Outcomes of Forest Improvement Work in Finland

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This paper discusses public subsidies aimed at intensifying timber production as an initial part of an evaluation of the profitability of forest investment subsidies in Finland. In many countries there are very few proper ex post evaluations of the forest policy instruments in economic terms. The scarcity of timber among users and their attempts to construct new forest policy are discussed first. The increments in annual growth and growing stock as well as its valuation are then evaluated. The final gross utility increments due to forestry investments are measured through their importance in the forest industry products. The direct and indirect changes in GDP are calculated by using the input-output method.

Keywords forest improvement work, subsidies, forest policy, input-output method, allowable cut
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1 Introduction

This investigation examines the economic outcomes of public forestry assistance and extension programmes by using the input-output method. The analysis examines how public subsidies have been used to intensify timber production in Finland and what have been the major impacts of these subsidies.

Public interventions in forestry and their evaluation in economic terms have been an important topic of forest research in the United States. Literature reviews of research in this field can be found in Boyd and Hyde (1989). They test the efficiency of different public intervention instruments with econometric tools. Alig et al. (1990) reviews the results concerning timber management behaviour of nonindustrial private forest owners. Forest policy in general, including public assistance to forestry, is addressed by e.g. Cubbage et al. (1993), who compare incentives and regulation in the United States, Canada and Europe, and find interesting differences. According to Cubbage et al. (1993), the European countries regulate all land use strictly, including forest management, the latter especially to encourage timber production.

The Organisation for Economic Co-operation

and Development (OECD) has reviewed European forest market and intervention failures studies (Wibe and Jones 1992), while Grayson (1993) has examined the private forestry policies in Europe. Studies on appraisals and evaluations in forestry investments, programs and policies have also been published (see Harou 1987). The evaluation of public intervention includes two parts: 1) the evaluation of the *intervention costs for government* and 2) the evaluation of the *intervention effects on society*. In this study we comment both of these.

The Finnish government has subsidised investments for the intensification of timber production since 1928. When the first, temporary, Forest Improvement Law was enacted. Since then, public subsidies have been expanded and diversified into large number of investment types, but each aimed at intensifying timber production. Subsidies are delivered by issuing low rent loans and direct cost compensations. The monetary-valued net benefits achieved by timber production investments are not analysed *ex post* in detail. The main target of the investment subsidies have been increases in the allowable cut (Ollonqvist and Immonen 1995).

Research on the forest owners investment behaviour has concentrated on individual activities, especially on tending of seedling stands (Tikkanen 1981, Vehkamäki 1986). Uusivuori and Leikas (1991) studied if subsidies to forest improvement had any effects on roundwood supply. They found out that decrease of subsidies by 40 percent from average level of years 1989–1990 would cause in the long run 6–8 percent reduction of cuttings from the private forests. In Finland there are no previous ex-post studies on economic effects of public subsidies.

This paper is the first attempt to estimate the gross utilities achieved by forest investments in Finland. Investments have increased both the annual growth as well as the growing stock during the period concerned. A major part of this timber has been used as the raw material for forest industry products. Gross utility increments are measured by counting GDP increments due to the increased production of the forest industries in 1993. The direct and indirect effects are measured by input-output analysis.

2 Forest Policy for Investment Subsidies

The scarcity of timber has to be considered in any attempt to understand the forest policy activities for timber management intensification in Finland. Forecasts of forest industry timber famines have typically preceded the initiatives to increase public subsidies for the intensification of timber production in Finland. Increased investment activities have been subsidized to produce more timber, not to make the timber production more profitable.

There have been two types of investment subsidies so far: a) annual financing through the Budget and b) national forestry programs to expand investments. The areas in the annual investment activities have increased rapidly during the national programs (MERA 1965–75, METSÄ 2000 1985–).

Investments on forestry can be divided into two categories: obligatory and voluntary. In Finland most of the investments such as pruning, fertilisation, tending of seedling stands, road construction and draining are voluntary. Regeneration after final felling can be taken as an obligatory investment (Hänninen 1998). Forest road construction and peatland drainage are investments which are normally carried out as cooperative projects due to small average size of forest holdings. Public support for and participation in these projects can be taken as a necessary condition for their execution on a larger scale. Peatland drainage projects require that all the landowners in the effected area must be considered. In the case of drainage, the returns from the investments occur after a longer period than the average ownership of forest holding (30 years, Ripatti 1998). Public support is therefore needed to get all the forest owners to carry out such cooperative projects.

The total investments in silvicultural and forest improvement work between 1963 and 1996 amounted to 37.0 bill. FIM, expressed in 1996 money. Most of the forest improvement work has been executed in private forests. In the early 1960's, the total costs of these investments in private forest were less than 300 mill. FIM annually. During MERA-period (1965–75), invest-

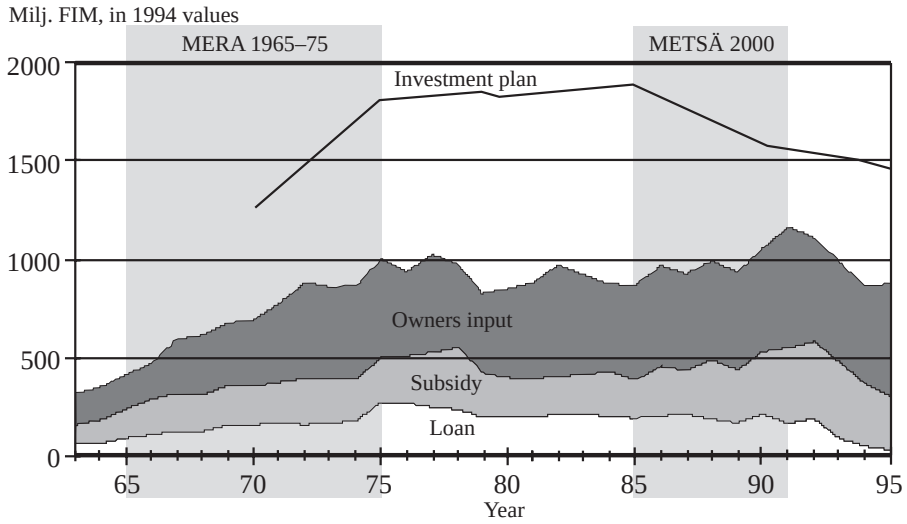

Fig. 1. Annual costs of investments into forest regeneration and the intensification of timber management in non-industrial private forests in Finland, 1963–95. Public loans and direct subsidies are identified separately. The investment plan curve is from the investment master plan for 1970–94 published by the Economic Council of Finland in 1969 (in 1996 money) (Forest Statistical Yearbooks 1968–1997).

ments increased until 1972, when the 800 mill. FIM level was reached. Since then, investments in private forests have varied between 800 and 1000 mill. FIM. Since the 1950's, all investments in wood production in non-industrial private forests have totalled about 28.5 bill. FIM. In the 1990's, investments in forest improvement have decreased remarkably (Fig. 1). The difference between investment plans and actual costs is particularly striking. One explanation is, that plans tend to be overoptimistic.

3 How Forest Improvement Contributes to Forest Increment and Allowable Cut

In the 1970's, those young stands that developed on the drainage and regeneration areas reached a phase of development where the increasing growth on those areas began to contribute to the total increment of Finnish forests.

According to Kuusela and Salminen (1991), when measured similar way, total increase in increment in the late 1980's was 12 mill.m^3/a compared to the level of increment at the beginning of the 1950's. The part of this additional increment resulting from drainage activities was about 7 mill. m^3/a. The total effect of the forest extension programs on growth and allowable cut is almost impossible to determine unambiguously.

Increases in the increment from the mid-1970's to the early 1990's were about 16.8 mill. m^3/a, of which about 10.9 mill. m^3/a were in Southern Finland and about 5.9 mill. m^3/a in Northern Finland. Drainage and the fertilisation of drainage areas accounted for was about 10 mill. m^3/a (Tomppo and Henttonen 1996).

Increases in the increment do not directly translate to allowable cut. The MELA-group at the Finnish Forest Research Institute has estimated that the allowable cut in the 1990's is about 66.6 mill. m^3/a, which is an increase of about 10 mill. m^3/a compared with the early 1980's. The present paper estimates that this increase has been the result of forest improvement work, because most of that increase has taken place on the drained peatlands (Nuutinen et al. 1998).

4 Data

4.1 Input-Output Tables for Year 1993

The basic data derives from a 33-industry input-output table for 1993, where the forest sector is divided into seven industries by Toropainen (1996). The input-output table used here is prepared from a 65 industry table constructed by Statistics Finland (see Toropainen 1998). The forest sector industries in the table are sawmilling, other woodworking, furniture manufacturing, pulp, paper and paperboard, paper and paperboard products.

Employment multipliers have quite short-term effects, about a year or two, and they do not include long-term impacts of new factories which change the character of the economy. Employment multipliers also become obsolete sooner than other tables (Toropainen 1998). In this paper, the multipliers were updated for 1996, because after the recession period, the rise of productivity was especially high and using old employment multipliers would have caused over-optimistic estimates of employment effects.

4.2 The Effects of Forest Improvement Work on Production of Forest Industry

In trying to estimate how forest improvement works have increased the allowable cut and via that, the production possibilities of forest industry, we have to keep in mind other factors effected production possibilities. The three most important factors are the reduction of fuelwood consumption in dwellings and other buildings, the change in the area of nature conservation area, and the more effective use of wood raw material in the pulp and paper industry. However these effects are very difficult to quantify.

In 1993, wood consumption in dwellings and other buildings was 7.3 mill. m^3 less than in 1964. This amount is released for other users and has partly been used by the forest industries. Another major change has been the increasing efficiency of the pulp and paper industry in its use of wood raw material. Assuming that the efficiency of production was the same in 1993 as it had been in 1965, an extra 15.7 mill. m^3 of roundwood would have been needed to achieve the corresponding production (19.3 million tonnes).

Using input-output tables, a hypothetical situation is investigated in which it is assumed that the use of wood raw material in 1993 would be 10 mill m^3 less than the level in that particular year. Following to the results of MELA-group (1998) we assume that 10 mill. m^3 equals the increase in increment resulting from forest improvement work. Without this additional increment, the forest industries would be using that much less roundwood and producing less than it actually did in 1993.

The input-output analysis only deals with domestic markets. Mechanical and chemical pulp are produced mainly for domestic markets and are used as inputs in paper making. Thus, the corresponding effects of changes are included in the figures for the paper industry. In other words, increasing cutting potentials have an effect on the paper industry and on exports via the pulp industry.

Roundwood consumption by the sawmill industry was 22.15 mill. m^3 in 1993 and by the pulp industry 38.45 mill. m^3 (Forest Statistical yearbook 1997). The assumption for the analysis is that the present corresponding wood consumption level would have been 17.56 mill. m^3 in sawmilling and 33.04 mill. m^3 in pulp production. This assumed total reduction of 10 mill. m^3 in wood consumption of these industries is in relation of their use of domestic roundwood in 1993.

It is assumed that the value of production of the sawmill industry would be less in relation to wood consumption. The value of the sawnwood production would be 2100 mill. FIM less or 7200 mill. FIM in 1993. When the effect of the pulp industry's wood consumption on paper production is taken into account, the value of the paper production would be 4900 mill. FIM less or 30 200 mill. FIM.

If the reader wishes to try different wood consumption estimates, simply multiply the figures presented in the tables by the ratio of his or her own estimates and 10 mill. m^3.

5 Direct and Indirect Effects of Forest Improvement

5.1 Effects of Forest Improvement Work on Domestic Production

Input-output analysis is used here for the investigation of direct and indirect effects of changes in forest sector production between industries and in the national economy, value-added and employment. It is a normal ceteris paribus-situation: one thing is changed and other things stay equal. In this analysis, it also assumed, that imports would not have been increased at all. As calculated earlier, the effect of forest improvement work estimated through wood consumption would be visible in the value of the end production. The direct and indirect effects of reduced production of end products of domestic production we get by using normal inverse matrix.

In input-output analysis, the exogenous variable is the production of final products, not total output. Direct and indirect effects on output, value added and employment in different industries is generated by the purchases of intermediate inputs used in the final production, not by selling those inputs. As Table 1 shows, sawmilling needs few inputs from other forest industries. In that respect, the paper industry is very different. The "same industry" row in the table consists of both the final products and the intermediate inputs produced by paper industry itself as well as those produced by combined pulp and paper industry. The "other forest industries" row consists of the intermediate inputs purchased from the mills producing only pulp and from sawmilling.

The reduction of total production here describes the decrease of economic activity in different industries (see Toropainen 1998). Indirect effects are most important in the case of the forest industries. If the value of final products in the sawmill industry would be 2100 mill. FIM smaller, it would mean indirect effects of 90 mill. FIM less in the same industry, 930 mill. FIM less in forestry and 20 mill. FIM less in other forest industries as well as a total of 850 mill. FIM less in other industries (Table 1). For every directly lost million FIM 0.9 mill. FIM would be lost indirectly. The corresponding figure for paper industry is 1.0. The total effect of a change in the production value of sawmill and paper industry would be 13.9 bill. FIM.

Table 1. The effects of reductions in the sawmill and paper industries' end production on domestic production.

	Reduction of the value of production of end-products: Sawmill industry, 2100 mill. FIM	Paper industry, 4900 mill. FIM	Total, 7000 mill. FIM
Reduction in production, million FIM:			
Forestry	930	590	1520
Same industry	2190	5080	
Other forest industries total	20	1130	8420
Forest sector total	3140	6800	9940
Chemical industry	10	270	280
Metal products, machinery	50	200	250
Electricity, heating, water	130	1170	1300
Trade	70	140	210
Transportation	310	400	710
Business and real estate service	90	290	380
Other industries (20) total	190	660	850
Total	3990	9930	13920

Table 2. The effects of reductions in sawmill and paper industries' end production on value-added at market prices.

	Reduction of the value of production of end-products: Sawmill industry, 2100 mill. FIM	Paper industry, 4900 mill. FIM	Total, 7000 mill. FIM
Diminishing portion of value-added, million FIM:			
Wages and employers' contribution to social security schemes	740	1700	2440
Indirect net taxes	–20	–30	–50
Wear-and-tear of fixed capital	420	1180	1600
Operating surplus	790	930	1720
Value-added total,	1930	3780	5710
of which direct effect	610	1280	1890
and indirect effect	1320	2500	3820

5.2 Effect of Forest Improvement on Value-added

The change in total production is gross value. For the national economy the net gain is value-added, or the GDP share of the industry of total production. The intermediate inputs are excluded. At market prices, it is sum of the wages, employers' contribution to social security, indirect net taxes, wear-and-tear of fixed capital and operating surplus (Toropainen, 1998).

A reduction of the final production of the forest industries has a strong impact on value-added. A reduction in the value of final production by 2100 mill. FIM in sawmill industry would decrease value-added directly by 610 mill. FIM and indirectly by 1320 mill. FIM (Table 2). Indirect effects are considerable in forestry, where the direct share of the value-added of production value is 90 percent.

5.3 Employment Effects of Forest Improvement Work

Employment is here defined by numbers of employed persons. The employment multipliers (= number of employed persons needed for the production worth one million FIM) are updated to the level of 1996 using fixed price changes in the productivity of work. These multipliers are also counted in 1993 prices. In this case, the base year is important. Employment multipliers change when price levels change, even if relative prices stay constant. Conversely, in the analysis of total production and value added, which is based on cost shares, the base year is not so important. However, the relative prices of both inputs and outputs must stay constant.

Considerable changes occur in employment in the production of final products. Forest industries are important employers, especially indirectly. Reduction in sawmill industry of 2100 mill. FIM causes a direct reduction in employment in the same industry of about 1950 persons and indirectly about 80 persons. In forestry the reduction is 2020 persons and in other industries 1450 persons (Table 3). For every job lost in the sawmill industry, 1.8 indirect jobs will be lost. In the paper industry, the corresponding coefficient is 1.7. The total effect of reduced final production in the sawmill and paper industries would have been 15 330 direct and indirect jobs.

6 Discussion

This paper is an initial evaluation in an analyses of the profitability of forestry investment subsidies in Finland. The most difficult aspect of the investigation has been to find reliable data on the increase in increment. Consequently no regional analysis has been attempted, even though these are important in a country where differences in growing conditions are considerable.

When the results of this study are further ana-

Table 3. The effects of reductions in the sawmill and paper industries' end production on employment.

	Reduction of the value of production of end-products: Sawmill industry 2100 mill. FIM	Paper industry 4900 mill. FIM	Total 7000 mill. FIM
Reduction in employment in, persons:			
Forestry	2020	1270	3290
Same industry	2030	3760	
In other branches of forest ind.	30	690	6510
Forest sector, total	4080	5720	9800
Chemical industry	10	240	250
Metal products, machinery	80	300	370
Electricity, heating, water	70	580	650
Trade	200	460	660
Transportation	600	750	1350
Business and real estate service	190	630	820
Other industries (20) total	310	1120	1430
Total	5530	9800	15330
of which directly in own industry	1950	3630	5580

lyzed, the reader must bear in mind the direction of the causality. Forest improvement work as such has not created the economical impacts. They are created by the increased demand for the end-products of forest industries. Forest improvement investments have helped to fulfill the forecasted increased demand for roundwood by increasing the amount of forest resources in a wood shortage situation. Such an investment at the present time would not necessarily lead to similar results which would occur only if the demand for forest products would increase in the future and supply of roundwood would not be high enough to fulfill the needs of increasing production without public subsidies.

Possibilities to increase imports of roundwood instead of using more from domestic sources have been ignored in this analysis. A challenge for future research will be to extend the analysis to include imports. Input-output methodology also has its own restrictions, which can disturb the interpretation of the results. In reality, products, inputs and production methods are not as homogenous as they are assumed to be in this paper (see Miller and Blair 1985, Toropainen 1993). Input-output methodology can be used in this kind of cross-sectional analysis, but not directly for long-term analysis. The effects in year 2003 are certainly different than those ten years earlier. Technology and the productivity of industries will change due to the investments in production.

It is also impossible to estimate the extent of forest improvement in the absence of subsidies and cost-share programmes. It is also clear, that the benefits from forest improvement work take their time. In the 1970's there would have been few benefits compared to the late 1990's. More benefit-cost type evaluation is needed to provide more information on the profitability and time aspects of all kinds of forest improvement investments. The opportunity costs were not included in this analysis. In coming studies it might be worth evaluating what would have happened if subsidies were given to other sectors. Would that have led to higher national economic benefits?

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References

Alig, R.J., Lee, K.J. & Moulton, R.J. 1990. Likelihood of timber management on nonindustrial private forests: Evidence from research studies. USDA Forest Service. Southeastern Forest Experiment Station. General Technical Report SE-60. 17 p.

Boyd, R.G. & Hyde, W.F. 1989. Forestry sector intervention. The impacts of public regulation on social welfare. Iowa State University Press, Ames. 295 p.

Cubbage, F.W., O'Laughlin, J. & Bullock, C.S. 1993. Forest resource policy. John Wiley & Sons Inc., New York. 562 p.

Forest statistical yearbooks 1968–1997. Finnish Forest Research Institute.

Grayson, A.J. 1993. Private forestry policy in western Europe. CAB international, Wallingford. 329 p.

Hänninen, H. 1998. Metsäpolitiikan keinot. In: Hänninen, H. (ed.). Puuvarojen käyttömahdollisuudet. Metsälehti kustannus. p. 140–142. (In Finnish.)

Harou, P.A. 1987. Essays in forestry economics: appraisal and evaluation of forestry investments, programs and policies. Vauk, Kiel. 195 p.

Kuusela, K. & Salminen, S. 1991. Suomen metsävarat 1977–1984 ja niiden kehittyminen 1952–1980. Summary: Forest resources of Finland in 1977–1984 and their development in 1952–1980. Acta Forestalia Fennica 220. 84 p.

Miller, R. & Blair, P. 1985. Input-output analysis: foundations and extensions. Prentice-Hall. New Jersey. 464 p.

Nuutinen, T., Hirvelä, H., Härkönen, K., Kilpeläinen, H., Salminen, O. & Siitonen, M. 1998. Metsien puuntuotantomahdollisuudet. In: Hänninen, H. (ed.). Puuvarojen käyttömahdollisuudet. Metsälehti kustannus. p. 67–79. (In Finnish.)

Ollonqvist, P. & Immonen, T. 1995. The institutional control of the allowable cut of timber resources and the roundwood market in Finland 1928–87. In: Korpilahti, E., Salonen, T. & Oja, S. (eds.). Caring for the forest: Research in a changing world. Abstracts of invited papers. IUFRO XX World Congress, 6–12 August 1995, Tampere, Finland. The Finnish IUFRO World Congr. Organ. Committee. p. 435–436.

Ripatti, P. 1998. Metsien omistus. In: Hänninen, H. (ed.). Puuvarojen käyttömahdollisuudet. Metsälehti kustannus. p. 62–67. (In Finnish.)

Tikkanen, I. 1981. Effects of public forest policy in Finland. An econometric approach to empirical policy analysis. Silva Fennica 15(1): 38–64.

Tomppo, E. & Henttonen, H. 1996. Suomen metsävarat 1989–1994 ja niiden muutokset vuodesta 1951 lähtien. Metsätilastotiedote 354. Metsäntutkimuslaitos. 18 p. (In Finnish.)

Toropainen, M. 1993. Metsäsektorin muutosten työllisyysvaikutukset 1989–1997. Metsäntutkimuslaitoksen tiedonantoja 459. 84 p. (In Finnish.)

— 1996. Panos-tuotos-taulukot 1993. Metsäsektori 7-toimialaisena. Mimeograph. Finnish Forest Research Institute. Joensuu. 128 p. (In Finnish.)

— 1998. Metsäsektorin kerrannaisvaikutukset kansantaloudessa. In: Hänninen, H. (ed.) Puuvarojen käyttömahdollisuudet. Metsälehti kustannus. p. 157–162. (In Finnish.)

Vehkamäki, S. 1986. The economic basis of forest policy: a study on the goals and means of forest policy. Acta Forestalia Fennica 194. 60 p.

Wibe, S. & Jones, T. (eds) 1992. Forests. Market and intervention failures. Five case studies. Earthscan, London. 204 p.

Uusivuori, J. & Leikas, T. 1991. Valtion metsänparannuksen metsätaloudelliset vaikutukset Suomessa. Pellervon taloudellinen tutkimuslaitos. Reports and discussion papers 17/1991. 18 p. (In Finnish.)

Total of 20 references