

4 PRINCIPLES OF SPECIES SELECTION FOR SLOPE STABILIZATION

This monograph considers vegetation that is suitable for stabilizing slopes against the seven types of erosion listed in the Introduction. These types of erosion can occur on both agricultural and non-agricultural land. On agricultural land erosion threatens the sustainable production of agricultural crops. On non-agricultural land, it can affect embankments that abut civil works e.g. bridges, buildings, and roads which can threaten public safety and well-being. The effectiveness of the vegetation in controlling erosion will depend on the

- type of erosion;
- physical and morphological properties of the vegetation;
- ability of the vegetation to survive and grow well under the specific environmental conditions.

4.1 *Principles of Species Selection for Protection against Splash, Rill, and Sheet Erosion*

There are two basic approaches to the use of vegetation to protect against splash, rill, and sheet erosion

- complete ground cover
- vegetative strip barriers

Species characteristics for complete ground cover

The species must

- be a perennial
- be short in height
- establish and grow readily under the environmental conditions
- not grow prolifically and ubiquitously
- not be a fierce competitor against other species
- not produce seeds in prolific quantities
- show a preference for particular environments

Species characteristics for vegetative strip barriers

The species must

- be a perennial

- be short in height
- not require frequent cutting
- establish readily but must grow slowly
- be sterile or produce non-viable seeds to limit spread from the barriers
- produce a root system that is dense at or close to the soil surface but must not be too shallow to cause ready desiccation

4.2 *Principles of Species Selection for Protection against Soil Slippage/Slumping*

Soil slippage can be shallow or deep and massive. The extreme cases frequently cannot be protected by vegetation except perhaps by huge trees. To protect the soil against slippage the roots must be extensive, well distributed, must extend well below the slip planes, and must have high tensile strength.

Slippage forces increase with increase in depth to the slip plane, soil water content, and the angle of the slope. Therefore, vegetation with the most extensive root systems will be required to protect the soil on steep slopes with deep slip planes.

Soil slippage or slumping may occur gradually and progressively with time and eventually erode the soil sufficiently to threaten civil works. The vegetation must again be selected based on the above principles and the protective vegetation must be located at the critical point or zone of the land slippage i.e. where the slippage is currently occurring or likely to occur. It must extend over a sufficient distance above and below the critical zone to ensure protection and avoid a shift to or creation of a new critical zone.

4.3 *Principles of Species Selection for Protection against Gully Erosion*

The vegetation is required to reduce the rate of flow of water in the gully and hence to prevent the erosion of the gully floor and walls. The vegetation is therefore planted at intervals across the gully floor. Since individual stems of the vegetation is not effective, the cuttings are planted close together or in a criss-cross manner. Recent findings by the author (unpublished data) that the stem of *Gliricidia* loses its apical dominance when ring barked at intervals and produces vertical shoots at intervals from

horizontal stems, mean that a row of plants can be developed across the gully from a single cutting. The eroding soil collects behind the vegetation to create check dams and prevent further erosion.

Grassing of small shallow gullies is frequently sufficient to arrest further erosion provided the grass species are appropriate. Shrubs are better suited to the medium sized and steeper gullies. However, vegetation is usually not effective in the large gullies. It is difficult for the young plants to resist uprooting by the erosive forces of the flowing water. Engineering structures or a combination of vegetation and engineering structures are more effective and are preferred.

Plant species which are suitable for shallow and medium sized gully control should have the following characteristics

- be a perennial
- establish and grow rapidly
- good rooting; grasses should have thick, strong dense roots which are well distributed in at least the top 30 cm of the soil profile; shrubs should have spreading, thick, deep branched roots
- withstand high soil moisture conditions and even temporary waterlogging
- grasses whether they reproduce by rhizomes, stolons, or tillers must be close growing to produce a dense growth and shrubs must be capable of growing closely together

4.4 *Principles of Species Selection for Protection against River and Stream Bank Erosion*

River and stream banks are eroded by the flowing water and erosion increases with increasing flow rates. Erosion is highest at river bends because of increased turbulence of water flow in these areas. Because the stage or level of water in rivers and streams varies enormously erosion can occur at different elevations or heights of the banks.

Vegetation that is suitable for protection against this form of erosion must

- be able to withstand the forces of flowing water
- have thick, deep, strong much branched root systems which extend below the depth of the lowest stage of the river or stream

- withstand high soil moisture, high water table, and waterlogging as well as low soil moisture conditions
- be a perennial and must not die back in the dry season

4.5 *Principles of Species Selection for Protection against Beach Edge and Coastal Areas*

Wave action can be damaging to both beaches and coastal areas. The sand on the upper reaches of the beach is less resistant to water erosion than the beach sand at the low tide levels. Consequently, beach erosion can be severe at high tide if the beach is unprotected. In addition, strong on-shore winds can cause wind erosion. Shrubs and small trees can significantly reduce beach erosion.

Similarly, wave action on other coastal areas which are not protected by rocks and boulders can also cause severe erosion. These areas cannot be readily protected by trees. However, many coastal regions are eroded by runoff water from elevated inland areas, and sandy areas are affected by wind erosion.

Vegetation that is suitable for protection against beach and coastal area erosion must be

- adapted to sand or sandy soils, in particular, must be drought tolerant and have a low nutrient requirement
- resistant to wind damage
- resistant to saline conditions