# Abstract template for the conference "A century of national forest inventories – informing past, present and future decisions"

Dear author. This is a two-page template that in the first page will ask for information on presenter name, topic, and preferred presentation form.

On page two, you are asked to fill in your abstract in the format and font size indicated. Please remember to include authors affiliation information in the footer section of page two. The length of the abstract may not be more than one page including references.

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|---|---|---|
| **Abstract title:** | | Use of auxiliary information in NFIs |
| **Take-home message:** | | Traditionally, other sources of data than those collected in the field have found limited use in NFIs. This is changing and today the trend is that remotely sensed data and other auxiliary information are being used for an increasing number of purposes, including mapping, small-area estimation, improved sampling designs, and new general estimation schemes. |
| **Presenter name:** | | Göran Ståhl |
| **Presenter contact info:** | | SLU, 901 83 Umeå, Sweden. goran.stahl@slu.se |
| **General topic, see website:** (please double click on the check box and activate the relevant one) | ☐ | Improving future NFIs by learning from the past |
| | ☐ | NFIs today and in the future |
| | ☐ | Cutting edge and futuristic inventory techniques and technologies |
| **Preferred presentation form:** | ☐ | Oral presentation |
| | | |
| | ☐ | Poster |
| *Abstracts will be reviewed by members of our scientific committee and you will be given information on decisions in due time after the submission deadline has passed.* | | |

# Use of auxiliary information in NFIs

## *Göran Ståhl[1]*

**Introduction:** Traditionally, NFIs have been field-based and the inference about target parameters has been based solely on field data. Auxiliary data from maps, aerial photos, etc. have been used for simplifying field work, but not for improving designs or estimators (albeit many NFIs have applied stratified and/or systematic sampling designs based on coarse scale map data). Important exceptions include the Swiss NFI which for a long time has used a multi-phase design with air photo interpretation as an important component, and Finland where a multi-source inventory system combining satellite and field data was established in the 1990s. During recent years the availability of auxiliary data from several different remote sensing (RS) sensors and other sources has increased dramatically. This has inspired a development where auxiliary data are used in novel ways to improve the overall cost-efficiency of the NFIs, and for developing new types of outputs from NFIs to support a wider range of forest-related applications and decisions. During this presentation some main approaches to using the new auxiliary information will be presented and discussed. These involve mapping, small-area estimation, improved sampling designs, and (for NFIs) new general estimation schemes, such as model-assisted estimation and model-based inference. It will also be discussed to what extent RS data in the future will be able to replace the traditional field-based data in NFIs.

**Materials and methods:** Based on the literature, different sources of auxiliary are reviewed and their strengths and weaknesses linked to different potential uses in NFIs evaluated.

**Results:** Maps of forest-related features based on combinations of RS and NFI field data have improved considerably in quality when shifting the RS data source from optical satellites to airborne laser scanning. These maps have found several novel uses and this application should be carefully considered when revising ongoing NFIs. Closely related to mapping are the different procedures developed for small-area estimation, which hold potential to expand the use of NFI data also to forest management planning at the level of individual forest holdings. Auxiliary information may also be used for improving NFI design. For example, balanced sampling based on auxiliary information strongly correlated with the core variables of interest has been shown to improve the precision of estimators considerably. Moreover, RS auxiliary data can be used to improve the precision of estimators through model-assisted estimation or model-based inference. While model-assisted estimators require probability samples model-based inference does not. The better auxiliary data we can obtain, the less dependent the NFIs will be on large probability samples of field plots. However, due to the increasing complexity of the information required from NFIs, in the foreseeable future it is not likely that these inventories will be conducted without a considerable portion of basic field inventory.

**Conclusion:** Traditionally, other sources of data than those collected in the field have found limited use in NFIs. This is changing and today the trend is that RS and other auxiliary data are being used for an increasing number of purposes, such as mapping, small-area estimation, improved sampling designs, and new estimation schemes.

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