



DECLINING EFFICIENCY OF NATURAL CARBON SINKS AND ITS IMPLICATIONS FOR GLOBAL CLIMATE REGULATION

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The Earth has long relied on a quiet, powerful system to keep the climate in balance. Forests stretch across continents, oceans cover more than two thirds of the planet, and together they act as natural carbon sinks, absorbing a large share of the carbon dioxide humans release into the atmosphere. For decades, these systems have slowed the pace of global warming, buying humanity precious time. But recent scientific observations suggest that this natural defense is beginning to weaken. Researchers now estimate that forests and oceans are about 20 percent less effective at absorbing carbon than they once were, a shift that could have profound consequences for the future of the planet.

To understand why this matters, it helps to consider the role these systems play. When carbon dioxide is released through activities like burning fossil fuels or deforestation, a portion remains in the atmosphere, trapping heat and driving climate change. Another portion is absorbed by natural sinks. Forests take in carbon dioxide during photosynthesis, storing carbon in their trunks, roots, and soils. Oceans absorb carbon dioxide directly from the air, where it dissolves in seawater and is used by marine organisms or stored in deep ocean

layers. Without these processes, the concentration of greenhouse gases in the atmosphere would be significantly higher, and global temperatures would have risen much faster.

However, these systems are not infinite in their capacity. Forests, for instance, are increasingly under stress. Rising temperatures, prolonged droughts, and more frequent wildfires are weakening their ability to absorb carbon. In some regions, forests are even beginning to release more carbon than they store. Parts of the Amazon rainforest, once considered one of the world's most important carbon sinks, have shown signs of this troubling reversal. Deforestation and land degradation further compound the problem, reducing the total area available to capture carbon and disrupting ecological balance.

The oceans are facing a different but equally serious set of challenges. As they absorb more carbon dioxide, their chemistry changes in a process known as ocean acidification. This affects marine life, particularly organisms like corals and shellfish that rely on calcium carbonate to build their structures. Warmer ocean temperatures also reduce the efficiency

of carbon absorption, as warmer water holds less dissolved gas. In addition, changes in ocean circulation can limit the movement of carbon from surface waters to the deep ocean, where it can be stored for long periods.

The weakening of these natural sinks creates a dangerous feedback loop. As forests and oceans absorb less carbon, more of it remains in the atmosphere, accelerating global warming. This, in turn, places further stress on the sinks themselves, reducing their capacity even more. It is a cycle that, if left unchecked, could make it increasingly difficult to stabilize the climate, even with significant reductions in human emissions.

This emerging reality challenges a long standing assumption in climate policy. Many strategies to limit global warming have relied, either explicitly or implicitly, on the continued strength of natural carbon sinks. If these systems are losing efficiency, then the margin for error becomes much smaller. Emission reductions will need to be deeper and faster to compensate for the reduced buffering capacity of the planet.

At the same time, the weakening of natural sinks highlights the importance of protecting and restoring ecosystems. Forest conservation is no longer just about preserving biodiversity or supporting local communities, though those remain vital goals. It is also about maintaining one of the planet's most effective climate regulators. Reforestation and afforestation efforts can help, but they must be carefully planned to ensure ecological integrity and long term resilience. Planting trees alone is not a simple solution if those trees cannot survive in a changing climate.

Similarly, protecting ocean health is critical. Reducing pollution, managing fisheries sustainably, and addressing climate change itself can all help maintain the ocean's ability to absorb carbon. Efforts to restore coastal ecosystems such as mangroves, seagrasses, and salt marshes are particularly promising. These environments, often referred to as blue carbon ecosystems, can store large amounts of carbon while also providing protection against storms and supporting biodiversity.

Technological solutions are also being explored to supplement natural sinks. Carbon capture and storage technologies aim to remove carbon dioxide directly from industrial sources or even from the atmosphere. While these approaches are still developing and come with their own challenges, they may become an important part of a broader strategy to manage carbon levels. However, they cannot replace the complex and interconnected functions of natural systems.

The growing evidence that natural carbon sinks are weakening serves as a stark reminder of the limits of the Earth's resilience. It underscores the urgency of addressing climate change at its source by reducing greenhouse gas emissions. It also calls for a more integrated approach that recognizes the interconnectedness of climate, ecosystems, and human activities.

There is still an opportunity to act. Forests can recover if given the chance. Oceans can regain balance if pressures are reduced. But time is a critical factor. The longer the delay, the greater the risk that these systems will reach tipping points beyond which recovery becomes much more difficult.

In many ways, natural carbon sinks are like a silent partner in the fight against climate change. They have worked quietly in the background, absorbing the excesses of human activity. Now, as their strength begins to wane, their importance is becoming impossible to ignore. Protecting and restoring these systems is not just an environmental priority, it is a fundamental requirement for maintaining a stable and livable planet.