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Optimal forest management topics in the boreal forest region with special focus on Sweden

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Abstract

This paper contains a briefing on forestry and forest management issues in Sweden and the Boreal forest region. It also introduces some topics of fundamental importance to present forest research and policy. This paper is an introduction to a keynote lecture.

Keywords: Forest management, Sweden, Boreal forest, optimal solutions.

Introduction

The boreal forest covers very large areas in Russia, Canada, USA, and Scandinavia, including Sweden. Considerable parts of these regions presently contain more or less natural forests, often dominated by different species of spruce, pine and larch. In several regions, in particular in Russia and Canada, the industrial utilization of forest raw materials presently is and historically has been close to zero. Expanding infrastructure, technological developments of harvesters and forwarders, increasing costs and environmental problems associated with fossil fuel extraction, a growing interest in sustainability and the debate on climate change, make it rational to investigate environmentally acceptable harvesting options in the remote and natural boreal forests. In Sweden, most forestry operations have for many decades been performed via "rotation forestry", clear cuts, usually followed by single species plantations. The Swedish level of harvesting in relation to the standing volume is much higher than in Russia and Canada. This paper contains a briefing on some topics of present importance to forestry and forest policy in the boreal forests, with a special focus on Sweden. Industrial expansion of forest utilization is often considered as very negative for the environment. It is often assumed to be obvious that the initially existing natural forests, with trees of many size classes and species, should be removed and replaced by uniform plantations. However, careful analysis shows that it is often optimal, also from a production economic point of view, to start harvesting the natural forests using continuous cover methods. Furthermore, mixed species forests do not only have environmental advantages compared to single species forests. They also contain the economically important option to sequentially adjust forest harvesting to the often rapidly shifting demands in the timber markets. Relative prices of different tree species often change in unpredictable ways. Furthermore, over time, we get more and more information about how different species grow in a particular area. If we have several species in the forest to work with, we can sequentially adjust the mix of species in the

forest to the latest information. The optimal forest management decisions in problems of this nature must be determined with adaptive optimization. Such methods and forestry applications are found in Lohmander (2007).

Forests and Forestry in Sweden

All kinds of statistical information concerning Swedish forests, forestry, rules and regulations are well document by the Swedish Forest Agency (2017).

Continuous cover forestry versus forestry with clear cuts

In the past, continuous cover forestry was common in Sweden. Only the largest trees were harvested and the rest of the trees continued to grow. Natural regeneration was the standard method. Forest workers used manual saws to make the trees fall, axes to remove the branches, manual saws to cut the timber to logs and horses with sleds to drag the logs to the roads. Harvesting was usually performed in the winter, when the ground was frozen and covered by ice and snow. This made it easy to transport the logs to the roads. The forest workers were usually employed in agriculture during the warm season, which made the winter season suitable for forestry activities. Over the decades, the number of combined small scale agricultural and forestry farms and the many workers, decreased. Most young people moved to the cities and large and heavy forest machines took over the forest operations. These machines could not move between the trees in the same way as a horse. Hence, all trees were removed simultaneously and the era of rotation forestry with clear cuts started. New forests were created in the form of uniform plantations, usually dominated by only one species, Scots pine (Pinus silvestris) or Norway spruce (Picea abies). The large scale forestry methods often included very heavy machines, deep tracks in the soil, erosion, the use of poison to handle insects eating the young softwood seedlings, other poison to kill large numbers of unwanted naturally regenerated hardwood seedlings, low seedling survival rates and poor timber quality development in the softwood plantations and several other problems. The large clear cuts gradually gave rise to a political debate. Many people preferred not to see large clear cut areas. Swedish forest management is presently dominated by rotation forestry, clear cuts and single species plantations. The forest political debate continues. Now, new developments of forest machines such as small and flexible harvesters and forwarders, make it possible to once again start using continuous cover forestry methods in Sweden and other countries with similar conditions, found in the Boreal forest region. Lohmander (2014a), (2015), (2016a) and (2016b) contain more information about these topics and new ways to optimize continuous cover forest management decisions.

Rational forestry considering forest industry, energy and the climate

Lohmander (2011b) includes a general briefing on forest harvesting potentials and utilization in the Boreal region and an analysis of some options to solve parts of the global warming problem via expanded utilization of these forests. Lohmander (2011c) studies the dynamic forest, forest industry and bioenergy supply chain optimization

problem in Sweden. It is found that considerable sustainable economic gains are possible to obtain via increased utilization of the forest resources. In Lohmander (2014b), a general model for the global climate, energy and forestry problem is developed and solved. Several general conclusions are derived that connect optimal forestry decisions to the global warming conditions.

Rational management of hunting and wildlife considering forestry and other effects

Forests do not only contain trees and other plants, but also animals. Sweden has a large moose population, compared to most other parts of the boreal forest region. This is partly an effect of the rotation forestry system with clear cuts and partly an effect of the very low number of large predators, such as grey wolf, and the Swedish hunting policy. In Sweden, the number of moose hunters is large. The value of the moose meat is considerable and the value of the hunting recreation is high. On the other hand, the animals eat young pine trees, which has a negative effect on the economics of forestry. Furthermore, many severe accidents are caused by moose. They randomly cross roads and are hit by cars, which often leads to killed and injured people and destroyed cars. Lohmander (2011a), (2011d), (2017) and Lu and Lohmander (2009), analyze the optimal combination of forestry and moose management decisions. When all revenues and costs are considered, it is found that the optimal size of the moose population is considerably lower than today. Furthermore, it is important to adjust forest management decisions to the stochastic moose problems. Mixed species plantations make it possible to sequentially adjust the species composition to possible moose damages, which increases the expected present value of forestry. With single species pine plantations, all of the forest may be completely destroyed by moose, since these animals move around randomly and usually prefer to eat pine.

Rational forestry considering market imperfections

It is often assumed that the optimal solutions can easily be calculated in case all market prices and technological options are known. In Sweden, almost all kinds of information is public and easily available in the form of statistical tables found in the internet. The large number of statistical tables found at Swedish Forest Agency (2017) illustrates this. However, all forest sector markets are not perfect markets. The number of independent pulpwood buyers is very low. The number of independent forest owners, selling all kinds of wood, is very high. In such situations, a monopsony can be expected, which leads to pulpwood prices that are much lower than what they would be in a perfect market. Furthermore, the market price is lower than the marginal value of the pulpwood in the forest industry. Since the market prices affect the activities in the forest sector, this leads to forest management decisions that do not optimize the total surplus in the economy. Furthermore, the distribution of the surplus between the actors in the markets is changed and the profitability in forestry is reduced. An introduction to these issues and very strong empirical evidence, based on public trade statistics, is given by Lohmander (2012).

Conclusions

This paper has introduced the reader to some of the forest management, forest research and forest policy topics that deserve special attention, in particular in Sweden and in several other parts of the boreal forest region. It is not always easy to obtain the optimal solutions in forestry in complicated situations. It is necessary that relevant and correct analyses and suitable empirical data are available. However, it is also necessary that the research results are not neglected and forgotten. The policy responsible organizations have to take the new scientific findings into account and modify the forest policies in the optimal way.

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