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Estimating CO_2 Sequestration by Forests in Oita Prefecture, Japan, Combining LANDSAT ETM+ and ALOS Satellite Data

SANGA-NGOIE Kazadi[1], IIZUKA, Kotaro[1*], KOBAYASHI Shoko[1]

[1]Graduate School of Asia Pacific Studies, Ritsumeikan Asia Pacific University

Carbon sink, which is one of the alternative methods for reducing CO_2 emission, as mentioned in the concept of Kyoto Mechanism, is very important in the current research context, considering that 68.9% of lands in Japan is covered by forests (OECD, 2004). While many Prefectures in Japan have been researching about the forests sequestration and have come up with policies for the implementation of reducing CO_2, still many others have not yet been involved in such processes although they have a great amount of forest cover. Oita Prefecture is one of them.

The final objective of this research is to re-assess the estimation of CO_2 sequestration by the forests in Oita Prefecture by evaluating forests extents and by quantifying their potential storage capacity using GIS and remote sensing techniques. This research is done in 3 steps: (1) Producing a detailed land cover map using satellite remote sensing data; (2) Analyzing the status of the forests (tree age) using satellite remote sensing data, and (3) Estimating CO_2 sequestration by the forest covers by combining the information obtained in steps 1 and 2.

LANDSAT ETM+ (May 25, 2002 and Dec 30, 2006) and ALOS PALSAR (Sep 15, 2009 and Oct 14, 2009) satellite remote sensing data covering the study area were acquired and were analyzed using IDRISI Taiga, the GIS software platform. Hybrid classification based on maximum likelihood method was performed for producing a detailed land cover map, and the areas were calculated for each forest type (coniferous, deciduous broadleaf and evergreen broadleaf forests). First, CO_2 sequestration for each forest type was calculated using the sequestration value per unit area multiplied by the total forests area. A total sequestration of 6.6 $MtCO_2$/yr was obtained: 3.56 $MtCO_2$/yr for Coniferous; 0.77 $MtCO_2$/yr for Deciduous-Broadleaf; 2.25 $MtCO_2$/yr for Evergreen-Broadleaf. Second, through a deeper analysis, the stem volume of the forested area was estimated by using the backscattering intensity information derived from the PALSAR image to find out the tree age for each forest type in order to estimate precise sequestration. Coniferous and deciduous broadleaf forests were classified into categories per ages and the sequestration re-estimated. We obtained 2.9 $MtCO_2$/yr and 0.3 $MtCO_2$/yr for coniferous and deciduous broadleaf forests, respectively.

These results show the importance of considering not only the forest type, but also the tree age for more precise CO_2 sequestration estimates, and therefore for avoiding overestimation of the forests sequestration capacity. They also show that analysis using LANDSAT and PALSAR data can provide better information on the status of the forests, helping thus for sound decision making and for more effective planning in resource management over time.

Keywords: Remote Sensing, CO2, GIS, Land Cover, SAR, Sequestration