GULLIES—HOW TO CONTROL AND RECLAIM THEM *

RESULTS OF GULLYING

THE greatest damage caused by gullies is the carrying away of fertile soil. Other bad features are: They cannot be readily crossed by teams and farm implements.

They grow rapidly, if unchecked, and often extend through a farmstead, undermining and necessitating the removal of farm buildings.

They encroach upon public highways and make travel unsafe.

They extend across farm roads, undermine culverts and similar structures, often necessitating the building of bridges.

They cause the silting up of reservoirs and natural channels, and of channels dredged at great expense.

They carry sand washed from hills and deposit it on rich bottom land, making it unproductive.

They give a farm an unsightly appearance, reducing its market value and that of adjoining farms.

They endanger the life of stock that graze near the edges of undermined banks.

CAUSES AND TYPES OF GULLIES

Gullies are caused by erosion due to water collecting and flowing at a velocity sufficient to move and carry away soil particles.

HEAD EROSION

When plants and soil are unable to retain all of the rain that falls on rolling or hilly land the surplus flows over the surface to a drainage channel at the foot of the slope. If there are no draws or depressions the water travels over the surface to the foot of the slope in broad, thin sheets. Where depression exist, however, the water from the surrounding area is collected and forms a stream with power to wash away the soil. The power to erode increases as the stream increases in size and velocity, and if the depression is not protected from erosion by grass or other means a gully is formed which is enlarged by each succeeding rain.

Gullies may also be started by artificial means such as the track of a wagon driven down a slope when the ground is soft, or by dragging a plow down a slope. Mole holes and cattle paths frequently cause the formation of gullies. One of the most common ways in which gullies are started is by ploughing or cultivating straight up and down a slope. A dead furrow extending in the direction of the slope may rapidly develop into a gully.

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DITCH EROSION

Where head erosion occurs on the upper part of a watershed it makes channels for the rapid removal of the excess water from the field slopes and delivers the water in large volume to the natural drainage channels at the foot of the slopes. The capacity of these channels is overtaxed by the quick delivery of the water from all parts of their watersheds, and the result is that the channels are greatly enlarged by the erosive action of the water. This enlargement continues until huge gullies are formed, often 15 to 20 or more feet deep. Enlargement caused by ditch erosion is very rapid on the upper parts of the watershed, where the slopes are comparatively steep. Ditch erosion generally decreases downstream as the fall of the channel becomes less, and the fall often becomes so slight that silting instead of erosion occurs, particularly where the channel extends across a wide bottom and discharges into another stream.

WATERFALL EROSION

Waterfall erosion, which is responsible for many of the deepest gullies or chasms, is caused by water falling over the edge of a gully or ditch bank. The falling water undermines the edge of the bank, which caves in, and the waterfall moves upstream. This undermining goes on rapidly, if the surface soil is underlain by sand or easily eroded sub-soil saturated with water.

In this manner gullies often start in the banks of natural watercourses which have been eroded to a great depth. They extend back into the land slopes and grow deeper up the slope, often attaining depths of 50 to 60 feet. As they extend backwards and cross tributary watercourses or natural depression, waterfalls are in turn formed in their sides, and branch gullies develop. This branching may continue until a network of gullies covers the entire watershed. Gullies formed by waterfall erosion may extend back through almost level land. Their growth is dependent upon the size of the drainage area furnishing water and not upon the slope of the land. They sometimes grow at the rate of 30 to 50 feet in a year, depending upon the amount of rainfall, the drainage area, and the character of the soil.

PREVENTION OF GULLYING

Many large gullies would never have been formed if steps had been taken to check them in the beginning. Gullies from head erosion could be prevented if each square foot of the field slopes could be made to absorb all of the rain that falls upon it. The water would then be fed slowly to the main watercourse below. Means employed to this end are: increasing the humus content of the soil, deep ploughing, the use of cover crops, proper crop rotation, contour ploughing and tile draining.

It is, of course, impossible to make any soil absorb all of the water from the heaviest rains, and in order to prevent erosion the excess water should be conducted from the field at a low velocity.

CHECKING HEAD EROSION

No matter what method is adopted for control and reclamation of a gully, it is first of all important to check erosion at the head of the gully. Where possible it is advisable to intercept the water before it enters the head of the gully and divert it into a natural watercourse nearby. In shallow guillies, 3 or 4 feet deep at the upper end, head erosion can be checked quickly by building a low obstruction or dam close to the head of the gully. A fill of soil will occur between the dam and the head of the gully, the drop of the water will be reduced by the height of the dam, and the erosive and undermining action of the water will be greatly decreased at the head of the gully. If the gully is deep, a comparatively longer time will be required to fill it, whatever method is employed, and during the filling some temporary means should be employed to stop head erosion and undermining.

One method of checking head erosion that is widely used consists in placing brush and straw in the head of the gully and fastening it down. Posts should be set deep in the ground, close to the bank of the gully, and 2 to 3 feet apart. Fence posts can be used. A layer of straw is first thoroughly packed around the posts and against the eroded and undermined part of the gully bank. A few branches are laid crosswise and interwoven between the posts to hold the straw in place. Brush is packed down over the straw the tops of the branches extending nearly to the top of the bank, and is held in place by the crosspiece nailed to the post. This affords a place on which the water fall without causing erosion and stops the progress of the gully by preventing undermining until the gully is filled by other methods.

NATURAL CONTROL AND RECLAMATION

Nature's method of controlling gullies is to prevent erosion on the surface by the growth of vegetation and to hold the soil together by the plant-root systems. The dead organic matter which accumulates on the surface of the soil from year to year prevents surface erosion and absorbs much of the rainfall. Nature can control gullies, but the natural process of reclaiming them after they are formed is very slow.

If eroded and badly gullied land is abandoned a volunteer growth of some sort usually springs up. The kind of growth depends upon the locality. Wild native grasses, weeds, shrubs and trees are the most thrifty and the best for rapid and permanent control of gullies. In some sections pine trees spring up spontaneously over eroded areas and in conjunction with weeds and grasses form a good natural control. Wild honeysuckle grows and spreads rapidly on poor soil and is very effective in controlling erosion, but because of its tendency to spread some farmers prefer other plants. Large gullies with steep, caving banks are the most difficult to control by natural means. They generally continue to enlarge for many years after the land has been abandoned for farming. Large trees figure prominently in the control of such gullies. Plants which supply both nitrogen and humus to the soil are best for natural control, for they will give to the land reclaimed for farming essential elements of fertility.

PLANTING TREES TO CONTROL GULLYING

In many localities gullying has been effectively checked by planting trees. This method is particularly adapted to land that is very steep or that has been gullied so badly that the cost of reclaiming it for pasture or cultivation would be prohibitive. In addition to building up the land the wood lot thus formed may be made a paying investment to the farmer, furnishing firewood and small timbers.

In planting trees on gullied and eroded areas the best results are obtained by ploughing the entire gully and thoroughly disking or harrowing the ground. The trees should be set out in rows 5 to 6 feet apart in deeply ploughed furrows. The rows on the sides of the gully should be laid out approximately on the level, as the trees should be cultivated the first year by throwing the dirt from each side toward them. Less washing occurs where the rows closely follow the contour of the ground. It is very important that the soil bed be properly prepared, as this will promote a rapid growth of the trees, and they are less likely to die at the start.

The best results are obtained where some kind of dam is built across the gully to catch and hold any soil that otherwise would be carried away in the drainage water. Brush dams are commonly used for this purpose; before they rot out the tree root systems will have extended so as to prevent serious washing. It is also a good plan to sow grass seed between the trees after setting them out.

This grass should not be pastured, at least not closely, because close pasturing greatly retards reclamation. Where thicket of locust is desired and the trees are not needed for posts, they are sometimes cut down after the first year; this causes sprouts to spring up between the tree rows and provides a dense growth which is effective in checking erosion.

SOIL-SAVING DAMS FOR GULLIES

The common method of controlling or filling in and reclaiming gullies consists of building soil-saving dams across them.

Temporary dams are built of stakes, brush, straw, logs, loose rock, or woven wire; permanent dams are built of earth, masonry, or concrete. Their cost is often very small if materials available on the farm are used. Stones are a nuisance in a field, but are excellent material for dams. If no stones are available, timber and brush may be plentiful and log and brush dams may be built at small expense. Where none of these materials is available straw may be plentiful and can be used for low dams, the straw being held in place by stakes. Woven-wire fencing costs little and is excellent material for low dams.

Most temporary dams are porous; that is, when first built they permit the water and part of the silt to pass through them. They are gradually built up as the spaces are filled with trash and soil brought down by the water and are never subjected to the heavy pressure exerted on a water-tight dam by the water ponded above.

Most permanent dams are water-tight, and in order to pass from the upper to the lower side of the dam the water must either flow over it, be diverted around it, or carried through it by a conduit. If the water is to flow over the dam, a spillway of non-erosible material is provided generally at the middle of the dam, and should be wide and deep enough to remove the greatest flow of water expected. If the water is to be diverted around the ends of the dam, it is generally made to flow over firm, sodded ground. Sometimes a shallow channel is dug to carry the water around the end of the dam and empty it into the gully at a considerable distance below. If the water is to pass through the dam, it is carried in a pipe.

The inlet consists of a vertical pipe connected to a horizontal line of pipe extending through the dam along the bottom of the gully. The top of the inlet is lower than the top of the dam and the water ponded above does not flow out until it reaches the top of the inlet pipe. The pond above the dam practically forms a sedimentation basin, as the silt in the water settles to the bottom and in time fills the gully to the top of the inlet pipe Such a dam is sometimes called the drop-inlet soil-saving dam, from its vertical inlet pipe.

SOD DAM

Sod dams are often successfully employed to check erosion in small gullies draining one-quarter acre or less on moderate slopes. To get sod well started it is necessary to place it above a small dam of brush, rock, or other inexpensive material. Perhaps the best way is to place the sod in loosely woven grain sacks, tie these up and build them into small dams in the gully. Usually the filled sacks are placed end-to-end across the gully. Each dam should be lower in the middle than at the sides of the gully so as to permit the water to flow over without washing around the ends sufficient soil should be placed between and around the sacks, particularly on the upper side—to prevent water percolating through the dam. Usually a good sod growth has developed before the sacks are rotted out. Native grasses which are hardiest in the locality can be used for this purpose.

WOODEN-STAKE DAM

A cheap method of filling-in and reclaiming gullies of moderate slopes and small drainage areas consists in driving several rows of stakes across the gully in checker-board fashion. The stakes should be 3 to 7 feet long with a diameter of 2 to 4 inches at the upper end. The rows should be from 6 inches to 2 feet apart, and the stakes the same distance apart in the rows. The stakes should be driven into the ground until the tops extend 8 to 20 inches above the surface; the larger and longer the stakes the greater may be the intervals. The rows of stakes should extend across the gully and up the sides as high as water ever reaches, and the tops of the stakes on the sides of the gully should be at least 1 foot higher than the tops of the stakes in the middle. The stakes may be made of any available hard wood. When stones are available the dam can be made more substantial by filling in the spaces between the stakes with them. Where stone is not available the ability of the stakes to check and hold silt can be increased by filling in straw between them. A series of such dams should be built along the entire length of the gully, the distance between them being such that each dam will cause a deposit of silt extending to the next above. As soon as the filling in above the first series of dams is completed other dams should be built between the first ones and the filling-in process continued by additional dams until the the gully is filled as desired.

BRUSH DAM

In localities where timber and brush are abundant excellent results have been obtained by the use of brush dams. The methods of building these dams differ somewhat in different sections of the country. In hillside gullies where the flow of water is small the dams are commonly built of loose brush, sometimes weighted down with logs or rocks. Where the flow is sufficient to overtop the dam the brush can be held down by crosspieces or wire and stakes, or the dams are sometimes built by weaving brush into a row of stakes across the gully. Successful results cannot be obtained by simply dumping brush into the gully.

WOVEN-WIRE DAM

The woven-wire dam consists essentially of a low fence across a gully. The posts must be set close together and anchored solidly upstream if the force of the water is great.

The common method of building these dams consists in setting a row of ordinary fence posts across the gully about 4 feet apart. The posts should be set at least 4 feet deep and should be anchored by wire to anchor posts driven 8 or 10 feet above the line of the dam. The deposit of soil caught by the dam later covers these anchor posts and greatly increases their holding power. The end posts should be set in a trench dug into the sides of the gully. The best results are obtained when a trench is dug along the upper side of the posts so that the woven wire may be fastened 6 inches or a foot below the surface. The wire should be at least 30 to 36 inches wide and should be set into the ground so that about 2 feet extend above the surface. The wire is fastened to the upper sides of the posts, and the trench in the sides and across the gully is filled up and carefully tamped. When there is not enough trash in the water to close the large meshes in the wire and catch the soil particles, a little straw leaves, or fine brush can be placed against the upper side of the wire to get a fill started.

LOOSE-ROCK DAM

Rock is a very good material for building low soil-saving dams. Its use is particularly advisable on farms where rock is plentiful and often a nuisance in the fields. Loose-rock dams should not be more than 2 to 3 feet high and should be built only in gullies of moderate slope and small drainage areas. The dam should be 4 or 5 feet wide at the base and about 2 feet wide on top. The rock should be so arranged that the small pieces fit in among the large. Only large pieces should be used on the top of the dam, as a current of water has often sufficient force to move even large stones. The dam should be built well into the banks of the gully and should be lowest in the middle. A trench about 6 inches deep should be dug across the gully, in which the foundation of the dam, consisting of the largest rock, should be laid. The gully below the dam for about 5 feet should be covered with loose rock to prevent erosion and the undermining of the dam.