

Study on the Influence of Resource Development on the Soil and Water Conservation and Ecological Environment and Countermeasures

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Abstract. Through the influence on ecological factors such as geological features, soil, hydrology and vegetation, the resource development process reduces the ecological service function of soil and water conservation in resource production areas, and the soil and water ecological environment is destroyed. The smooth operation and the corresponding function of ecological compensation for soil and water conservation by resource development need the restraint of institutional norms, solutions and suggestions for this are put forward: establish a legal system for resource development and soil and water conservation, broaden the channels for compensation for resource development and soil and water conservation, implement the examination and approval system for soil and water conservation program, and strengthen the soil and water conservation monitoring system.

1. Introduction

The research on the impact of resource development on water and soil environment in China mainly focuses on soil erosion and various types of pollution, which can be summarized as two aspects: The first is to conduct quantitative research on soil erosion or pollution caused by a certain stage of mining or a certain mining technology. Second, based on the analysis of the problem of soil erosion caused by resource development in different regions, the cause and countermeasures are discussed. The impact of resource development on soil and water conservation and ecological environment should not be underestimated. The ecological compensation system for soil and water conservation with the characteristics of resource development industry is in the initial stage, and theoretical research is still in its infancy. The case study of regional and industrial soil and water conservation compensation has not formed a wide range of practical application system. The paper will start with the influence of soil and water conservation ecological factors, and expand the industry field of soil and water conservation compensation research from the perspective of resource development.

2. Impact of Resource Development on Ecological Factors of Soil and Water Conservation

The direct purpose of soil and water conservation is to prevent soil erosion, the fundamental purpose is to maintain the ecological service function of the water and soil environment. Resource development affects the ecological service function of soil and water conservation by acting on ecological factors such as geological features, soil, hydrology and vegetation. The resource development process triggers changes in the ecosystem components and reduces the ecological service functions of soil and water conservation in resource production areas, therefore destroying the water and soil ecological environment.

2.1 Terrain Changes

Resource development activities, both above and below ground, can lead to changes in surface configuration. The above-ground activities will directly change the geological and geomorphological forms, resulting in changes in surface slope, slope direction, slope length, roughness and undulation. Underground activities are more concealed, and it may take some time to show the impact, which can also cause surface deformation, such as ground uplift, surface collapse, ground fracture, etc. The specific performance is: on the one hand, the stability of the earth's surface is reduced. Unreasonable resource development activities may induce disasters such as landslides, ground collapse, slope collapse, etc. For example, a large number of exploration and mining on hillsides will make the slope steeper and may accelerate collapse and landslide. The development causes natural vegetation to be slashed and cut, the soil loses its function of retaining, and the erosion resistance is greatly reduced. Once it encounters strong winds or rainfall, it is easy to cause natural disasters such as mudslides, etc. On the other hand, soil and water conservation facilities are destroyed. When the terrain changes greatly, it will cause a large-scale change of the surface configuration, the soil and water conservation facilities will be seriously damaged, and the ecological service function of the regional soil and water conservation will be impaired. For example, ground collapse and uplift caused by underground coal mining will cause various soil and water conservation facilities such as terraced fields, silt arrester, intercepting drains and water cellar that have been built on the ground to be directly damaged. When the damage is serious, such as surface cracks, the roots of the plants will be broken, causing extensive degradation and death of the vegetation. Vegetation damage will in turn further aggravate the damage of soil and water conservation ecological service function, resulting in further deterioration of the ecological environment.

2.2 Soil Changes

Soil is the substrate and matrix of terrestrial plants. Soil not only provides the necessary nutrients for the plants to survive and accumulates water, but also is the habitat for the soil animals. Any direct or indirect damage to the soil can be said to be a disruption of ecosystem services. On the one hand, there is soil pollution. Oil and gas resources development resulted in crude oil contaminated soil scattered on the ground due to oil testing, well construction, well washing, oil well overflow and pipeline leakage. After the soil is contaminated, the pollutants are absorbed by the plants and accumulate in the plants, which affects the growth and development of the plants, may lead to genetic variation, and may enter the human body through the food chain, endangering human health. After the soil is polluted, its pollutants will also enter the underground river surface water body due to rainwater scouring, leaching, leakage, thus polluting the water source. On the other hand, there is soil compaction. Soil compaction is the process by which soil compaction and structural failure result in the loss or decline of one or more functions of the soil. At present, Daqing Oilfield conducts a large-scale hydraulic fracturing for some single wells every one to three years, and each large-scale hydraulic fracturing take up about 8,000-9,000 square meters of land. The vehicle group needs to transport fracturing equipment, lay fracturing pipelines and construct reservoirs for fracturing preparation, and continue to occupy the surface during fracturing. The vehicle rolls over the land back and forth, changing the compactness and permeability of the soil, destroying surface vegetation and farmland. Ground hardening is a serious manifestation of soil compaction, after compaction, the internal pores of the soil structure are sharply reduced, the compactness is increased, the soil structure is destroyed, and the structural stability is weakened. The soil infiltration rate after compaction is significantly reduced, and the surface layer is susceptible to water erosion.

2.3 Hydrological Changes

The benign cycle of water on the land surface is an important indicator of the ecological service function of soil and water conservation in terrestrial ecosystem. The goal of soil and water conservation is not simply to store water, but to maintain and promote the efficient recycling of water in ecosystems. Production and construction activities such as resource development change the natural environment and affect the process of water circulation more and more strongly. On the one

hand, water resources are consumed in large quantities. Water flood recovery causes excessive consumption of water resources and occupies ecological use of water. In 2018, Daqing Oilfield had 46,600 injection wells, with high-intensity water injection of 40-50 million tons per year, forming a regional large-scale underground funnel. China's water resources are unevenly distributed in time and space. In most areas, water resources are seriously depleted. The excessive consumption of water resources by industrial and agricultural production and life has occupied a large amount of ecological use of water, resulting in land desertification, and serious damage to ecosystems. On the other hand, groundwater level declines. Groundwater is the main source of water for the growth and development of natural vegetation. Groundwater depth directly affects the soil moisture and nutrient dynamics closely related to vegetation growth, and is the dominant factor determining the distribution, growth and population succession of surface vegetation. When human factors (such as underground mining) cause the groundwater level to drop, it will affect the effective and continuous replenishment of surface soil water. The drop in groundwater level may cause a large area of underground funnel area, causing land subsidence, collapse and ground fissures, and damage to the surface soil and water conservation facilities.

2.4 Vegetation Changes

Vegetation plays an important role in the soil and water conservation ecological service function of ecosystems. It can not only change the flow pattern, reduce soil erosion caused by wind by reducing the wind speed, but also can consolidate the soil with a strong root network in the soil to reduce loss speed. Therefore, vegetation changes have a greater impact on soil and water conservation ecological service function. On the one hand, resource development activities on the ground inevitably disturb the surface, directly destroy the landform vegetation, or indirectly lead to vegetation death. The reduction of vegetation area caused by vegetation damage, including the decline of coverage and canopy density, making the surface exposed a lot, the soil loses the fixation protection of litter layer, canopy and root system of vegetation, causing severe wind erosion, water erosion and even gravity erosion. On the other hand, plant community is degraded. After the completion of the resource development activities, although the artificial vegetation will be reconstructed for some temporary land occupation, due to the single species of reconstruction, the short age and less forest layers, it is difficult to restore the soil and water conservation ecological service function of the original landform vegetation in the short run. When natural vegetation is replaced by artificial vegetation, the diversity of species is destroyed, the population of animals and plants is reduced, and the ecosystem becomes extremely unstable.

3. Countermeasures

Resource development has caused many problems in soil and water conservation and ecological environment. The smooth operation and the corresponding function of ecological compensation for soil and water conservation need the restraint of institutional norms, solutions and suggestions for this are put forward.

3.1 Establish a Legal System for Resource Development and Soil and Water Conservation

The soil and water conservation and ecological compensation is inseparable from systematic legal system norms. The legal basis for the compensation for soil and water conservation in China's current resource development is mainly the Water and Soil Conservation Law revised in 2011 and the Administrative Measures on the Collection and Use of Soil and Water Conservation Compensation Fees issued in 2014. There is a legal system that is not perfect, it is recommended to improve and revise it with the Water and Soil Conservation Law and the Administrative Measures on the Collection and Use of Soil and Water Conservation Compensation Fees as the core, reflect the specific provisions on the ecological compensation for soil and water conservation in oil and gas resources development In other environmental protection laws, and add relevant laws and regulations on soil and water conservation. For the development of resources, the Mineral Resources Development Law should be further introduced to implement a strict mining examination and

approval system; after years of historical accumulation, improve the relevant legal system for soil and water conservation, and introduce a number of laws to refine water, soil, sand, disaster and other works, such as the Water Resources Protection Law, which aims to protect water resources and improve water environment, the Law on Prevention and Control of Soil and Sand Disasters, which takes prevention and control of soil and sand disaster as the basic policy, and the Law on Prevention and Control of Landslides that prevents and controls slope landslide, etc. Built a legal environment to protect water and soil resources with the strictest legal system in an all-round way, and accelerate the establishment of a complete legal system for soil and water conservation.

3.2 Broaden the Ways of Compensation for Soil and Water Conservation in Resource Development

The main way for China's compensation for soil and water conservation in resource development is the government's vertical financial allocation. The main source of funds comes partially from the state financial subsidies, and partially comes from administrative fees, and the way of compensation is narrow. Multi-channel, multi-faceted, and multi-participation in the compensation work for soil and water conservation, and improve the compensation mechanism. On the one hand, ensuring the full collection of compensation funds should be considered, make sure that the main way of government compensation can play a smooth role. On the other hand, based on the experience of prevention and control by various means abroad, an ecological compensation fund with the characteristics of oil and gas industry and radiating the whole country should be established. Through the establishment of special fund for ecological protection, a regional and industry eco-environmental sub-fund should be established to promote the protection and restoration of ecological environment, environmental protection industry development and environmental protection infrastructure construction, etc. Third, encourage resource development enterprises to help it self to compensate. The tax paid by enterprises are fed back to enterprises for environmental restoration to realize different compensation conditions selected for the interests of different resource enterprises. The compensation channel should be extended from the state to the society and enterprises and they should participate widely to complete the compensation work together.

3.3 Implement the Examination and Approval System for Soil and Water Conservation Program

The report of the 19th National Congress of CPC pointed out: in a certain period of time in the future, China will still be in a critical period of rapid development. Strengthening the monitoring and controlling of soil and water conservation in the resource development process and managing and controlling the impact on ecological environment are important responsibilities for soil and water conservation in the new era. It is necessary to strictly enforce the water and soil conservation program examination and approval system, and the water administrative department should limit approval of water and soil conservation plan for production and construction projects in the area where the soil and water conservation ecological service function is significantly reduced, the soil and water loss situation is seriously deteriorated, and the ecological protection red line areas that divided into nature reserves, drinking water source reserves, important wetlands and others. In terms of strengthening management and strict control, supervision and management of activities such as soil unloading, sand excavation, kiln burning and road repair should be strengthened. In the case of mineral resources exploration, mining and other production, construction and management activities that require excavation of mountain bodies, resource development enterprises should go through relevant examination and approval procedures in accordance with the law and take effective measures to prevent geological disasters, environmental pollutions and the soil and water loss, and do a good job in soil and water conservation and vegetation restoration as well as land reclamation work.

3.4 Strengthening Soil and Water Conservation Monitoring System

On the one hand, accelerate the establishment and implementation of a dynamic monitoring system for soil and water loss. Accelerate the establishment of soil and water loss monitoring and evaluation system by provincial local governments, carry out dynamic monitoring of soil and water loss, provide

support for regional ecological security warning of soil and water loss, and implementation of the target responsibility system of water and soil conservation of municipal and county governments in accordance with the law as well as assessment of rewards and punishments. On the other hand, improve soil and water conservation tracking and monitoring technology. Optimize, adjust and upgrade the existing monitoring station network, and build a monitoring network with reasonable layout, complete functions and synergy. Accelerate the deep integration of intelligent technology and soil and water conservation monitoring work, comprehensively apply methods and means such as geographical remote sensing, ground observation, sampling survey, etc., and vigorously promote the application of UAV monitoring, multi-scale remote sensing, GIS technology, mobile acquisition systems, automatic testing and data transmission equipment in the dynamic monitoring of soil and water loss. Comprehensively construct a long-term mechanism for soil and water conservation monitoring and forecasting, and a new model of soil and water conservation development with dynamic feedback and intelligent decision-making abilities, which will provide a basis for comprehensive control of soil and water loss and macro-decision of ecological civilization construction in the new era.

4. Conclusion

The resource development process disturbs the original natural environment, geological features and hydrological conditions of resource-rich areas, and induces natural disasters such as soil desertification, grassland degradation, water pollution, aggravated erosion, etc. caused by soil and water loss, and becomes one of the main factors that affecting soil and water conservation and ecological service function in resource production areas. China's resource development ecological compensation for soil and water conservation is not only a problem that can be solved by "soil and water conservation compensation fees", legal support needs to be replenished, examination and approval system needs to be improved, and the soil and water conservation monitoring system needs to be followed up. Production and construction activities such as resource development threaten soil and water conservation, and the accountability mechanism and compensation system for soil and water conservation based on industry characteristics need to be further explored and improved.

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