

## Soil and Water Conservation Technologies for Resource Conservations in Watershed

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#### Abstract

Watershed management is an important programme involving the conservation, replenishment, and improvement of water resources. Managing a watershed area is essential for sustainable development and ensuring water availability. It aids in maintaining the water supply for agriculture, industry, and domestic use. The main objective of watershed management is to conserve water resources and maintain their quality. This process involves the collection and replenishment of surface water, groundwater, and rainwater. It helps increase agricultural productivity, prevent soil erosion, and maintain environmental balance. To prevent soil erosion and maintain land quality, several effective techniques are employed, each designed to mitigate the loss of soil due to water and wind erosion while preserving soil fertility and overall land productivity. Some of the major technologies used for soil and water conservation in watershed management are detailed below:

#### Contour Bunding

Contour bunding is a soil and water conservation technique that involves constructing embankments or bunds along the contours of sloped fields. This method is particularly effective in hilly and

mountainous regions where water flow is rapid and soil erosion is a significant concern. By creating these bunds, the flow of water is slowed down, allowing it to spread evenly across the field and seep gradually into the soil. The bunds act as barriers that interrupt the downhill movement of water, capturing and holding soil that would otherwise be lost. This retained fertile soil and supports better crop growth. Additionally, the moisture retained in the soil due to slowed water flow ensures that plants receive adequate water over a longer period, even after the rains have stopped. This consistent moisture availability is crucial for maintaining agricultural productivity, especially in regions that experience irregular rainfall patterns.



(Contour Bunding)

### Check Dams

Check dams are small but significant water structures designed to slow down the flow of rivers or streams, thereby facilitating groundwater recharge. These dams, often constructed using locally available materials like stones, concrete, or soil, play a crucial role in water management, particularly in areas prone to water scarcity. By controlling and slowing the water flow, check dams create small reservoirs that allow water to seep gradually into the ground, thereby replenishing the aquifers. This process is vital for increasing groundwater levels, which in turn enhances the overall availability of water resources in the region. The benefits of check dams extend beyond groundwater recharge. They help in maintaining a steady water supply for agricultural purposes, ensuring that crops receive adequate irrigation during dry spells. Check dams also contribute to environmental conservation by reducing soil erosion. By slowing down the water flow, they minimize the erosive force of running water, which can otherwise wash away fertile topsoil. This not only preserves the soil quality but also prevents the silting of downstream water bodies, which can reduce their storage capacity.



(Check Dam)

### Gabion Structures

Gabion structures are a sustainable and effective solution utilized along riverbanks and streams to address various environmental challenges. These structures consist of wire mesh cages filled with

stones or other locally available materials, strategically placed to combat soil erosion, enhance water retention, and manage water flow dynamics. One of the primary uses of gabion structures is in preventing soil erosion along water bodies. By lining riverbanks and streams with these cages filled with stones, gabions create a barrier that absorbs the impact of water flow, reducing the erosive forces that can degrade soil and undermine stability. This erosion control function helps to maintain the integrity of riverbanks, protect adjacent land from degradation, and preserve valuable agricultural or residential areas from water-induced damage. Gabions also play a crucial role in increasing water retention capacity in riparian zones. The porous nature of the wire mesh allows water to pass through while trapping sediment and debris, thereby facilitating the gradual infiltration of water into the soil. This process helps to replenish groundwater tables, sustain base flows in streams, and support vegetation growth along watercourses.



(Gabion Structures)

### Silt Traps

Silt traps serve as essential infrastructure designed to mitigate the accumulation of silt and soil in reservoirs and rivers, thereby preserving water quality and maintaining effective water management systems. These traps are strategically placed structures that intercept sediment-laden water, allowing particles to settle before water proceeds downstream, thereby preventing sedimentation within critical water storage facilities. The primary use of silt traps lies in their ability to maintain reservoir storage capacity by capturing and retaining sediment before it can accumulate within the reservoir. Sedimentation, typically consisting of fine particles carried by runoff from land surfaces, can gradually reduce the effective volume of water storage in reservoirs. Silt traps are integral components of effective sediment management strategies, crucial for maintaining reservoir functionality, enhancing water quality, and promoting sustainable water resource management practices. By mitigating sedimentation impacts, these structures support resilient water structure and ecological health within riverine systems. Emphasizing the installation and maintenance of silt traps underscores their importance in safeguarding water resources for present and future generations, ensuring sustainable use and conservation of freshwater ecosystems worldwide.



(Silt Traps)



(Silt Traps)

### Bioengineering measures

Bioengineering techniques harness the power of living plants and organic materials to bolster the stability of watershed areas, effectively combating soil erosion and enhancing water quality. Unlike traditional engineering methods that rely on non-living structures, bioengineering utilizes the natural capabilities of vegetation to strengthen soil structure and mitigate erosion. One of the fundamental approaches in bioengineering involves planting a variety of grasses, shrubs, and trees strategically in vulnerable areas. These plants play crucial roles: their root systems bind soil particles together, creating a stable matrix that prevents erosion caused by rainfall and runoff. Grasses are particularly effective for their fibrous root systems, which form dense networks that hold soil in place and reduce surface runoff velocities. Vegetation intercepts sediment and pollutants carried by surface runoff, trapping them within plant structures and root systems. This filtration process helps to reduce sedimentation in water bodies and improves overall water clarity. Moreover, plants contribute organic matter to the soil as they grow and decompose, enhancing soil fertility and nutrient availability.



(Rainwater Harvesting)



(Grasses with bunds under Bioengineering measures)

### **Rainwater Harvesting**

Rainwater harvesting is a crucial measure for water management that involves the collection and utilization of rainwater to replenish water resources. The primary goal of this practice is to prevent rainwater from being wasted by allowing it to run off and instead store it for various uses. One common method involves collecting rainwater from rooftops. This rainwater is directed through pipelines into storage tanks, making it readily available for later use. This technique is effective and widely implemented in both rural and urban areas, providing an alternative water source during dry periods. It promotes water conservation and encourages sustainable living practices. Overall, rainwater harvesting is an efficient technique that addresses both immediate and long-term water needs.

### **Conclusion**

Watershed management is essential for conserving, replenishing, and improving water resources, crucial for sustainable development and ensuring water availability. Key objectives include conserving water resources and maintaining their quality through techniques like terracing, strip cropping, and cover cropping, which prevent soil erosion and enhance agricultural productivity. Community participation is a cornerstone of effective water conservation and watershed management strategies. Engaging local communities ensures that water resources are managed sustainably and in accordance with the needs and priorities of the people who live in the area. By integrating traditional wisdom with modern techniques, communities can implement holistic strategies that promote biodiversity, restore degraded habitats, and maintain healthy water cycles.