Optimal Forest Management in Sweden with Consideration of the Forest and Energy Industries and Pulpwood Cartels

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Tuesday March 20th 4:00-5:45 PM
NCSU, North Carolina State University, Daniels Hall, Room 218.

Audience: Operations Research Faculty and Students

Abstract

Optimization is useful in order to maximize the total profitability of several industrial sectors with physical flow dependencies. The forest and energy sectors are such examples. In typical cases, it is practically impossible to create rational development plans for units and firms in such sectors without optimization of the complete and linked supply chains. However, in case the number of firms in some part of a system with linked supply chains is low, imperfect competition, in the form of cartels, should be expected. In Sweden, more than 50% of the roundwood, is produced by a very large number of private forest owners. The average forest property covers 50 hectares. The number of pulp industry companies is low. In such a case, a cartel, acting as a monopsony in the pulpwood market, should be expected to appear. Recently, such a cartel was revealed in Finland and legal processes started. Pulpwood prices in Finland were found to be lower than what they should be in a perfect market and forest owners in Finland demand compensation. Now, a similar situation has been discovered in Sweden. Pulpwood prices in Sweden are much lower than what they should be in a perfect market. Because of the market imperfections, the total economic surplus is reduced, the total production decisions and volumes are not optimal, forest owners loose money and the relative prices of different kinds of forest products have been changed. Such relative price changes, in turn, influence forest owners to modify long term forestry decisions and sometimes to change forest management methods completely. Furthermore, the energy industry has increased the utilization of cheap pulpwood. This gives heat and power instead of paper pulp. If we can get rid of the cartels and other imperfections in the markets, optimization of the total present value is however a useful and relevant method.

The joint supply chain of the forest and energy industries in Sweden is defined as a full system multi period optimization model with forest production and the forest- and energy industries. The complete chain is optimized in order to maximize the total expected present value over a 50 year planning horizon, divided into ten five year periods. A multi period quadratic programming model solves the complete problem with a finite number of iterations. The multi dimensional state space is continuous. Complete and consistent solutions are obtained in seconds. These properties of the model make it useful as a tool during continuous discussions with decision makers. The dynamically optimal coordinated decisions are determined. These include:

- harvests of timber, pulpwood and energy assortments such as tops and branches
- distribution of the harvested raw material between different industries,
- distribution of intermediate products such as saw dust, chips and black liquor between the different industries,
- production and capacity investments in the different industries

For the Swedish case, it is found that it is feasible and economically rational to significantly increase both the bioenergy production and the forest industry production. The future use of fossil fuels will be strongly reduced and the employment level improves. The optimization model can be adapted also to other countries and regions in the world.

The Economics of Forest Biomass and a Rational European Carbon Policy

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Thursday March 22nd 3:30-4:30 PM
NCSU, North Carolina State University, Pulp and Paper Laboratory, Room 2221.

Audience: Forestry and Forest Biomaterials Faculty and students.

Abstract

Economics, optimization of industrial processes, infrastructure, logistics, sustainable energy systems, forest resources, global warming, and international trade are mostly studied as more or less independent topics. It is however obvious that these things have very strong links. This lecture focuses on the big picture, painted this way: Our planet has a common atmosphere. If, and to what extent, we have global warming problem, partly caused by an increasing CO2 level in the atmosphere, is and has been intensively debated in connection to international negotiations during the latest period. In any case, some countries and regions of the world, have already defined targets with consideration of the CO2 issue. For instance, European Union has the target to have at least 20% renewable energy in the year 2020.

The global distribution of forest resources such as standing timber and forest land with different properties can be studied via official statistics published by United Nations and different national and regional organizations. The rationality of existing and potential forest activities, such as harvesting and forest investments in different parts of the world, can be studied and analysed via cost and revenue data obtainable from a large number of sources, including published reports from forest research organizations. Statistics of relevance to infrastructure and logistics, such as capacities and costs in different countries, are available from the World Bank.

It has been found that the "forest production capacity utilization" levels are very different in different countries. In large regions, such as Russian Federation and Canada, the harvest levels are several times lower than what is possible if the production potential of the land is fully utilized. This partly depends on limited infrastructure availability in these regions.

The present lecture contains a general analysis of some of the central decision problems of relevance to "Economic optimization of sustainable energy systems based on forest resources with consideration of the global warming problem, with international perspectives".

An operations research approach to the total optimization problem is suggested, that maximizes the expected present value and takes the CO2 considerations into account in different forms. In order to generate optimal total results, infrastructure investments have to be coordinated with forest utilization expansion. Furthermore, all other related decisions have to be handled in an optimal way. Some examples are given that show that it is possible to generate considerable economic results and simultaneously reach the CO2 targets. In order to obtain the best possible total economic and environmental results, it is important to update existing national forest laws and regulations and to investigate the problems without considering national boundaries as strict constraints. Economics and environmental issues are global topics and have to be treated as such, in the interest of general economic development and the sustainability of life on our planet.