Journal of Electronic Research and Application, 2025, Volume 9, Issue 2
http://ojs.bbwpublisher.com/index.php/JERA
ISSN Online: 2208-3510
ISSN Print: 2208-3502

Research on the Prevention and Control Measures of Soil and Water Conservation in Water Conservancy Projects

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Abstract: With the development of our country's social economy, the construction scale of water conservancy project has had an obvious expansion. In the construction of water conservancy projects, certain impacts on the surrounding water and soil conditions are inevitable. These impacts may lead to problems such as soil erosion, which can directly affect local production, livelihoods, and the natural ecological environment on which people depend. In severe cases, such issues may even hinder the progress and quality of the water conservancy project itself. Therefore, in the construction of water conservancy projects, soil and water conservation work is extremely important. Based on this, this paper mainly aimed at the prevention and control of water and soil conservation of water conservancy projects launched the relevant analysis and research.

Keywords: Water conservancy project; Water and soil conservation; Prevention and control

Online publication: March 28, 2025

1. Introduction

With the rapid development of water conservancy engineering construction in China, soil and water conservation has gradually attracted wide attention [1]. While water conservancy engineering provides important support for economic development and social progress, it also inevitably brings environmental problems such as soil erosion. These problems will not only cause a certain negative impact on the ecological balance, but also affect the long-term stability and security of water conservancy projects. Therefore, it is of great significance to strengthen the exploration and research on the prevention and control measures of water and soil conservation in water conservancy projects.

2. The harm of soil and water loss

Soil and water loss refers to the process of removing soil from its original place in the form of water flow under the influence of natural erosion, human activities, and other factors, leading to land degradation and ecological environment deterioration [2]. This kind of loss not only affects the productivity of the land but also causes serious damage to the environment. Specifically, the harm of soil and water loss is mainly manifested as follows:

First, it will reduce agricultural productivity. Soil erosion will directly weaken the soil quality of cultivated land and greatly reduce the fertility of soil, which will have a certain impact on the growth of crops and lead to a decline in agricultural output, which is not conducive to the sustainable development of the agricultural industry. Second, it will aggravate the problem of water shortage. Soil erosion will lead to a large amount of sediment is washed into the river, the increase of sediment makes the transparency of the water body decreased, will not only affect the water quality, but also reduce the storage capacity of the reservoir and the available water resources, which will pose a threat to the safety of water supply, and even affect people's health.

Furthermore, it will exacerbate flooding. One of the most immediate consequences of soil erosion is the destruction of regional vegetation. Once vegetation is damaged, during the rainy season, the limited ground cover combined with steep slopes makes it difficult to effectively intercept and slow down surface runoff. As a result, the soil's ability to retain water is significantly reduced, increasing the risk of severe flooding [3]. However, if the precipitation intensity exceeds the permeability of the soil surface, it will lead to the formation of runoff on the ground, which may even cause serious flooding disasters and ultimately pose a greater threat to people's lives and property safety [4].

Additionally, it will destroy the surrounding ecological environment. Soil erosion is usually accompanied by changes in the structure of the ecosystem. For example, sediment accumulation can lead to the degradation of wetlands and water environments, resulting in reduced biodiversity. Additionally, the long-distance transport of sediment may damage ecosystems far from the erosion source, such as obstructing waterways and disrupting the habitats of aquatic organisms. These are direct manifestations of ecological and environmental degradation.

Lastly, it will greatly reduce the economic and social benefits of water conservancy projects. Once the sediment and plant residues produced by soil erosion enter the downstream river or reservoir with the water flow, it will reduce the flood discharge capacity of the river and the storage capacity of the reservoir. In serious cases, there may even be problems such as dam collapse, which will have a certain impact on the economic and social benefits of the water conservancy project.

3. Causes of soil and water loss in water conservancy projects

In the construction of water conservancy projects, the main reasons for soil erosion are as follows:

(1) During the construction period, operators generally need to frequently dig soil or move rocks; these operations are often accompanied by the risk of soil erosion [5]. In addition, if the operators do not pay enough attention to the disposal of waste soil and rock, it usually leads to the risk of soil erosion.

(2) In the construction process of water conservancy projects, it is usually necessary for operators to use large rolling equipment to compact the road. However, this approach can easily cause significant changes to the construction site's topography, landforms, surface vegetation, and other natural features. In severe cases, it may even disrupt surrounding underground runoff, greatly reducing the stability of the soil or mountain structure [6]. In this way, when encountering rainfall or prolonged gravitational effects, the ground is prone

to severe soil erosion problems.

(3) During construction, the ground and vegetation are usually damaged to varying degrees, which will not only upset the original balance between the two, but also reduce the erosion resistance of the soil structure. As a result, in the event of heavy rainfall or continuous erosion by daily water flow, it will directly lead to serious soil erosion.

4. Water and soil conservation work management technology

4.1. Structural control technology

In water conservancy projects, structural control technology is an important means of soil and water conservation work, mainly including engineering measures and ecological measures, aimed at effectively preventing and controlling soil erosion. The commonly used structural prevention and control means mainly include dam body, revetment, and so on [7]. Specifically, the dam body is usually set on the slope and river bed, and the relevant staff needs to be able to design its slope and height according to the terrain characteristics and hydrological conditions. Under normal circumstances, the height of the dam body is controlled at 1–3 meters to effectively intercept watershed runoff and reduce sediment loss.

Revetment technology is primarily a preventive and control measure aimed at mitigating soil loss along both sides of a river. Common methods include gabions, concrete blocks, and vegetation slope protection. Among these, gabion revetments can effectively enhance the stability of riverbanks, resist wave impact and river erosion. Typically, groups of gabions are installed at intervals of 50 meters, and trees are planted every 900 meters to form green belts, thereby reducing soil erosion [8]. Vegetation slope protection involves planting drought-resistant and deep-rooted plants to consolidate the soil, which not only helps beautify the environment but also effectively enhances the soil's resistance to erosion.

In addition, soil reinforcement and soil consolidation technology is also an important part of structural control technology. This technology mainly utilizes materials such as geotextiles, geomesh, and reinforced earth walls to enhance soil stability, reduce the risks of rainwater infiltration and soil liquefaction, and achieve more effective soil consolidation.

4.2. Vegetation restoration and control technology

Vegetation restoration and control technology is an effective technical means for soil and water conservation. In water conservancy projects, relevant workers can reduce soil erosion and improve soil quality by using plant roots to consolidate soil and conserve water sources. Under normal circumstances, we can choose some adaptive and developed roots of native plants for vegetation restoration, such as ash, Chinese ash, neem, etc., in order to effectively enhance the ability of soil erosion resistance. As for the planting density of these plants, it can usually be set to 300 to 500 plants per mu, so that the biomass per unit area can be effectively increased while ensuring the coverage [9]. When implementing the plant configuration of soil and water conservation functions, relevant staff need to fully take into account the growth habits and ecological niches of different plants, and rationally mix deep-rooted and shallow rooted plants to form a multi-level root network, such as strip, layered, or ribbon configuration. In the face of steep slopes and areas prone to landslides, plants with strong drought and wind resistance should be selected as far as possible, such as wild rhododendron and honeysuckle, to enhance slope stability.

4.3. Comprehensive treatment technology

In the comprehensive management of water and soil conservation in water conservancy projects, it can be

achieved mainly through the following measures:

(1) Source control

Source control mainly involves the reasonable planning and management of land use, actively promoting and publicizing crop rotation, fallow systems, and relevant laws and policies, while continuously enhancing public environmental awareness. These measures aim to improve soil structure, strengthen its ability to conserve water and soil, and ultimately reduce soil erosion.

(2) Process control

Process control refers to measures taken during specific stages to mitigate soil erosion. For example, during flood discharge, it is essential to carefully consider factors such as the volume of water released, the impact on flood discharge capacity, waste accumulation, and riverbed exposure. In flood prevention efforts, the construction of flood-resistant structures should prioritize vegetation restoration in idle areas and ensure the protection of flood-prone sections. Additionally, increasing vegetation coverage through afforestation and grassland restoration can effectively reduce surface runoff and enhance the soil's water storage capacity, thereby improving soil and water conservation during the process.

(3) Terminal management

Terminal management focuses on strengthening the monitoring and evaluation of soil and water resources to achieve dynamic and continuous management. In the process of soil and water conservation, a comprehensive monitoring network should be established to track changes in soil and water loss. By leveraging advanced technologies such as remote sensing, GIS, and other technical tools, real-time monitoring of soil erosion and the impact of water conservancy project construction can be achieved. Based on monitoring data, targeted regional control measures should be formulated according to the specific conditions of different areas, to ensure that water conservancy projects effectively fulfill their role in soil and water conservation [10].

4.4. Engineering protection technology

In the process of water conservancy project construction, soil and water conservation control can also be achieved by using engineering protection technology. For example, during construction, cut-off ditches can be set up to discharge wastewater and prevent its uncontrolled flow. In addition, when implementing soil and water conservation measures in material collection yards, materials can be gathered along designated lines or areas to minimize disturbance and reduce the unnecessary waste of water resources [11]. At the same time, the operators should reasonably formulate the mining mode according to the actual situation and establish a certain drainage channel, as far as possible to reduce the waste of resources and prevent the loss of water resources. This is the best way to better prepare for the later greening and flood discharge during the flood season.

5. Water conservancy project soil and water conservation prevention and treatment measures

5.1. Forestry measures

Forestry measures are an important measure of soil and water conservation prevention and control in water conservancy projects, which can effectively reduce soil and water loss and maintain ecological balance. First of all, the existing forest cover should be protected to ensure its integrity and health, which is an effective measure to reduce the risk of soil exposure to wind and water erosion. For degraded forests, forest coverage and stability can be continuously improved through forest restoration and vegetation reconstruction, to better maintain soil fertility

and water resources as well as achieve the purpose of gradually restoring soil and water conservation ability [12]. Among them, during this process, relevant personnel should reasonably manage forest cover, including optimizing and adjusting forest structure and density, as well as selecting and configuring appropriate tree species and vegetation. These measures can effectively reduce the impact of wind on soil erosion and slow down water flow velocity, thereby enhancing the soil's ability to resist erosion and improving overall ecological stability.

Secondly, forest fire prevention should be properly carried out by establishing firebreaks, regularly clearing combustible materials, and strengthening monitoring and management. These measures help reduce the occurrence of forest fires, thereby avoiding soil erosion and ecological damage caused by forest burning. And for the forest land that has been felled, exploited, or destroyed by other ways, the effect of forestry prevention and control should be effectively improved through land reclamation, soil restoration, afforestation, and other ways. Finally, we can also use the way of forest tending and management to strengthen the regular management and effective management of forest thinning, renewal, and tending activities, to further strengthen the effect of forestry prevention and management measures.

5.2. Agricultural measures

Agricultural measures play an important role in the prevention and control of water and soil conservation in water conservancy projects. From the present point of view, the common agricultural measures mainly include vegetation cover, intercropping, as well as soil and water conservation tillage technology. For example, by maintaining vegetation cover and intercropping, the risk of soil exposure to rain and water erosion can be greatly reduced. Furthermore, by introducing integrated forest and grassland agricultural management systems, such as farmland shelterbelt networks and gully forest networks, the soil environment can be effectively stabilized, thereby reducing soil erosion and enhancing ecological resilience. In addition, farmers in Shangri-La and other areas will take advantage of the local terrain characteristics to build terraces, which is also an important measure to solve the problem of soil erosion [13].

5.3. Engineering measures

Engineering measures play a key role in the prevention and control of water and soil conservation in water conservancy projects. At present, the common engineering measures mainly include gully control, slope protection engineering, construction of drainage system, construction of shelterbelt and so on [14]. For example, by building fixed structures or taking vegetation protection measures, soil slope erosion can be effectively avoided; Through the construction of drainage system, the water can be rationally discharged, which is conducive to avoiding soil liquefaction or landslide. IIn addition, by constructing earth and rock dams in the upper reaches of channels and rivers, rainfall runoff can be effectively intercepted, the flow velocity reduced, and the risk of soil erosion and scouring mitigated. This approach not only enhances soil moisture and provides a continuous water source but also contributes to stabilizing the soil environment and promoting vegetation restoration.

5.4. Ecological measures

At present, common ecological measures mainly include wetland protection and restoration, biodiversity protection, forest ecological restoration, and so on. For example, by protecting wetlands and restoring damaged wetlands, soil hydrologic regulation and water purification functions can be effectively improved, and the risk of soil erosion can be greatly reduced. A series of biodiversity protection measures such as the establishment of

protected areas and the protection of endangered species can well maintain the ecological balance and improve the stability of the ecosystem, to achieve the purpose of reducing soil erosion [15].

However, in this process, attention should not only be paid to the fertilization and irrigation of plants, but also to the prevention and control of diseases and pests. On the one hand, during the process of plant fertilization and irrigation, it is essential to ensure the proper application of fertilizers and rational use of water to provide sufficient soil nutrients and moisture for plants in the early stages of growth, thus preventing plant death caused by drought. Techniques such as drip irrigation or sprinkler irrigation can be adopted to improve water resource utilization efficiency and reduce unnecessary water waste.

On the other hand, in the control of plant diseases and pests, biological control and physical control can be used, such as the introduction of natural enemies insects to control pests. By setting traps to catch adult insects, the frequency of use of chemical pesticides can be effectively reduced, which is conducive to further improving the stability of the overall ecosystem. In addition, in the process of water conservancy engineering construction and vegetation conservation, attention should also be paid to the protection of soil structure. Heavy machinery should avoid directly working on the slope, to reduce soil compaction and improve soil permeability as well as water retention ability. At the same time, in the management of vegetation restoration, a regular monitoring mechanism is set up to evaluate plant growth and soil quality, and timely adjustment of conservation measures according to the monitoring results.

6. Conclusion

In short, in the view of green ecology, the development of the country's social economy must not be based on the destruction of ecological environment. Therefore, in the construction of water conservancy projects, the relevant operators should pay full attention to the development of soil and water conservation work as well as actively take scientific and effective prevention and control measures to protect the surrounding ecological environment. Specifically, the use of structural control technology, vegetation restoration and control technology, comprehensive management technology, engineering protection technology, engineering protection technology and other technical means should be used to strengthen forestry measures, agricultural measures, engineering measures, ecological measures of water conservancy engineering soil and water conservation effect, to promote our water conservancy to achieve high quality and sustainable development.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Liu J, 2024, Influence of Soil and Water Loss in Hydraulic Engineering Construction and Its Prevention Strategies. Water Safety, 2024(24): 166–168.

[2] Zhang Q, 2024, Analysis of Soil and Water Conservation and Sustainable Development in Hydraulic Engineering Construction. China Water Transport, 2024(24): 100–101+121.

[3] Gu Z, 2024, Application of Soil and Water Conservation in Hydraulic Engineering Construction. Value Engineering, 43(26): 158–161.

[4] Li F, 2024, Application of Soil and Water Conservation Technology in Hydraulic Engineering Construction. Science and Technology of Shanxi Soil and Water Conservation, 2024(1): 19–21.

[5] Luo R, 2023, Analysis of Soil and Water Conservation and Sustainable Development in Water Conservancy Project Construction. Agricultural Development and Equipment, 2023(10): 111–113.

[6] Wang C, 2023, Research on Prevention and Treatment of Water and Soil Conservation in Hydraulic Engineering. Water Safety, 2023(10): 76–78.

[7] Mao M, 2023, Analysis of Soil and Water Conservation and Sustainable Development in Water Conservancy Project Construction. Shaanxi Water Resources, 2023(4): 98–100.

[8] Chen A, 2023, Existing Problems and Countermeasures of Soil and Water Conservation in Farmland Water Conservancy Construction. Control of Huai River, 2023(3): 64–65 + 68.

[9] Hu S, 2023, Analysis on the Application of Soil and Water Conservation Technology in Water Conservancy Project Construction. Control of Huai River, 2023(1): 63–64.

[10] Li S, 2022, Case Study on Soil and Water Conservation Measures in Hydraulic Engineering. Value Engineering, 41(28): 8–10.

[11] Li X, 2022, Discussion on Comprehensive Control Measures of Soil and Water Loss in Water Conservancy Project Protection. Agricultural Development and Equipment, 2022(8): 122–124.

[12] Zhang G, 2022, Discussion on Soil and Water Conservation Measures in Water Conservancy Project Construction Area. Southern Agriculture, 16(12): 211–213.

[13] Liu A, 2021, Analysis of Soil and Water Conservation Management During Water Conservancy Project Construction Period. China High-Tech, 2021(23): 139–140.

[14] Lin X, Deng F, 2021, Exploration of Soil and Water Conservation Design in Water Conservancy Project Construction. Shaanxi Water Conservancy, 2021(11): 134–135 + 138.

[15] Fan M, 2021, Comprehensive Control Measures of Soil and Water Loss in Water Conservancy Project Protection. China Science and Technology Information, 2021(22): 57–58.