Carbon Inventory Methods: Handbook for Greenhouse Gas Inventory, Carbon Mitigation and Roundwood Production Projects

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Carbon Inventory Methods
Handbook for Greenhouse Gas Inventory, Carbon Mitigation and Roundwood Production Projects

Springer

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Preface

Global awareness of environmental issues has increased on an unprecedented scale. Deforestation, land degradation, desertification, loss of biodiversity, global warming and climate change are some of the environmental issues linked directly to terrestrial ecosystems, both natural and human-managed. Forests, grasslands and croplands constitute over 63% of the global land area. Terrestrial ecosystems play a critical role in the global carbon cycle. Global rise in demand for food, fodder, fuel and roundwood is increasing the pressure on land-use systems, and conservation and sustainable development of land-use systems are critical for meeting those demands sustainably and stabilizing CO_2 concentration in the atmosphere to mitigate global climate change.

My interest in carbon flows in forest ecosystems was initiated about 15 years ago with the global concern about the contribution of the growing CO_2 emissions to climate change. My first paper about carbon flows was published in 1996 in *Climatic Change*; since then my interest and the global interest have only increased (R).

My participation in the preparation of IPCC reports on *Greenhouse Gas (GHG) Inventory Guidelines* as a member of the team of authors responsible for the *Revised 1996 IPCC Guidelines* (Land Use Change and Forestry – LUCF), 2003 (Land Use Land-Use Change and Forestry – LULUCF) and 2006 (Agriculture, Forests and Other Land Uses – AFOLU) cemented my interest in carbon inventories, which was stimulated further by my contribution to the *Special Report of IPCC on Land Use Land-Use Change and Forestry* (LULUCF) and the third and fourth assessment reports of IPCC. Participation in preparation of the IPCC GHG inventory guidelines, their application for carbon inventory and review of their use across a large number of countries sowed the seeds of a carbon inventory methods manual, since I knew what IPCC guidelines provided and what was needed by the inventory experts to prepare the inventory for land-use systems, as all countries are required to prepare a carbon inventory for land-use categories as a part of their GHG inventory (R).

Secondly, in the global efforts to address climate change, there is huge interest in the critical role land-use systems can play in stabilizing CO_2 concentration in the atmosphere. However, efforts to consider land-based mitigation projects are constrained by uncertainties and by limitations of methodology and data. Any climate

change mitigation project that is part of land-based projects requires carbon inventory. Large spatial and temporal variations in the stocks, accumulation rates and losses of the five carbon pools and even within a single vegetation type such as an evergreen forest, grassland and eucalyptus or pines plantation complicate the methods of estimation of carbon benefits. Mitigating climate change through land-use systems requires reduction of emissions from land-use sectors, removal of CO_2 from atmosphere and storing it in vegetation and soil and using biofuels to replace fossil fuels. Such carbon benefits should be permanent and sustainable, but they could be lost by clearing forests, burning biomass, land-use change or even simply disturbing the topsoil. Further, protection of forests in one area could lead to loss of forests and leakage of carbon benefits in another area. Addressing such issues requires methodological and accounting approaches, and a carbon inventory is at the heart of these approaches.

Thirdly, commercial roundwood production as well as community forestry projects require estimation of carbon, particularly in biomass and growth rates of timber and fuelwood production. Finally, grassland improvement, watershed development, land reclamation and halting desertification programmes require carbon inventory.

From a teaching and research perspective, the need for a handbook designed for academic courses and research projects has been obvious during our research and teaching career. This applies to projects aimed at land-use change, vegetation assessments and biomass inventory, where limitations of time, money and experience exist. With this handbook, we hope to help teachers, students, researchers as well as project developers in this process. The aim is also to give adequate background to the methods that can act as a basis for teaching and application for land-use and vegetation inventories.

There are textbooks for professionals, for example, on forest inventory or on soil chemistry. We always wondered why manuals of simple carbon inventory methods are not available despite the need for such practical guidance for a large variety of institutions and individuals. The manual should provide step-by-step guidance on methods of estimating carbon stocks and rates of change to project developers, reviewers, evaluators and, most important, to the beneficiaries, such as industry plantation managers requiring roundwood as raw material, rural communities requiring fuelwood or timber and climate change mitigation project stakeholders.

This handbook is prepared to provide a simple approach to carbon inventory from the perspective of the user covering all aspects of the inventory process at all stages of project conceptualization, planning, proposal development, appraisal, implementation, monitoring and evaluation. The approaches, methods and steps could be applied equally to generating values of carbon stocks and rate of change for carbon emissions and removals for national greenhouse gas inventory estimation as a supplement to the IPCC GHG Inventory Guidelines.

Carbon inventory methods are dynamic and new techniques are being developed and made available. For example, application of remote sensing techniques could become more cost-effective and user-friendly for large-scale applications with technological developments. But traditional methods are robust and simple to adopt

and will always be in use. Very often, default data are used in carbon inventory preparation for stock and rate of growth values of different carbon pools. We have attempted to provide valuable sources of default data and approaches to selection and validation of data from different sources.

We were in a dilemma when it came to deciding between the levels of simplicity and detail and hope we have achieved a right balance for the users. We have resisted the temptation to increase the complexity and length of the handbook and have stayed within reasonable limits. For convenience of the user – but at the cost of being repetitious in places – we have attempted to make some chapters self-contained; these are therefore "stand-alone" and can be read independently of the rest of the book. There is a need to change the perception that carbon inventory in land-use systems is contentious and complex and involves large uncertainties. We hope this handbook will go a long way in helping all the potential users in making carbon inventories for different programmes, mechanisms and end uses.

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Acknowledgements

This handbook is a result of my long-term collaboration with a large number of authors of several reports of the Intergovernmental Panel on Climate Change, and I cannot risk taking any names, since there are so many of them and I am sure to miss a few. In addition, my work in many developing countries on greenhouse gas (GHG) inventory estimation and carbon mitigation potential assessment in land-use sectors has given me greater insights into the need for a handbook. I am grateful to many of them: the number of such countries is again very large. My effort in preparing a guideline for UNDP-GEF on a manual for carbon inventory also gave me the idea to develop a handbook, for which I am grateful to Richard Hosier and Bo Lim. Further, I and Bo Lim had realized the need for a Handbook during our work for IPCC Report on Land-Use, Land Use Change and Forestry (R).

This book would not have been possible without the dedicated support of many of our colleagues: first, Indu Murthy, who worked so devotedly at various stages of the preparation of this handbook; second, Niranjan Joshi, who gave incisive comments on the draft of this handbook; third, Yateendra Joshi, who was a friendly and efficient copy editor; and, finally, K.S. Murali, R. Chaturvedi, Matilda Palm, Eskil Mattsson, Elisabeth Simelton, Jonas Ardö, G. Chaya, R. Tiwari and G.V. Suresh, who gave comments and assisted us in the preparation of the handbook (R & O).

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I thank Shailaja for her continued support in the preparation of all my books, which, over the years, has involved long absences from home and negligence of many things that matter in life. I am sure she will continue to support my pursuit of writing more books that are taking shape in my mind (R). I thank Ola, Vilgot and Lisen and the rest of the big family for encouragement and help while working on this book (O).

We acknowledge the support provided by UNDP, in purchasing copies of the handbook, which will go a long way in promoting the use of this handbook in different parts of the world for preparing GHG inventories and developing land-based mitigation projects. Thanks to UNDP, this handbook will be used in training and

capacity-building programmes on GHG inventory in land-use sectors. We thank, in particular, Bo Lim, who encouraged and supported work in many developing countries on GHG inventories and carbon mitigation potential assessment in land-use sectors.

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