EROSION AND ITS CONTROL IN THE NORTHWEST

by

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INTRODUCTION

Purpose:

In this thesis the author will describe problems of the Pacific Northwest, their importance, and something about the conservation measures that are being used as well as those that should be followed for the best results in conserving our soil. A brief discussion on the organization and work of the Soil Conservation Service is also included.

Importance:

The problem of soil erosion and conservation is sufficiently important that in 1935 the Soil Conservation Service was set up under the Department of Agriculture for the purpose of studying soil erosion, and to work in cooperation with farmers and other government agencies in actual conservation work.

Erosion is a natural process which has been sculpturing the face of the earth since the first winds began to blow and the first rain began to fall. It is a result of the impact of climatic forces such as rainfall, frost, and wind upon the land under varying conditions of slope and cover of natural vegetation. For thousands of years rain, wind, running water and other natural forces have been wearing away the land. Great canyons have been carved from the earth's surface. Geologic erosion of this type is one of the greatest fundamental processes, and the results of its action may be seen about us everywhere. Soil erosion and its control constitutes a complex problem, requiring for its solution the coordinated efforts of specialists in many fields. On many of our Oregon lands, erosion is not a normal process of nature. Man has ruined the natural balance by removing the vegetation. The resulting accelerated erosion of the soil is very abnormal and becomes progressively worse which, unless cared for in the proper way, will surely result in death to large areas of our valuable soil. If we are to remedy this destructive use, a thorough study of the situation must be made. Each field or unit must be carefully examined and its troubles analyzed. If the trouble is serious, the help of specialists may be a necessity: land-use experts to advise on the care of the land and cropping systems, and geologists to assist in determining the planning cures as well as the erosion conditions themselves. The causes of the present condition of the land, the best ways of improving past damage, and satisfactory plans for the future are all problems that must be taken into consideration. Then, having determined what is wrong, a plan of treatment must be initiated which will restrain the destructive erosion and which will bring the land back to normal condition and productivity as soon as possible.

History:

According to the 1930 census, there are in the Pacific Northwest 18 million acres of cultivated land, including about 5½ million acres of irrigated land. About 6 million acres lie in the sub-humid zone and are subject chiefly to erosion by water. Six and one-half million acres in the semi-arid zone are subject to erosion by both wind and water.

The survey revealed that approximately 47 per cent of the agricultural land in the intermountain zone of the Northwest is subject to either slight or severe wind erosion. About 2 million acres of it can still be protected against serious damage if the proper measures are used. About 6 million acres of water-eroded croplands in the intermountain zone have, on the average, lost about half of the original top soil. This surface soil, of course, has not been removed as a uniform layer. It has been entirely removed along with some subsoil in parts of fields, and partially removed in others. Some of it has been redeposited on lands of lower elevations.

West of the Cascade Mountains in Washington and Oregon there are about five million acres of tillable land. About three-fifths of this are rolling or hilly. These rolling lands are subject to erosion where intensively cultivated. In-as-much as this soil is valued very highly, this problem is very great.

There are also about 60 million acres of open range land in Oregon, Washington, and Idaho. Erosion has removed so much of the top soil on about 3 million acres of this, that the forage producing capacity has been reduced to practically nothing, and an additional 7 million acres has

E 1.—*Under natural conditions soils are protected from the erosive action of wind and water by a cover of vegetation.* *tically all of those parts of the Pacific Northwest that were not forested were covered, 60 years ago, with bunchgrasses.*

GURE 6.—*Forests exhibit little or no destructive erosion except where fire or excessive grazing has destroyed the cover.*

been reduced to a point far below half the original. The additional 48 million acres has been somewhat eroded; but with careful and immediate attention, it can probably be restored to somewhere near normal conditions.

The Forest lands of these three States have fared better. Less than 10% of the 45 million acres is severely eroded. This 10% includes those areas that have had repeated fires on them time after time. About 45% is protected by sufficient cover to prevent serious damage from run-off. The remaining area has been partially denuded by fire, logging, and grazing, until moderate erosion damage has resulted. Less than one-fourth of our forested areas shows signs of any accelerated erosion.

TYPES OF EROSION

Signs of soil erosion are visible to everyone, but recognition of the present and future implications is not quite so simple. To learn what is actually happening, we must first differentiate between normal and accelerated erosion and must understand the significance of each. Although the process of erosion may go on so slowly that it can scarcely be detected, it is steadily sapping the vitality of lands everywhere, and from the long-time viewpoint the loss is tremendous. In considering geologic erosion, we must think of it as being natural and slow; while accelerated erosion is more often associated with some type of misuse and ordinarily results in damage occuring much faster.

PROCESSES OF EROSION

Erosion is placed under three major classifications as to process, namely: gullying, sheet erosion, and wind erosion. Gullies are the most spectacular symptoms of this destruction. They begin only as small sized rills, but may soon grow to be very deep and wide. Many have been known to become 50 and over 100 feet deep or more. Gullies even much smaller than these interfere with cultivation, grazing, or timber management. Unless prompt action is initiated on these gullies they soon get so large that scarcely any means of control could ever be sufficient. As a result large areas have been so badly damaged that it will be necessary to abandon them. Gullies may develop from rills, ruts in old roads, depressed cattle trails, drainage ditches, improperly constructed terrace outlets or any other line along which running water is concentrated. Periodic flow of water increases the soil removal from the floor. It removes material that has caved in or fallen into the gully. This both widens and deepens it. Less apparent but just as important is the problem of sheet erosion. This form is exceptionally bad because it removes the top soil first. It is a well known fact that the top soil has a very large bearing upon the producing capacity of the land. In fact on many areas only this layer will produce vegetation. True sheet erosion follows no definite

GURE 7.—*In areas of greater rainfall the summer-fallow system contributes heavily to soil washing, particularly when the soil enters the winter finely pulverized and nearly saturated with water.*

IGURE 29.—*The flood hazard to the city of Pocatello, Idaho, is alleviated by building contour furrows on the hillsides of the watershed. This is a first step in revegetating the denuded area that deluges the city with water, silt, and rock during cloudbursts.*

channels. However, water tends to concentrate its flow and small ditches soon develop.

Wind erosion also attacks the top-soil surface, removing the most valuable portion of the soil.

FACTORS AFFECTING DEGREE OF EROSION

There are many factors affecting the degree of erosion. Type and quantity of precipitation has a very definite bearing on it. Intense rains give a larger proportion of immediate surface run off than do slow drizzles. Although intense rains ordinarily last only a short time and cover relatively small areas it is these rains that cause the greatest amount of sheet and gully erosion. They enlarge rills to form gullies. For example, washing out of dams is usually caused by this type of storm. The slow drizzling rains have much less effect on erosion. They deposit the water slowly enough so that better percolation can take place and therefore, there is far less runoff. However, rains of this type may saturate the soil to such a point that it will cave off into creeks and gullies, thus causing a greater loss at times of harder rains. If the flow of water through a gully is great and the debris low, the water can cut into the floor and pick up additional material. On the other hand, if the water is heavily loaded with solid matter, it may actually deposit and raise the level of the gully floor.

Soil type and condition form a large measuring stick of potential erosion. The depth to which gullies can cut is determined in large part by geologic conditions, particularly the thickness of soil or distance to solid rock, the character and resistance of bedrock and the gradient of the gully floor. Gullies in some areas can cut down only a few feet before encountering resistant rock. Some places have soil so deep that it seldom, if ever, erodes to bedrock. The slope of the land surface, likewise, influences the degree of erosion. Where topography is rugged and overgrazing or cultivation has left the ground poorly protected by vegetation, heavy rains sometimes start large saturated masses of mud, sand, and boulders flowing down the slopes. Increased slope naturally increases the rate of runoff. Doubling the rate of runoff quadruples the erosive power of a given volume of water.

On any slope the activity of soil erosion by running water depends in part on aspect or the direction in which the slope faces. Aspect affects the amount of sunshine received and also the drifting of snows by prevailing winds. South-facing slopes get much more warm sun than do north slopes, thus the tendency is towards less erosion on north slopes because the snow remains longer.

Under natural conditions soils are protected from the erosive action of wind and water by a cover of vegetation. The foliage breaks the force of the fall of raindrops which splash or trickle to the ground. The moisture is absorbed

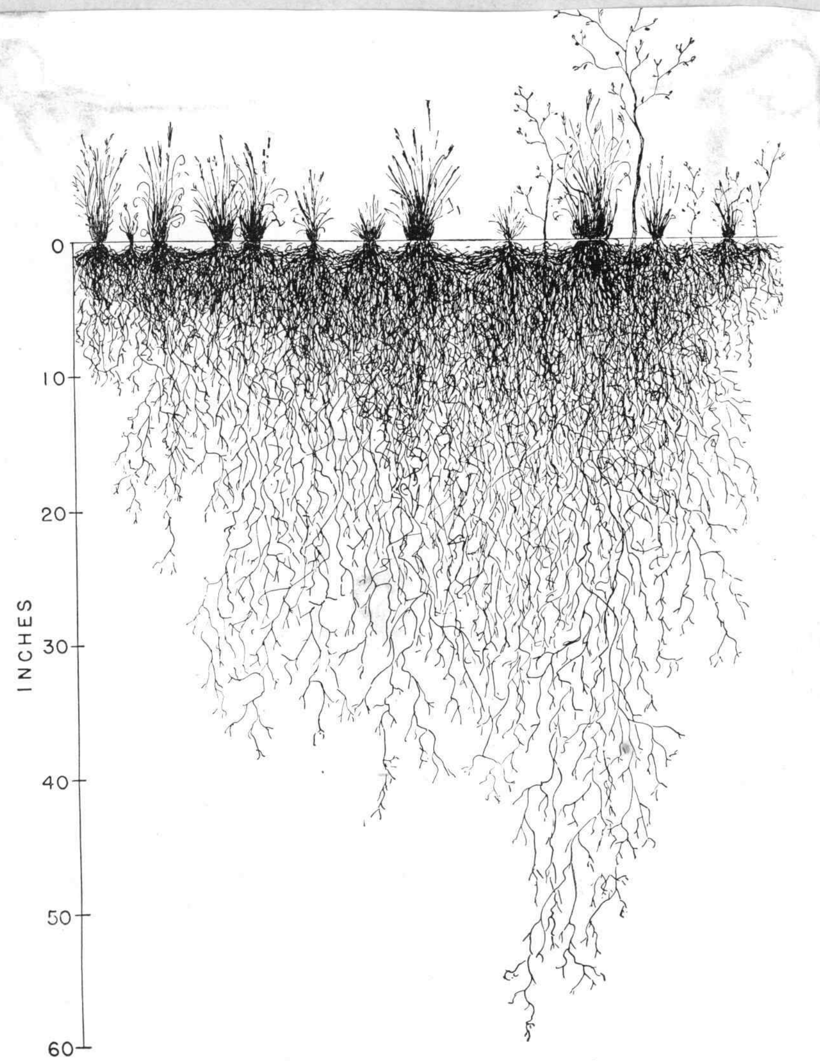


FIGURE 3.—*The soil, in virgin condition, is held in place by plant roots. The fibrous roots of bunchgrasses penetrate downward into the soil 40 to 60 inches. Plants 3 inches in diameter at the crown send out 250 to 400 fine fibrous roots. About a fourth of the roots are shown in this actual cross section.*

FIGURE 2.—*Only vestiges of the original bunchgrass cover survive; in fence corners, along roadsides and railroads, in cemeteries, and on ranges moderately grazed. This patch is growing within the city limits of Spokane.*

by a soil mat of vegetable material which absorbs several times its own weight in water. Water is then released slowly from this vegetable debris and seeps into the soil through crevices, tunnels, and passages opened by the action of roots, frosts, animal life and plant decay. During drenching rains it flows slowly away impeded by each stem, blade of grass or bit of residue from plants. Flowing slowly and quietly between each plant or part of plant, it carries only the very smallest particles in suspension. The soil itself, under thick vegetation, is held in place by the roots of plants. The fibrous root systems of many grasses penetrate downward into the soil 40 to 60 inches and spread outward several inches from the plant itself. Some roots die each year, hence adding organic matter to the soil and providing small passages for water to enter.

The Northwest must have lain under the protection of grass and forests for thousands of years while the top soil accumulated to a depth of two to fifteen inches. Soil forms very slowly under normal conditions. With adequate cover soil is formed from beneath at a faster rate than it erodes. A large number of factors have caused the reduction of vegetation covering the soil. It has been seriously depleted or entirely removed by cultivation, overgrazing, fire, and logging. As a result it is eroding many times faster today than new soil can be formed.

The rapidity with which soil is lost under cultivation in the Northwest is being measured in a series of plots at the Erosion Experiment Station at Pullman, Washington. The soil at the station is palouse silt loam. Each of a series of plots on a 30% slope is protected by steel guards from intake of water from above or from the sides. Run-off and soil are caught in steel tanks and measured. During the 4-year period from 1932-1935, soil losses were equivalent to about 8.52 tons an acre each year from the plot in winter wheat and summer fallow sequence, even though crop residues were carefully utilized for erosion control. On the plot bare of vegetation or crop residues, the soil loss was equivalent to about 27.82 tons an acre each year. The plot in grass, however, lost soil at the rate of only 1.45 tons an acre and most of this washed from the plot during the first year of the seeding before the grass was fairly established. At these rates of loss, 6 inches of top-soil will wash from the bare-soil plot in about 37 years; from the plot in winter wheat and summer-fallow with crop residues utilized, in approximately 117 years; and from the plot in grass, in about 700 years.

The plot in grass lost 3.71 per cent of the rainfall in run-off in the 4 years. The winter wheat and summer-fallow plot lost 9.3 per cent of the precipitation and the bare plot lost 25.03 per cent. The average annual rainfall at Pullman is about 21 inches.

RESULTS OF EROSION

Erosion results in the area of productive soil being diminished. As previously stated, several million acres of land have already been removed because of damage caused through soil erosion. Part or all of the soil profile is lost through erosion, whether it be wind or water. This is usually destroyed in a few years time, while it requires thousands of years for natural processes to form sufficient soil for crops to grow. When the top layer or "A" horizon is removed, the fertility is reduced and hence, crop yields deminished. The land-use practices must many times be changed as a result of erosion. Ordinarily this change is one to a less productive type of use. Since the condition of the soil has a direct bearing on the vegetal cover, it may be said that soil erosion affects the vegetal cover. Erosion reduces vegetal cover, and as vegetal cover holds the soil, it necessarily follows that erosion will both directly and indirectly result in more erosion. Experiments carried on at various erosion experiment stations show that yields on normal soil were from one and one-half to 33 times as large as on soils that had been artificially desurfaced. It is evident that erosion is a major factor in crop yields. Through the removal of top soil, available plant food materials are removed. Probably one of the most detrimental effects of erosion is the removal of organic matter, with resultant decrease in bacterial action and in water-holding capacity.

Erosion results in gullies and deepened arroyes which drain water out of the soil and thus make the water table lower. This in turn makes the soil less able to meet drought conditions.

Erosion of soil often results in great damage by the silting of reservoirs, which diminishes their holding capacity. Only reservoirs in entirely forested headwater areas are without some silting, and the reservoirs in which sufficient excess capacity has been provided for silt storage are the exception rather than the rule. Sooner or later, if steps are not taken to reduce erosion, most of our reservoirs will lose all utility. Present studies indicate that 38% of all reservoirs will have a useful life of from one to fifty years and only about 15%, more than 200 years. Many water power dams and reservoirs have already lost all usefulness or suffered a great reduction in effectiveness as a result of silting. There is a definite relationship between the two problems. Floods are concentrations of water in excess of stream-channel capacity, and since eroding land sheds water in greater volume and with greater velocity than non-eroding land, erosion adds to the danger and damage of floods. Furthermore, erosion results in the depositing of large quantities of silt in the smaller streams, thereby increasing the possibility of floods by decreasing the water-carrying capacity of the stream channels. This consequently results in diminished ability to cope with floods.

Erosion results in streams being muddied, channels clogged, and fish-life destroyed. This evolves itself into a problem of local sportsmen.

With erosion reducing vegetal cover and lowering the water table, another important result is the drying up of our streams and wells. This causes detrimental results from several standpoints: for example, hindering irrigation and causing a shortage of water for home and livestock requirements.

Erosion has resulted in a lower standard of living for those whose land has been effected, and if it is allowed to go on in the future as in the past, still lower standards will have to be accepted. In spite of the constant retirement of poor land, the shift to more fertile soils, and the adoption of improved techniques, average crop yields have not increased. The realization of this situation should focus increased attention on the difficult problem of soil conservation. A wise land use program must be the first step in conservation.

CONTROL MEASURES

It may be said that there are many things that can be done to control erosion. Each particular locality or problem will require a different solution according to variable conditions. We can do nothing to alter the climate, nothing to change the topography of our land, nothing to change the basic materials from which the soil is derived. We can, however, crop our land more skillfully, do something towards making our soils more permeable to rainfall, and hence reduce the volume of water that now flows into our rivers and finally to the ocean, carrying away soil.

Most owners can look over their land and recall past mistakes they have made. For example: this field should have been left in timber, or this one in pasture. Many things have caused these poor land use policies. Many of them are outside influences, such as transportation facilities, distance to market, real estate values; or particularly favorable markets for certain products may lead to land uses that have bad influences from erosion standpoints. Likewise, the necessity for current incomes, may force the owner to follow a detrimental type of land use against his own best judgement. Problems like these are very difficult to solve. Considering the short span of an individuals life, it is hard for him to look at the picture from a long time viewpoint when a greater immediate return can be made even though it deteriorates the land for future use. The most important initial step in the control of erosion is placing each parcel of land in the crop or rotation of crops to which it is best adapted. If the land now under cultivation and being given the advantage of soil conservation practices cannot be farmed on a sustaining basis, it should be converted to pasture or meadowland. Through the history of our agriculture runs a thread of erosion control effort. Many individual farmers were conscious of the problem and some tried remedies of their own. Gradually the Department of Agriculture and a few states began to study the process of soil washing and methods looking to its control or prevention. Concern grew with knowledge and culminated finally in the Soil Conservation program now being carried on by the Federal Government in cooperation with states, various public and private agencies and individual farmers. This part of the subject will be dealt with later in this report.

The following control measures that are briefly discussed are in no way arranged in order. Each of the present known methods are mentioned and would vary in order of use or importance under each set of conditions.

Crop Rotation:

Crop rotation on a given area is one means of control. A cropping system must provide a cover of growing vegetation or a vegetal litter as much as possible during the wet weather months; it must supply organic matter to the soil, and it must help to improve, or at least to maintain, the productive capacity of the soil. For example: growing a legume crop in rotation with winter and spring wheat has proven an effective means of decreasing erosion in the Northwest. Land that has grown alfalfa for several years does not erode as badly when plowed up as land farmed by the wheat fallow system. Past experiments have proven sweet clover to be the best crop to use in such rotations. It is capable of gathering nitrogen from the air during growth, and is turned back into the soil.

Contour Farming:

Our rectangular system of farm layout of land has enforced field arrangements that are inappropriate for a rolling countryside. It has been said that this system "tried to fit square farming to a round country". There are a number of obvious reasons why fields should have been laid out on the contour or across the slope. Plow furrows around the slope make a series of soil dams that hold water on the field, giving it more time to soak in rather than run off. Harrow teeth have smaller but more of these obstructions, and cultivator teeth leave similar grooves on the soil devoted to row crops during the growing season. Contour farming is a benefit not only from erosion standpoints but field work is much easier on man and teams because all machinery is drawn on the level. Present evidence indicates that much less power is required to farm on the contours than going up and down the slope.

Strip Cropping:

Strip cropping is a proven device for holding soil. To strip crop a field, one plants the crops in long and relatively narrow bands of approximately equal width across the slope on the contour. Soil-laden water flowing down from the clean-tilled strips, encounters the bands of thick vegetation in the next strip below. Since the rate of flow is checked by the stems of plants, soil is deposited. Since the water has been made practically clear by this action, it enters the soil more readily because there are fewer soil particles to seal the downward passage. If row crop strips are given the protection from the wash above and if there is another strip below ready to stop the soil and water movement, little damage will result, except from rains of near cloudburst proportion. Whether strips should be narrow or broad will depend on the degree and length of slope, water holding capacity of the soil, rainfall, and other factors. Present results show the most satisfactory widths to be from 50 to 125 feet.

Since overgrazing often results in erosion, regulated grazing is the only control measure justified and should be considered as a necessary part of any erosion-control plan on the range. Many things are to be considered in regulating grazing. Besides proper numbers we must have satisfactory distribution of stock. This may be accomplished by well-distributed watering places. Salting will help if salt troughs are properly located. In many places it is necessary to have stock riders on the area during the grazing season, and on some ranges, fences have proven to be a necessity.

Terracing:

Terracing is a very satisfactory means of erosion control.

The main function of a terrace is interception of water, which is either absorbed or conducted slowly from the field. The type of terrace used depends on the kind of soil in question, topography, and amount or intensity of rainfall. When properly applied, constructed, and maintained, terraces are valuable conservers of soil on practically all soil types. Even though they are costly to build, the advantages far outweigh the disadvantages. They require some maintenance and often a slightly higher cost of tilling the land, but on lands that require them, a higher yield is obtained over a period of years than on unterraced lands because of loss of the topsoil. Terracing is essentially a planned surface-drainage system for cultivated lands that cannot be adequately protected by other measures alone.

The terraces must intercept the surface run-off before it attains sufficient velocity to erode the soil to any extent. They must carry the surplus rainfall from the field at non-erosive velocities and deliver it to stabilized waterways. This is accomplished by placing a series of terraces across the slope, the first one being near enough to the top of the slope to intercept the run-off from above before it attains excessive erosive power or volume that will exceed the capacity of the terrace channel. Each succeeding terrace down the slope is located in similar manner. Hence the slope and the rate and velocity of run-off are the first factors to be considered in planning a terrace system. The steeper the slope, the shorter must be the distance between terraces. Terraces are classified into either of two types: the drainage type and the absorption type terrace. In some sections of the country both drainage and absorption are important objectives in terracing, but there are large sections where drainage is of primary importance and other areas where absorption is the principal requirement.

A somewhat modified form of a terrace system called the diversion terrace or diversion ditch is being used on land not well adapted to complete terracing. It is usually used in conjunction with strip cropping. The diversion ditch is placed at the bottom of a permanent sod strip. These channels are given more capacity than ordinary terraces.

Productive pastures protect the soil on a farm in two ways: (1) The heavy vegetation is ideal protection against erosion, and (2) The increased income made possible by the higher carrying capacity makes it less necessary to provide additional supplemental feed from cultivated lands. Pastures with proper management and stocking seldom are eroded to any great extent.

Trees, as mentioned previously, have demonstrated their usefulness as soil and water conservers. Except on already badly eroded areas, new plantings for erosion purposes are made on the contours. Rows are usually spaced about 6 feet apart and the same distance in the rows. Normally a mixture of both conifers and hardwoods is preferred. With this

IN THIS VIEW TOWARD THE EAST in Walla Walla County, Wash., note the striking differences between the pine-covered north-facing slopes and the poorly vegetated slopes facing south. In subhumid and semiarid lands aspect is of great importance and north-facing hillsides have a double advantage. They receive less sun and therefore do not suffer as greatly from the excessive heat in summer when vegetation on south-facing slopes becomes parched and dry. More moisture is available to plants on the northerly slopes because snow which falls there is not melted off so rapidly and the water has a better chance to soak into the soil.

13.—*Slopes planted to trees in demonstration districts are contour* *ved. The moisture caught by the furrows may mean, on drier sites, the* *nce between success and failure.*

mixture the resulting leaf litter and decaying roots increase the permeability and water-holding capacity of the soil. Mixed plantings tend to reduce disease and insect attack.

When reforestation is selected as the method to be used for controlling erosion, a salient fact to be remembered is that the resulting forest must be protected if it is to perform its work satisfactorily. The most common mistakes in this type of forest management are burning, over-grazing, and cutting unwisely.

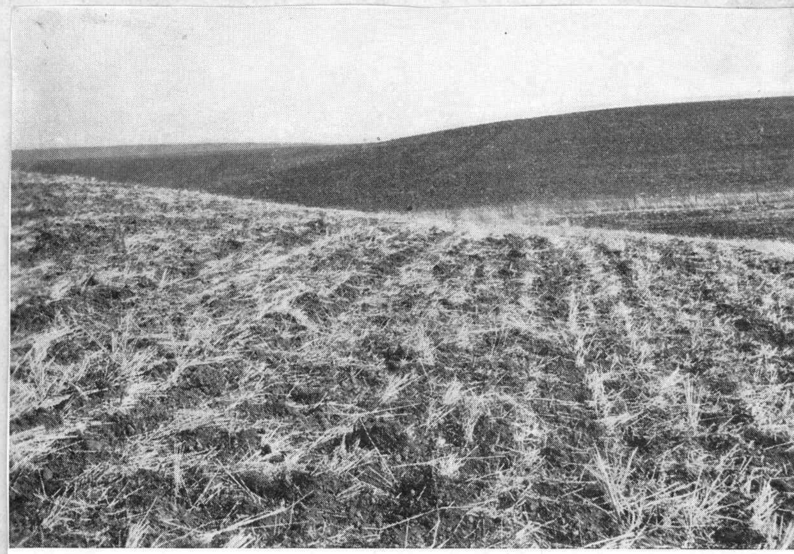
In 1936, the Soil Conservation Service alone planted over 114,000 acres for erosion control.

Land is being released from cultivation at the rate of one and one-half million acres per year. The Soil Conservation Service estimates that at least one-half of this should immediately be planted to trees.

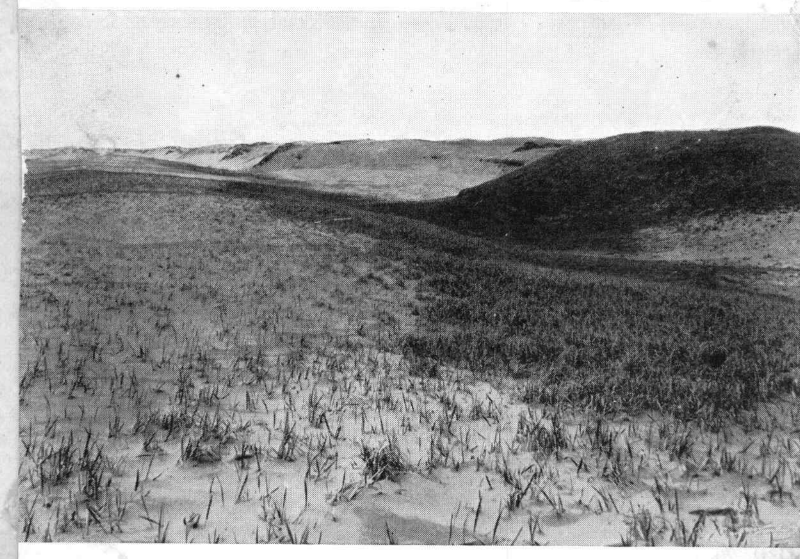
Many fields in the Northwest have depressions or draws which serve as paths for surplus water. If these paths are kept permanently in grass they provide an excellent means of conducting water safely off the field.

Crop Residues:

Mixing all or a part of the residue from the harvested crops with the surface soil is one practice that may be applied universally as a measure for erosion control through the Pacific Northwest wheat belt. Wheat straw when mixed in the surface soil offers considerable mechanical resistance to erosion. Straw, roots, and trash protruding above the



GURE 14.—*Mixing all or a part of the residue from the harvested crop with the surface soil is one practice that may be used universally as a measure for erosion control throughout the Pacific Northwest Wheat Belt.*



URE 28.—*As a first step to control drifting sands with vegetation, dune-stilling grasses are planted to the landward side of an artifically created fore dune.*

ground surface interfere with the lifting force of the wind and during wet periods reduce the water flow. A trashy surface helps to prevent puddling, and this reduces run-off and erosion.

Run-off must be expected from all agricultural land regardless of the control measures used. Provision must be made to conduct the excess water to a stabilized channel. Channels may be considered as minor or major. Minor channels are those that carry the water from a small area such as a terrace system. They may be protected from erosion by vegetation. Major channels are ones usually having a continuous flow of water. Most of the damage is done by bank cutting. In this case, it is usually necessary to construct jetties, wing dams or riprapping before vegetation can get a good start.

There are several minor ways of controlling erosion that require no explanation. Among them are: structural aids as fences and corralls, salling, road location, alinement of fences, and soil saving tillage.

THE SOIL CONSERVATION SERVICE

The Soil Conservation Service was set up in 1935 under the supervision of the United States Department of Agriculture. Under the law, states and individuals are cooperators. State legislatures must pass laws permitting organization of soil conservation districts before anything can be done. These laws are enabling acts which permit farmers to organize and form soil conservation districts which will have the status of governmental subdivisions of the state. There is nothing which makes it mandatory for a state to form soil conservation districts. This decision is decided upon entirely by the farmers themselves. If they wish to take advantage of the opportunity afforded them, they, themselves must take the initiative.

The powers granted a district are two-fold. After a district is formed and granted a certificate of organization from the state, farmers then have the authority (1)to engage in cooperative action to combat soil erosion and (2) to prevent local misuse of land by voting land-use regulations upon themselves.

According to the provisions of the laws the supervisors of a district are permitted, under their first set of powers, to adapt known erosion-control practices and measures to local needs, and to discover new means of controlling the particular kinds of erosion that are impoverishing the land in the district. They are empowered to carry out soil-conservation operations on the land, such as contour cultivation, strip cropping, terracing, and contour furrowing, or ridging of pastures. They may enter into contracts with farmers and give them financial and other assistance; they may buy lands for retirement from cultivation and for other erosion-control purposes; make loans and gifts to farmers and ranchers of equipment, machinery, seeds, etc.; take over and operate erosion-control projects; and recommend land-use plans for soil conservation.

The second set of powers granted district supervisors permits the administrative officers of a district the power to formulate land-use regulations for soil conservation. Such regulations must be approved by vote of the farmers on the area, before they can be put into effect. However, most districts find it unnecessary to adopt land-use laws. All farmers either cooperate, or those who do not are in no way hindering the measures being taken by their neighbors.

The administrative affairs of a district are directed by a board of three to five supervisors or directors. Usually one is appointed by the State Soil Conservation Committee and three are elected by the farmers whose district is concerned. Supervisors are always local residents, and serve for a period of 3 years. All supervisors and State Committeemen serve without pay. They may be reimbursed for actual expenses incurred in line of duty.

Sources of Funds for Districts:

"Although the soil conservation districts are governmental subdivisions of the State, like counties and municipalities, they do not have the power to levy taxes or to issue bonds. The soil-conservation work that the districts do will be financed in several ways. (1)The landowner and land operator who directly benefit from the application of erosion-control measures to their lands may bear a share of the expense, furnishing labor, materials, equipment, etc.

(2)Society, as represented by the State and Federal Governments, may bear a share. Appropriations may be made available to the districts out of funds in the State treasury and allocated by the State soil conservation committee, and services, funds, and properties may be contributed by the United States through the Department of Agriculture or other agencies.

<u>How a District Operates</u>:

First of all, you petition the State soil conservation committee, asking it to organize a district and to include your land within its boundaries. This petition must bear the signatures of a certain number of land occupiers or landowners, depending on your State law. After your petition is presented, the State committee holds a public hearing on the question. You talk over things with your neighbors and discuss the proposition at length at the hearing. The meeting adjourns.

The State committee, guided by the testimony given at the hearing, then decides whether a district is needed. The committee defines the boundaries of the district and gives notice of a referendum to be held to determine public sentiment. Since erosion problems have natural boundaries, the district would generally include all of a territory which should, for physical and economic reasons, be handled as a unit. The district may be a watershed. It very often should be. It may be a type-of-farming district. Or it may be an extent-of-erosion area. It may include all or parts of several counties, or if the problem is localized, the district may be smaller than a single county. But in any case the boundaries are determined by the State committee.

All land occupiers or landowners may vote in the referendum, according to the procedure and conditions laid down in your State law. If a majority vote against creation of a district, that ends the matters.

But let us assume that in your proposed district a large majority voted in favor. Then the State committee appoints two supervisors. The appointed supervisors file an application for a certificate of organization with the Secretary of State. When the certificate is issued, the district comes into being. An election is then held to elect three more supervisors.

The board of five supervisors then studies the problems of the district and formulates a program of erosion-control projects and decides on preventive measures. The committee may call upon the personnel of State and Federal agencies for help with this work.

The supervisors then proceed to carry the program to its effect, securing such technical assistance and buying such equipment as their funds permit and your program requires.

To carry our hypothetical case further, let us assume that the soil conservation program in your district has been under way some time. An overwhelming majority of the people have gone along with the program, expressing confidence in the soil conservation measures recommended. But there is a small minority which has not taken part in the program. It happens that soil wash or dust from the farms of this minority is damaging the land and the crops of other people. For example, a farm may lie on a hillside, and water, subsoil, and sand may be washing down to the bottoms, damaging other people's best land. Or your district is in a dust area, and soil blown from one man's field is ruining the crops on another man's field. Their neighbors and your supervisors have tried to induce the minority to cooperate and put soil conservation measures into effect, but they have failed to do so.

What, then, can be done? Under their first set of powers, which specifies that erosion-control work can be done on private lands only with the consent of the land occupier or landowner, your supervisors are helpless. So they turn to their second set of powers, which permits them, as elected representatives of the people of the district, to draw up soil conservation ordinances and submit them to a vote of the people. You vote "yes" or "no". If the vote is against regulations, that of course ends the matter. But let us say that the vote is close, with a small majority in favor of regulations. If your State law requires only a majority vote, the supervisors may or may not invoke the proposed regulations; they probably will not. But let us say that a large majority favored the regulations.

Then, doubtless, your supervisors will declare them in force. Should the "hold-outs" still refuse to employ the conservation measures called for by the regulations, your supervisors may petition the local court to order the land occupier to observe the soil-conservation ordinances. The court order, if issued, may provide that if a land occupier fails to employ the conservation measures the regulations require, then your supervisors may go on his lands, do the necessary work, and collect the costs from the land occupier; or, as in a few States, the court could fine him for committing a misdemeanor.

It may be readily seen, however, that there is a chance here for grave injustice. The farmer who refuses to carry out the provisions of the regulations may be right in his stand, and your supervisors wrong in determining whether a particular regulation is reasonable as applied to a certain piece of land. What then? The laws provide for this eventuality by requiring that a board of adjustment be established in districts which adopt land-use regulations. This board is athorized to permit exceptions and variances from land-use regulations in cases where the application of the strict letter of the law would result in 'great practical difficulties or unnecessary hardship'. The decisions of the board of adjustment are, of course, subject to review in the local courts.

It is possible that there will be districts in which the procedures just outlined will prove impractical. The laws therefore provide that after a district has existed for a certain number of years (5 years in most of the State laws), farmers may petition to have the district dissolved. The question of dissolution is then submitted to a referendum. If a sufficient number of the people affected vote to dissolve the district, its affairs are brought to an end."(1)

BIBLIOGRAPHY

1. U.S.D.A. Miscellaneous Publication No. 293

2. Farmer's Bulletin #1809
   "Soil Defense In The South"

3. Michigan Extension Bulletin #203
   "Conserving Soil by Better Land Use Practices"

4. "Forests and Water in the Light of Scientific Investigation"
   Raphael Zon

5. Miscellaneous Publication #248

6. Farmer's Bulletin #1760
   "The Use of Blue Grass Sod in the Control of Soil Erosion"

7. Farmer's Bulletin 1758
   "Cover Crops for Soil Conservation"

8. "Little Waters"
   Soil Conservation Service - 1935

9. Farmer's Bulletin 1776
   "Stripcropping for Soil Conservation"

10. U.S.D.A. Leaflet #164
    "Erosion on Roads and Adjacent Lands"

11. U.S.D.A. Leaflet #163
    "Legumes in Soil Conservation Practices"

12. Farmer's Bulletin #1812
    "Native and adapted grasses for Conservation in the Western States"

13. Farmer's Bulletin 1789
    "Terracing for Soil and Water Conservation"

14. Miscellaneous Publication #286
    "What is Soil Erosion?"

15. Farmer's Bulletin 1773
    "Soil and Water Conservation in the Pacific Northwest"

16. Farmer's Bulletin 1823
    "Reseeding Range Lands of the Intermountain Region"

17. Farmer's Bulletin #1810
"Soil Defense in the Northeast"

18. G 98
"Western Grass"
U.S.D.A.

19. U.S.D.A Year Book - 1938
"Soils and Men"

20. "Range and Pasture Management"
F. Sampson

21. "Erosion and Its Control"
Ayres

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