Assessment of Soil Carbon Stock Changes due to Land Use Changes and Its Application to National Greenhouse Gas Inventories

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[Abstract]

Key Words: Land-use change, Soil carbon stock change, Equivalent soil mass, Method for measuring activity, National Gas Inventory Report

In the National Greenhouse Gas Inventory Report (NIR), the amount of change in soil carbon due to changes in land-use needs to be reported for 20 years for land with land-use change. In this study, our objectives were to provide land-use factors for all land-use changes in soil carbon content, especially between land used for settlements and forest land / cropland.

Soil surveys were conducted using the paired sampling method to compare soil carbon stock at a depth of 0-30cm between land-use categories, such as cropland (tea gardens and orchards), grassland, and forest land. Soil carbon stock was measured by using the equivalent soil mass method as recommended in the IPCC guidelines. Because the land-use change factor between forest land and cropland showed a linear change in line with the number of years that had elapsed since the land-use change occurred, we recommend that the land-use factor from cropland to forest land is 1.21, and from forest land to cropland is 0.77 for a period of 40 years.

To obtain the average soil carbon stocks in Japan for settlements, soil surveys were conducted at more than 30 locations nationwide. Based on these results, the initial values for carbon content right after land development were estimated at 20.8 tC/ha (from forest land) and 22.9 tC / ha (from cropland). We evaluated the effect of vegetation cover after land development, and the average carbon stock for settlements was calculated to be 30 tC/ha.

Challenges and good practices related to inventory reporting in other countries were also identified through expert hearings and online questionnaire surveys. Based on these, an estimation method integrating the results of each sub-theme was developed for Japan's GHG inventory. The estimation method developed in this study was approved by the Committee for Greenhouse Gas Emissions Estimation Methods of Japan and is expected to be used for the Japan's GHG inventory to be submitted in April 2023. As a result, the accuracy of Japan's GHG inventory for land use, land-use change, and the forestry (LULUCF) sector is expected to improve by about 10% of net removals in the same sector.

A land-use classification that subdivides land cover in settlement land was developed by satellite image classification through deep learning, and was applied to identify areas of land-use changes between settlements and other land uses. A method for estimating GHG emissions and removals based on the land-use classification was proposed.

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