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SUSTAINABLE MARKET-BASED FORESTRY AND THE FINANCIAL BENEFITS OF FOREST MANAGEMENT IN ESTONIA: A LOCAL-LEVEL CASE STUDY

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Sustainable Market-Based Forestry and the Financial Benefits of Forest Management in Estonia: A Local-Level Case Study

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1. INTRODUCTION AND SUMMARY

Estonia has a long tradition of public and private forest management. This tradition will continue in the future as it is expected that about sixty percent of the existing forest stock will remain as state-owned land and forty percent will be returned to private ownership. After a two-year lull in forestry activities during 1992 and 1993, 1994 brought a new upturn in Estonian forestry. The rapid development of forestry was promoted by several factors, including: (1) the appearance of an export market for pulpwood, which had little value in Estonia during the Soviet period; (2) the development of an export market for sawlogs and sawn materials which enabled the establishment of successful local saw mills; (3) the integration of timber prices on the local market with world market prices, and the greater demand for lumber by the rapidly growing local construction industry; (4) the rising price of imported fuel which forced more of the local population to turn to wood as a cheaper energy source; and (5) enterprises, persuaded by the continued economic reforms, began dealing extensively in the forest sector.

On both private and public forests, Estonia will continue to manage this natural asset for the multiple services it provides. For example, forests provide what economists call non-consumptive use benefits created by tourism and the protection of natural habitats. Forests also provide consumptive use benefits created by harvesting and selling timber and related forestry sector activities (milling, transportation, export). There can be some tension in meeting these multiple objectives for non-consumptive and consumptive use benefits.

The purpose of this paper is to address the following two policy questions for the management of Estonian forests. First, is the current level of harvests a concern for meeting environmental objectives? And second, what amount of income is generated from harvests, and how is this income divided among various stages/groups in forestry (i.e. the government, harvesting, processing, and exporting)?

As a first step in a more national level analysis, this paper focuses specifically on the forest districts that overlap four local government units (called Vald in Estonian and perhaps best translated as "parish" in English) in Võru and Valga counties in Southern Estonia. This case study region was chosen because of the importance of forestry for the local economy and because Karula National Park--the second national park in Estonia--was established in the region in 1993. Creating this park, and preserving a substantial portion of older forests in the area, will create large changes in the future land use and development of the local economy.

The paper is organized as follows. After a brief introduction to the case study region in Section 2, Section 3 presents basic information on harvest levels in the study region. Section 4 reports on auction prices for harvesting rights (final felling and thinning) in the region. Based on these data and additional best estimates of uses and production costs, Section 5 analyzes the overall financial benefits being generated from forestry in the region and estimates how these total benefits are distributed among the various participants in forestry activities. Section 6 concludes with some final remarks and suggestion for further policy analysis of the forest sector.

In sum, the data show that harvests levels are small relative to the amount of standing volume, past harvest levels, and as specified in management plans for the region. It can be concluded that the current level of harvests, or even substantially higher harvests, are very consistent with meeting Estonian forest management objectives of supplying non-consumptive use benefits to the economy. Estonian forest prices are integrated into world market prices, and the relatively competitive pricing policy has generated an additional benefit for Estonia. The price for harvesting rights for sawlogs has risen to an extent that it has become less profitable to export unprocessed material and more profitable to process products locally. As a result, more domestic Estonian value-added is being generated. Based on existing data, it is estimated that forestry generates about EEK 58 million (a little over $US 4.8 million) in the case study region, with the government receiving about 14% of this total directly through stumpage sales and other taxes. Of the remainder, about 54% is generated by harvesting and processing, with export of sawn materials and pulpwood accounting for about 30% of total income.

2. THE CASE-STUDY REGION

The study area consists of forest districts that overlap with four parishes in Võru and Valga countries in southeastern Estonian (see Map 1). For reference, parishes are government management units, while forest districts are forest management units. For this study, the forestry districts of the Võru Board of Forests are Ansla, Moniste, Roosa. In the forest districts of the Valga Board of Forests are Hargla, Iigaste, Karula, Valga, Taheva.

The study area consists of a total land area of 88,033.5 ha, with forest area covering 47,165 ha (53.5 % of total land area). Table 1 summarizes basic land category information of the study region over the last decade, while Table 2 summarizes information on forest area and standing timber as well as the number of state forest employees in the district. In Estonia, forest area is divided between "forest land" which were in previous times and still are state-owned forests, and "agricultural forests" which are forests growing on private land or land that will be privately owned in the future. Districts are further subdivided into smaller units of oversight called wards (see Table 2). In the region, the main difference between Soviet times and today in land use is that about 40% of fields are idled because of declines in the agricultural economy.

About 20% of families in the region engage in private farming. Agricultural total land use, and intensity of use, remain low and are likely to remain low because milk and grain production are not profitable given new market conditions and world market prices. Forest use by farmers is still limited and controlled by state. The slow pace of final land privatization, with only 5% of farm land currently privatized, has limited timber harvests from private lands.

The total population of the case study parishes was about 7200 (as of January, 1995), and the region includes one town, Antsla, with 1700 inhabitants. There have been few changes in population over the last decade, but changes have been larger in the past. For example the population in Karula parish decreased from 2060 in 1960 to 1147 in 1995.

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Official employment in the region is generally stable except for Taheva parish (see Figure 1), although official incomes are relatively low compared to the national average. Many people also find work in other regions and in new occupations due to the low level of employment generation in the region. Local private business has started, mainly in local trading, timber processing and tourism.

3. FOREST HARVESTS

In principle, Estonian forests are managed according to 10-year plans. In order to understand the intensity and scope of forestry management activities in the parishes under investigation, Table 3 shows the planned and actual extent of felling during the previous management plan period (1982-1992 or 1984-1994)) and planned during the next period. When compared to estimated forest stocks from Table 2, the level of planned harvests are under two percent and closer to one percent of standing volume. Given growth rates in the region, no obvious concern is raised by these plans.

Figure 2 and 3 report actual felling levels by forest district by type of harvest (final felling, thinning/sanitary felling, and other for 1993 and 1994). In the investigated Forest Districts, it is reported in official data for 1994 that 87,831 cubic meters of timber were harvested from state owned forests and a further 16,575 cubic meters were harvested in farm and municipal forests. Given the estimated seven million cubic meters of standing volume, this harvesting rate of about 1.4% per year does not raise any obvious concerns that over-harvesting will limit provision of environmental services from forests in the case study region.

In comparison to 1993, the quantity harvested rose by 29,392 cubic meters, which is quite a significant increase over one year. In real terms, however, this increase is not so great taking into account the trough in 1993. Indeed many areas planned to be harvested in 1993 were left unfelled.

Market conditions are driving harvesting decisions. Final felling in 1994 was mainly carried out by private enterprises (over 90 percent of harvest), and thinning (selective logging and sanitary felling) was also mainly done by the private sector (about 60%). In former years final felling was carried out exclusively by state owned forestry companies. Regarding thinning, forestry districts continue to complete a substantial amount of the total (about 38%), a portion of which is essential for forest preservation tasks and portion of which is used to provide income for the people associated with the forestry district. The participation of farmers in thinning has also grown to about 9% of total thinning. This percentage will increase steadily over the coming years as ownership reform progresses.

In the study region, the proportion of final felling of total felling will fall in the future because older forests were extensively harvested during the Soviet period. Until 1940, felling was not very intensive because the transport of lumber in remote areas was difficult, local needs were small, and investments for road building or local processing facilities were unavailable. Forests in the region were already overaged for commercial forestry purposes when the Soviet period began. Felling was

primarily promoted by the building of the Saru board mill and by the construction of forest roads. As a result, forests were intensively felled until the end of the 1980s, reducing the reserves of older timber available today.

While the relative importance of final felling will decline, it can be expected that the amount of thinning (for intermediate and sanitary felling) will increase due to the increased demand for timber in the present economic climate and the possibility of using less valuable timber. In the past, the organization of the required sanitary felling was a hardship for forestry districts due to the lack of manpower and financial incentive. Final fellings were made for manufacturing needs by the state forestry production plants. The logs from sanitary felling were sold to local inhabitants for firewood and saw logs for their own use. Forestry districts were required to carry out the necessary sanitary felling.

Today the export of less valuable timber (birch, aspen) to the Scandinavian countries for cellulose production is an essential activity. This has also brought about changes in the local firewood market, where prices have risen several times and some higher quality material such as birch is used only for export. Also, by transforming central heating plants to burn wood chips, which creates a larger market for low quality timber, the price of wood chips has risen about 400% recently in nominal terms at a time when annual inflation is under 30 percent per year.

While not yet a major source of harvesting, felling on former farm lands in forests due to be returned to owners will probably increase. About 35% of forests in the study region will be returned to the private sector. In the past, private owners harvested to meet their direct needs for timber. There is some indication that intensive felling of overaged forests has already begun on farm lands returned to owners, which is still only a very small amount of the total that will be privatized. In the agricultural sector, some farmers are selling harvesting rights or harvesting themselves to raise starting capital for new operations. Data collected by the authors suggest that many are living only from timber revenues due to low profits in agriculture.

As a final point, it should be noted that forest harvests will be restricted in the study area in the future through the creation of Karula National Park in 1993. In this park area, a large proportion of forests was given protected status. Final felling activities were stopped, and the National Park includes about 30% of all forests (mainly state forest) in the study region. Due to concerns about the restrictions on the local economy from the park, most local farmers and landowners oppose the national park protection regime. It is not yet clear what level of economic cost (or benefit) local residents will receive from the creation of the park. A follow-up analysis will address this question directly.

4. AUCTION PRICES FOR HARVESTING RIGHTS.

Areas of standing forest for final felling are sold by forestry districts at auction. Rights for thinning are sold partly at auction and partly contracted out by the forestry districts. The starting

price of a standing forest area for auction is determined according to a national price scale, on the basis of which a stumpage tax is levied. The final sale price is determined at open auctions. However, about 30% of the final felling volume is sold in closed auctions to local enterprises and farmers.

Figure 4 and Figure 5 show the 1994 auction prices (EEK/cubic meter) in the counties of Võru and Valga respectively relative to the starting price. A steady increase in prices since the beginning of 1994 has been noticeable, although the growth in real prices adjusted for inflation was less. A sharp increase in October and November 1994 was due to the arrival in the market of firms with large foreign assets.

In addition to the steady increase in prices, it is also noticeable that the prices at auctions for local buyers do not differ significantly from the prices at open auctions and in the case of valuable timber the prices are identical. This situation is nevertheless the result of intensive activities by internationally financed companies in the timber market which pushed up prices by over 100 EEK($US 8.3) per cubic meter in the autumn of 1994.

Figure 6 shows auction prices for selective harvests in Võru County from 1994 (intermediate and sanitary fellings), based on an experimental use of an auction to sell selective harvest rights. These prices are much lower, but the price increase is even more noticeable. Due to heavy competition for final felling logs, smaller firms have chosen to buy and process the intermediate and sanitary fellings timber.

Several factors affect forest auction starting prices referenced in Figures 4-6 including road access, terrain and forest type. As would be expected, the actual selling price of standing forest depends on the characteristics of the specific auction, including: timber quality and types; demand; the market; the size of the felling area; the type of the terrain; and subjective characteristics of the bidders. For reference, Table 5 reports the final auction prices reached in Southern Estonia.

In part due to auction pricing, open trade policies, and a stable economy, the Estonian timber market has become integrated with world markets. With most final felling rights sold in open auctions, substantial competition between buyers (local and foreign) exists. This competition has had a direct positive impact on Estonia by creating market incentives for more efficient use of forest resources by type and quality. This has limited to a large degree the waste commonly found during Soviet times.

Due to this competition, auction prices for the best quality forest have reached 600 EEK/m^3 ($US 50) which no longer enables it to be sold as raw material or exported as round timber. This price level creates the incentive for processing in Estonia, with the resulting additional jobs and value-added. In fact, many former saw log exporters are investing in domestic processing themselves. For reference, buyers who can afford this most expensive material are: the local timber processing industries (furniture), and foreign firms who process timber in Estonia and export the material themselves. Of course, this increase in raw material prices for local manufacturers will

decrease somewhat the competitiveness of their products for export. But this increase also provides the right incentives for processors to improve their productivity for the international market.

There is some concern at the local level that, due to price increases and increased competition especially for final fellings, locally-owned timber processing will die out unless the government intervenes. It is not yet clear whether this is a likely event and whether it would call for government action. For example, while small locally owned enterprises have been pushed out of the higher quality timber market, they have started dealing in thinning. Considering the greater labor intensity but cheaper price, profits can remain acceptable for small enterprises while creating jobs which benefit the local economy.

As a final note, Figure 7 shows average management costs in the study region, calculated as total management costs divided by harvested volume. When compared to Figures 4-6, Figure 7 shows that state revenues from forestry are positive and the issue of state-subsidized forestry, such as has occurred in the United States, was not a problem in Estonia at least during 1994.

Table 7 also shows that management costs are highest in the Karula where management focuses on non-timber benefits and lowest in Taheva where management is primarily for timber benefits. To some degree, this difference in management costs could be interpreted as the supply cost of environmental services from the state managed forests.

5. TOTAL AND DISTRIBUTION OF NET REVENUES FROM FORESTRY

While Section 2 concluded that the overall level of harvesting in the study area is not fundamentally of concern for environmental protection policy, it is interesting to consider the overall amount of money being generated from forestry in the region, and who gets the money. Exact data on uses and the resulting financial flows do not exist in Estonia. Tax evasion is common as well. Based on existing market information and informed opinion, we provide one estimate of the net revenues--gross revenues minus direct costs--that were generated by forest harvests in the study region during 1994. These revenues include direct revenues from state forest auctions, harvesting, processing (if relevant), and exporting (if relevant) for three main categories of timber (sawlogs, pulpwood, and firewood).

In the study region, harvested volume during 1994 was reported at 87,831 cubic meters from state forests and 16,575 cubic meters from farm and municipal forests, for a total of roughly 105,000 cubic meters. There are no data to determine how precisely these harvests were used. However, based on discussions with Forest District employees, a best guess is as follows: 49,000 cubic meters for sawlogs; 29,000 cubic meters for pulpwood; and 27,000 cubic meters for firewood. It should be mentioned here that the percent of total harvest going to sawlogs is high in this region compared to other parts of Estonia due to a large sawmill located in the region.

Direct State Revenues. In 1994, approximately 87,831 m^3 of standing forest were sold in the state forests under investigation. Based on official sales data, this resulted in gross revenues of 8,009,700 EEK($US 668,000), and an implicit price of about 91 EEK($US 7.6) per cubic meter. Of this total , 2,604,200 EEK($US 217,016) was used to finance local forestry management costs. The remainder, 5,405,500 EEK($US 450,458), is government rent from forest harvests.

Net Revenues from sawlogs. For sawlogs, we estimate revenues associated with harvest, local processing, and export. For the harvesting stage, net revenues are calculated as :

$$NR(SL; H) = p * h - h(a+b) = 12,691,000 \quad (1)$$

where

NR(SL;H)	=	estimated net revenues from harvesting for sawlogs (EEK)
p	=	average sawlog selling price (450 EEK/cubic meter)
h	=	harvest level for sawlogs (49,000 EEK/ cubic meters)
a	=	average timber price (91 EEK/cubic meter calculated above)
b	=	local transportation and harvest costs (100 EEK/cubic meter).

While this estimate of net revenues may exclude some costs of harvesting, our estimate provides a reasonable indication of the amount of income being generated at the local level from harvest of sawlogs.

After the trees are harvested and sold to local saw mills, such as Saru, additional net revenues are earned by the local mills through processing to sawn material. These net revenues from the saw mills, NR(SL;M), are calculated as:

$$NR(SL;M) = h*(p_I*q_I * p_{VI}*q_{VI} * p_{VII}*q_{VII}) - p * h - c * h * q_I = 15,220,000 \quad (2)$$

where

NR(SL;M)	=	net revenues from saw materials (EEK)
h	=	harvest for sawlogs (49,000 cubic meters)
p_I	=	average sales price for quality class 1-5 material (1550 EEK/cubic meter)
q_I	=	estimate of percentage sawn material in quality class 1-5 (0.35)
p_{VI}	=	average sales price for quality class 6 material (1100 EEK/cubic meter)
q_{VI}	=	estimate of percentage sawn material in quality class 6 (0.18)
p_{VII}	=	average sales price for quality class 7 material (600 EEK/cubic meter)
q_{VII}	=	estimate of percentage sawn material in quality class 7 (0.10)
p	=	purchase price of sawlogs (450 EEK/cubic meter)
c	=	processing costs for electricity and labor (100 EEK/cubic meter)

Processing costs of 100 EEK are assumed to be split between 10 EEK for electricity, 40 EEK for saw operators, and 50 EEK for other labor and other costs.

After harvesting and processing, it is assumed that most sawn materials are exported. Net revenues from this exporting stage, NR(SL;E), are calculated as:

$$NR(SL;E) = h*(qI * peI + qVI * peVI) - h*(qI * pI + qVI * pVI) - h*(qI + qVI) * (ca+cb) = 12,597,900 \quad (3)$$

where

NR(SL;E)	=	net revenues from exporting of sawn materials (EEK)
h	=	harvest for sawlogs (49,000 cubic meters)
p_{eI}	=	average export sales price for quality class 1-5 material (2300 EEK/cubic meter)
q_I	=	estimate of percentage sawn material in quality class 1-5 (0.35)
p_{eVI}	=	average export sales price for quality class 6 material (1600 EEK/cubic meter)
q_{VI}	=	estimate of percentage sawn material in quality class 6 (0.18)
p_I	=	average purchase price for quality class 1-5 material (1550 EEK/cubic meter)
p_{VI}	=	average purchase price for quality class 6 material (1100 EEK/cubic meter)
c_a	=	transportation costs to harbor (80 EEK/cubic meter)
c_b	=	harbor and loading costs (100 EEK/cubic meter)

Pulpwood processing. Besides sawlogs, a portion of total harvests is for pulpwood. We estimate revenues for two stages: harvest and then export. Net revenues from harvesting, NR(PW;H), can be calculated as:

$$NR(PW;H) = p * h - h (a + b) = 5,365,000 \quad (4)$$

where

NR(PW;H)	=	estimated net revenues from harvesting for pulpwood processing (EEK)
p	=	average pulpwood sales prices (300 EEK/cubic meter)
h	=	harvest level for pulpwood (29,000 cubic meters)
a	=	average auction price (15 EEK/cubic meter)
b	=	local transportation and harvest costs (100 EEK/cubic meter).

Following harvest, net revenues from pulpwood export, NR(PW;E), are calculated as:

$$NR(PW;E) = pe*h - h*(ca + cb + p) = 3,770,000 \quad (5)$$

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where

NR(PW:E)	=	estimated net revenues from pulpwood export (EEK)
p_e	=	average export price for pulpwood (600 EEK/cubic meter)
p	=	average pulpwood sales prices (300 EEK/cubic meter)
h	=	harvest level for pulpwood (29,000 cubic meters)
c_a	=	transportation costs to harbor (70 EEK/cubic meter)
c_b	=	harbor and loading costs (100 EEK/cubic meter).

Firewood processing. The final amount of total harvest in the region (27,000 cubic meters) is primarily used for home consumption as firewood. While this wood is not directly marketed, we can roughly calculate the implicit value of this harvest to local residents as the money they save from not having to buy firewood on the local market. As a related alternative for low valued material, we note that the market for woodchips for boiler houses has grown recently, and wood chips can be sold for 40 EEK/m^3 ($US 3.33).

This implicit net revenue from harvest for firewood, NR(FW;H), is calculated as:

$$NR(FW;H) = p * h - h\ (a+b) = 677{,}000 \qquad (6)$$

where:

NR(FW;H)	=	estimated net revenues from harvesting for firewood (EEK)
p	=	average market price for firewood (40 EEK/cubic meter)
h	=	harvest level for firewood (27,000 cubic meters)
a	=	average price for harvesting right (10 EEK/cubic meter)
b	=	local transportation and harvest costs (5 EEK/cubic meter).

The cost of harvest of 10 EEK/m^3 ($US 0.8) is a reasonable average for the study region. Compared to the value of harvests for sawlogs or pulpwood, this price is low because of lower quality, and the low incomes of local residents.

Local-Level Importance of Forestry. The final results of the above calculations are summarized in Table 4. While Table 4 provides an estimate of incomes earned from forestry in the region, it is also possible to consider directly the jobs and related taxes generated at the local level. This local-level impact is important for at least two reasons. First, incomes generated locally will create additional multiplier effects on the local economy, generating additional jobs and tax revenues. And second, concern has been expressed in Estonia that forest policy, which is driven primarily at the national level, does not adequately incorporate local interests and concerns. This view sometimes concludes that financial benefits from forests are being gathered from "local forests", but the local area is not enjoying in the proceeds.

Regarding the income summarized in Table 4, local incomes ("local profits in forestry" in Table 4) are generated via government revenues (through revenue sharing), by harvesting for

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local processing and pulpwood and firewood, by local processing of saw logs, and, to a limited degree, transportation.

Based on best guesses from local municipal governments, it is estimated that about 50 percent of net revenues from timber harvesting and processing, all together 33,276,000 EEK ($US 2,773,000), stayed in the region. Much of this money has been invested in timber processing as evidenced by the 14 new sawmills and small firms starting operations. There remain some problems with tax collecting, as in all of Estonia for that matter. It is estimated that about one third of local forestry activities are not paying required taxes. However, while the government is not getting this money, the money in some large part remains in the region.

Regarding direct employment in forestry, official statistics report the following job levels in forestry: 111 in Forestry Districts; 25 in felling; 206 in timber processing; and most local farmers (about 190) also work part time in forestry. Altogether, this provides over 500 part or full time jobs in forestry, which is perhaps 25% of total employment. Informal discussions with local governments suggest that perhaps over half of the male working age population earns some income from forestry. It is well known at the local level that there are many people working somewhat informally (illegally) in forestry and that many companies are also using workers from outside the region and country. For example some felling companies from Finland use operators and drivers from Finland.

6. CONCLUDING REMARKS

Forests are clearly an important natural resource for Estonia, providing both non-marketed and marketed economic values. There have been many changes in the forestry sector with the transition to a market economy, and both the commercial and non-commercial value of forests have risen substantially since independence.

The data reported in Section 2 suggest that current and likely future levels of harvests, at least from state-owned forest lands, are not likely to harm the supply of future non-market timber values (e.g. wildlife habitat, tourism). This report does not explicitly consider harvests from non-state-owned lands that will be privatized in the near future, since such privatization has not yet been completed to any substantial degree. Further research is needed to investigate potential harvests from private lands, taking into account the private market incentives to harvest and how related government policies will influence these incentives. For example, if government policies begin to protect Estonian agriculture, thereby raising future returns in the sector, it is likely that farmers would increase harvests on their land to raise additional capital to finance agricultural production and investments (which seems to be happening to some degree at the moment on the small amount of land that has been privatized). At the same time, since much of this land has been drained and used in agricultural some year ago, it seems unlikely that substantial environmental harm would come from larger harvests on this land. Further research and analysis is needed to address this question more completely.

From a current policy standpoint, perhaps the most important issue concerns whether Estonia is gaining as much economic development benefits from forestry as possible and is happy with the current distribution of the total benefits among the various actors. Section 5 provides one estimate of this total and distribution (Table 4) based on existing data and best estimates. As far as is known, this is the first estimate of the distribution available in Estonia. While Estonian policy makers and citizens need to determine if the distribution of benefits reported in Table 4 are considered best for Estonia, there are no obvious causes for concern about this distribution.

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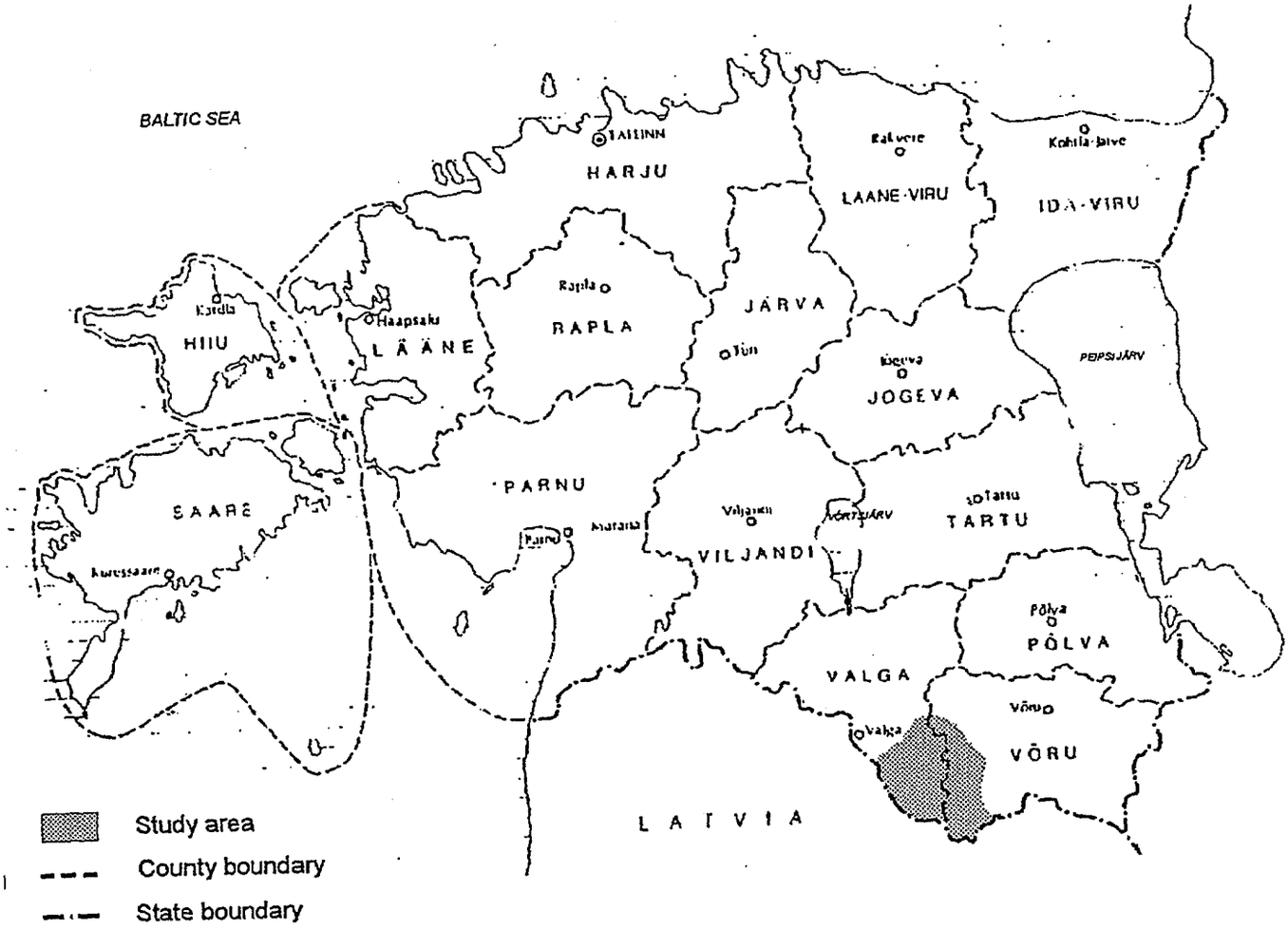
A Note On Data Sources

The data contained in this report were gathered by Rein Ahas from local government and forest administration offices in the study region. Since this information is not really contained in official publications, we explain below where the data were collected.

Population, employment, and local budget information come from the "Estonian State Statistic List (called Vallavalitsus in Estonian), population page, in the local government (Vald in Estonian) offices. Forest district information comes from the forest district office's "felling books", the forest district budget papers, and the Estonian State Statistic List, forestry page. Karula National Park information comes from the park office in Lüllemäe. Other general forestry statistics come from the Estonian State Forestry Board. All questions regarding primary data sources and locations can be directed to the authors.

Maps, Tables, and Figures



Map 1. Estonia and Case Study Area

parish	total area (ha)	fields (ha)	meadows (ha)	forest (ha)	other land (ha)
Antsla	27000.8	9455.3	1416.3	12193.5	3935.6
% total area		35.2	5.1	45.2	14.5
Moniste	17450.2	2945.7	1417	9073.6	4013.7
% total area		16.9	8.1	52	23
Karula	23112.1	5688.3	1047.3	13243.7	3132.8
% total area		24.6	4.5	57.3	13.6
Taheva	20470.4	3743.5	1726.2	12654.2	2346.5
% total area		18.3	8.4	61.8	11.5

Table 1. Land Resources of the Study Area

Forestry district	area (ha)	standing timber	wards	state empl.
Antsla	7012	1025310	9	10
agricult. forests	6673	1125000		
Moniste	4350	796890	7	11
agricult. forests	4472	N.A.		
Saru	6172	830030	5	10
agricult. forests	812	N.A.		
Roosa	373	N.A.	1	1
Hargla	4250	570000	7	6
agricult. forests	649	N.A.		
ligaste	2854	470000	5	2
Karula	6346	914710	6	11
agricult. forests	3355	503590		
Taheva	4200	731000	7	9
agricult. forests	3000	450000		
Valga	1684	N.A.	3	2
total	56202	7416530	50	62

Table 2. Forest Area and Standing Timber in Forest Area

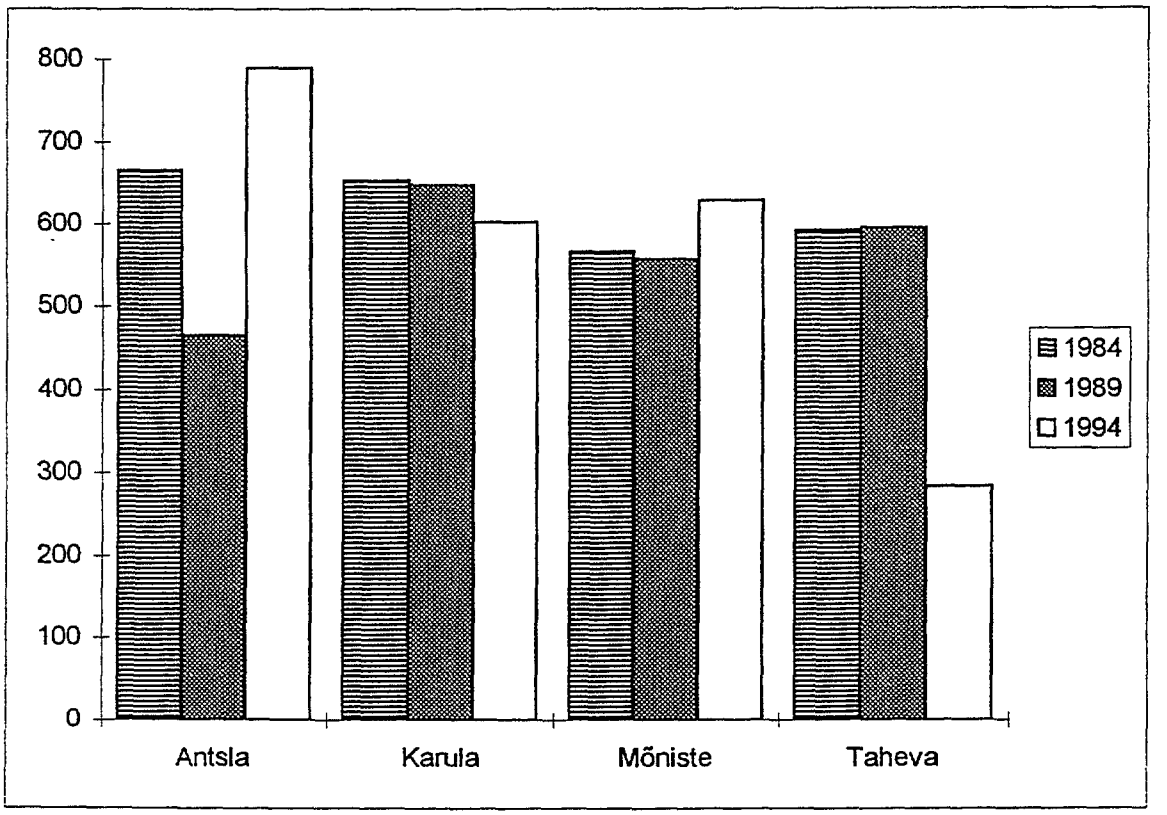


Figure 1. Official Employment in Study Area

	final felling		intermediate felling		sanitation felling	
forestry dis	ha	m3	ha	m3	ha	m3
Antsla						
1982-1992						
plan	390.3	93200	1259.6	33908	238.3	2590
real	283.1	68800	940.5	22436	N.A.	40000
1992-2002						
plan	271.8	74720	1417.3	41734	1172.3	12010
Mõniste						
1982-1992						
plan	219.9	69070	1367	66415	473	5110
real	214.8	71620	1141	30800	1180	30200
1992-2002						
plan	289.7	99240	1131.4	44995	336.7	39500
Saru						
1982-1992						
plan	405.7	94070	990.4	19484	173.2	1770
real	340	75640	893	15320	N.A.	31600
1992-2002						
plan	229.4	60020	1359.9	44895	1379	14340
Hargla						
1984-1994						
plan	150	N.A.	N.A.	47000	N.A.	N.A.
Taheva						
1984-1994						
plan	N.A.	50000	N.A.	40000	N.A.	N.A.
Karula						
1984-1994						
plan	N.A.	629190	N.A.	41360	N.A.	32918

Table 3. Planned and Actual Harvest in Study Area (1982-2002)

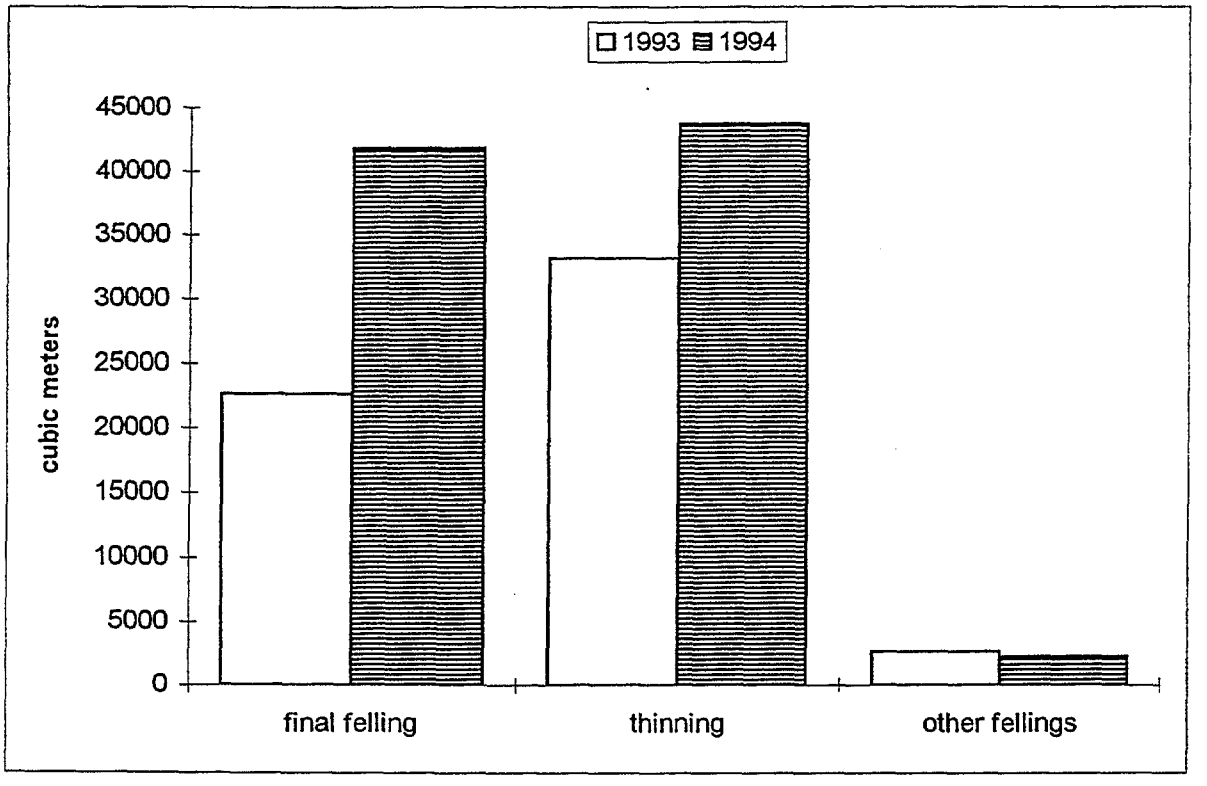


Figure 2. Felling in 1993 and 1994 in Study Area

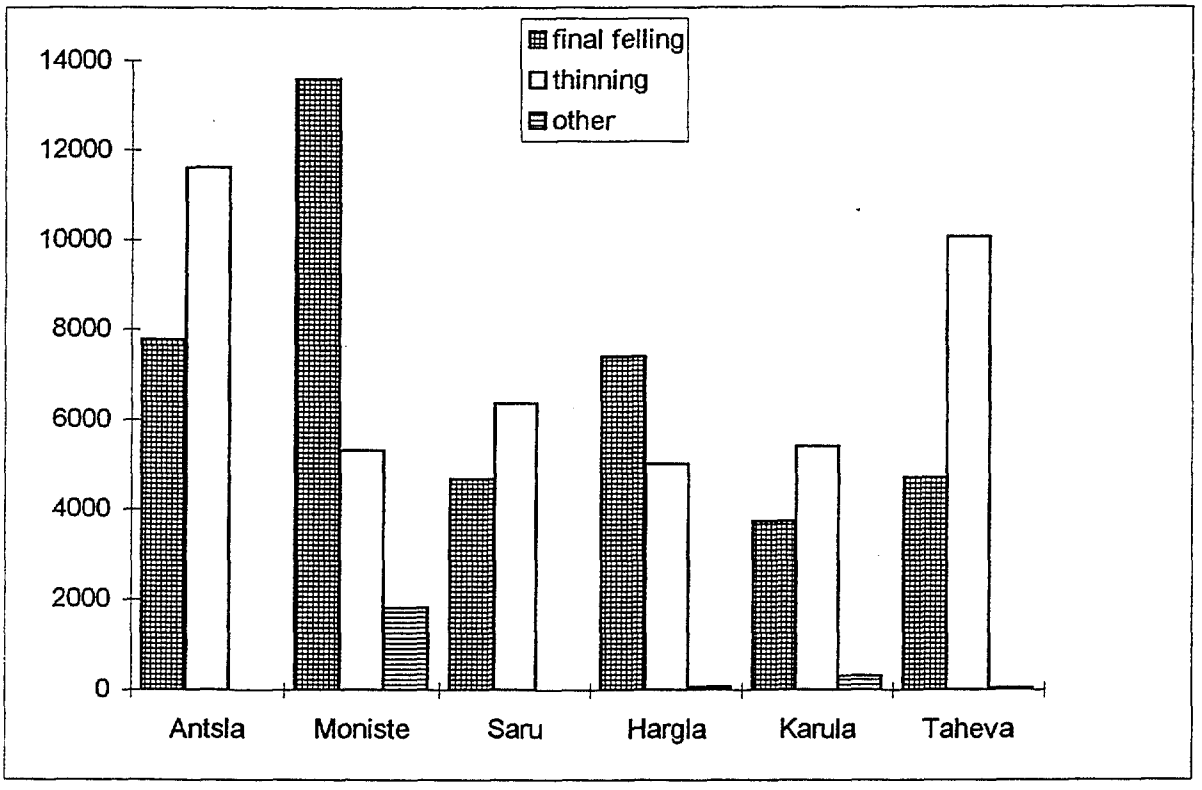


Figure 3. Felling in 1994 by Forest District (Final Felling, Thinning and Other)

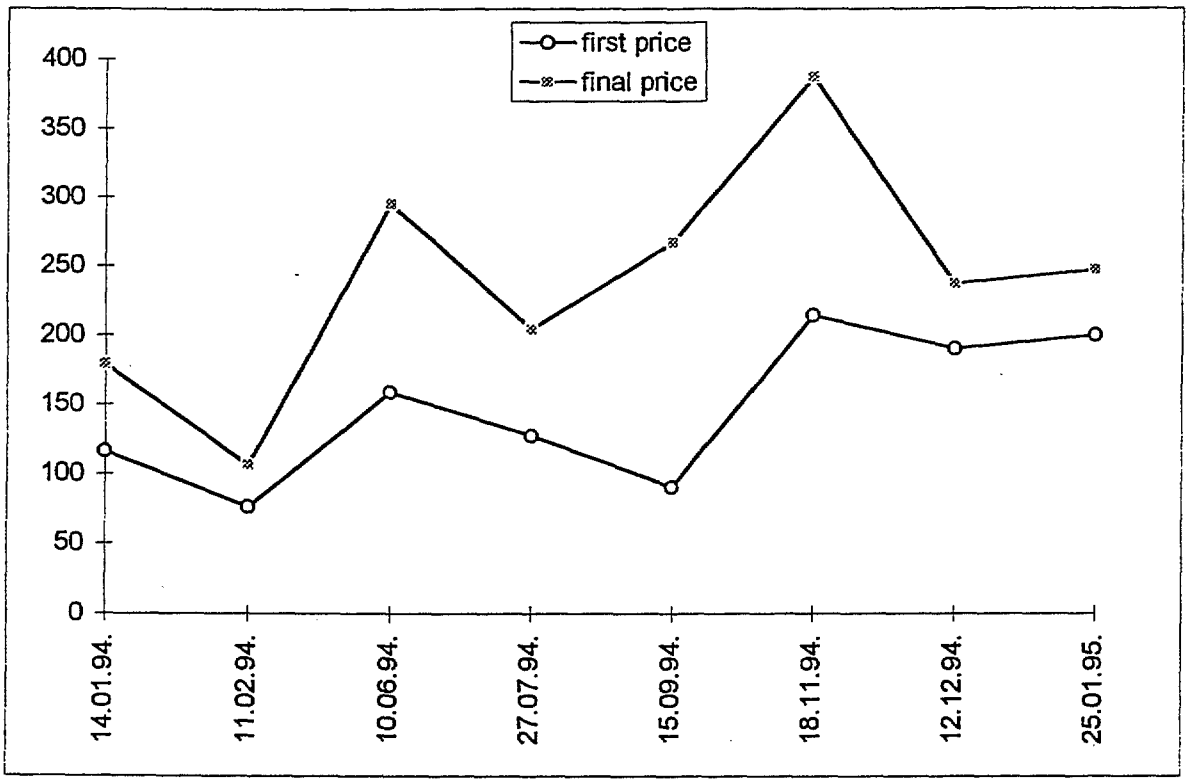


Figure 4. Auction Prices for Final Felling in Võru County 1994

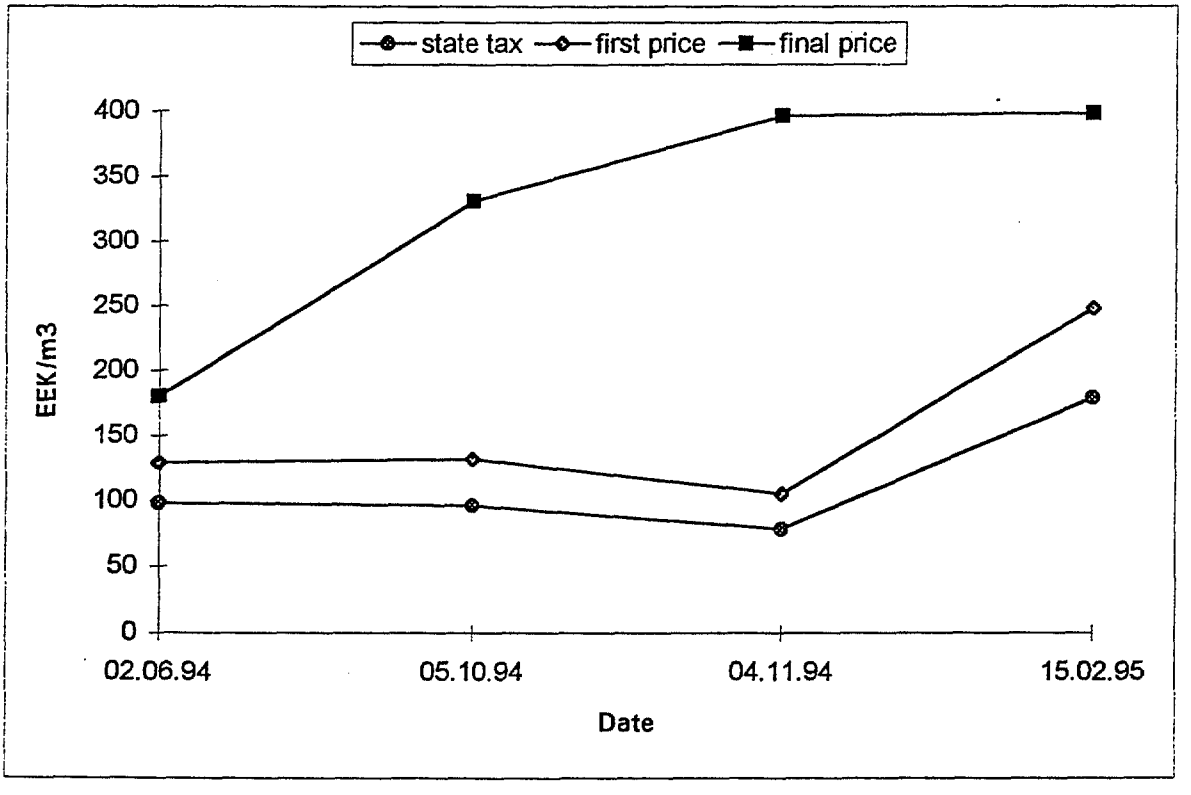


Figure 5. Auction Prices for Final Felling in Valga County 1994

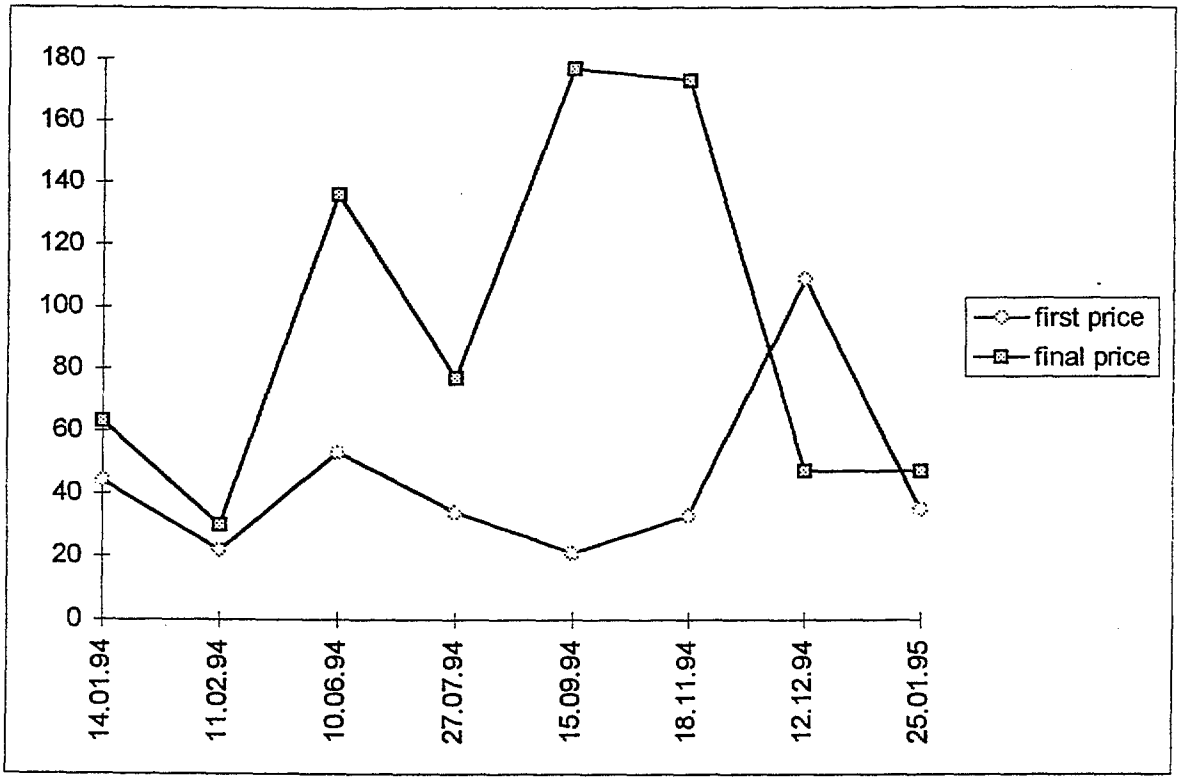


Figure 6. Auction Prices for Selective Harvests in Võru County 1994

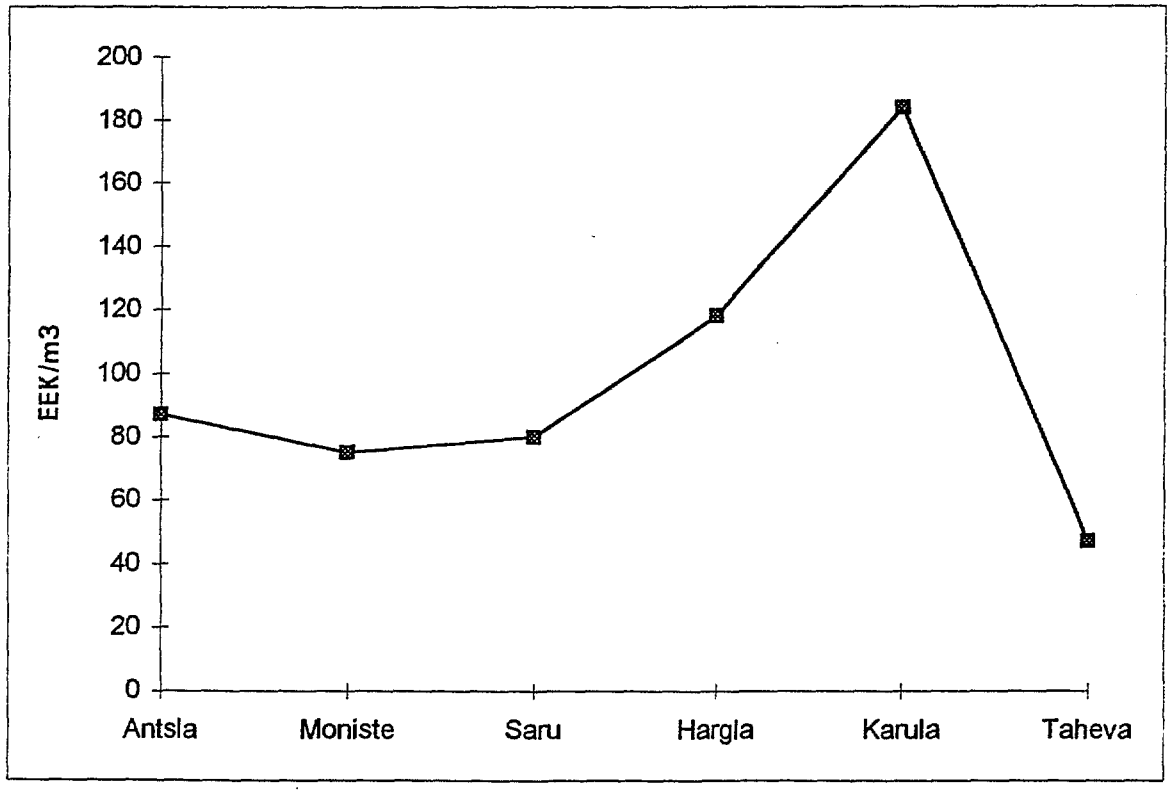


Figure 7. Average 1994 Forest Management Costs by Forest District

Stage	Notation	EEK (million)	Precentage Total
Government Direct	NR(G)	8	13.70%
Revenues			
Sawlogs			
Harvest	NR(SL;H)	12.7	21.70%
Saw Mill	NR(SL;M)	15.2	26.00%
Export	NR(SL;E)	12.6	21.60%
Pulpwood			
Harvest	NR(PW;H)	5.4	9.30%
Export	NR(PW;E)	3.8	6.50%
Firewood	NR(FW;H)	0.7	1.20%
Total		58.4	100%

Table 4. Distribution of Net Revenues from Forestry in the Case Study Region

14.01.1994. open auction			state tax	first price	final price
	area	m3	EEK/m3	EEK/m3	EEK/m3
total	25.4	8200	72	116	179
11.02.1994. open auction					
total	41	10088	54	76	106
10.06.1994. open auction					
total	24.4	6346	106	159	295
27.07.1994. open auction					
total	19.6	5548	93	127	204
15.09.1994. open auction					
total	33.2	10175	69	90	267
18.11.1994. open auction					
total	108.2	32828	181	214	387
12.12.1994. auction for Vorumaa firms					
total	43.9	10341	81	190	237
25.01.1995. open auction					
total	90.7	22183	165	200	247
average price			103	147	240

02.06.1994. open auction					
	area	m3	EEK/m3	EEK/m3	EEK/m3
total	26.3	6618	98	129	180
05.10.1994. Valgamaa auction for local firms					
total	63.5	16173	96	132	331
04.11.1994. open auction					
total	105.9	28524	78	105	396
15.02.199	open auction				
total	92	23852	179	248	398

Table 5. Forest Auction Prices in Vorumaa and Valgamaa Districts

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