Range Lands

Rangelands can be forests, deserts, or grasslands.

Rangeland management is the manipulation of rangelands to gain the best combination of goods and services for society, in a sustainable fashion. The “goods and services” produced by rangelands include animal forage, open spaces, recreation areas, fish and wildlife habitats, and watersheds (areas that trap precipitation for productive use). While forage is still the main resource obtained from rangelands worldwide, more affluent societies with food surpluses (such as the United States) are increasing the use of rangelands for recreation and fish and wildlife habitat, rather than just livestock forage.

Climate

1. The Pacific climate is seen along the coast of the western United States. In this area, the summers are dry and the winters are wet. As you move inland from the coast, the amount of precipitation decreases dramatically. Vegetation along the West Coast is dominated by dense conifer forests, while grasslands are much more common inland.
2. The Great Basin climate is found in the Great Basin area of the United States (Nevada, Utah, and surrounding areas). This area is known for hot, dry summers and cold winters. Not much precipitation falls in this region, so shrubs like salt bush and trees like pinyon-juniper are dominant because they have long roots that can reach moisture deep in the soil.
3. The southwestern climate is seen in the southwestern United States. This region has a precipitation pattern in which the largest amounts of water are available in the winter and midsummer. The plants in this region are drought-tolerant.
4. The plains climate is seen in the flat, Midwestern plains of the United States. This area receives most of its precipitation in the late spring and summer, and gets little precipitation during the winter. Most precipitation is in the form of regular, light-intensity rainstorms during the summer. Grasslands are dominant.
5. The eastern climate is observed along the eastern coast of the United States. This area receives a fairly regular amount of precipitation during every month of the year. This pattern of precipitation is favorable to deciduous forests.
6. The Florida climate is seen in the state of Florida. This area receives a huge amount of rain during the summer. This large amount of precipitation combined with warm temperatures makes for favorable growing conditions year-round, and Florida is the most productive of all regions for forage plants.

Topography: The degree of slope describes the steepness of a land's slope, and is a very important factor in range management. As the degree of slope increases, vegetation productivity decreases, because more water runs off steep slopes and can't be used by the plants. Also, as slope increases, grazing animals (like cattle) will use an area less, but more mobile goats and sheep may still be able to forage.

Drainage: In flat areas with high rainfall and poor drainage, some soils may be too wet to plant most crops throughout the year; some may be too wet early in the year, but plantable later in the spring; and others can be planted at any time. In arid climates, drainage is vitally important to selecting and managing soils for irrigation and for reclaiming saline and alkaline soils.Drainage is expressed in relation to the way water moves through or accumulates in the soil under natural conditions. A rangeland's drainage can be modified by drain tiles or ditches, or by introducing water for irrigation.

Soil

While fractured and weathered rock is the principal component of most soils, plant and animal remains, and many living organisms are also present in all natural soils. These living organisms include fungi, bacteria, grubs, worms, rodents, and, most importantly, plant roots. The proper function of all these living constituents is essential for the productivity of the soil. Soil properties are systematically described in the following order for each horizon (layer) in the soil:

- Color
- Texture
- Consistency
- Reaction
- Temperature

In the Munsell system, soil colors are described by three characteristics: hue, value, and chroma. The term hue refers to the dominant spectral color of the soil. The Munsell book provides seven hues: 10R, 2.5YR, 5YR, 7.5YR, 10YR, 2.5Y, and 5Y. In these abbreviations, the letter Y stands for yellow, and the letter R stands for red. The number associated with the hue refers to the pureness of the hue, and these values range from 1 to 10.

The term value refers to the relative lightness or darkness of the soil color. A soil sample that's given a value between 0 and 5 is a darker color, and a value between 6 and 10 is a lighter color.

The term chroma refers to the purity of the soil color. This characteristic is labeled with the numbers 0 through 8. A soil sample with a chroma of 0 is considered to be neutral in color, while soil with a chroma of 8 has the purest color.

Soil

A soil that contains less than 27 percent clay and approximately equal parts of silt and sand is called loam. A soil that has between 27 percent and 40 percent clay is called clay loam, and one with more than 40 percent clay is called clay. A loam that’s composed mostly of sand is called sandy loam, and one that’s composed mostly of silt is called silt loam. In nature, very few soils consist of more than 80 percent sand, silt, or clay.

There are six degrees of consistency that are recognized when soil is dry. These six degrees are

1. Loose. The soil is incoherent and without resistance to pressure.
2. Soft. The soil is weakly coherent, but easily crushed to powder or single grain.
3. Slightly hard. The soil is easily broken between the thumb and the forefinger.
4. Hard. The soil can be broken in the hand, but is difficult to break between the thumb and forefinger.
5. Very hard. The soil can be broken in the hands with difficulty.
6. Extremely hard. The soil can’t be broken in the hands.

There are four degrees of stickiness that are recognized when soil is wet. These are

1. Non-sticky. The soil has no tendency to adhere after it’s crushed between the thumb and forefinger.
2. Slightly sticky. The soil adheres to both thumb and forefinger, but comes off rather cleanly and doesn’t stick.
3. Sticky. The soil adheres to both thumb and forefinger and tends to stick somewhat before pulling apart.
4. Very sticky. The soil adheres very strongly to both thumb and forefinger and stretches markedly when they’re pulled apart.

There are four degrees of plasticity that are recognized when soil is wet. These are

1. Non-plastic. The soil can’t be rolled into a ribbon (a string-like mass) between the thumb and forefinger.
2. Slightly plastic. The soil can be rolled into a short ribbon shape with some care.
3. Plastic. The soil can be rolled into a short ribbon easily.
4. Very plastic. The soil can be rolled into a long ribbon easily.

Rangeland Plants

Climax perennial grasses. Climax perennial grasses (such as bluebunch wheatgrass) require moist soil with moderate temperatures, and spring rain to augment groundwater. Parent plants grow in soils with moderate temperatures, and seeds grow from moist soil near the base of the parent plants. This plant has diffuse roots that are very deep. It converts solar energy for plant maintenance, and produces seeds only in favorable years.

Weedy perennial grass. Weedy perennial grasses (such as needle-and-thread grass) require dry, hot soil and spring rain to augment groundwater. Parent plants grow in soils with moderate temperatures, but the seeds grow in hot soil cracks. The plant has shallow diffuse roots and produces a copious number of seeds over a long season every year.

Sandberg bluegrass. Sandberg bluegrass is a short-lived perennial grass with very shallow, diffuse roots. It grows during spring rains and shrivels up in the summer sun. Most of the plant's energy is used for seed establishment. It grows on dry sites between bunchgrass plants and in overgrazed sites.

Junegrass. Junegrass is a short-lived perennial grass. It has shallow, diffuse roots and grows in spring rains. Though most of its energy is placed in plant growth, seed establishment may be specific.

Annual grass. Annual grasses (such as cheatgrass) require dry, hot soil and spring rains for surface moisture. They have short, shallow roots because the plant converts solar energy into seeds, then dies.

Half-shrubs. Half-shrubs (such as pasture sage) have deep taproots and evergreen leaves. These plants grow when conditions are favorable and water is available. They may increase on sites that have no grazing wildlife; they aren't preferred by cattle. Half-shrubs don't increase when grazed by both cattle and wildlife.

Balsamroot sunflower. The balsamroot sunflower is a perennial forb that grows in spring. Plants have very deep taproots and put most of their energy into seed production and plant growth. The leaves dry up early in summer. It increases on sites where only cattle graze, since wildlife prefer eating the flowers and leaves in the spring.

Pussytoes. Pussytoes is a perennial forb with shallow, diffuse roots. It grows with available surface moisture and has evergreen leaves. The plant can enlarge by vegetative (rhizomatic) growth. It increases on sites where only cattle graze (it isn't a preferred forage) and is eaten by wintering wildlife.

Perennial lilies. Mariposa lilies, death camas, and onions are all perennial lilies with bulbs deep in the soil (at a level of 3 to 5 inches below the surface). They grow in spring when moisture is plentiful, and dry up for the remainder of year. Much of their energy is placed into flower and seed production.

Managing Livestock

A sufficient supply of nutrients (particularly nitrogen, phosphorus, and potash) are necessary for abundant growth, especially in humid areas where rainfall is high. Also, in humid regions, lime is a necessity. Management of the numbers and kinds of livestock on grasslands, as well as the grazing periods, is also important in developing good pasture.

Rotation pastures are established on better cropland as a part of a regular crop rotation program. These pastures are planted with grasses and legumes that grow rapidly, and are higher in production throughout the growing season than permanent pastures. Rotation pastures are popular in dairy areas where highly nutritious feed is required all year round.

Irrigated pastures are a very important part of the pasturing program in the western United States. This single innovation has done much to relieve stresses on overburdened rangelands. Under an irrigated pasture program, one hundred acres of irrigated pasture will carry as many animals during six to seven months of the summer as one thousand acres of range will support during the remaining five to six months of the year. Irrigated pasture is cheaper than any other source of feed except range grass.

Renovated pastures are so named because the methods of establishment and management differ from those used in rotation or permanent pastures. The object of renovation is to increase the production of a rundown permanent pasture. Renovation can be accomplished by applying the following methods:

- Disking (preparing a field for planting by plowing with a disk plow or harrow that pulls up shallow-rooted plants and levels out the field for planting)
- Applying lime and fertilizer
- Seeding with rapid-growing grasses and legumes
- Avoiding planting crops on the land

Managing Livestock

Temporary pastures (or supplemental pastures, as they're sometimes called) take several forms. Fields of harvested corn, small grains, or hay are sometimes used as temporary pasture . Cattle are allowed to feed on the stubble during the part of the season when pasture feed is in short supply. If winter killing or other hazards have damaged regular pasture feed, a temporary pasture may be planted in the spring to carry the cattle through the summer. Annual plants are used for this purpose to supply feed for no more than one crop season. Cereal crops, Sudan grass, soybean, and pearl millet are examples of annual crops that are commonly used.

When you're selecting a grazing system, the factors to consider include the following:

- The kinds of livestock to be grazed
- The native vegetation
- The soil topography
- The climate
- The available watershed protection
- The need for developments (such as fences)

The specialized grazing systems that you'll learn about in this section of your study unit work best in areas where

- Water is poorly distributed
- Wildlife are important in the region
- The terrain is rugged
- The vegetation isn't tolerant to grazing
-

Managing Livestock

Under a continuous grazing system, livestock remain on a rangeland indefinitely. In the arid western United States, this type of grazing system works best if the terrain is flat and access to watering areas is controlled. Access to waterholes must be controlled because these are often the favorite grazing areas of livestock. If access isn't restricted, then the vegetation and soil will become degraded. Season-long grazing is a form of continuous grazing in which animals are continuously grazed for only a portion of the year. This grazing system is common in the intermountain west, where harsh winters prevent the use of rangelands in the winter months.

The deferred rotation grazing system was the first specialized grazing system developed in the United States. Under the original design used in the early 1900s, a large pasture was split into two pastures, and each was deferred every other year. While this original design has since been modified, the important part of the system that remains is that parts of the rangeland are deferred every few years. However, note that deferred rotation hasn't really improved vegetation growth in arid environments, such as sagebrush-steppe rangelands. This system seems to help vegetation growth the most when the areas that are alternated have very different plant palatability and ease of grazing

The Merrill system of grazing requires three livestock herds and four pastures. Each pasture is continuously grazed for one year, and then rested for four months. The period of nonuse is rotated so that by the end of four years, the pasture has been rested at every season of the year.

When a seasonal suitability grazing system is used, the rangeland is divided up according to the different types of vegetation that are present. Often, seeded, non-native pastures are an important part of this system, because these regions provide nutritious forage that can often withstand more intense grazing.
In order for this system to work well, a variety of vegetation must be present on the rangeland and the quality of the forage must be high enough to warrant fencing

Managing Livestock

The best-pasture grazing system was designed for use in regions that have unpredictable precipitation that can lead to big changes in the amount and quality of forage from year to year. A good example of this type of rangeland is seen in the semidesert regions of the southwestern United States. The best strategy is to place livestock on one area during the spring and summer, and then switch to a different vegetation type during the winter.

Under the high-intensity, low-frequency grazing system, three or more pastures are used. Each pasture is grazed for about two weeks, and is then rested for about three months. The main idea of this strategy is that grazing intensity is high, which forces livestock to eat less palatable plants along with higher-quality forage. The net result should be reduced competition among plants and the prevention of tall, low-quality forage.

The short-duration grazing system is also known as holistic management, rapid rotation, or time-control. The design of this system involves a central location where a water supply or livestock area is surrounded by at least eight pastures. Livestock graze a pasture for about five days, and then the pasture is rested for a month.

Overgrazing can cause long-term damage to rangelands, particularly in the arid West. (Some of the changes that occur to plants under different levels of grazing are shown in Figure 22.) In order to sustain healthy rangelands, a minimum level of dry matter needs to be left that will protect the soil and promote forage growth. When you determine grazing intensity, your goal will be to keep this minimum level of dry matter in mind.
Several pieces of information are needed to determine proper grazing intensity levels. First, you need information about the average forage production of the area, and how much grazing the primary plants can withstand. Average forage production is measured in kilograms per hectare per year, and is usually based on standing crop. Average forage production is combined with utilization estimates to determine the proper grazing intensity for an area.
The term utilization refers to the percentage of vegetation production that's consumed or destroyed by herbivores in a given year.

The term stocking rates refers to the amount of land allocated to an animal unit for the grazable period of the year.

Conserving Soil with Farming Techniques

In order to understand the principles of soil management, you need to understand the basic concepts of tillage. All tillage implements—plows, disks, harrows, and cultivators— pack down soil. The continued cultivation or tilling of soil can have detrimental effects on underlying soil over time. This is because tillage devices compress the soil aggregates immediately below the layer they disturb. (Soil aggregates are clumped-together soil particles.) When land is tilled to the same depth with the same kind of equipment over many years, a compacted layer or plowpan is created immediately below the cultivated layer. Plowpans are very common in the United States and in other countries where heavy equipment is used for intensive cultivation.

Minimum tillage is another soil pressrvation method that's closely related to the practice of crop rotation. In minimum tillage, the lowest possible number of tillage operations is used to prepare seed beds and control weeds. The use of herbicides has greatly reduced the need to plow for weed control in many areas. In some cases, seedbeds don't need to be disked. Reducing the number of times that a field is tilled helps the soil structure and reduces the cost of labor and farming operations.

Contour strip-cropping combines contour planting with strip-cropping. Crops are planted in strips of different widths, and the strips alternate clean-tilled crops and close-growing crops or grasses. The strips are laid out approximately on the contour. On irregular slopes, contour strips are allowed to deviate from the true contour by as much as 2 percent per 100 feet. Crops grown on contour strips are rotated in the same manner as those used in solid planting. Field strip-cropping is used on land that slopes gently (between 2 percent and 5 percent) in areas where it may be impractical to design contour strips. Parallel, uniformly wide strips are laid out at right angles to the predominant slope. These strips are much easier to farm with large equipment. Strips across natural depressions or waterways are maintained in permanent grass cover.

Wind strip-cropping is used on land that's nearly level in areas where wind erosion is a problem. Strips are laid out at regular angles to the prevailing wind, and waterways are kept in permanent grass cover. Tall-growing crops (such as corn) can trap lots of snow when planted in strips at right angles to the prevailing wind, providing more moisture to the adjacent strips in the spring.

Buffer strip-cropping is used in areas where irregular slopes or odd-shaped field boundaries make it difficult to design uniformly wide contour strips, or where steep or severely eroded areas require permanent grass cover. Row crops of irregular width are planted from both sides inward, so that the long rows are planted on the contour and the short rows are planted in the middle. Buffer strips may be planted to grass or a grass/legume mixture and cut for hay or grazed.

Conserving Soil with Farming Techniques

Crop rotation is the growing of different crops in succession on the same land. it greatly improves crop yields, as well as conserving the land's resources. It helps control diseases, insects, and weeds, and saves labor by systematizing farming operations.

An important factor in determining the kind and sequence of crops that should be grown on any piece of land is the susceptibility of the soil to erosion. Erosion may occur anywhere that water moves over land, and is greatest and most damaging in areas of high rainfall and steep slopes. The amount of water erosion is influenced by the structure, texture, and the organic matter (plant residue) content of the soil.

When you're considering crop rotation,

The following are three examples of crop rotations that are commonly used in the midwestern United States:

1. A three-year rotation of corn, oats, and red clover-timothy grass
2. A four-year rotation of corn, soybeans, oats, and clover
3. A five-year rotation including two years of corn, one year of oats, and two years of alfalfa-brome grass

The following are two examples of crop rotations that are commonly used in the Southern United States:

1. A three-year rotation of cotton, wheat, and lespedeza
2. A four-year rotation of corn, cotton, oats, and fescue-clover

The following are two examples of crop rotations that are commonly used in the New England area of the United States:

1. A three-year rotation of potatoes, oats, and red clover
2. A two-year rotation of potatoes and red top is used

it's important to remember that water penetrates more readily into soil that's deep and permeable. Where water penetrates the subsoil slowly, it runs over and erodes the surface. On less permeable soil between row crops (especially if they run up and down a slope) erosion is readily induced. Where a sod crop is planted, the soil is protected from the impact of raindrops by the vegetative cover over the entire surface. The dense mixture of a sod crop also impedes the downslope movement of water. This slows down the flow of water and permits more water to move into the soil. The extensive root system of a sod crop (especially where grasses are present) serves to bind the soil together and further prevents erosion.

Soil

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1. Loose. The soil is incoherent and without resistance to pressure.
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3. Slightly hard. The soil is easily broken between the thumb and the forefinger.
4. Hard. The soil can be broken in the hand, but is difficult to break between the thumb and forefinger.
5. Very hard. The soil can be broken in the hands with difficulty.
6. Extremely hard. The soil can’t be broken in the hands.

There are four degrees of stickiness that are recognized when soil is wet. These are

1. Non-sticky. The soil has no tendency to adhere after it’s crushed between the thumb and forefinger.
2. Slightly sticky. The soil adheres to both thumb and forefinger, but comes off rather cleanly and doesn’t stick.
3. Sticky. The soil adheres to both thumb and forefinger and tends to stick somewhat before pulling apart.
4. Very sticky. The soil adheres very strongly to both thumb and forefinger and stretches markedly when they’re pulled apart.

There are four degrees of plasticity that are recognized when soil is wet. These are

1. Non-plastic. The soil can’t be rolled into a ribbon (a string-like mass) between the thumb and forefinger.
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3. Plastic. The soil can be rolled into a short ribbon easily.
4. Very plastic. The soil can be rolled into a long ribbon easily.

Water Conservation

A rich layer of humus that’s at least six inches deep can hold a lot of rain. Over four or five days, the humus gives up more than half of its water to the soil, and is ready to retain more water. The soil mantle itself, if relatively dry and deep, can also absorb lots of rainfall. Every square foot can absorb between one inch and five inches of water. Furthermore, many toxic substances can be broken down into harmless chemical compounds by the organisms in soil.

Snowslides. Steep, mountainous country is often subject to snowslides. When a heavy fall of new snow covers an old snow crust, the new snow layer may slide right off a steep slope. In especially susceptible areas, forests can’t grow. Such areas are often found at the heads of sheer canyons and along small side valleys. Encouraging tree growth can help some, but some places may need retaining walls and other engineering measures to keep back the snow.

Landslides. Landslides and snowslides are essentially the same thing, with different materials involved. Landslides happen when a huge mass of soil on a steep slope becomes saturated and slides over the underlying rock surface. One storm on record caused more than 50 small avalanches along the Lehigh River in Pennsylvania. The rocky valley walls were usually covered with trees and shrubby growth, but fires had thinned the cover. Very few of the avalanches occurred where the tree cover was still in good shape.

Water Conservation

Gullies. Gullies form where a lot of water rushes across unprotected soils without permanent stream channels (Figure 34). While it's true that willows and alders may grow up in eroding meadows, planting trees can't stop active gullies. The water causing the erosion must be diverted and the soil stabilized in some way. Once this has been accomplished, trees will be able to grow there and the gully formation can be stopped.

Silting. In some cities, runoff from heavy rains can pick up a lot of soil and vegetable debris and deposit it in municipal water supplies. This problem is called silting. Silting can ruin irrigation systems by clogging pipes and screens, and can even suffocate fish if the dirt gets thick enough. Some cities prevent this problem by planting the borders of their reservoirs with conifers. Sod covers can also be used to help keep the earth in place so it isn't as easily carried away by water erosion.

Floods. One of the most important functions of every watershed is controlling flood damage. Hundreds of millions of dollars worth of flood damage is caused every year along the Mississippi River system alone. The more forests that are cleared, and the more clean-tilled cropland in the watershed, the more frequent and serious the floods will become. Also, the more we build our cities on the great flood plains of the rivers, the greater the property damage when the floods come.

Water Conservation

Erosion is as great a menace to soils in dry areas as it is to soils in humid regions. In arid areas, soils are generally light, shallow, and lacking in organic matter content, which makes them very susceptible to wind and water erosion.
In areas where row crops have been grown continuously without replacing organic matter, the soil structure breaks down. This reduces water's ability to enter and flow through the soil and provide moisture for crops. So, still more water is wasted because it runs off instead of soaking into the soil.
Another way irrigation water is lost before it's used is through improper logging and grazing of watershed areas. This changes the flow patterns of water to the streams and removes the watershed's protective covering. In such a situation, streams and rivers that once gave a steady supply of water could instead flood in the spring and dry up the rest of the year.

Road erosion can be controlled, though, if you follow these guidelines:

- Plan the road system before you build it. The methods you'll use to prevent erosion at every point of a road should be decided after you've had a professional thoroughly analyze the ground's stability.
- Learn to recognize and avoid trouble spots. Avoid seeps (small springs), clay beds, and steep, rocky slopes where landslides are likely to occur.
- Keep the grades low. The Forest Service prefers seven percent grades, but exceptions can be made where steeper grades are needed to take advantage of favorable topography or to avoid excessive cut and fill.
- Provide adequate drainage. Roads produce and carry muddy water during rains. Streams that cross under roads shouldn't be contaminated with surface drainage and ditch water.
- Don't build a road in or near stream channels.
- Don't move any dirt that you don't absolutely have to. Deep cuts and extensive fills are a bad idea. The roadbeds should be as narrow as safe use will allow. If some earth must be wasted, it should never be dumped near a live stream. The stream will silt up and die.
- Build during dry weather.
- Keep the road in good repair, and make sure cross-drainages are open so that water will drain off the roadbed. Permanent forest roads should be surfaced with rock and gravel and graded with a center crown so that they'll drain property.

Conserving Soil with Farming Techniques

Here are some guidelines that will help minimize logging erosion:

- Don't pile logs along stream channels. Locate the landings so that logs are dragged away from streams, not through or across them.
- Keep skid trails well drained by diverting runoff water from them into areas where the sediment they carry will be filtered out.
- Don't use tractors or jeeps on steep slopes or wet ground. On moist soil, the steepest slope that you can use a tractor on is 30 percent. To avoid chewing up saturated soil, restrict tractor use to the less rugged parts of the landscape and to the drier seasons of the year.
- Reseed erosive areas to get a cover on them quickly. Skid trails and landings on unstable soil should be sown with grasses and legumes where natural regrowth is slow. Trees will have a better chance of growing on these sites again if you use grasses that aren't sod-forming for this purpose.

In basin irrigation, a diked area of land is quickly filled with water to the desired depth, and the water is allowed to soak into the soil. Basins are built so that water can be applied rapidly and efficiently. The size of the basins is dependent on the kind of soil and the volume of water that can be delivered.

In border irrigation, narrow strips are built between low ridges. Water is then permitted to enter one end and flow down the entire length of the strip. The strip must be well leveled between the ridges, and the slope down the strip must be uniform to prevent the water from gathering in ponds.

Contour irrigation (also called bench border irrigation) is used where contour farming is practiced. Strips are laid out across the slope on the contour, but are slightly graded so that water will flow in them. This method may be used where slopes are moderate and the soil is deep.

In corrugation irrigation, the corrugations are small furrows that are closely spaced. This method is ideal for heavy soils that take water slowly, and then seal over and bake hard when flooded. Water is applied to the small furrows laterally.

Furrow irrigation is used most frequently for irrigating row crops because it's simple and inexpensive. In this irrigation method, V-shaped furrows between each row are watered. However, the furrow grade is often too steep for safe irrigation, which can lead to serious erosion damage.

Conserving Soil with Farming Techniques

Contour furrow irrigation is a modification of furrow irrigation. Furrows are installed across the slope with just enough grade to permit water to flow from the inlet to the outlet end of the furrow. There's a critical grade for each type of soil. As long as the furrow grade is below this point, it's possible for water to flow in the furrow without danger of erosion. The contour furrow irrigation method can be used on slopes of up to eight percent.

In broad furrow irrigation, broad-bottomed furrows are used instead of narrow V-shaped furrows where more water intake is desired and there's no danger of furrow erosion. This system is frequently used for orchards that are planted on the contour.

Sprinkler irrigation can be used in areas where the land isn't completely level. Water may be applied with sprinklers at a rate the soil will absorb without runoff or erosion. This water can be carefully controlled, and therefore has a special value in conservation irrigation. Sprinklers may be used to establish pastures on steep slopes. Sprinklers aren't useful in areas where the climate is hot and dry, because too much water is lost through evaporation and wind drift.

In controlled flooding irrigation, closely spaced field ditches running across the slope are allowed to flood over, and water flows over the land downslope. This must be accomplished in a manner that will prevent the formation of gullies as the water moves over the land. Frequent openings in the ditches allow for uniform distribution of water over the field.