

## Book review

# Multi-source national forest inventory – Methods and applications

Erkki Tomppo, Markus Haakana, Matti Katila, Jouni Peräsaari

The purpose of national forest inventories is to provide a regularly updated assessment of national forest resources. Core variables such as forest area, growing stock or forest yield are estimated, and can be further decomposed according to geographic units, tree species or production systems. Traditional forest inventories are based on field measurements, taken in forest plots sampled from systematic grid designs. The precision of forest inventory estimations is therefore influenced by sampling errors, and increases with the size of the geographic area considered. By contrast, forest owners and managers need information at local scale, at which the accuracy of estimates is usually poor.

To address that weakness at the lowest cost, new forest inventory methods have been designed, that combine high-resolution continuous land cover data from external sources with field plot measurements. In addition to the gain in precision of estimates, forest resource maps can also be derived. Such so-called “multi-source” forest inventories (MS-NFI) were initiated in Finland in 1990, based on satellite images and digital maps of land use and administrative units. Their full development in Finland is related in the book “Multi-source national forest inventory – Methods and applications”, by E. Tomppo and colleagues (Springer, series “managing forest ecosystems”).

The book is organized in a classical IMRD structure. The text section is restricted to the first 92 pages and is followed by a large appendix section subdivided into a table (256 pages) and a coloured map (17 pages) set. All text sections are helpfully introduced by an abstract.

- (1) A short introduction exposes the history of the Finnish forest inventory and gives the reasons for introducing MS-NFI. An overview of MS-NFI developments in the world is also provided.
- (2) The section Materials is a thorough and well-illustrated exposition of the traditional Finnish NFI sampling designs, the coverage and properties of available satellite image and digital map data (peatlands, arable lands, urban areas, etc). While the method principles have not been presented, it is difficult to handle what is fundamental and what is not in this section, loaded with a profusion of details, and often elaborate tables and figures (for instance, we learn on page 13 that problems appeared on Landsat 7 ETM+ Scan Line Corrector on May 31 2003, which made it unsuitable for MS-NFI !).
- (3) The section Methods gives a concise and accurate insight into the MS-NFI principles : (i) targeted forest areas are defined from digital land-use map data, (ii) any satellite image pixel of such areas is close – in terms of image properties – to a particular set of pixels covering field forest plots, identified from a k-Nearest Neighbour (k-NN) algorithm. Information from these forest plots is thus used for the inference of forest variables on the initial pixel. As a classical application of k-NN methods, continuous maps of forest variables can be derived, (iii) reciprocally, the set of pixels to which a field plot participates are used to define the plot weight – or expansion factor – required to estimate forest variables in the targeted area, in a much more accurate way than would be possible from a low-resolution systematic grid sampling. The remainder of the section is dedicated to refinements on optimizing the method and its parameters (“improved” or ik-NN method) for reaching minimal prediction errors, on dealing with errors in land-use maps and forest variable estimates. As compared to the Materials section, this one is not so well illustrated. Several fundamental sketches (figures 3.4 to 3.6) would have been more didactic with additional explanations. Figure 3.1 is a key figure to the understanding of the data-computation-map-statistics interaction processes of MS-NFI, and should have been better included in the introduction.
- (4) The section Results is a presentation and a regional comparison of the results of the 9th (MS-)NFI cycle. It also provides a comparison to the former NFI cycle and an analysis of errors. For all 14 regional forestry centres and 416 municipalities of Finland, forest variable estimates are supplied in the table appendix and comprehend : forest area, forest land classes, mean volume of growing stock, dominant tree species, age class distribution, stand development class, volume of growing stock by age, stand development class, tree species, roundwood assortment, and biomass for energy wood. The map appendix is illustrative, and

shows the mean volume of growing stock by forestry centre. Section is easy to read, and well supported by map illustrations. Though, it is not sure that all readers will be interested in the detailed features of the Finnish forest resource.

(5) A concise and welcome Discussion section summarizes the uses and limits of the MS-NFI method.

Overall, the technical nature of the content and a concise text, embodied in an active structure, makes the reading challenging for a non-specialist. It is doubtful that the exhaustive nature of the Appendix material is mandatory to the understanding. Rather, a more illustrative strategy would have permitted expanded explanations in the text section. The reader interested by an overview on MS-NFI principles and derived products may be recommended to have an introductory look at the valuable paper of Tomppo et al. (2008, Combining national forest inventory field plots and remote sensing data for forest data release. Sensing of Environment 12:1982–1999), which appears as a condensate of the present book.

Also, the book lays greater emphasis on the “how” than on the “why” of the method, standing more as a synthesis on the last years research activity on Finnish forest inventory than an introduction to MS-NFI. As a consequence of the pioneer work performed by the authors, 43 out of the 82 references are issues or work connected to the Finnish forest inventory, and 27 arise from Tomppo and colleagues’ work. Hence, the title is somewhat misleading (but a hint is provided by “inventory” used in the singular), since the content is actually dedicated to “the method and municipality-level results of the 9th multi-source national forest inventory of Finland (MS-NFI9)”, as stated in the introduction.

In our view, the MS-NFI issue would have reached a far wider impact in a book focusing on the method principles as a main issue, using the Finnish case study as an illustrative example. Accordingly, a starting point would have been to present traditional NFI designs showing their weaknesses, to expose the potential of multi-source data for supporting the objectives and targeted products (maps and accurate forest variable estimates), to detail core principles and methods, to present the satellite and land-use data, ending by the detailed implementation on the Finnish forest inventory as an application example. Actually, the paper format of the book is missing such a didactic dimension. So, the book may have provided an enlarged view on the issue by showing more consideration for other team works, as the MS-NFI methodology is spreading to other European and Asian countries, and Ronald McRoberts and colleagues (USA) are developing similar MS-NFI at the USDA Forest Service.

Taken as a specialized report on A implementation of the MS-NFI strategy, this very useful book will find its primary audience among those committed in national forest inventory development, or communities interested in forest resource assessment. It may also widen to a public of researchers involved in the field of macroecology or biogeography. Whereas forest and environment policy managers will consider the typical products of MS-NFI presented in the appendix of very high relevance, not all of them should find interest in the methodological aspects presented.

Jean-Daniel Bontemps  
Forest and Wood Resource Laboratory (UMR 1092 “LERFoB”)  
AgroParisTech-ENGREF, Nancy, France  
jean-daniel.bontemps@engref.agroparistech.fr

Springer series No. 18 “ Managing Forest Ecosystems ” (Klaus Gadow, Timo Pukkala, Margarida Tomé, Eds.), Springer, 2008, 373 p. Price: 174,00€