

Know Your Soil

Oklahoma's Basic Resource

By

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IMPORTANCE OF SOIL

Our country owes her position as a great nation to her soil and its products. Our happiness, independence, safety, and welfare depend upon our soil. Our victories in two world wars within a 30 year period were due, to a large extent, to the food and fiber produced from our farms and ranches.

Soil is a basic resource. Land has been and will always be a most important item in financial and national security.

Soils differ in productive ability. Fields and farms vary due to different soils, topography, erosion, and past management. It is advisable for people of all professions to study land characteristics in order to know the methods of caring for the land.

SOIL COMPOSITION AND ITS USE

Soil is the upper few feet of the earth's crust. It is composed of residue of weathered rocks, minerals and decaying organic matter. The rock material forms the bulk of the soil. As plants and animals live and die, they return to the earth, thus becoming a part of the soil. Nature requires hundreds of years to produce an inch of top soil.

Soil also contains organic matter, air and water. Organic matter in the soil is derived from the residues of plants, small animals and insects. Soil bacteria live on the organic matter and release the necessary food for plant growth. The organic matter creates acids that work on the mineral elements in the soil and change them into forms that the growing plants can use.

Water and air are held within the spaces between the grains of soil and around each grain. Both move through the soil and carry traces of every element present. A high percent of plant composition is manufactured from light, air and water. Therefore, it is necessary to have a soil that will take air and water freely.

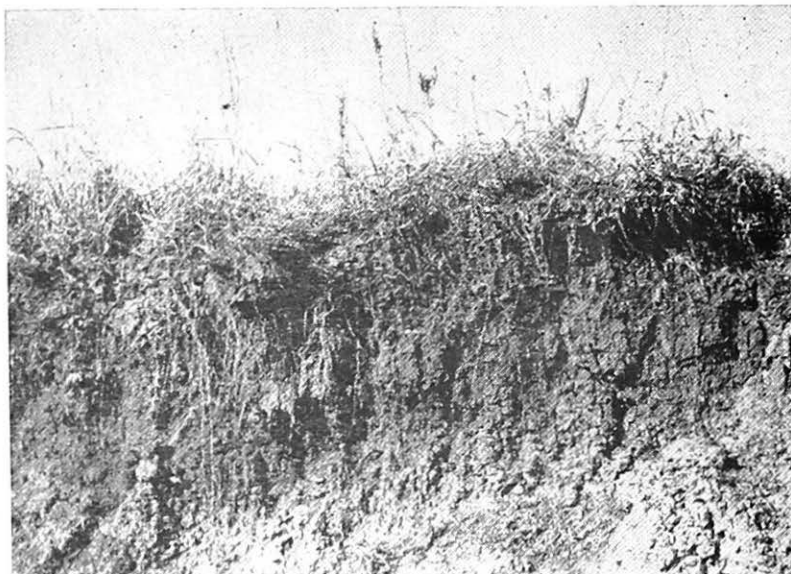


FIGURE 1. — Roots help bind soil together. After roots decay they form organic matter and replenish the soil.

SOIL CHARACTERISTICS

Different soils may be described, by way of comparison, similar to different conditions of livestock. We speak of a fat hog, a canner cow, a feeder steer, and use many other terms in describing animals in the livestock industry. Soil also has different characteristics. They mean just as much to a farmer or rancher in production of crops, grasses or fruits as the different kinds of livestock or dairy cattle mean to them. However, there is a lack of common terminology with regard to soils description. Once we have learned to know the proper terms with regard to soil characteristics, it will be easy to describe land as it would be for one rancher to describe a beef animal, such as a canner cow, to another rancher. Cattlemen know that white face calves have their color characteristics due to the characteristics inherited from their parents (sire and dam). Likewise, soils are different because of the parent material from which they were derived.

Parent Material — Parent material is the substance from which soils are developed, such as sandstone, shale, limestone, gypsum, or granite. However, some soils have silted into valleys and along stream beds. These soils were developed on the uplands and were transported to lower positions. Sometimes only one type of parent

material is found on a farm. However, there may be a combination of parent materials in one locality. It is important to note that the type of soil is due to the parent material from which it was developed. Sandy land is generally developed from sandstone. Red land is developed from red sandstone or red shale. Black lands are developed from limestone.

Top Soil — The top soil is the crust of the earth found on the surface. The depth varies from a few inches to several feet. Generally speaking, the average top soils in Oklahoma are approximately 4 to 9 inches in depth. It contains most of the organic matter and available mineral supply. Due to the higher organic matter content, the top soil has a richer and darker color. Top soil is the zone in which most of the feeding takes place by the plant roots. A deep top soil provides capacity for water and minerals and, in addition, space for plant root development.

Subsoil — The subsoil lies beneath the top soil. Subsoil is the storage place for potential plant food such as minerals which contain phosphorus, calcium, potassium, and other elements. It is also a reservoir for soil moisture and root development. The depth of subsoil varies from nothing to several feet. The subsoil lacks the organic matter found in the top soil. It fails to have that "lively," rich color. It contains little humus and is usually low in available plant food. When the top soil has eroded all that remains is subsoil which is usually low in fertility.

Depth of Soil — The depth of soil means the total of both the surface soil and the subsoil. The depth of soil is determined by the depth of soil layers readily penetrated by plant roots or some particular layer, such as dense clay, subsoil or rock, that would restrict root penetration. In general it means the total of the virgin surface soil and subsoil down to parent material. The depth of soil may be compared



FIGURE 2. — The upper crust of the earth is the top soil. It usually has a "richer" color. This is the area from which the plant's roots take in a large amount of moisture and plant food. In this photograph the darker portion is the 7 inches of top soil. The subsoil lies underneath the top soil.



FIGURE 3. — This is a soil profile. The first foot is surface soil or top soil. The second and third feet are the subsoil. From the third foot down is parent material which is sandstone and shale.

to the depth of body of a beef animal. In selecting a beef animal, the depth of body is considered because it is a factor in producing more beef. Depth of soil might also be compared with the barrel of a milk cow. Dairymen select dairy cows with a large barrel in order that they will have an enormous capacity for food and water. This makes it possible for the animal to manufacture a larger amount of milk. Fields or areas which have a deep soil have a capacity for more plant food, a larger area for root penetration and development, and more capacity for moisture. The three important variations of soil depth are as follows:

Deep Soils — Deep soils have surface and subsoil layers more than 20 inches deep that can be readily penetrated by plant roots. They are sufficiently deep to provide good moisture and mineral storage during normal seasons.

Shallow Soils — Shallow soils have surface and subsoils less than 20 inches deep, but more than 10 inches deep. They have less storage space for moisture and minerals and are apt to be droughty and are of lower productivity than the deep soils.

Very Shallow Soils — These are the soils that have less than 10 inches of soil over rock or dense, heavy clays. They are not suited for cultivated crops.

Knowing the depth of soils helps a farmer in selecting the correct type of crops adapted to the proper land use. For example, if it is determined that a certain field has a very shallow soil, then it is not practical to plant alfalfa or other deep-rooted crops on that land. It would be wise to use this land for pasture grasses, some clovers, and if the subsoil is easy to penetrate, it could be used for trees.

Slope of Land — Slope is a factor which should be given consideration in selecting land for cultivation. Every farmer that has

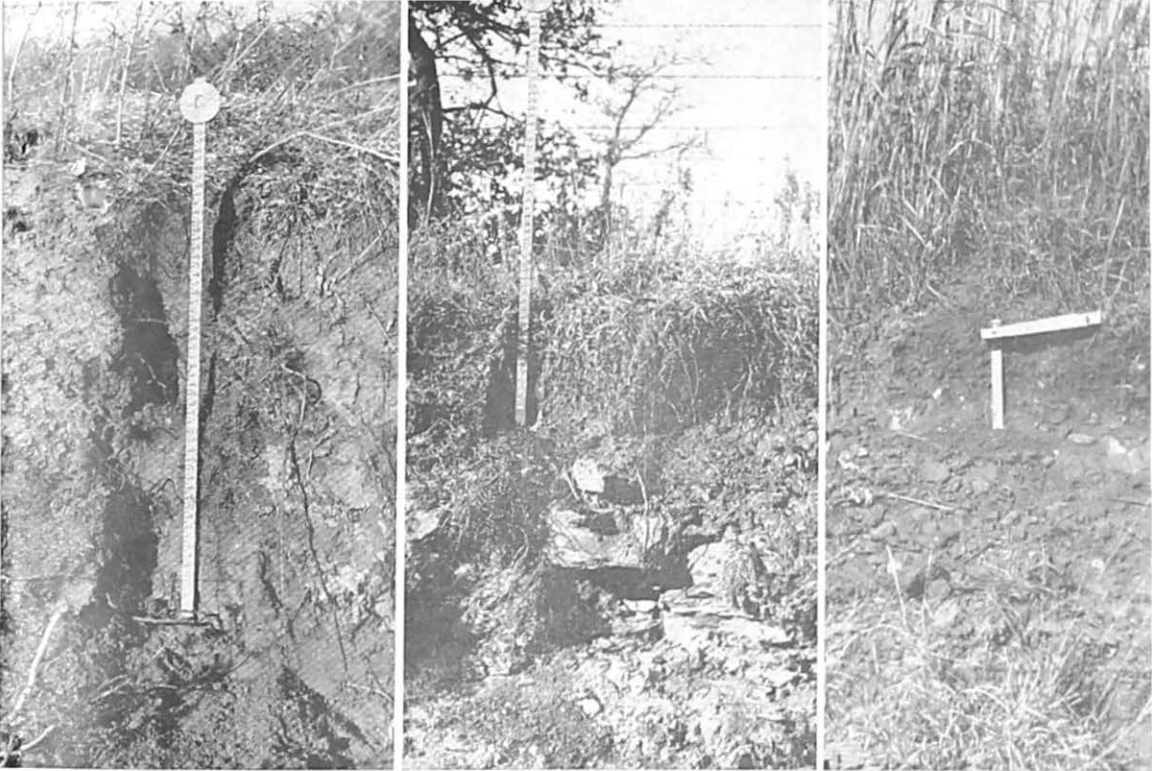


FIGURE 4. — (left) This is a deep soil. It was photographed along a creek bottom. This has a total depth of better than five feet of top soil and subsoil combined.

FIGURE 5. — (center) A photograph of shallow soil. A profile showing an example of shallow soil. The total of both the top soil and the subsoil is between 10 and 20 inches to the parent material which is sandstone in this particular case.

FIGURE 6. — (right) Very shallow soil. The total of the top soil and the subsoil is 10 inches or less down to the parent material which is rock. The carpenter's rule indicates that the top soil is approximately six inches in depth. This is a profile of virgin grass land. Some soils are shallow when formed while others are deep when formed.

sloping fields has a problem of erosion because the water runs off. The longer the slope and the greater the speed of water runoff, the more erosion will occur. Hard, beating rains that fall in a short length of time bring about serious erosion. When the speed of water, for example, is doubled as it runs down a slope, the cutting capacity is tripled. Nearly level land is not affected as seriously by water erosion as steep land. On sloping land it is necessary to apply a mechanical or vegetative conservation practice which will resist the water runoff.

The slope of land is considered as the number of feet of fall in each 100 feet. There are 5 different degrees of slope which are considered with regard to land. They are as follows:

Nearly Level — Less than 1 foot fall in each 100 feet.

Gently sloping — One to 3 feet fall in each 100 feet.

Rolling — Three to 5 feet fall in each 100 feet.



FIGURE 7. — Slope is a factor with regard to water erosion. Notice how the rain has washed away the top soil and left little rills on the surface of the soil.

Steep — Five to 8 feet fall in each 100 feet.

Very Steep — Eight feet fall or more in each 100 feet.

Erosion — Erosion is the loss of soil by water and wind. The following are definitions of water erosion terms:

None — No sign of soil removal.

Slight — Less than 25 per cent of surface soil removed with no gullies.

Moderate — 25 to 75 per cent of surface soil removed with or without gullies, but not including infrequent uncrossable gullies.

Severe — 75 per cent or more of surface soil removed with occasional uncrossable gullies.

Very Severe — 75 per cent or more of surface soil removed with frequent uncrossable gullies.

Sloping fields which have been in cultivation a long time usually show signs of water erosion. This will be noticed in the form of gullies. Some fields erode but gullies are not formed. Where gullies are not formed on sloping fields, the erosion is usually termed as "sheet erosion." This means the loss of a thin, uniform layer of soil all over a field. This might be explained by comparison with a notebook. Suppose you tear out 1, 2, or 3 sheets of a notebook. It is hardly noticeable because of the thinness of each leaf. If hundreds of sheets are withdrawn from the notebook, then it will be noticeable and the thickness of the notebook will be reduced. Each hard rain on a sloping, bare field brings about a loss of soil by erosion. It may be only a thin layer. During a long period of cultivation, many inches of top soil may be lost.

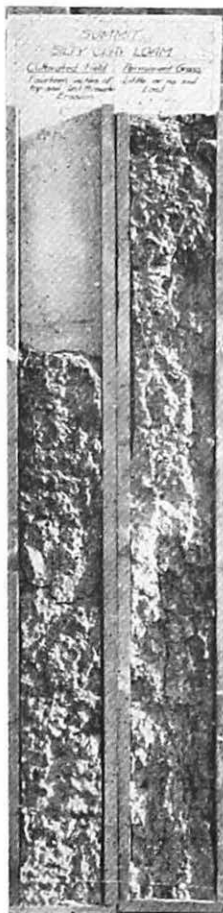


FIGURE 8. — Here are two soil profiles taken from adjoining fields, one under cultivation and one is permanent grass. The one on the left has lost 14 inches of top soil due to sheet erosion. It has been cultivated with the slope. The profile on the right has remained in permanent grass. There is little or no soil erosion.

The signs of wind erosion are different from those of water erosion. Sandy fields are easily disturbed by winds. The wind moves the soil particles and often sand drifts are observed along the fence row. Wind erosion may be described by the following terms:

None — No signs of soil removal or accumulation by wind erosion.

Slight — Less than 6 inches of accumulation, either on the level or in hummocks or removal of less than 25% of top soil.

Moderate — Accumulation on the level of 6 to 36 inches or removal of 25 to 75 percent of top soil.

Severe — Accumulation of small dunes, 36 to 72 inches in height or removal of all of the top soil and 25% of the subsoil.

Very Severe — Accumulation of large sand dunes 72 inches or more in height or the removal of all of the top soil and 25 to 75% or more of the subsoil.

Land which is bare of vegetation is very susceptible to wind erosion. Nature has provided a means of checking wind erosion by the growth of vegetation. Generally, there are two methods that are used to check wind erosion. One is by the use of vegetation to cover the land and to offer resistance to the force of wind. This is a permanent method. The other is by stirring the

land by plowing or making furrows crosswise with the direction of the wind. This is only an emergency measure which offers temporary control.

FIGURE 9. — (left) Soil of sandy texture is subject to wind erosion.

FIGURE 10. — (right) This is a view from an airplane. The field below has been ruined by water erosion. The many gullies seem to produce a "bleeding effect" upon the land. The soil has been seriously depleted due to the steepness of the land which was in cultivation.



Soil Structure — The structure of the soil is important. Soil may be in single grains, or several grains may stick together into groups called granules, like granulated sugar. Granular soil is “mellow” and has good “tilth.” The grains of soil are grouped together in granules principally by humus.

A granular soil takes in water faster, holds more of it, and contains more organic matter than a single-grained soil. It also farms easier. We should farm so as to maintain the granular structure of the soil. This can be done by continually adding organic matter to the land. Growing legumes is one of the most practical ways to add organic matter.

The structure of soil should be considered because it determines the rate at which soil takes up air and water. It should also be considered before irrigation systems are established.

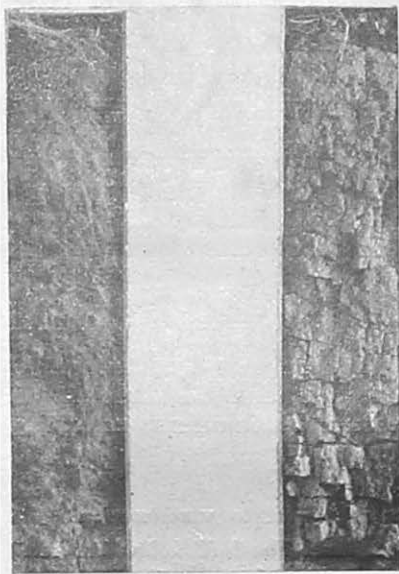


FIGURE 11. — Here are two soil profiles. The one on the left is virgin soil which was shielded with thousands of vegetative and grass roots. It contains a lot of organic matter. Compare this with the profile on the right which has been cultivated. It contains less organic matter. There are fewer roots of the native grass found in this profile.

Texture of Soil — Texture of soil is determined by the percentage of sand, silt, and clays that make up the soil.

- a. **Sand** is the gritty material which is felt when soil is rubbed by the finger.
- b. **Silt** is the floury material which is felt when soil is rubbed by the finger.
- c. **Clay** is the sticky material which is felt when soil is rubbed by the finger.
- d. **Loam** is a combination mixture of sand, silt, and clay.

Note: Soil must be moist to determine soil texture by the sense of touch.

Fine texture — These are the clay soils.

Medium texture — These are the silty or loamy soils.

Coarse texture — These are the very sandy soils.

The word “texture” is more commonly used in describing top soil. Clay soils will hold more water than sandy soils. That is because the particles are smaller. In clay soils there is a larger surface area to absorb the water because it has a larger number of small particles than the sandy soil. This can be

clarified by comparing two gallon buckets filled, one with golf balls and the other with buckshot. You can put more buckshot in a bucket than golf balls. There is more surface space on the buckshot for the total number in the bucket. This bucket filled with buckshot would hold more water than the bucket filled with golf balls. This illustrates why a fine textured soil, like clay, will hold more water than a coarse textured soil, like sand.

A study of the texture of soil is important because of its relationship to the rate of water absorption. For example, many sandy fields (coarse textured soils) will wet down one foot from one inch of rain while a clay top soil (fine textured soil) may only wet down four to six inches from one inch of rain. An inch of rain will wet the sandy land down deeper than it will a clay soil and there is less possibility for rapid evaporation. The sand does not dry as quickly only because it is wet down deeper by the same amount of rain. Hot, dry weather will cause the clay soil to lose its moisture content and form cracks whereas the sand does not crack. The loamy soil (medium texture) is a mixture of both clay and sand and therefore is not an extreme in either direction, with regard to moisture absorption. Loamy soil is the choice texture of soil. It has neither too much sand nor too much clay, but is an ideal combination for moisture conditions and tillage operations.

Permeability of Subsoil — Permeability is the ability of soil to take up water and air and to give up water and air to plants. The following are definitions of terms regarding permeability:

Very Slowly Permeable—These soils have dense, heavy clay or clay pan subsoils.

Slowly Permeable—These soils have crumbly, clay subsoils.

Permeable—These soils have highly granular, clay loam subsoils.

Freely Permeable—These soils have sandy subsoils.

It is beneficial to learn about the permeability of subsoil because this has a great deal to do with water penetration and crop production. Droughthy land cracks in dry weather because the land has clay texture top soil and a very slowly or slowly permeable subsoil.

In order to determine the permeability of soil, a test must be made when the soil is moist. By rubbing the subsoil between the thumb and forefinger, a determination of the permeability can be made. If the soil presses out in a thin leaf shape, it is a good indication of very slowly permeable subsoil. A lesser degree of this heavy clay or clay pan subsoil, which would show a crumbly effect, would indicate slowly permeable subsoil. When subsoils are permeable, they have a granular effect and have a sense of feeling like crumbled cornbread. Freely permeable subsoil is composed of sand or gravel.

This is an extreme condition of open, porous subsoil which allows rainfall and fertilizer to pass through the soil too rapidly. Very slowly permeable subsoil is an extreme in the opposite direction and is an undesirable condition for crop production because of its denseness and tightness which hinders plant root development.

The above information can be used from a practical standpoint in recognizing good land of high productivity. Land which has permeable subsoil is valuable. This is the type of soil which is ideal for irrigation purposes due to its water absorption qualities. Slowly and very slowly permeable subsoils are choice for use in an earthen dam for the construction of ponds and lakes. Knowledge of all these factors will be helpful in selecting the type of crops to grow, conservation measures needed, and proper use of land.

Soil Drainage — There are two kinds of drainage, surface and internal. Surface drainage has reference to the drainage from the top soil. Land having some slope will help the surface drainage. Internal drainage is different. This has reference to the drainage of the soil underneath the surface. The permeability of the subsoil determines the different degree of internal drainage whether it be good or poor. The permeability of subsoil has been discussed in preceding portions of this circular and it has been explained how the different degrees of permeability would affect the penetration of the soil by water. The color of subsoil in many cases is some help in determining the drainage conditions internally, for example, yellow-like soils or a variation from yellowish red to reddish or brownish yellow usually indicates good drainage of the land. Gray soils usually indicate poor drainage and air ventilation and are usually wet. Brown soils show an indication of plenty of air ventilation, more organic matter, and better drainage. Mottled soils are not so favorable for drainage and aeration.

LAND CAPABILITY CLASSES

The land capability classes indicate two things about soil. First, the land is classified with regard to its productive capacity. Second, the amount of conservation treatment needed on the land to check erosion is determined. These two factors, when combined, give a good indication of capability of soil and the farming practices which should be applied. The land capability classes are termed Class I through Class VIII. In determining land classes, the following things must be considered: type of soil, degree of slope and degree of erosion. The amount of rainfall, the growing season, and the climatic conditions are also considered in determining land classes.

Misuse of land costs money. It makes the soil susceptible to erosion by water or wind. The loss is immediate and permanent, although sometimes so gradual that it is scarcely noticed. If the misuse is failure to grow crops on land suitable for cultivation, the farmer, at best, obtains less than the maximum return for his labor, seed and fertilizer. Such waste can be prevented by farming according to land capability, using practices that have been tested and proved by practical farmers and by agricultural experiment stations.

Land Suitable for Cultivation

Class I Land

This is land that is suitable for cultivation over a long period of time. The lands included in this class are well drained, deep, productive bottomlands and uplands—soils which are nearly level; and not subject to more than slight erosion regardless of treatment; free from overflows that interfere with planting, growing, or harvesting of crops. The following are some of the practices that are needed to maintain production: planting legumes and use of fertilizers and lime where needed.

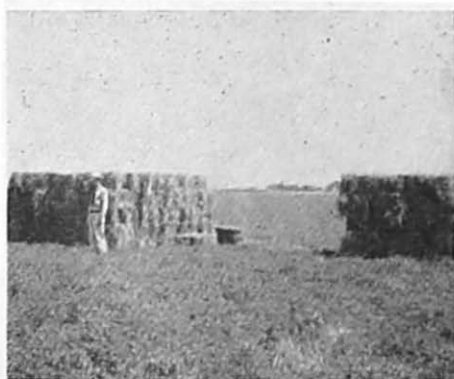
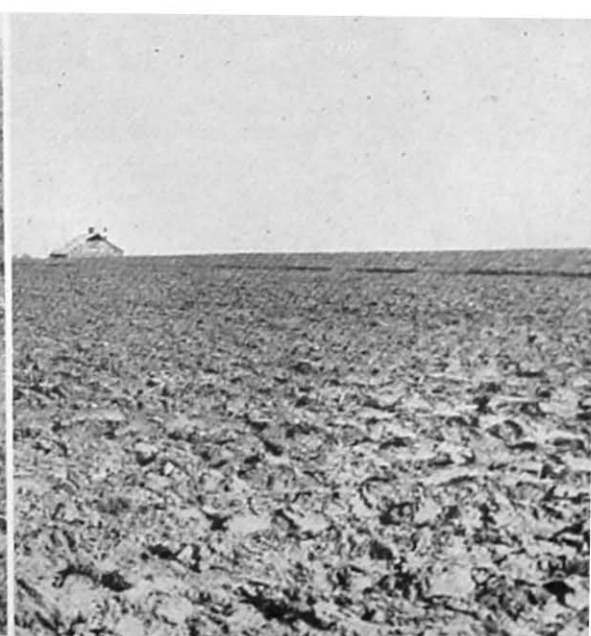


FIGURE 12. — This is a rich alfalfa field of Class I land. It is flat, un-eroded, productive land which is suitable for cultivation.

FIGURE 13. — (left) This field needs surface drainage. It is Class II bottomland which is fairly flat or slightly eroded, productive land and is suitable for cultivation with moderate conservation measures.

FIGURE 14. — (right) Class II upland. It is fairly flat or slightly eroded, productive land which is suitable for cultivation with moderate conservation measures.



Class II Land

This is land that is suitable for cultivation over a long period of time, however it has some hazards and limitations such as gentle slopes, slight erosion, or it may be moderately wet. The following are some of the practices which may be needed to overcome the hazards and limitations of this type of land; rotations including legumes, surface drainage, contour sloping lands, diversions of overhead water, applying fertilizers and lime where needed.

Class III Land

This is moderately good land and can be used safely for cultivated crops but it has severe limitations in use. The following treatments may be needed: terracing and contouring, strip cropping, crop residue management. It also needs intensive crop rotations, including legumes, diversion of overhead water, application of fertilizers and lime where needed. If the land is permanently wet, it will need drainage for crop production.

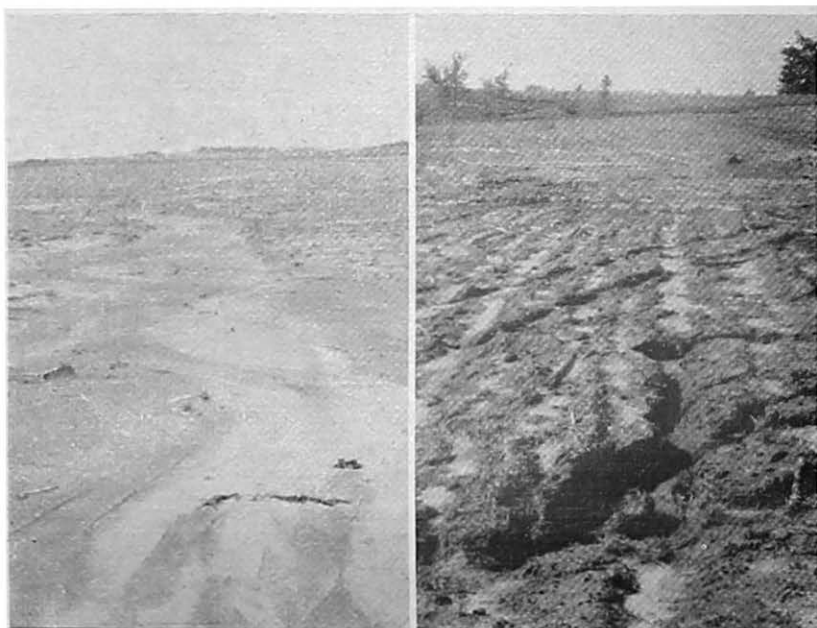


FIGURE 15. — (left) Class III land. It is usually sloping or moderately eroded, fairly productive land and is suitable for cultivation with intensive practices.

FIGURE 16. — (right) Class IV land. It is usually steep or gullied, something shallow, moderately productive land and is suitable for occasional cultivation with intensive conservation treatment.

Land Suitable for Occasional Cultivation

Class IV Land

Class IV land is fairly good land, but it has severe limitations and restrictions in use. As a rule, it is best used for pasture or hay. This land should

not be cultivated more than one year in a five year rotation. When cultivated, it should be sown to a close grown crop. If not utilized for permanent vegetation it will require practices such as terracing, contour farming, conserving all organic residues, application of fertilizer and lime where needed.

Land Not Suitable for Cultivation but Suitable for Useful Permanent Vegetation

Class V Land

This is land that is suitable for permanent vegetation and is not more than slightly susceptible to deterioration, and therefore, requires no special practices or restrictions in use. This includes frequently flooded, poorly drained, or level, stony land. The treatment needed is good grazing management, if utilized for pasture, and good timber management if used for woodland.



FIGURE 17. — This is Class V land. It is flat, overflow, poorly drained or stony land and is suitable for productive pasture meadow or woodland without special conservation treatment.



Class VI Land

This is land that is suitable for permanent vegetation and is subject to moderate deterioration. It is not suitable for cultivation. The restrictions commonly needed on range land are deferred and rotation grazing (grazing to the carrying capacity), protection from fire, and distribution of watering and salting facilities.

FIGURE 18. — This is Class VI land. It is sloping, shallow, suitable for productive pasture, meadow, or woodland with moderate conservation treatment.

Class VII Land

This is land that is suitable for permanent vegetation and is subject to severe deterioration. It is not suitable for cultivation. The following are some of the practices needed: severe restrictions in grazing must be practiced due to low productive capacity of the soil. If the land has been in cultivation, soil improvement practices such as pre-treatment of legumes and cover crops will be needed; fertilizer and lime will also be desirable in the establishment of a permanent cover.



FIGURE 19. — This is Class VII land. It is steep, eroded, rough or very shallow land and is suitable for moderately productive pasture or woodland with intensive treatment.

Land Not Suitable for Cultivation, Grazing or Woodland

Class VIII Land

This is land that is not suitable for cultivation and not suitable for useful permanent vegetation or woodland. It is land of little or no economic value except for wildlife purposes. It needs protection from fire and restriction from grazing.



FIGURE 20. — This is Class VIII land. It is extremely steep, rough, broken, permanently swampy or barren land and is suitable for no agricultural use other than wildlife.

FIGURE 21. — This is another photograph of Class VIII land. This is a group of large sand dunes.

