APPLICATION OF AN OPPORTUNITY COST APPROACH TO SUPPORT POLICY DECISIONS ON THE USE OF FORESTS IN GERMANY

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Abstract

Forests are experiencing a new situation in many highly industrialized countries: their goods and services are much more in demand than they were a couple of decades ago. The development of forest-based industry; the use of wood for energy production as a contribution to climate protection and to the security of energy supplies; and initiatives to tackle the loss of biodiversity, are doubtless some of the most prominent sources of growing demand for forest goods and services. This new situation increases the competition between consumers of the respective private and public goods and services, and hence, necessitates a revision of forest allocation decisions. Using the example of Germany, a simple forecast of supply and demand to the year 2020 shows that supply and demand will probably not match. To close this gap, demand must either be adjusted, e.g., through the improvement of material and energy efficiency, and/or supply must be enhanced through, e.g., reduction of high accumulated forest stock, use of small wood and short rotation coppices or imports. Since valuation results for non-market forest services are still limited to some rather general examples, opportunity costs are calculated to support policy decisions with regard to forest allocation. For this purpose, a partly closed input-output model was used to calculate added value in the use of wood. The results were applied to a current proposal to protect biodiversity. A decision to refrain from harvesting timber on 460,000 ha old beech stands yields an overall of added value loss of 2.3 billion €, which is equivalent to 41,600 full-time employees in Germany., About 880 million € taxes are included within the loss of added value. However, in order to find “optimal” solutions for forest allocation, opportunity costs only mark a minimum threshold, which benefits must exceed.

Key words: added value, forest demand forecast, future wood balance, tax revenues, wood production.

Description of the Problem

Forests in Germany, as in Europe as a whole, serve the demand for a variety of goods: wood for traditional material use; wood for “green” technology; wood for energy use; nature protection and the conservation of biodiversity; carbon sequestration; ground water recharge, recreation, etc. Many of these goods are public goods and therefore their “production” is a part of political goals and initiatives. Demand for all of these goods has increased significantly. However, forest area is rather limited, despite afforestations, which in most countries are only of minor dimensions. For Germany, net annual forest area growth averaged 0.2% of the existing forest area in the period from 2002-2008. Consequently forest goods are becoming more and more scarce. Competition between forest users increases, and political goals can conflict with the required forestry measures to achieve the goals. This means that trade-offs are needed between the goals concerned. With the following paper, the past and present situation in Germany is described and an outlook is given for the year 2020. Departing from this outlook, political implications are deduced and a method to calculate opportunity costs is presented. Finally the results are applied to a concrete proposal to maintain and enhance bio-diversity in German forests.

Past and Present Situation

At present about 70% of the German forest areas are covered under nature and landscape conservation categories. They comprise small scale (nature conservation and landscape protection areas) and large scale (national parks, biosphere reserves and nature parks) categories according to the Federal Nature Protection Law as well as Natura-2000-sites according to the EU-Habitat-Directive. A further, rather strict, category is projected: according to the National Strategy for Biodiversity, 5% of the forest area shall be left to its own natural development. We will refer to the implications of this strategy later on.

On the other hand, demand for wood has increased significantly. From 1991, the year after German reunification, to 2007, the year before the world economic crisis, round wood demand grew by 75%. In particular, saw mills and private households raised their wood consumption remarkably (Mantau 2009, p. 30 f). Additionally, large capacity extensions are projected in particular in the south of Germany (Ochs et al. 2007, p. 15 ff). Among wood users, competition between material and energy uses becomes harder. Fossil fuel prices rose, as did prices for fuel wood as a substitute. Moreover several national energy acts affect the wood markets. The Renewable Energy Sources Act rules different feed-in compensations for electricity from renewable energy sources. The compensation must be paid by the electricity network operators, but is in fact transferred at least partly to the power end-user. The Biofuel Quota Act regulates biodiesel and bioethanol proportions in fossil fuel; and a third rather recent act applies to newly erected buildings. The Renewable Energies Heat Act obligates the use of renewable energies (certain % for different energy sources), the use of heat from combined heat and power generation or the improvement of heat insulation. Financial support shall be given by strengthening the existing market incentive programme.

Economic and political support for bio-energy has influenced the development of wood prices, as can be shown for the good example waste wood (Weimar 2008). Four different waste wood category prices are available for: (i) untreated recovered wood (chipped), (ii) untreated recovered wood (crushed), (iii) treated recovered wood (crushed), and (iv) contaminated recovered wood (crushed). In 1997 only (i) yielded a positive revenue of 5 €.t^{-1} air-dry. For all other waste wood categories a disposal fee had to be paid. For (iv) it amounted to 90 €.t^{-1} air-dry. In 2008, the price for category (i) reached 25 €.t^{-1} air-dry and only prices for category (iv) were still negative. But the disposal fee for this category dropped down to 7 €.t^{-1} air-dry.

Future Outlook

There are a couple of scenarios for future wood demand in Germany. They comprise either material or energy use, or both. The oldest scenario we consulted is the EFSOS study (UNECE/ FAO) from 2005. Wood demand for material use in 2020 is projected with 80 to 83 million m³ depending on the scenario. National projections (Dispan et al. 2008) range between 64 and 80 million m³. Dispan et al. (2008) also projected wood demand for energy use. Their results can be supplemented by UNECE studies together with the University of Hamburg (Prins et al. 2008) and the guidance study for implementation of EU 2020 renewable energy goals in Germany (Nitsch 2007, 2008; Schweinle 2008). According to these sources, wood demand for energy use in 2020 is projected to be between 43 and 85 million m³. In the "Future Wood Supply and Demand Balance 2020" drawn below, we refer to the 83 million m³ value of EFSOS for material use and the 72 million m³ value of the recent Nitsch study (2008, amended by the Federal Ministry of Food, Agriculture and Consumer Protection, BMELV) for energy use.

The projected demand of 155 million m³ in total is contrasted with projected supply. Since demand figures represent gross demand, including double counting (wood residue recycling, in particular saw mill by-products as raw material for panel, pulp and energy production) supply has to be estimated as a gross figure as well. Basic supply source is the forest. By means of the Forest Development and Timber Supply Model WEHAM (Schmitz et al. 2005) future round wood supply (up to a minimum end diameter of 7 cm o. b. – coarse wood) is projected. WEHAM assumes a continuation of the prevailing forest management standards in Germany. Supply of saw mill by-products is deduced from the projected sawn wood production. Wood sources outside the forest are waste wood, short rotation coppice and wood from landscape and park work. The projected overall wood supply in 2020 sums up to about 120 million m³.

According to the underlying assumptions, the Future Wood Supply and Demand Balance 2020 does not balance. Supply falls short of demand by about 35 million m³; the respective political goals are jeopardized.

Currently a "National Forest Strategy 2020" is being elaborated under the leadership of BMELV to coordinate the emerged demand. Several options are feasible to close the supply gap.

On the demand side, the enhancement of material and energy efficiency is crucial. The aim here is to get more wood products or energy power from the same volume of round wood. Another option is quite theoretical. The demand for wood for the manufacture of wood products can be curtailed and political goals affecting forests can be revised downward.

On the supply side, a fast-working measure would be to reduce high accumulated forest stocks. Obviously this is not a long term option. Under the provisions for maintenance of nutrient balance, use of wood residues, small wood and roots is an auxiliary supply option. Under a long term perspective, regeneration with higher-yield tree species like Douglas Fir (*Pseudotsuga menziesii*) or Grand Fir (*Abies grandis*) is a promising option to sustainably enhance wood supply. Options outside German forests comprise, e. g., extension of short rotation coppice cultivation on agricultural land. Import of round wood and wood residues is also an option, but restricted to cases where the costs for transport can be kept low.

Political Implications

As already mentioned above, forests produce private as well as public goods. The most important private good is wood, in particular for material use. With regard to private goods, the political implications of the supply gap are rather low. Under the assumption of perfect markets, market prices will ensure that an optimal production volume is realized and the scarce factor wood is used for those products where factor income is highest. Under the traditional economic assumptions (people and enterprises as utility, respectively, profit maximizers, perfect markets, no external effects, etc.) this would be efficient from a welfare perspective. However, reality does not meet these assumptions. Forests also produce public goods (e. g., nature conservation) or private goods which are associated with public goods (e. g., wood for energy use serving the public good, climate protection). In those cases policy influences production volume either through administrative law or market interventions (e. g., Renewable Energy Sources Act, see above).

To find "optimal" solutions from a welfare perspective (in contrast to a power preservation perspective as argued by new political economy, see Weimann 1995, p. 175), policy makers need information based on the utility- and cost-curves of production volume of all forest goods. Even though a respectively highly sophisticated welfare economic theory has developed for practical application, some severe constraints exist: (i) Utility estimates of public goods are largely not available. Estimates are available only for single, rather general, examples of public goods or changes in the supply of those goods. Since many public goods are concerned and many interactions exist between them, the required information would have to cover a multitude of possible changes.

If information were to be gathered by a survey, only a slight chance would exist that respondents fully understand the problematic, and hence the answers on willingness to pay would be not too reliable. (ii) Interpersonal comparison of individual utility is not possible; there is still a theoretical deficit. (iii) Even if individual utility were to be ascertained, the precondition to match demand for public and private goods would not be given. Models to estimate price changes of all affected private goods are lacking.

Against this background an alternative approach is followed: opportunity costs of the production of public goods are calculated. They mark a minimum threshold benefits must exceed, if production of public goods is favourable from a welfare perspective.

Method

Opportunity costs are calculated as change of added value due to a change in round wood supply. This means that added value as defined in the European System of Accounts (Eurostat 1996) is the economic unit. A rather sophisticated model would be required to cope with this task. It should be comprehensive and cover all production processes and final consumption of wood products and substitutes of wood. Likewise, it should be differentiated and include cross price elasticity between wood products and substitutes. Such a model is not available for Germany. As an alternative solution, an input-output-analysis is chosen. Data source is the Input-Output-Table 2004 of the Federal Statistical Office, broken down in its deepest subdivision into 71 branches of production. A fundamental constraint of the input-output-analysis is the assumption of strict linearity of factor input to achieve one unit of good irrespective of the production volume, of possible price changes and resulting substitution. This is why input-output-analysis can be applied for the present purpose only with three significant preconditions (for more details see Dieter 2008):

1) To avoid substitution effects on the domestic markets, the surplus in wood product output induced by a change in round wood supply must be sold on foreign markets. To ensure this, regarded branches of production must have performed as significant exporters in the past (high export share).

2) The input factors wood and wood products must be relevant as compared to the other complementary production factors. This is to prevent the absolute increase in these complementary input factors from being so high that a relevant rise in prices can be expected.

3) The regarded branches must be dependent on domestic wood supply. This is assured through the third precondition: import share of wood input factors must be low.

Among all branches of production, these three preconditions are given only for manufacturers of wood. A partly closed input-output-model is used where foreign demand is exogenous according to precondition 1). With this model the relationship between one unit supply of round wood and the corresponding value of (exported) wood products is detected. The results are presented for two different assumptions: (i) soft proportionality assumption – direct, indirect and feedback effects are regarded only for the manufacturers of wood and (ii) rigid proportionality assumption – direct, indirect and feedback effects are regarded for the economy as a whole. The second assumption implies that additional income of all branches contributing to the manufacture of wood induces economic growth in all branches of production. For the sake of keeping the estimate conservative, assumption (i) stands in the focus of the following analysis. Model formulation is given by the following equations.

$$\mathbf{A\,x} + \mathbf{c\,Y} + \mathbf{g} = \mathbf{x}$$

since $\mathbf{Y} = \mathbf{v}^T\,\mathbf{x}$

$$=> \quad \mathbf{A\,x} + \mathbf{c\,v}^T\,\mathbf{x} + \mathbf{g} = \mathbf{x}$$

$$<=> \mathbf{x} - \mathbf{A\,x} - \mathbf{c\,v}^T\,\mathbf{x} = \mathbf{g}$$

$$<=> (\mathbf{I} - \mathbf{A} - \mathbf{c\,v}^T)\,\mathbf{x} = \mathbf{g}$$

$$<=> \mathbf{x} = (\mathbf{I} - \mathbf{A} - \mathbf{c\,v}^T)^{-1}\,\mathbf{g}$$

with

A = quadratic non-negative matrix of input-coefficients;

x = n-element column vector of production;

c = n-element column vector of the share of income-related final consumption (domestic demand);

Y = scalar of total final consumption;

g = n-element column vector of autonomous final consumption (export);

$\mathbf{v}^T$ = n-element row vector of primary input coefficients.

Opportunity Costs

Under the preferred soft proportionality assumption (i), one unit round wood in monetary terms induces added value through the manufacture of wood amounting to 10.4-times the value of round wood (Dieter 2008, p. 205). Accepting the rigid proportionality assumption (ii), one unit results in an added value factor of 30.6. The added value factor of 10.4 shall be applied to an example in the field of nature conservation.

In 2007 the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) published the National Strategy for Biodiversity. Among others, it comprises the target to leave 5% of forest areas to their own natural development. This was concretized by the Federal Agency for Nature Conservation (BfN) in a proposal to abandon old state-owned beech forests. Based on data of the second National Forest Inventory and the model WEHAM, this proposal will be valuated by its opportunity costs.

120,000 ha forest area are already strictly protected and not available for wood supply. The difference to the 5%-goal amounts to 460,000 ha. To meet the proposal, all beech forests older than 60 years, owned by the Federal Republic of Germany and the Laender, must be set aside (see Dieter 2009, p. 43). Potential timber (coarse wood) use in these forests sums up to 4.4 million m^3 u. b. or 6.6 million m^3 biomass per year. At a timber price of 50 €.m^{-3}, the very loss of timber value sums up to 220 million € a year, with further losses when other woody biomass is accounted for as well. Taking into account the omission of added value through wood manufacture, the loss of value results in 2.3 billion € a year. Taxes and duties amounting to 880 million € a year are included therein, affecting public budgets on Federal, Laender and communal level (see Dieter and Bormann 2009, p. 171). In Germany, the average (gross) value added per employee amounts to 55,000 € a year. Transferred to the calculated added value, loss employment effect of the proposed implementation of the National Strategy for Biodiversity corresponds to a loss of 41,600 employees in full time equivalent.

Conclusion

Competition between forest users in Germany is fact. Higher future round wood demand can be expected on the basis of the projected development of the forest based sector, energy security and climate protection initiatives, etc. On the other hand, demand for conservation purposes also increases, e. g., due to implementation of FFH-directive, National Biodiversity Strategy, etc. Thus both an intensification of forestry and a reduction of forestry intensity are needed. Without change in forest management, future demand to reach all economic, ecological and social targets related to forests can not be met. Opportunity costs of refraining from timber use and the related negative employment effects are considerable, in particular when including manufacture of wood. However, costs must be opposed to benefits, which are only known for some rather general examples. The opportunity costs presented here represent the minimum threshold level that benefits must exceed to be of value. Thus the opportunity costs should serve as a very helpful decision support for policymakers.

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