

SMALL AREA ESTIMATION OF FOREST ATTRIBUTES IN THE NORWEGIAN NATIONAL FOREST INVENTORY

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The Norwegian National Forest Inventory (NNFI) provides estimates of forest parameters on national and regional scales by means of a systematic network of permanent sample plots. One of the biggest challenges for the NNFI is the interest in forest attribute information for small sub-populations such as municipalities or protected areas. Frequently, too few sampled observations are available for those small areas to allow an estimate with acceptable precision. However, if an auxiliary variable exists that is correlated with the variable of interest, small area estimation (SAE) techniques may provide means to improve the precision of estimates.

This study aimed at estimating the mean above-ground forest biomass for small areas with high precision and accuracy by using SAE techniques. Therefore, the simple random sampling (SRS), the generalized regression (GREG) and the unit-level empirical best linear unbiased prediction (EBLUP) estimators were compared. Mean canopy height obtained from a photogrammetric canopy height model (CHM) was the auxiliary variable available for every population element. The small areas were 14 municipalities within the 2184 km² study area for which an estimate of the mean forest biomass was sought. The municipalities were between 31 and 527 km² in size contained one to 35 NNFI sample plots within forest.

The mean canopy height obtained from the CHM was found to have a strong linear correlation with forest biomass. Both, the SRS and GREG estimator result in imprecise estimates, if they are based on too few observations. Although this is not the case for the EBLUP estimator, the estimators were only compared for municipalities with more than five sample plots. The SRS resulted in the highest variances in all municipalities. While the GREG and EBLUP variances were similar for small areas with many sample plots, the EBLUP variance was usually smaller than the GREG variance. The difference between the EBLUP and GREG variance increased with a decreasing number of sample plots within the small area. The EBLUP estimates of mean forest biomass within the municipalities ranged between 95.01 and 153.76 Mg ha⁻¹ with standard errors between 8.20 and 12.84 Mg ha⁻¹.

More information on this study can be found in the presentation at the end of the proceedings. A manuscript describing all details of the study (Breidenbach and Astrup, submitted 2011) is currently under review. The estimators are implemented as functions of the R software for statistical computing and can be obtained from CRAN (Breidenbach 2011).

Breidenbach, J, 2011. JoSAE – Functions for unit-level small area estimators and their variances. <http://cran.r-project.org/web/packages/JoSAE/>.

Breidenbach, J, and Astrup, R, submitted 2011. Small area estimation of forest attributes in the Norwegian National Forest Inventory. European Journal of Forest Research.