JUST AGRICULTURE
multidisciplinary e-Newsletter

Soil Conservation Practices in Hilly Areas- Agronomic Practices

Nongmaithem Leindah Devi*, Jotish Nongthombam1, Santosh Kumar1, Joshi Kumar Khagembam1 and KP Chaudhary
*Post Doctoral Fellow, UGC, Department of Soil Sciences and Agricultural Chemistry, College of Agriculture, Central Agricultural University, Imphal, Manipur
1K.V.K. Aizawl, College of Veterinary Sciences and Animal Husbandry, Central Agricultural University (I), Seleish, Mizoram

ARTICLE ID: 88

Introduction:

Soil is the most important resource on which agriculture is based on. Proper management of this valuable resource is vital to sustain long-term agricultural productivity. Soil conservation practices are the tools for farmer that can be use to prevent soil degradation and build organic matter. These practices include: crop rotation, reduced tillage, mulching, cover cropping and cross-slope farming. Most common agronomical practices used for soil conservation, are discussed below

Strip Cropping:

Strip cropping is a practice of growing field crops in narrow strips either at right angles to the direction of the prevailing wind, or following the natural contours of the terrain to prevent wind and water erosion of the soil. Strip cropping involves planting crops in strips across the slope, with alternate strips of grain and/or forage crops. Strip cropping combines the soil and moisture conserving properties of cross-slope farming with the soil building advantages of a crop rotation and is more effective in reducing soil losses. This method becomes more effective for erosion control, which it is followed with crop rotations in the area where terraces are not practically feasible due to the fact that the length of slope is divided into different small segments. The strip crops check the surface runoff and force them to infiltrate into the soil, thereby facilitates to the conservation of rain water. Strip cropping is more intensive practice for conserving the rain water than contouring (i.e. about twice as effective as contouring) but it does not involve greater effect on soil erosion as terracing and bunding. Generally the use of strip cropping practice for soil conservation is decided in those areas where length of slope is not too longer.

JUST AGRICULTURE
multidisciplinary e-Newsletter

Forms of strip cropping are :

1) **Field strip cropping**: A specialized strip cropping where crops are planted in parallel bands across a slope but do not follow contour lines; bands of grass or other close-growing species are alternated with the bands of cultivated crops.
2) **Contour Strip Cropping**: Contour strip cropping is the growing of a soil-exposing and erosion permitting crop in strips of suitable widths across the slopes on contour, alternating with strip of soil protecting and erosion-resisting crop.
3) **Wind Strip Cropping**: It consists of planting tall-growing crops such as jowar, bajra or maize, and low-growing crop in alternately arranged straight and long, but relatively narrow, parallel strips laid out right across the direction of the prevailing wind regardless of the contour.
4) **Permanent or Temporary Buffer Strip Cropping**: In the case of permanent or temporary buffer strip cropping, the strips are established to take care of critical, i.e. steep or highly eroded, slopes in fields under contour strip cropping.

Purposes:

- Reduce soil erosion from water and wind
- Increasing the infiltration rate of the soil under cover condition.
- Protect growing crops from damage by windborne soil particles.

Fig.3. Forms of Strip cropping

Smothering/Cover Crops:

Cover crops are the plants which are grown to improve soil fertility, prevent soil erosion, enrichment and protection of soil, and enhance nutrient and water availability, and quality of soil. Cover crops provide several benefits to soils used for agriculture production. Cover crops are helpful in increasing and sustaining microbial biodiversity in soils. Effectiveness of the cover crop depends on close spacing and development of good canopy for interception of rain drops so as to expose minimum soil surface for erosion. Major role of

JUST AGRICULTURE
multidisciplinary e-Newsletter

plant cover is to protect the soil from the force of falling rain drops which is the primary cause of erosion on cultivated land. Plant cover controls splash erosion by intercepting the rain drops and absorbing their kinetic energy which reduces soil and water loss. Pulse crops are generally more suitable for such purposes.

Fig. 4. Different types of cover crops with different season

Crop rotation:

Practice of growing a series of dissimilar or different types of crops in the same area in sequenced seasons. Crop rotation is a common practice on sloping soils because of its potential for soil saving. Rotation also reduces fertilizer needs, because alfalfa and other legumes replace some of the nitrogen corn and other grain crops remove.

Various Crop rotations:

- Groundnut and pulses/ ragi/ gingerly/ coriander/ per millets
- Maize and groundnut
- Maize and pulses - pulses
- Horse gram/ pearl millet/ pulses/ ragi/ minor millet

JUST AGRICULTURE
multidisciplinary e-Newsletter

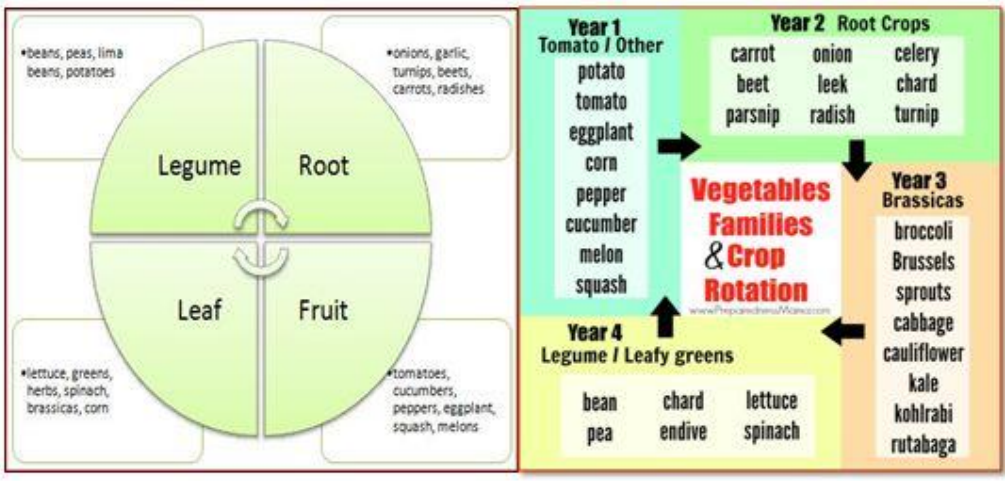

Fig.5. Crops cycles for plantation in crop rotation.

Rainfall (mm)	Soil type	Growing season (weeks)	Profile storage capacity (mm)	Suggested cropping system
350-600	Alfisols, shallow vertisols	20	100	Single rainy season cropping sorghum / maize / soybean
350-600	Deep aridisols, Entisols(alluvium)	20	100	Single cropping sorghum / maize / soybean in kharif / rabi
350-600	Deep vertisols	20	100	Single post rainy season cropping sorghum
600-750	Alfisols, vertisols, entisols	20-30	150	Intercropping 1. Sorghum & Pigeon pea 2. Cotton & Black gram
750-900	Entisols, deep vertisols, deep alfisols, inceptisols	30	200	Double cropping with monitoring 1. Maize & safflower 2. Soybean & chick pea 3. Groundnut & horsegram
> 900	As above	> 30	> 200	Assured double cropping Maize & chick pea Soybean & safflower

Table 1. Potential cropping system based on rainfall and soil characteristics.

Advantages of crop rotation:

- Prevents soil depletion.
- Maintains soil fertility.
- Reduces soil erosion.
- Help control weeds.
- Reduces reliance on synthetic chemicals.
- Reduces pest and diseases build up.

Mixed/ Intercropping:

It is a practice of growing more than one crop in the same field simultaneously. In this practice, there is one main crop and one or two subsidiary crops. Generally, legume is used as one of the crops. This system of cropping is very extensively adopted by the farmers in India. This practice gives better cover on the land, good protection to soil from beating action of rain and protection from soil erosion, by binding the soil particles. Growing soybean,

JUST AGRICULTURE
multidisciplinary e-Newsletter

groundnut, cowpea etc. with maize, sorghum, pearl millet, etc. is a common example of this practice.

Fig.6. Intercropping/mixed cropping in a piece of land.

Green Manuring:

Green manuring can be defined as a practice of ploughing or turning green plants/vegetation into the soil for the purpose of improving physical structure as well as fertility of the soil. These green plant tissues provide stable soil aggregate, good aeration, add more organic matter and enhanced beneficial microbial activities into soil after decomposition which either directly or indirectly helps in conserving soil and water resources. There are two types of green manuring.

i. **In- Situ Green Leaf Manuring**: In this system, green manure crops are grown and buried in the same field which is to be green manured. The most common green manure crops grown under this system are sunhemp (*Crotalaria juncea*), dhaincha (*Sesbania aculeata*), greengram and cowpea etc.

ii. **Ex-Situ Green Leaf Manuring**: Green leaf manuring refers to turning into the soil green leaves and tender green twigs collected from shrubs and trees grown on bunds, waste lands and nearby forest area. This system is generally followed in southern India. The common shrubs and trees used are- Glyricidia (*Glyricidia maculata*), *Sesbania* speciosa, Karonj (*Pongamia pinnata*).

Planting across the slope:

JUST AGRICULTURE
multidisciplinary e-Newsletter

Farming across the slope helps to shorten slope lengths, slowing down runoff water so it can soak into the soil and reduce soil erosion.

Fig.7. Planting crops across the slope

Vermicompost

Vermicompost is the product of the composting process using earthworm to create a mixture of decomposing vegetable or food waste, bedding materials, and vermicast. Several researchers have demonstrated that earthworm castings have excellent aeration, porosity, structure, drainage, and moisture-holding capacity. Epigeics (surface feeders) earthworms are important in vermicomposting. The epigeics such as Eisenia foetida and Eudrilus eugeniae are exotic worms and *Perionyx excavatus* is a native one being used for vermicomposting in India.

Advantages of vermicompost

- Vermicompost is rich in all essential plant nutrients.
- Provides excellent effect on overall plant growth
- It improves soil structure, texture, aeration, and water holding capacity and prevents oil erosion.
- It prevents nutrient losses

Fig. 8. Vermi composting unit

JUST AGRICULTURE
multidisciplinary e-Newsletter

Azolla

Azolla is an aquatic fern which is regarded as "Live Nitrogen Manufacturing Factory", because it harbors nitrogen fixing cynobateria. It had been widely used as biofertilizer or green manure for rice cultivation in South East Asian Countries. *Azolla pinnata* has substantial nitrogen content and has been utilized as an environmentally friendly fertilizer for wetland rice farming as well as for their capability to preserve considerable amounts of nutrients. It is amongst the additional types of fertilizer utilized in addition along with other bio-fertilizers.

Fig. 9. Azolla cultivation

Liquid Organic manures:

Liquid organic manures are products obtained from the fermentation and or decomposition of organic matter such as crop residues, animal dung, urine and other plant materials. Liquid organic manures provide nutrients for the plants, and can work as a pest control. It also improves the soil. Some examples of liquid organic manures are Seaweed extract, Vermiwash, Kunapajala, Panchagavya, Amritpani etc.

Contour Cultivation:

In contour cultivation, all agricultural operations such as ridging, ploughing, harrowing and sowing are recommended to be done on the contour wherever possible or at least generally across the direction of the slope where the land holdings are very small. The purpose of contour farming is to make the rows and tillage lines across the normal slopes. The rows and tillage lines works as a protecting material for water to reduce its flow and provide more opportunity time to water to infiltrate into the soil. Contour farming is more important for in the areas where water and soil pose the main limitations for growing crops.

JUST AGRICULTURE
multidisciplinary e-Newsletter

Fig 10. Contour farming

A forestation:

Forests play an important role in controlling soil erosion. The forest canopy intercepts the erosive force of rain drops and the forest utter protects the soil and helps in absorbing more rain water, thus reducing the runoff. Afforestation of economic plants should be done on contour benches to the specific needs of the area.

Conclusion:

An agronomic practice contributes high in the long term agricultural sustainability and sustainable agricultural farming. The major agronomic soil practices in hilly areas are strip cropping, mixed cropping, intercropping, mulching, crop rotation, conservation tillage and agroforestry. The plant canopies, litter and mulching intercept rain by decreasing the amount, intensity and the spatial distribution of the precipitation reaching the soil surface and this protects the soil surface from the direct impact of raindrops which can cause a splash and sheet erosion. In soil conservation, agronomic practice is higher than others, because crops and leguminous woody perennials in agronomic practice improve and enrich soil conditions by atmospheric nitrogen fixation, an addition of organic matter through litterfall and dead and decaying roots, nutrient cycling, modification of soil porosity and contribution to infiltration rates. Hence, the use agronomic practices for soil conservation is vital for both protective role (soil conserving functions) as well as for productive role (producing food and fodder).

Reference:

Ashraf Hanafy and Gehan, 2018, Role of Azolla Pinnata Biofertilizer Extract in Producing Healthy Tomatoes, *Asian journal Of Research in Biotechnology*, 3 (3):1-8.

Parmodh Sharma, Atinderpal Singh, Charanjit Singh Kahlon, Amandeep Singh Brar, Kulbhushan K. Grover, Mahendra Dia, Robert L. Steiner, 2018. The Role of Cover Crops towards Sustainable Soil Health and Agriculture — A Review Paper. *American Journal of Plant Sciences*, 9, 1935-1951

S.S. Ranasr, Biological intensive nutrient management: vermicompost

Shivarani, Measures for Soil and Water Conservation Soil Management, Soilmanagementindia.com