# Assessment of Biochar Application to Cropland Based on Carbon Footprint

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## Introduction

Aligned with the global "4 per 1000" soil-carbon initiative, biochar (a carbon-rich product of heating biomass) is applied to cropland to sequester carbon [1]. In conventional assessments, the carbon-sequestration effect is evaluated by comparing the carbon content of biochar at production versus the carbon applied to soil. However, in Japan biomass for biochar often comes from pruning branches, and the carbon emissions of harvesting and transporting this biomass are seldom included in evaluations. To address this, we develop a method that explicitly accounts for biomass source location and transport emissions in the carbon-footprint of biochar.

## Experimental Procedures

This study focused on Sakura City, Chiba Prefecture (35°40'N, 140°10'E; 103.7 km²), selected for its active municipal efforts in biochar use for decarbonization and agriculture. Carbon sequestration was calculated following MAFF guidelines. The fixed carbon content of bamboo charcoal was set at 0.778 [2], with a carbonization yield of 1 t charcoal from 4 t dried bamboo [3]. Emissions from carbonization were assumed to be 1.0 t-$CO_2$/t-char [4]. Transport emissions were calculated for a Suzuki Every light truck (payload 350 kg; 110 g-$CO_2$/km) (Suzuki Motor Corporation, 2023). Two scenarios were evaluated: (i) fresh bamboo transported before drying/carbonization, and (ii) pre-dried bamboo transported from the forest to cropland.

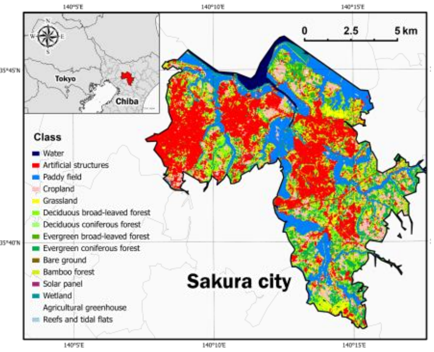


Figure 1 Land-use distribution of Sakura City

## Results and Discussion

For a 350 kg payload, the break-even distance (B/C=1) was 226.0 km in the fresh-bamboo scenario and 443.5 km in the pre-dried scenario. The same pattern held for 50, 100, and 200 kg payloads, with distances scaling nearly linearly, showing that pre-drying almost doubled the feasible transport radius. These results highlight how distance and payload strongly determine net carbon benefits. Even with modern kilns emitting only 1.0 t-$CO_2$/t-char, transport quickly offsets gains. Thus, only biochar sourced within the break-even radius yields positive sequestration. Integrating such distance-based B/C evaluation into a Web-GIS can guide planners to locate areas where bamboo biochar use remains climate-effective.

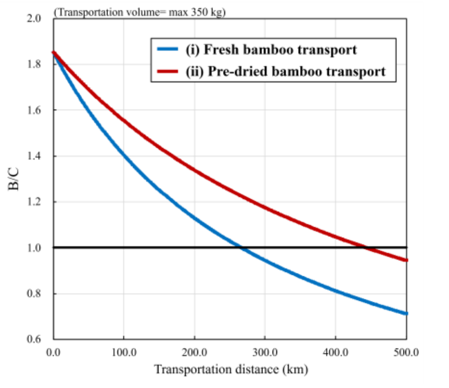


Figure 2 B/C ratio of bamboo charcoal under fresh-bamboo and pre-dried transport scenarios.

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## References

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