Title of the course **:** Rainfed Agriculture and Watershed Management
Topic : Soil conservation techniques
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Soil conservation: It is the prevention and reduction of the amount of soil lost through erosion. It seeks to increase the amount of water seeping into the soil, reducing the speed and amount of water running off. Erosion is prevented by keeping enough vegetation to protect the soil surface and binds the soil together and maintains soil structure.

The main aims of soil conservation are as follows:
(1) To protect the soil from erosion.
(2) To maintain the productive capacity of the soil.

Practical methods of soil conservation are broadly grouped as follows:

(A) Biological measures

(B) Mechanical or Engineering methods

A. Biological Measures: The following are the biological methods which are helpful in checking the soil erosion:

1. Agronomic practices
2. Agrostological methods
3. Dry farming practices

1. Agronomic practices: The important agricultural practices which contribute to the conservation and productivity of cultivated lands are referred to as conservation farming's or advanced agronomical methods. These are listed as under:

(i) Contour farming
(ii) Tillage and keeping the land fallow
(iii) Crop rotation, sowing of leguminous crops and mixed cropping
(iv) Mulching
(v) Strip cropping
(vi) Cover crop

(i) Contour farming: It is practiced in the hilly regions or on the slopes. In such areas the rain water is absorbed in very little amount because of its quick downward movement on the slopes. If these sloppy areas are ploughed up and down the slope, the heavy rainfall may cause gully development. Taking into consideration this defect, the sloppy areas are ploughed and seeded

against the slope, i.e., in circular furrows around the slopes. This process is termed as contour farming.

The contours (circular or peripheral furrows) catch the downwardly moving water until it is absorbed in the soil. The ridges reduce the flow of water. The circular rows of plants across the slopes check the soil erosion. Thus, contour farming reduces run off, saves more water for crops, reduces soil erosion and increases the yield of crops

(ii) Tillage operation and keeping the land fallow: There are several diverse opinions as to whether deep ploughing gives good result or shallow ploughing. Shallow ploughing removes the weeds and enables the soil to absorb water. Deep ploughing (upto 15-30 cm deep) is effective in removing weeds and increasing crops yields. If the land is left uncultivated and sheep, goats and other cattle are allowed to graze and sit over it for some time, the soil becomes fertile. Though this practice is useful yet it is not possible in the countries like India where exists severe problem of cereals because of thick human population.

(iii) Crop rotation, sowing of legumes and mixed cropping: When the same crop ‘s grown in the field every year, the soil becomes depleted in certain minerals. The soil loses its fertility even after the use of fertilizers and ultimately erosion sets in. Rotation of crops is an important method for checking erosion and maintaining productivity of soil. After 2 years crop should be changed in the fields.

A good rotation should include a cultivated row crop, densely plan e small grasses and a spreading legume or a legume and grass mixture. Selection of crops for rotation should be made taking into consideration the climate, economic condition soil types, soil texture, slopes, nature of erosion, etc. Deep-rooted crops should be rotated by shallow-rooted crops.

Deep-rooted crops absorb nutrients from the deeper strata of the soil Thus, the minerals of top soil remain stored for future use by shallow-rooted plants. Growing of Mung and urd in kharif season before wheat cropping improves soil fertility as well as yields of cereal crops.

The rotation of crop serves the following purposes:

(a) Enriches the soil,

(b) Improves the soil texture,

(c) Improves water holding capacity of the soil,

(d) Improves crop production,

(e) Controls the recurrence of weeds and diseases.

Mixed cropping is another important method for increasing productivity of the soil. In this practice, one main crop and one or two subsidiary crops are grown together on the same land, as for example, growing of Arhar, Urd, Til along with millet. This practice checks the soil

erosion and avoids the risk of crop failure. If one crop fails due to diseases or any other factor, the others remain ensured.

(iv) MULCHING : Mulching is done by covering the soil between crop rows or around trees or vegetables with cut grass, crop residues, straw or other plant material. This practice help to retain soil moisture by limiting evaporation, prevents weed growth and enhances soil structure. It is commonly used in areas subject to drought and weed infestation. The mulch layer is rougher than the surface of the soil and thus inhibits runoff. The layer of plant material protects the soil from splash erosion and limits the formation of crust. The optimal propotion of soil cover ranges between 30% and 70 %.

The choice of mulch depends on locally available materials. In alley-cropping systems, hedgerow biomass is often used as mulch, another strategy is to leave crop residues, such as maize stalks on the ground after harvesting. Mulch can be spread on a seedbed or around planting holes. It can also be applied in strips. Large pieces of crop residues should be cut into smaller pieces before application. The mulch may be covered with a layer of soil to protect it against wind.

Advantages :

1. Increases soil moisture
2. Reduces evaporation from the soil surface.
3. Suppresses weeds and reduces labor costs of weeding.
4. Reduces high fluctuations in soil temperature, which means improved conditions for microorganisms in the soil.
5. Increases soil organic matter and thereby improves soil structure.
6. Protects the soil against splash erosion and runoff.

(v) Strip cropping: It is an important method which employs all the advanced cultivation practices such as contour farming, proper tillage, crop rotation, mulching, cover cropping, etc. Strip cropping is very effective for controlling soil erosion.

It is of the following types:

(a) Contour strip cropping
(b) Field strip cropping
(c) Wind strip cropping and
(d) Permanent or temporary buffer strip cropping.

(a) Contour strip cropping: It is special crops are grown on the strips across the slope on the level of contour and in the following season soil protecting crops are shown on the strips on which soil exposing crops were grown in the previous season and again in place of these soil protecting crops some soil exposing crops are sown. This practice is useful because it checks the flow of runoff water, increases the infiltration of water in the soil and prevents soil erosion.

(b) Field strip cropping: It is a farming in more or less parallel strips across fairly uniform slopes but not on the exact contour.

(c) Wind strip cropping: In this method tall growing plants (e.g. bajra, jowar, etc.) alternating with the short growing crops, such as 'mung', 'urd' are sown in long straight strips right across the direction of wind regardless of contour.

(d) Permanent or temporary buffer strip cropping: This is a special type of contour strip cropping in which care is taken to check the soil erosion. In this, crop rotation practice is not applied and on the strip perennial legumes and grasses are planted on permanent or temporary basis.

(vi) COVER CROPS : Cover crops are usually creeping legumes which cover the ground surface between widely spaced perennial crops such as fruit trees and coffee, or between rows of grain crops such as maize. Often cover crops are combined with mulching. They are grown to protect the soil from erosion and to improve soil fertility. Cover crops protect the soil from splashing raindrops and too much heat from the sun. Most of the plants used as ground cover are legumes, such as different varieties of beans and peas. Pigeon peas and other crops with strong tap roots and longer growing season than maize and beans make good mix and can be used to break hard-pans in semi-arid areas. Over 100 species of cover crops are in use around the world. For the cover crop to compete with the main crop as little as possible the cover crop should be of a low yielding variety. Cover crops should be planted as soon as possible after tillage to be fully beneficial. This can be done at the same time as sowing the main crop, or after the main crop has established, to avoid competition at crop nutrition level.

Advantages

1. Improves soil structure and soil fertility.
2. Reduces soil erosion and runoff.
3. Suppresses weeds.
4. Provides human food and animal forage.
5. Improves soil moisture and reduces surface crusting.
6. Reduces high fluctuations in soil temperatures.
7. Some cover crops can provide good cash income.

2. **Agrostological methods:**

The following are the important agrostological practices that check soil erosion:

(i) Cultivation of grasses (ley farming)

(ii) Afforestation and Reforestation

(iii) Checking of overgrazing

(i) **Cultivation of grasses (Ley farming):** This method consists in growing grasses in rotation with agricultural crops. This practice improves the fertility of soil and helps in binding of the soil, thus preventing the soil erosion. This practice is recommended for Nilgiris and similar places which are subjected to very severe soil erosion.

(ii) Afforestation and reforestation: Afforestation means growing forests at places where there were no forests before due to lack of trees or due to adverse factors such as unstable soil, aridity, or swampiness. Reforestation means replanting of forests at places where they have been destroyed by uncontrolled forest fires, excessive felling and lopping. Plantation of trees in short blocks is known as a wind break and extensive plantation of trees is called shelter belts.

Wind is a problem in dry areas. Soil erosion by wind can be checked or reduced if the soil is covered by vegetation. Wind breaks are planting of trees or other plants at right angles to prevailing wind that protect bare soil from full force of wind. Wind breaks reduce the velocity of wind, thereby decrease the soil erosion. The plantation is usually done in two or three belts. Small sized plants are planted on windward side and tall trees on leeward side. Wind breaks and shelter belts reduce the wind velocity considerably and also check the transport of lifted sand and soil particles. Afforestation is the best means to check the soil erosion.

(iii) Checking of overgrazing: Since grazing in all the areas subjected to soil erosion cannot be completely stopped, a system of restricted and rotational grazing may be helpful in checking soil erosion to some extent. The area open to grazing for sometimes should be closed for the following years to facilitate regeneration of forest and to maintain thick ground vegetation.

3. Dry farming practices:

Dry farming is useful in those areas where rainfall is very low, uncertain and uneven in distribution. In such areas maximum conservation of water in the soil and reduction of soil erosion are the two main problems. The improved dry farming practice developed as result of researches carried out in India is an integrated rational system of cultivation of purely rained and drought enduring crops in dry areas. This practice consists in bonding, both contour and compartmental, and all other advanced agricultural practices to conserve maximum amount of rain water in the soil so as to make it available for crops during their growth period. In this, usually early maturing crop varieties are selected for cultivation.

B. Mechanical Methods:

The mechanical practices of soil conservation include various engineering techniques and structures.

Mechanical methods for soil conservation are:

(i) Basin leaching,
(ii) Pan breaking,

(iii) Sub soiling,
(iv) Contour terracing,
(v) Contour trenching,
(vi) Terrace outlets,
(vii) Gully control,
(viii) Digging of ponds and reservoirs, and
(ix) Stream bank protection.

(i) Basin leaching: In this method, a number of small basins (water reservoirs) are made along the contour by means of an implement called basin blister. Basins collect and retain rain water for long period and also catch and stabilize downwardly moving soils of the slopes.

(ii) Pan breaking: In some areas, soils become impervious to water and are less productive because of formation of hard sheet of clay a few feet below the surface. Such areas can be made productive and water permeable by breaking hard clay pans by means of pan breaker on contour at a distance of about 5 feet. By pan breaking, drainage and percolation of rain water is improved and soil is saved from residual run-off and erosion.

(iii) Sub-soiling: In this method hard subsoil is broken deeply by means of an implement called sub soiler. This process promotes absorption of rain water in the soil and makes the soil more loose and fit to allow luxuriant growth of vegetation.

(iv) Contour terracing: Sometimes drainage channels or properly spaced ridges or soil mounds are formed along the contour (at right angles to the slope) to retain water in the soil and check the soil erosion. These are called terraces. Terraces are leveled areas constructed at right angles to the slope to reduce soil erosion.

Terracing may be of the following four types:

(a) Channel terracing: This is concerned with making of wide but shallow channels on contours at suitable distance. In this process, the excavated soil is deposited along the lower edge of channel in the form of low ridge.

(b) Narrow based ridge terracing: This process is commonly called bunding. In this a number of narrow based ridges or bunds are constructed at distance of 1into 2inacross the slope along the contour.

(c) Broad-based ridge terracing: In this, wide but low bunds are made on contour by excavating soils from both the sides of ridge.

(d) Bench terracing: This method involves making of wide step like platforms, the so called bench terraces, having suitable drops along contours . Along the outer edges of bench terraces bunds of about one foot height are raised to check the downward flow of rain water and also soil erosion. The vertical drops may vary from 1into 2 m. Bench terracing is very costly process and so it should be applied in the area of land scarcity for growing money crops.

Terracing is the only practical method of soil conservation on steep land. It is an expensive method or reducing soil erosion since it requires moving soil to construct the leveled areas, protecting the steep areas between terraces and constant repair and maintenance. Many factors such as length, the steepness of slopes, type of soil, and amount of precipitation determine the feasibility of terracing.

(v) Contour Trenching: This method involves making a series of deep pits (2′ x 1′) or trenches across the slope at convenient distance. The soil excavated from the trenches is deposited along the lower edge in the form of bund. On the ridges tree seeds are sown.

(vi) Terrace outlet: In order to reduce soil erosion and to remove excess of rain water safely from the contour terraces pipe outlets are used or channels are made which are thickly covered by grasses.

(vii) Gully and ravine control: Gully formation can be checked by the following methods

(a) By making perimeter bunds around gullies to check flow of water through it.

(b) By growing suitable soil-binding vegetation on the gullies to check soil erosion.

(c) Diversion trenches should be made around gullies.

(viii) Ponds and reservoirs: Small ponds and water reservoirs or dams should also be made at suitable places for irrigation and some other purposes. Various types of dams have been devised to arrest and plug gullies and thus to check soil erosion. These dams may be (a) brush dams (b) earth dams, (c) concrete dams or (d) woven wire dams.

(ix) Stream bank protection: Banks of ravines and rivers with high vertical drops are subjected to heavy soil erosion. The bank erosions can be checked by making the drop slopy and by growing vegetation on the slopes or by constructing stone or concrete pitch.