

The Role of Forest Carbon Sinks in Climate Change Mitigation

Introduction

Climate change has emerged as a critical global environmental and societal challenge, with rising greenhouse gas concentrations driving global temperature increases, extreme weather events, ecosystem degradation, and socio-economic risks. Forests, as major terrestrial carbon sinks, play a crucial role in the global carbon cycle by absorbing atmospheric carbon dioxide (CO₂) through photosynthesis. Estimates indicate that global forests sequester approximately one-third of human-induced CO₂ emissions annually, highlighting their significant potential in climate change mitigation.

The formation of forest carbon sinks depends on forest type, species composition, growth rates, and land management practices. Natural forests, plantations, and urban green spaces differ in their carbon sequestration capacity, and carbon fixation rates vary across growth stages. Sustainable forest management, afforestation, and restoration of degraded lands can increase biomass carbon storage, enhance ecosystem services, protect biodiversity, and improve ecosystem resilience. Moreover, forest carbon sinks can be integrated with carbon trading and credit mechanisms, providing economic incentives for climate policies and green economic development.

However, challenges exist in realizing the mitigation potential of forest carbon sinks. Deforestation, land-use changes, wildfires, and pest outbreaks can reduce carbon stocks and release significant amounts of CO₂. Additionally, climate change itself affects forest growth and carbon fixation capacity, increasing the uncertainty of carbon sequestration. Accurate assessment, long-term monitoring, and scientifically informed management strategies are therefore essential to maximize forest carbon sink contributions.

This study aims to systematically analyze the role of forest carbon sinks in climate change mitigation, focusing on the carbon sequestration potential of different forest types and management practices. Furthermore, it explores the integration of forest carbon sinks into global and regional climate policies, carbon markets, and sustainable development objectives, providing theoretical and practical guidance for effective forest management and climate mitigation strategies.