

The Role of Carbon Removal and Certification Standards for Biochar in Climate Change Mitigation

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Introduction

According to the IPCC's 2022 Climate Change Mitigation Assessment Report (AR6), achieving net-zero greenhouse gas (GHG) emissions is projected to be feasible between 2070 and 2075 under the 1.5°C scenario. Carbon removal (CDR) is categorized into biological (terrestrial and marine) and chemical (DACCS) methods. Among them, land-based biochar (AR, BECCS, Biochar, SCS, etc.) is recognized as a significant carbon removal measure. The EU has set a target of reducing GHG emissions by 55% by 2030 (NDC) and is implementing the 'Fit for 55' package, which includes amendments to the LULUCF law, sustainable carbon cycle policies, and a carbon removal certification system. Korea has also incorporated biochar into its Agricultural and Food Carbon Neutrality Promotion Strategy. However, clear standards for biochar quality and its carbon removal performance are lacking. This study analyzes biochar's carbon removal function and EU policies based on the IPCC assessment report and discusses the role of biochar and the need for certification standards.

Materials and Methods

This study examines certification standards established by international non-profit organizations such as the International Biochar Initiative (IBI), the European Biochar Certificate (EBC), and the Japan Biochar Association (JBA). The IPCC revised its Greenhouse Gas Inventory Guidelines in 2019 to recognize biochar as a carbon removal method, enabling it to be traded in carbon markets. We compare certification standards from IBI, EBC, and JBA and evaluate methodologies for assessing carbon removal performance.

Discussion

Since the revision of the IPCC guidelines in 2019, research on biochar production and carbon sequestration has been actively conducted, alongside the development of regulations on raw materials and quality certification. Biochar feedstocks are classified into unused biomass and waste biomass, with EBC recognizing a broader range of feedstocks than IBI and JBA. Ensuring quality certification is crucial to mitigating potential limitations on carbon sequestration and utilization, such as toxicity from feedstocks. The IPCC's methodology for assessing biochar carbon sequestration estimates changes in soil organic carbon accumulation based on pyrolysis temperature ($\geq 350^\circ\text{C}$) and feedstock type. This methodology aligns with certification criteria established by IBI and EBC. In Korea, certification standards should incorporate key IPCC parameters, such as organic carbon content (FC_p) and 100-year survival rate (F_{permp}).

Table 1. Basic characteristics of biochar by certification organization

Organi-zation	Basic characteristics
IBI	· C_{org} : 10% or more · H/C_{org} : less than 0.7
EBC	· H/C_{org} : less than 0.7 · O/C_{org} : less than 0.4
JBA	· Volatile content/hardly decomposable carbon content : less than 0.6

· In common, the thermochemical temperature is 350°C or more
· As a thermochemical process, torrefaction and HTC are excluded (based on EBC)

Conclusion

Carbon removal, along with GHG reduction, plays a critical role in climate change mitigation, with land-based biological CDR becoming increasingly significant. The EU is implementing legislative measures such as LULUCF amendments, sustainable carbon cycle policies, and a carbon removal certification system, with carbon farming at its core. IBI and EBC are leading biochar certification standards, with EBC establishing criteria for various applications beyond soil amendment, including material and product use. EBC's approach, which aligns with EU-level hazard assessment laws (REACH) and member state regulations, provides policy insights. Japan is also pursuing carbon neutrality strategies, emphasizing the need for scientific validation and certification standards for biochar. Future research will examine international trends and methodologies in carbon emissions trading to expand the biochar market.

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