

Forest management scenarios and their effects on ecosystem services: modelling results from Sweden

¹Bishnu Chandra Poudel, ²Tomas Lundmark, ³Johan Bergh, ⁴Annika Nordin, ⁵Roger Sathre, ⁶Eva-Maria Nordström, ⁶Hannes Böttcher

¹Ecotechnology and Environmental Science, Mid Sweden University, Akademigatan 1, Sweden, Email: bishnu.poudel@miun.se

²Department of Forest Ecology and Management, Swedish University of Agricultural Sciences (SLU), 901 83 Umeå, Sweden. Email: tomas.lundmark@slu.se

³Swedish Forest Research Centre, Swedish University of Agricultural Sciences (SLU), 230 53 Alnarp, Sweden. Email: johan.bergh@slu.se

⁴Department of Plant Physiology and Forest Genetics, Swedish University of Agricultural Sciences (SLU), 901 83 Umeå, Sweden. Email: annika.nordin@slu.se

⁵Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory, Berkeley California 94720, USA

⁶International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria

Swedish forests have been actively managed for last 100 years. The active management has led to increase forest biomass production, harvest, wood product use and thereby has increased Swedish forest sectors role in country economy. It is unclear, however, whether actively managed forest are supporting or jeopardising the forest's ecosystem services. Lately, the Swedish society have been critical about intensive forest management claiming that it has been deteriorating forest ecosystem and limiting ecosystem services. There have been suggestions for a better scientific understanding for the effect of different forest management strategies on different ecosystem services.

We use a system analysis approach to perform a model based analysis that includes forest management and their effects on different indicators of ecosystem services in Swedish forest landscape for the next 100 years.

Forest management scenarios with different management intensity are assumed based on set aside area. Forest management scenarios such as, Reference, Intensive Management, Environmental and Conservation are chosen to analyse. We use empirical forest growth model HUGIN to calculate forest biomass production, harvest amount including all types of biomass i.e. stem-wood, bark, needles/leaves, branches and tops, dead wood availability in the forest floor, forest age structure and tree species composition. With these values, we set indicators for different types of ecosystem services under supporting, provisioning, regulating and cultural services for example, biodiversity conservation and recreation. Moreover, we perform a comprehensive literature review to establish the ecosystem service indicators in Swedish forest landscape and combine them with our modelling results for the assessment. Finally, we evaluate the effect of forest management scenarios in ecosystem services in Swedish forest landscape. Our preliminary result showed that intensive forest management would increase forest biomass production thus creates opportunity for economic benefit as well as carbon emissions reduction benefit. However, a forest management policy where large areas are set aside will potentially support biodiversity conservation and natural succession of forest. We found a mixed result for the cultural services that any of the forest management strategy would increase importance for future generation.

Keywords: biomass, intensive forestry, carbon balance, dead wood, forest structure