished another joint of tile may be added to the first, and so on until the gully has been filled as high as is possible. In adding joints of tile to the vertical pipe, care should be taken to keep the earth dam a safe height above the tile. This vertical pipe should be protected by means of three or four posts set around it, about which may be tacked netting or wire fencing. The outlet end of the pipe below the dam should be protected so that it will not be dislodged by caving or washing of the soil.

The soil saving dam just described is suitable only where there is some storage capacity above the dam. If there is no chance for storage above the dam it would take such a large pipe to handle the flow of water that it might not be economical to use this type of dam.

SIZE OF PIPE THROUGH EARTH DAM

The size of pipe required for a certain drainage area will depend on the storage capacity above the dam, the fall of the land drained, and other factors. The following table may be used as a guide to estimate the size of tile required to handle the water from a certain acreage of land.

Where the drainage area is large it may be found economical to use a galvanized iron conduit, or a concrete conduit with a square or rectangular cross section, built in place on the ground.

Diameter of pipe	Acres drained	Diameter of pipe	Acres drained
10 inches	4	21 inches	30
12 inches	8	24 inches	40
15 inches	15	30 inches	80
18 inches	20	36 inches	125

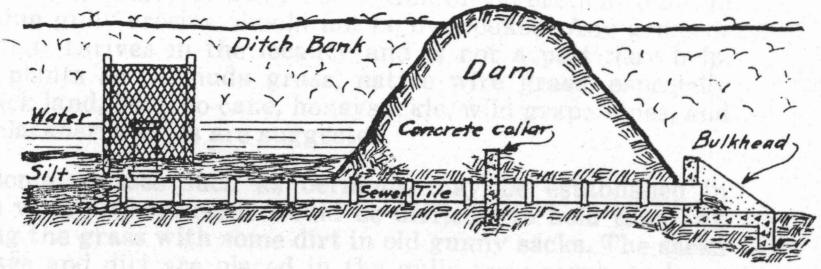


Fig. 13—Soil saving dam with outlet pipe of sewer tile.

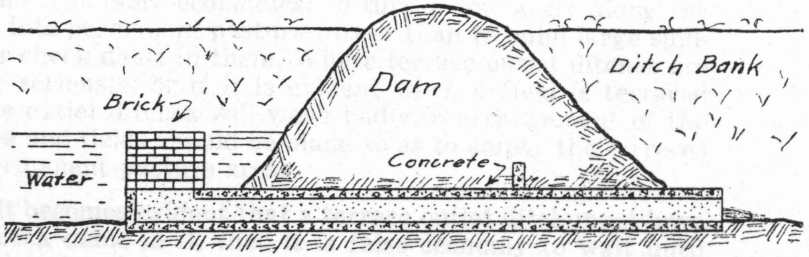


Fig. 14—Soil saving dam with the outlet flume made in place. The outlet is raised by adding a few rounds of brick.

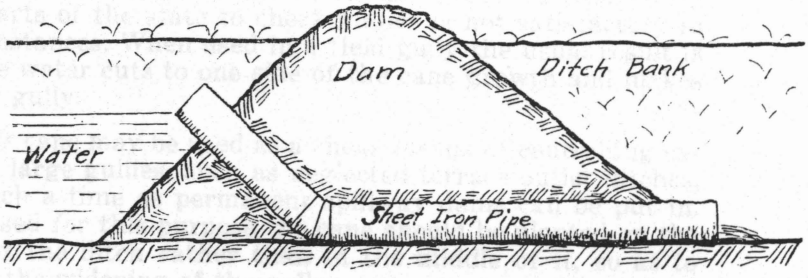


Fig. 15—Soil saving dam with an outlet pipe of corrugated sheet metal. A concrete bulkhead, and a concrete collar in the earth dam would make this pipe more secure.

VEGETATION TO CONTROL GULLIES

The possibility of using some kind of vegetation to aid in checking gully erosion should not be overlooked. Any grass or vine that thrives in the locality and is not a pest may help. Such plants as bermuda grass, native wire grass, especially on black land, bamboo cane, honeysuckle, wild grape vines, and wild blackberry vines are suggested.

Some grasses such as bermuda may be established in places where otherwise it would be difficult to hold them, by putting the grass with some dirt in old gunny sacks. The sacks of grass and dirt are placed in the gully very much as loose rocks are placed. Four or five filled sacks may be all that are required for a small ditch.

In many instances terrace outlet ditches are neglected too long, and it is more economical to turn a few acres along the ditches into permanent pasture rather than to build large spillways or check dams in them. Where terrace outlet ditches are eroding seriously, or if it is evident when a field is terraced that the outlet ditches will wash badly, rearrangement of the pastures and fields should be made so as to empty the terraces onto permanent pasture areas.

If it becomes evident that a terrace outlet ditch must have some check dams in it, then it is false economy to wait until the ditch grows into a miniature canyon before building some control structures in it.

BAMBOO CANE

Bamboo cane which has been used very extensively in some parts of the state to check gullies is not satisfactory in many instances. When used in a field gully the usual result is that the water cuts to one side of the cane growth and makes another gully.

This cane may be used as a cheap means of controlling extremely large gullies, such as neglected terrace outlet ditches, until such a time as permanent spillway dams can be put in. When used for this purpose the cane should be planted on the banks of the ditch rather than in the middle of it, so as to prevent the widening of the gully.

A row of the cane along a farm boundary where the runoff water leaves the farm in a very wide stream, sometimes gives satisfactory results in preventing small gullies from eating back into the field.

STOP GULLIES WITH TERRACES WHEREVER POSSIBLE

The best and cheapest means of stopping a gully is to build a terrace across it, and for that reason terraces should be used wherever practicable. It is only in a gully from which the water cannot be diverted by means of terraces that some sort of a spillway dam should be built.

Where a dam is used to control a terrace outlet it may be placed at the end of the terrace, in the terrace ditch; or it may be placed in the outlet ditch into which the terrace empties. If the dam is placed in the outlet ditch it should be located just below the outlet of a terrace.

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