Conserving Soil by Better Land-use Practices
Michigan State University Extension Service
Paul M. Barrett
Revised December 1949
32 pages

EXTENSION BULLETIN 203

Cropping planned to fit the land.

CONSERVING SOIL *by Better* LAND-USE PRACTICES

By PAUL M. BARRETT

MICHIGAN STATE COLLEGE
COOPERATIVE EXTENSION SERVICE
EAST LANSING

SUMMARY

1. Erosion has become a serious problem on most Michigan farms. One field in four has lost much of its topsoil by wind or water action, and unless control practices are adopted, this loss will become greater.

2. The immediate results of erosion are lowered crop yields and greater difficulty in field operations. The final result is loss of farm value to the point of abandonment. Every farmer must be alert for signs of erosion just as he is for signs of poor crop growth, low milk production, and disease in livestock.

3. Specific control measures are designed to reduce soil loss under different conditions. Each farm and field is a separate problem and must be treated according to its needs. Control measures are not effective without good general farm management.

4. Sheet erosion may be controlled by suitable rotation, contour cultivation, strip cropping, cover crops, and terraces. Any, or all of these may be necessary for control, depending on the erosion, soil, slope, watershed and crops.

5. Control of sheet erosion conserves topsoil and prevents gullies. Once formed, gullies may be controlled by proper management of the watershed, with the aid of diversion channels and vegetation. Permanent sod waterways in natural water courses will carry water safely and prevent formation of gullies.

6. Loss of soil by wind can be lessened by windbreaks, strip cropping, and cover crops. Blowouts are the "gully stage" of wind erosion and are best controlled by brush until trees or other vegetation can become established.

7. It is better to fit the farm program to the land than to try to fit the land to the farm program. The whole farm enterprise should be considered and planned if every acre is to be utilized best and true soil conservation achieved.

Issued June 1939; First Revision, June 1948; Second Printing of First Revision, December 1949

Conserving Soil by Better Land-Use Practices

*By PAUL M. BARRETT**

Soil fertility is our most valuable natural resource. For that reason, it is as worthy of defense against loss and depletion as our sea coasts are against foreign invasion. The field which grew the prize-winning sample of wheat for the World's Fair in 1893 became so unproductive that it was planted to forest trees in 1934. In less than 40 years the fertility was taken from the soil, and the man who had grown the champion crop lived to see the field so gullied that cultivation was impossible. The total acreage of good farm land similarly destroyed is large, and the rate of depletion is so rapid that the conservation of our soil resources must be considered a problem of great national importance. Crops take fertility from the soil and mismanagement destroys tilth and organic matter, but soil erosion by wind and water removes more soil fertility than all the other forces combined.

There is a great need in this country at present for all citizens to acquire a high regard for the soil. The man in the shop, store, or office, as well as the farmer, has a stake in this soil of ours which produces food, clothing, and shelter for all. The farmer, however, has a double interest. He must assume the direct responsibility for keeping the soil permanently productive while making a living from it at the same time. To contribute information concerning the nature and treatment of the erosion problem, this bulletin describes soil erosion as it occurs in Michigan and outlines some of the most practical means of erosion control.

*Former soil Conservation Specialist at Michigan State College and a representative of the Federal Soil Conservation Service. The writer expresses appreciation to E. C. Sackrider, State Conservationist, and to several members of the Soil Science Department of Michigan State College for valuable suggestions in the preparation of the manuscript. L. J. Braamse and R. G. Hill, Extension specialists in Soil Conservation, were most helpful in preparing the revised edition.

KINDS OF EROSION

Erosion, as discussed in this bulletin, is the moving of soil particles by wind or water. It may occur with every rain or wind on unprotected soils. Kinds of erosion include: 1) Sheet erosion; 2) Gullying, 3) Wind erosion.

Fig. 1. One of Michigan's beautiful lakes being gradually filled up by erosion. On the opposite side can be seen a gully with the soil deposited below. Silting in streams and lakes destroys spawning beds and sources of food for fish.

Sheet Erosion

Gradual removal of the surface soil by water without formation of gullies is called sheet erosion; this may progress unnoticed for years because the small rills and miniature gullies produced on the slope by rains are smoothed over by tillage operations and forgotten. Repetition of this process, however, brings changes which are apparent to the alert farmer. The soil on the eroded parts of the field changes color as portions of subsoil are brought to the surface by plowing and mixed with the topsoil. There is an actual lowering of the land, indicated by the height of old fence rows above the field level, and by exposed tree roots. In more serious cases, the subsoil appears on the slope, and then one realizes that the "clay knobs" on the farm were once covered with topsoil like the rest of the field. Sheet erosion is the most serious and costly of the three types of erosion because it results in decreased crop yields. Tests and observations show that yields of most crops are in proportion to the amount of topsoil in a field. Where sheet erosion has taken its toll of topsoil, the life of the soil is gone and nature's work of centuries is wasted, possibly in one generation.

Fig. 2. Sheet erosion—the most common, most costly, and least noticed type of erosion. Evidence of sheet erosion may be "erased" temporarily by cultivation, but the effect remains. The best protection against it is through use of grass, legumes and cover crops.

Gullies — The end product of sheet erosion

Nature gives little warning of her actions. Usually, sheet erosion continues at an increased rate of soil loss until suddenly gullies appear. Often these are the first signs of erosion recognized by the farmer, signs that cannot be ignored. Gullies eat their way into fields, dividing them, and like a parasite, seem to grow on the fertility they drain from the land.

Wind Erosion

Erosion by wind, as by water, may be slow in making itself evident. Nevertheless, the removal of the lighter soil particles and humus is a serious loss. In addition to the loss of soil, serious damage often results from cutting off or bruising of young tender plants by blowing soil particles. Drifts of wind-blown soil sometimes smother considerable areas of crops and bury good soil. Sand drifts, accumulations of soil along fences, and "blowouts" in fields are some of the signs of erosion by wind.

"Blowouts" represent advanced stages of wind erosion. These vary from "pockets" a few feet in diameter to holes of considerable depth and several rods in width. These, like gullies, effectively ruin the land for further production of anything but forest trees, and some difficulty is often experienced in establishing plantations of trees on them. However, by use of brush, mulching material, or other protection, trees usually may be established.

Fig. 3. A wind-eroded area that is being stabilized and put to better use by growing trees.

Fig. 4. A young orchard on slightly rolling land that is suffering serious erosion. The future of this orchard will depend on how promptly and effectively this erosion is brought under control.

SOIL EROSION IN MICHIGAN

Soil, in its natural undisturbed state, is covered with a growth of forest or grass which, together with the accumulated humus, holds the soil in place against action of wind and water and leads to absorption of a large percentage of the rainfall. Bringing the land under cultivation destroys this natural cover, and unwise farming results in a rapid decrease in organic matter, thus leaving the soil subject to erosion. Sometimes the loss by erosion is so gradual that it escapes attention, but, if it continues unchecked, the result is a worn-out, abandoned farm, a loss to the owner and to the community.

The diversified agriculture of Michigan, requiring rotation of crops and large acreages of meadow and pasture for livestock, has helped to prevent soil loss and has kept this state in a favorable position, compared with many other states, so far as soil depletion through erosion is concerned. Michigan soils, however, do suffer serious loss from erosion on the majority of farms, and in many communities erosion control demands immediate attention if successful farming is to continue. The need for erosion control in these critical areas is evident, but it is equally important that control measures be taken on farms where erosion is occurring but as yet is not so apparent. The farms

that have suffered the least from erosion have the most to save, and usually soil-conserving methods are more easily established on such farms than on areas where erosion is already serious. Thus, the adage of prevention being more desirable than cure is again borne out.

Erosion on farms in Michigan has reached serious proportions and with a continuation of present farming methods will increase unless control measures are adopted. A day's ride through the agricultural section of Michigan or a critical servey in almost any community will show that erosion is taking a heavy toll of our farm lands. Farm credit organizations, both private and federal, now recognize that uncontrolled erosion destroys security in a farm. The time has come when permanency of land values is determined to a great extent by the effectiveness with which erosion is controlled.

Recent surveys show that about 25 percent of Michigan land has lost from 2 to 3 inches of topsoil, while the loss is some areas has been considerably greater. Erosion losses occur largely on cropland, and since most fertile land already is in farms, the conclusion is that in less than a century we have lost about one-fourth of the available productivity of our soil. The first hundred years have been the easiest so far as soil management is concerned, and hence the generations of the next hundred years will have a more difficult task if they control erosion, maintain soil fertility, and make a satisfactory living.

Fig. 5. Gullies may eat their way into fields that are almost level and will continue to grow unless checked by cover on the watershed. Diversion ditches may be necessary to divert water until grass can be established.

Erosion is, or is likely to be, a problem on every farm in Michigan. Some fields with slopes as low as 2 percent have had the topsoil washed away and gullies formed. In localities where the organic matter in the soil has been depleted and the land is rolling, evidence of soil washing may be found in every field. On level land, unprotected by windbreaks or cover crops, it is not unusual to find a serious loss of topsoil by wind erosion even on loam and clay loam soils.

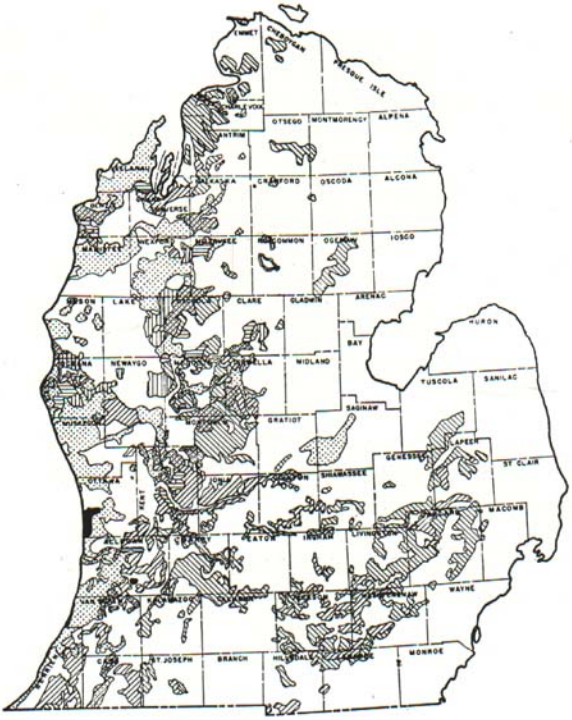
GENERAL EROSION SURVEY, LOWER PENINSULA OF MICHIGAN

Land in the western part of the state, along Lake Michigan, suffers extensively from wind erosion. Large areas frequently damaged by wind extend east through Wexford and Osceola counties. Blowing of soil by wind is not confined to the western part of the state. It occurs to some extent in every county, and the area affected may be large.

Loss of soil by water erosion is even more extensive and involves more farm land than that affected by blowing. Often the combined forces of wind and water are active in the same area, sometimes even on the same field. Water erosion is most destructive in rolling country that has been cropped for a long time. The land in the western and south central part of the state has suffered most from erosion by water.

In 28 counties of the lower peninsula more than 30 percent of the land is seriously affected by wind or water erosion. These counties are Allegan, Antrim, Barry, Berrien, Cass, Charlevoix, Clinton, Grand Traverse, Ionia, Isabella, Jackson, Kent, Lapeer, Leelanau, Livingston, Manistee, Mason, Mecosta, Montcalm, Muskegon, Newaygo, Oakland, Oceana, Osceola, Ottawa, Van Buren, Washtenaw, and Wexford. Other counties may have less total area affected, but in certain localities within them, erosion is very serious.

The erosion survey map of the lower peninsula (page 10) was made by the Soil Conservation Service. This is a very general map and indicates only the larger areas of most severe erosion. There are many small areas not shown on the map where erosion is doing great damage.



LEGEND

- LITTLE OR NO EROSION
- MODERATE SHEET EROSION
- MODERATE SHEET EROSION OCCASIONAL GULLIES
- SLIGHT WIND EROSION
- MODERATE SHEET EROSION SLIGHT WIND EROSION OCCASIONAL GULLIES
- SEVERE WIND EROSION
- MODERATE SHEET EROSION SEVERE WIND EROSION OCCASIONAL GULLIES
- VERY SEVERE WIND EROSION

Fig. 6. Recent surveys show that about 25 percent of Michigan land has lost 2 to 3 inches of topsoil and in some areas, the loss has been much greater. Erosion is, or is likely to be, a problem on every farm in this state because we find fields with slopes as low as 2 percent which have the topsoil washed away and gullies formed. Many examples of serious erosion occur in places shown as having little, or none on this map.

(Photo, E. B. Swingle)

Fig. 7. Results of tests on "run-off" plots show that many tons of topsoil went down the back furrow of this fall-plowed field. Sloping fields which are fall-plowed or left bare without the protection of a cover crop are likely to suffer such erosion. It takes more fertility from the soil than was removed by crops during the growing season.

EVERY FARM A PROBLEM

Specific control measures have been developed for the different kinds of erosion and for various soil conditions. This bulletin describes briefly those practices most applicable under Michigan conditions, as recommended by the U. S. Soil Conservation Service and the Michigan State College. The circumstances of each individual case will determine which practices or combinations of practices should be adopted.

It is interesting and important to note that every control measure recommended is consistent with good farm practice. Properly applied and carried out, these practices will improve the fertility of the soil,

usually increase crop yields, and maintain the value of the farm by conserving the soil. These measures are designed to supplement present farming practices. Good soil management and conservation practices are the foundation of permanent agriculture.

NON-CROP LAND

It is quite apparent that a complete farm plan is necessary if every acre is to be put into proper use and the soil conserved. In the determination of the best use of land on the farm, it is possible that certain areas will be too steep, too badly eroded or too infertile for cultivated farm crops. Often the best use for these portions of the farm is to retire them to permanent meadow, pasture, or to the production of forest products such as firewood, fence posts, timber, or Christmas trees. If reforestation is decided upon, adapted species should be used and plantings made consistent with good farm forestry practices. In woodlots already established, attention might well be given to their improvement.

Grazing the woodlot is a practice that does not pay. The pasture

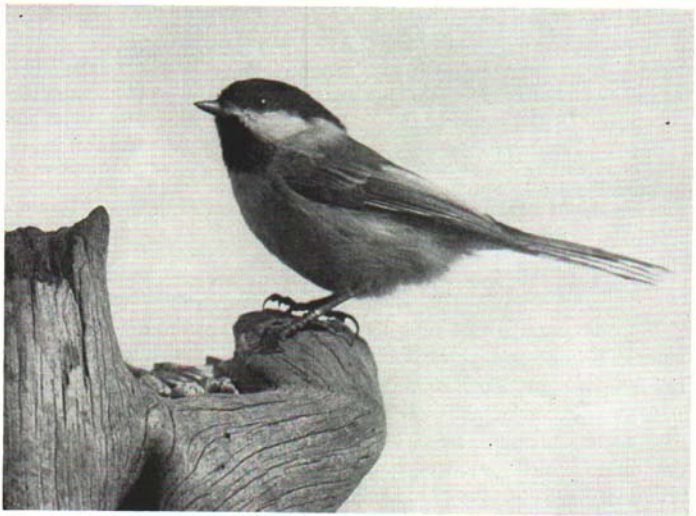


Photo: M. D. Pirnie

Fig. 8. Chickadees, like many other birds respond to feed and cover, making life more cheerful and better for all.

Fig. 9. This ungrazed woodlot shows a vigorous reproduction of new growth that will replace the mature trees now ready for cutting. A well-managed woodlot can be a profitable part of the farm supplying firewood, posts, and lumber.

in a woodlot is meager, and the possibility for a sustained yield of timber from a grazed woodlot is remote. It is generally true that the pastured woodlot is neither pasture nor woodlot. There is a place for forest products on most farms, and the woodlot can be made a valuable source of material and income.

BIRDS, BUNNIES AND BEES

Liberty Hyde Bailey's observation, "It is still possible to hoe potatoes and to hear birds sing at the same time," reminds us that land affords more than the material things of life. Most farms have odd corners or areas rather impractical for crops, but naturally suitable for birds, game and other wildlife if left alone and permitted to grow natural cover. Sometimes these areas can be improved by planting trees or shrubs that afford special food and cover for wildlife, and marshes left undrained can produce a crop of fur that will add materially to the farm income. It is a proven fact that birds are of real economic value to farmers by destroying harmful insects. Add to that their songs and color to brighten the day together with rabbits, squirrels and pheasants for those who like to hunt, and it is obvious these considerations are a part of a good land use program on the farm. For detailed information obtain Michigan State College Extension Bulletin No. E-218 "Producing Wild Life by Good Farm Land Use."

GOOD PASTURES SAVE SOIL

In allotting different areas of the farm to the various uses to which they are best suited, serious consideration should be given to pasture, not only because a sod is effective in controlling erosion and restoring the humus content of the soil, but also because good pasture is one of the most profitable crops that can be grown. Land too steep to be cultivated without excessive loss of soil or too difficult to work because of stones might well be devoted to pasture. This does not mean that land too poor for anything else is suitable for pastures. Good soil is necessary for good pasture.

Michigan pastures need more attention if they are to make the returns of which they are capable. The selection of a suitable seed mixture is the first step in pasture improvement. Attention is called to a combination of alfalfa and smooth brome grass, which offers great possibilities for the best pasture on certain soils and at the same time is very effective in erosion control. If the soil is acid, liming will be necessary before this pasture mixture can be established.

Pasture improvement experiments have demonstrated that it often pays to lime, fertilize, and re-seed. Large acreage alone will not make up for mismanagement and lack of fertility. Low wet areas may often be most profitably used as pasture by seeding Reed Canary grass on a well-prepared seed bed.

CROP LAND

Cultivated crops on sloping fields may lead to serious erosion unless fitting, seeding, and cultivation are on the contour, or at least across the general slope. Erosion may occur on slopes as low as 1 percent, and in these places the rotation should include a maximum of soil-protecting sod crops. The entire farm program may be affected by the rotation as it is changed to suit the land. A rotation for soil conservation purposes may contain a smaller acreage of cultivated crops. This, in turn, may involve a change in the livestock program of the farm. An increase in good quality legume hay is advocated since it is the most economical source of protein for livestock and permits a decrease in grain and corn silage. Further efforts to use more alfalfa in the ration have led to experiments in making alfalfa silage. The addition of 40 pounds of molasses to each ton of alfalfa as it goes into the silo seems to be all that is necessary to convert alfalfa into palatable silage.

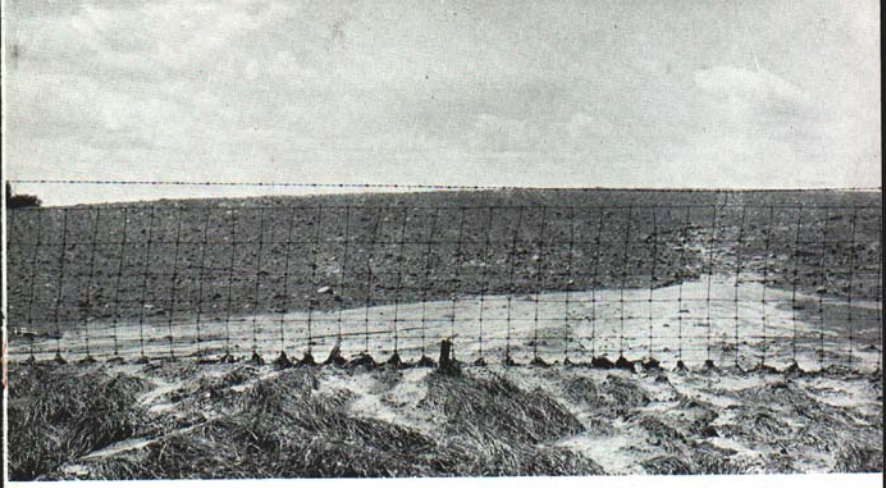


Fig. 10. A strip of sod along the fence slowed down the water and caught at least a part of the soil being carried from this field. If a strip of sod had been left across the slope part way up the field, most of this soil would have been kept on the farm.

As this practice becomes more widely accepted, it will aid materially in reducing the acreage of cultivated crops which permit erosion.

Grass, with its millions of roots, and trees, which provide leaf litter and soil-retaining roots, are nature's front line of defense against erosion. However, cultivated crops are necessary in our agriculture. Cultivation of slopes or places subject to blowing will be followed by erosion unless special care is given. Results of a demonstration on the Soil Conservation Service project in Berrien County, described below, illustrate the effects of different types of crops and of crop arrangement on soil erosion and moisture absorption.

RUN-OFF PLOT RESULTS

"Although the loss of surface soil by sheet and gully erosion has been widely discussed the last two years by many groups in Michigan, little information was available as to exactly how much erosion actually was taking place.[1] To make a visual demonstration that might be viewed by visitors to the Berrien County Soil Conservation Service demonstration project, run-off plots were laid out on two different soil types and two different slope conditions.[2]

[1]From "Soil Losses in Berrien County," by E. C. Sackrider, Soil Conservation Service, and G. M. Grantham, Section of Soils, in the Michigan Agricultural Experiment Station Quarterly Bulletin, Vol. 20, No. 3, February 1938.

[2]The run-off plots are now operated by the St. Joseph River Soil Conservation District and may be seen by visitors.

TABLE 1.*

Soil	Percent of slope	Tons soil loss per acre with			Percent of rainfall lost by run-off		
		Cultivation up and down slope	Sod	Cultivation across slope and sod strips	Cultivation up and down slope	Sod	Cultivation across slope and sod strips
Hillsdale Loam	13½	152.	.22	26.	37.5	5.4	19.4
Hillsdale Sandy Loam	6	40.	.0	2.	28.6	7.4	11.4
Coloma Sandy Loam	14	26.	.06	1.	9.2	1.3	3.5
Coloma Sandy Loam	6	9.	.0	.9	7.2	0.5	4.6

*Results are for period June 1, 1937 to June 1, 1938.

"These plots were one-hundredth of an acre in size and were enclosed with a 10-inch board set 6 inches in the ground, to keep all the water that fell outside of the plots from running in and to keep the water that fell on the plots inside. A cistern was constructed at the lower end of each plot to collect all the water and soil that ran off the plot.

"Inasmuch as these plots are located in a fruit section, treatments were established to correspond to cultural practices in orchards, such as clean cultivation up and down the slope, complete sod, and cross-slope cultivation with a 4-foot sod strip in every tree row.

"The necessary apparatus to make accurate determinations was not available at the project, and the results shown in Table 1 are only approximately correct. However, these results check closely with the visual observations made on soil and water collected in the cisterns at the foot of the slope.

"The results shown in Table 1 (Fig. 4) indicate that sheet erosion is each year removing large amounts of fertile topsoil—but is removing it in thin layers, not readily observed under field conditions.

"The Soils Department of Michigan State College has cooperated in making moisture determinations throughout the growing season to study the effect of these various treatments on soil moisture.

"These observations made at Benton Harbor cover only a short period and hence are not advanced as final. They are, nevertheless, in accord with research data obtained elsewhere.

"A study of this demonstration brings us to the conclusion that the use of arrangement of cover is of vital concern in controlling erosion on land under cultivation."

Fig. 11. Oats and corn in contour strips across the slope. On fields so arranged, the speed of the water is checked by the cultivator marks and rows of corn and what soil is carried from the cultivated areas is deposited in the sod or close-growing grain. A regular rotation must be followed under this system, and farmers are finding it practical.

REARRANGEMENT OF CROP FIELDS

Since the distance water travels is one factor governing its destructive power, it is obvious that shortening the cultivated slopes will do much to prevent soil loss. This fact supports the theory that planting crops in strips is a means of decreasing soil loss, and experience under field conditions justifies the practice. Strip cropping is an arrangement of crops in long narrow fields across the slope, or on the contour, with crops arranged in the rotation in such order that a sod alternates with open-growing cultivated crops that leave the soil susceptible to washing.

The width of strips may vary from 70 feet on a 15-percent slope to 125 feet wide on a 5-percent slope. It is convenient to use 100-foot strips on a 10-percent slope, decreasing the width of strips on steeper slopes and increasing the width on more gentle slopes. Usually heavy soils or sandy loams with clay subsoil are likely to erode, hence narrower strips are desirable on these soils.

By eliminating one or more fence rows and combining fields, the length of rows can be increased for more efficient operation of machinery.

CONTOUR STRIP CROPPING

It is recognized that on much Michigan land it is impossible to travel far in one direction without going either up or down a slope. Cropping a field with strips laid out on the level or contour to avoid running rows up and down hill is called contour strip cropping. This is a radical departure from the long-established practice of square farming with accompanying pride in straight rows, but it does have its advantages. First, and most important, is keeping the rows across the slope to save soil and moisture. This is justification enough for the practice. Second, it has the advantage of rows that may be longer and easier to work because it takes less effort to work on the level than up and down hill.

The disadvantages of strip cropping are the necessity for rearrangement of fields, the difficulty in pasturing a part of the field, and the problem of providing a lane to connect fields with the buildings. However, by means of electric fences, any field may be pastured, and careful arrangement of fields does allow convenient access for harvesting. In contouring there may be some short rows, but these can be avoided to some extent by leaving correction areas in sod.

As with any other problem, the conditions on each farm must govern the practices adopted. Some land is too irregular for practical operation of strip cropping. On such farms, if erosion is a major problem, the only alternatives are either field stripping or a rearrangement of farm program and enterprises to allow a large part of the land to remain in sod much of the time. It is possible to carry on a livestock program with a minimum of cultivated crops, and this, it seems, is the answer on many farms. For further information on strip cropping, refer to U. S. Department of Agriculture Farmers' Bulletin 1919, "Strip Cropping for War Production."

FIELD STRIPPING

Field stripping is the growing of crops in strips at right angles to the general slope or prevailing wind direction.

While not as effective as contour cropping, field stripping offers a solution to the water erosion problem on irregularly sloping or "choppy" fields.

By arranging the strips across the direction of the prevailing wind, the velocity is checked at intervals, thus lessening the movement of

Fig. 12. A strip in this corn field left without a seeding of rye for a cover crop shows the power of water to move soil unprotected by cover.

topsoil. The tall-growing crops act as buffers and protect the shorter, more open-growing crops such as beans.

COVER CROPS TO HOLD SOIL

Cover crops have an important place in holding soil. One of the most effective and convenient methods is to use a cover crop following a cultivated crop. An example is rye planted in corn at the time of the last cultivation, which gives growth sufficient to protect the land during the fall, winter, and spring. Cover crops may include any of the grain crops or even legumes, and are useful not only for protection of the soil but also to furnish material to turn under with the soil in the spring as organic matter. Farmers are finding that sweet clover sown in corn about the first of July decreases run-off and builds up the soil. Fall plowing and fields left bare over winter are likely to result in erosion that takes more fertility from the soil than was removed by crops during the growing season. Cover on the land slows down the run-off of water and thereby reduces flood damage.

SOD WATERWAYS TO CARRY WATER SAFELY

In most sloping fields there are natural watercourses that must be recognized and maintained as such. Usually a permanent sod once

Fig. 13. A well established sod waterway that is a productive area of the farm rather than a gully. Cultivators must be raised when crossing in order to maintain a good sod.

established will carry the water safely from the land. It also accumulates considerable silt dropped by the water. Moisture and fertility make these sod waterways productive, and they become valuable hay-producing areas instead of gullies.

A sod waterway may be difficult to establish where considerable water must be handled and washing occurs. One of the most practical and effective means of getting sod started in such places is to seed heavily and cover with a light straw mulch, held in place by old woven wire fencing staked down. With an area protected in this manner and fertilized, a good sod can usually be obtained. Since sod waterways are recognized as a necessary and valuable part of the producing acreage, it is wise to allow ample width of waterway to avoid building up the center with soil deposited by the water, and subsequent cutting along the sides. At least two mower's widths, or from 12 to 24 feet, seem to be about the proper width.

TERRACES AND DIVERSION CHANNELS

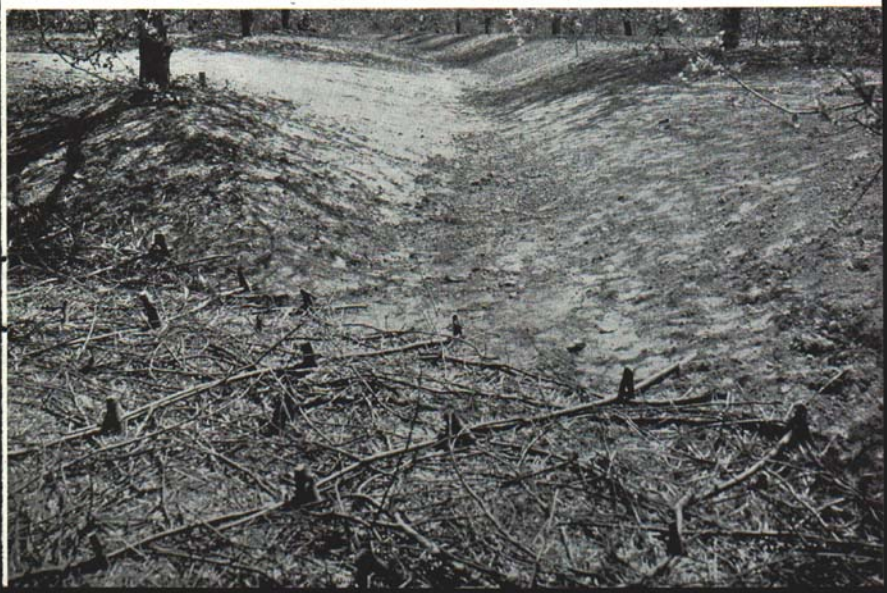
The use of cover and arrangement of crops to control erosion have been discussed, and it is believed in most cases these measures will be sufficient to give good soil protection. However, there are conditions where mechanical devices may be required to aid in effective

control. Of these, the oldest and most commonly employed is the terrace. This is simply a broad-base ridge thrown up across the slope to check the water and allow it to be absorbed into the soil and the surplus led off slowly. To prevent breaking through at points of concentration, terraces should be spaced at proper intervals to keep the volume of water within the capacity of the terraces. Careful study of all conditions should be made and experienced supervision employed or trouble may result.

A safe outlet for water at the end of the terrace is important and must be provided or a gully may start at this point. For detailed information on terracing, refer to U. S. Department of Agriculture Farmer's Bulletin 1789, "Terracing for Soil and Water Conservation."

Diversion channels are similar to terraces but are specifically designed and placed to protect certain slopes and critical areas by diverting water. They are most useful in establishing gully control and should be kept in sod at all times. It is particularly necessary that the outlet be protected by sod to insure safe disposal of water.

Fig. 14. A diversion channel emptying into a sod waterway. The brush staked down will slow the water until a sod can be established. A light straw mulch over the seeding held down by old woven wire is fully as efficient and easier to use. The diversion channel will carry the water across the slope to a new outlet and so prevent it from flowing down through the old gullies and making them larger.



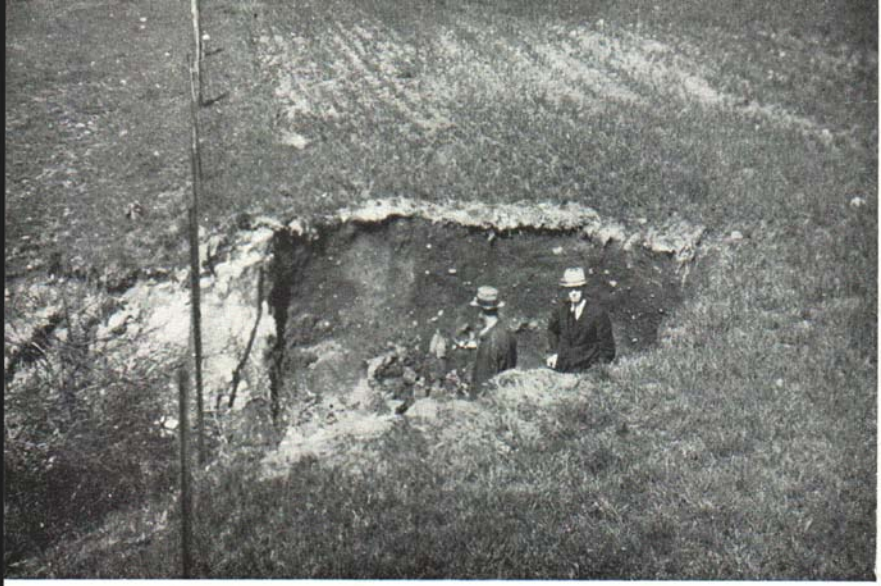


Fig. 15. The brush on the left piled in this gully failed to stop its growth into the next field to the right of the fence. Gullies are stopped by diverting water into new channels farther up the slope. Grass, cover crops, contour cultivation and diversion of water by terraces or other means are necessary to prevent formation and growth of gullies.

GULLY STABILIZATION

Gullies, like many other difficulties, are better prevented than cured. The place to start control is above the gully on the watershed, where the real source of the trouble lies. This may require cover crops, grass, or even reforestation, and it is likely that if some such action is not taken, the gully will not be controlled nor will there be much topsoil left on the land above. With the watershed above under control, the gully is ready for consideration. The sides may require sloping back to make them less steep. A heavy seeding of a good grass mixture, well fertilized and protected with a light straw mulch held in place with old woven wire, will insure a good sod in most gullies. Natural vegetation of grass, shrubs or trees is much more practical and effective than mechanical structures in most cases. U. S. Department of Agriculture Farmer's Bulletin 1813, "Prevention and Control of Gullies" is recommended.

Usually small gullies are an indication that permanent sod waterways should be established. In any event, regardless of the gully's

size, it is not effective to dump in loose brush, boulders, or junk because the water will continue to cut around and under the trash. Too much brush is likely to do more harm than good, for it will shade out and kill grass that might otherwise grow.

WIND EROSION

Reference has already been made to the use of good crop rotations and strip cropping across the direction of the prevailing wind as a means of reducing wind erosion.

"Blowouts" usually occur on sand, and it may be difficult to establish vegetation on these spots even with a scattering of brush to stop the sand from blowing. In the driest and sandiest areas, beach grass will grow and is quite effective in holding the sand. This can be followed by planting trees; usually conifers will be found most satisfactory. Jack, red, and Scotch pine will grow well on the more drouthy soils, while white pine and spruce require sites with more favorable moisture conditions.

Windbreaks are effective in reducing erosion by wind and also have many other advantages, such as winter protection of seedings

Fig. 16. Remains of what was once an orchard. An extreme case of what happens on a poorly chosen site with lack of adequate care. Use of cover crops, sod under proper conditions, and mulch are a part of good soil management for orchards.

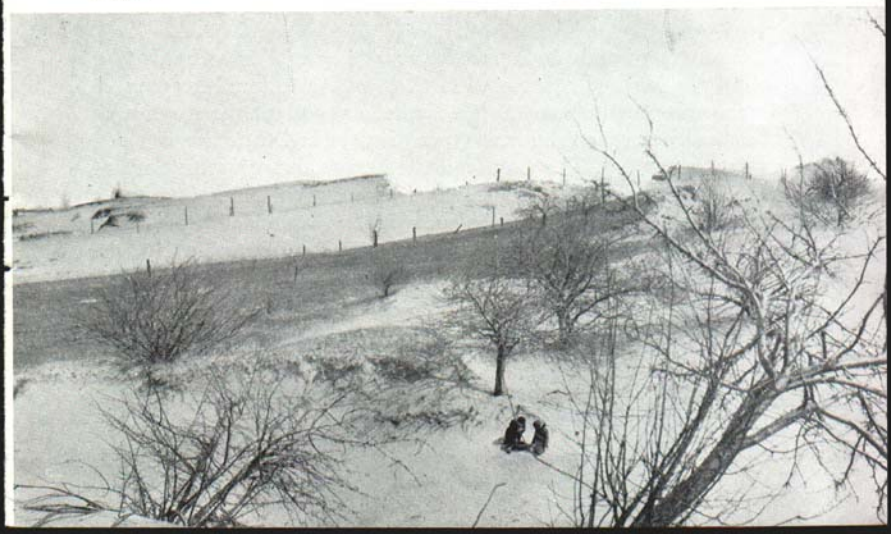


Fig. 17. One of three gullies doing serious damage in a valuable orchard. The owner is asking the county agricultural agent and a representative of the Soil Conservation Service to suggest means of control.

against cutting and injury. Low-branching evergreens are desirable, as they afford best protection the year around. Two or three rows spaced alternately are most effective. Detailed information on planting and care of upland windbreaks may be obtained from the Forestry Department, Michigan State College.

EROSION CONTROL IN ORCHARDS

Cover crops and use of sod for erosion control in orchards is a special problem and is discussed in Michigan Agricultural Experiment Station Circular Bulletin 199. This bulletin points out the advantages and disadvantages of different types of cover and their usage under various conditions. The main consideration is that of getting maximum protection with a minimum of competition for moisture and plant food. The choice may be sod where soils are fairly well supplied with moisture and the trees, such as apples, are not unduly sensitive to drouth.

A combination of sod strips and cover crops is effective. The sod strips can be used in the tree rows across the slope for permanent protection, while cover crops can be used between the rows to prevent washing and blowing during critical periods, later to be turned under to add humus and conserve moisture. In young orchards it is well to

take every opportunity to build up fertility and organic matter to make possible other practices in the future that will help control erosion.

It is easy to get the advantages of cultivation across the slope by simply following the rows across the hill, and when the grade is uniform and in the same direction this works nicely. However, much of our fruit land in Michigan changes direction of slope so often that a straight row soon leads up or down hill and invites erosion. Many new orchards are being planned to fit the land and are set with the rows curving around the hill. In these orchards that are set on the contour, it is found that it is much better to change direction than to go up and down the hills. Contour-planted orchards save moisture, soil, and work.

In setting an orchard on the contour, there may be a slight departure from the exact contour in order to space the rows evenly and to

Fig. 18. A single rain on this unprotected slope caused serious damage. Mulch and sod are effective means of avoiding such loss.

Fig. 19. A soil conservation demonstration farm. The cooperator has established contour strip cropping, sod waterways, cover crops, and other good soil conservation practices.

avoid short turns. Curving rows in a rectangular field will likely necessitate some short rows, but it will also permit some longer rows than the straight distance across the field, so that in the end the rows will average about the ordinary length and will permit about as many trees.

Orchards set on the contour lend themselves readily to terraces and diversion channels. It is on such plantings that these devices are the most practical and effective. In some orchards, each row has the trees set on the crown of a small terrace.

Mulching in orchards is often an effective means of controlling erosion, building up a supply of organic matter, and establishing a seeding. Lack of sufficient quantities of mulch is the major reason for its limited use. In many orchards mulching material is so essential that special acreage is devoted to growing it. Sudan grass, millet, and legumes, as well as straw, are suitable materials grown especially for this purpose.

EXTENSION SOIL CONSERVATION DEMONSTRATION FARMS

The establishment and use of soil conservation demonstration farms has been one important phase of the soil conservation educa-

tional program in Michigan. The Extension demonstration farm plans are based upon an inventory of the farm, capabilities of the soil, needs of the farm family, need for individual farm practices and other factors which must be considered in making a good farm conservation plan. The cooperators are selected by the county agricultural agent, and the conservation program is planned cooperatively by the extension service, the soil conservation service, and the farm operator. This is done in such a way that the conservation program, including the necessary practices, can be fitted into the farm program with the least amount of labor and expense. It requires at least 3 years to establish the soil conservation practices on most Michigan farms.

Local people are encouraged to study demonstration farms, to observe practices which are established, to judge their merit from the standpoint of reducing soil loss, and to determine whether the practices would be useful on their own farms.

Individuals or groups wishing to visit a soil conservation demon-

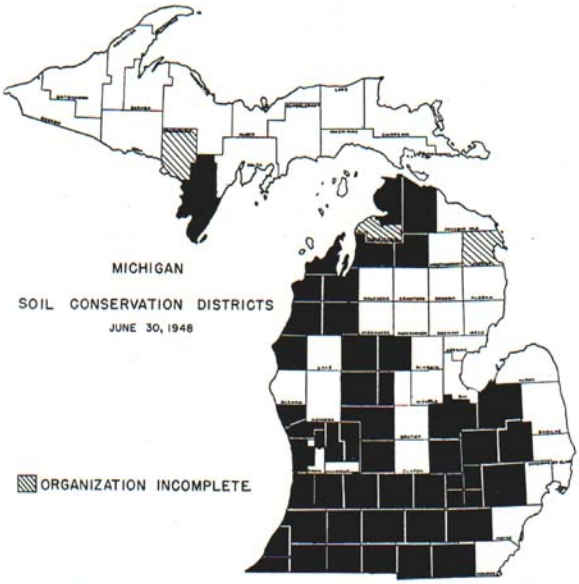


Fig. 20. Michigan soil conservation districts, June 30, 1948.

stration farm or district cooperator's farm can make arrangements with the county agricultural agent in their county.

SOIL CONSERVATION DISTRICTS

Erosion and loss of soil fertility have reached a point on many farms, and in many communities, where farmers working alone are not able to control the problem. To meet this situation, the Michigan Soil Conservation Districts Act was enacted as law in 1937 and amended in 1945 by the State Legislature.

This act provides a means whereby a community may organize itself as a soil conservation district in order that farmers of the district may effectively combine their efforts to control erosion and to increase soil fertility in cooperation with local, state, and federal agencies.

A soil conservation district is formed when a petition for organization has been filed with the State Soil Conservation Committee, a hearing conducted as to its need, and a majority of land owners and occupiers voting have declared themselves in favor of a District. Two directors are appointed by the State Committee, and three are elected by the people of the area. These five are the first governing body of the district. They may ask assistance from and cooperate with other agencies in making surveys and demonstrations, they may accept donations, gifts, or services in the interests of the district, but they have no authority to levy taxes or make assessments. Cooperation with the district is voluntary. Individual farmers wishing assistance with soil and water conservation problems may request help from the board of directors. After such help is requested, conservation technicians will be sent to the farm to make surveys and recommendations on erosion control, drainage, land-use, rotations, liming, tree planting, pasture improvement, and woodlot and wildlife management. A complete soil and water conservation plan is made for the farm. There is no direct charge to the individual farmer for this assistance. However, any materials or equipment purchased or used to carry out the plan must be furnished by the farmer. No payments for carrying on conservation practices are made. Value to a farmer comes from increased yields and higher land values. Districts are legal subdivisions of the state and may receive assistance from any local, state, or federal agency or civic group. After 5 years, a district may be dissolved by the same method used in its organization.

The West Ottawa Soil Conservation District, organized in 1938 in the west side of Ottawa County, was the first district in Michigan. Since then 57 such districts have been organized in the State and over 2,200 in the United States.* Complete soil and water conservation plans have been made for more than 9,000 farms in Michigan since 1938.

Further details concerning districts are available from your county agricultural agent, Cooperative Extension Service, Michigan State College, or from the State Soil Conservation Committee, Agricultural Hall, East Lansing.

*September 1, 1949.

Cooperative extension work in agriculture and home economics. Michigan State College and U. S. Department of Agriculture cooperating. C. V. Ballard, Director, Cooperative Extension Service, Michigan State College, East Lansing. Printed and distributed under acts of Congress, May 8 and June 30, 1914.

December 1949: 7.5M