Cost Comparison Between Alternative Thinning Technologies in Russian Karelia

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ABSTRACT

Planning of timber procurement has faced new challenges in North-West Russia due to new economic circumstances, invasion of foreign forest companies and western technology and the need of increased thinnings. In this study the costs of manual cutting, cutting with Russian prototype harvester, and Scandinavian harvester and forwarding with Russian and Scandinavian forwarders were investigated with unit cost calculation method. The manual cutting and harvesting with Russian prototype harvester were about 27% cheaper than the use of Scandinavian harvester. In forwarding the difference was less than 20%, the Scandinavian forwarder was more expensive. We have to remember that Russian harvester was only a prototype, and Russian forwarder used in this study is not widely used and exact data concerning long period was not available.

Keywords: unit cost calculation, thinning, Russian forestry, harvester, forwarder, manual cutting.

INTRODUCTION

Background

New political circumstances and economic transition in Russia have created conditions where planning of timber harvesting faces new challenges. A Scandinavian harvesting technology has been taken to use simultaneously with Russian technology. It is not likely that the same methods of timber harvesting are optimal both in the Scandinavia and in Russia. Major reasons for that are the low level of salaries in Russia if compared with western Europe and differences in infrastructure.

Russian timber enterprises have several possibilities in choosing harvesting technology for thinnings, when short-wood method is used. Western machine constructors are effectively marketing the most up-to-day technology, but Russia has their own machine industry and manual cutting (man and chainsaw) is also one of the alternatives. The selection of technology can be made by many criteria. One of the mostly used methods is cost minimization, but factors like availability of alternatives, safety of work, legislation etc. have also to be considered [1].

Aim of the Study

The purpose was to compare how unit costs of harvesting differ between the following three cutting technologies and two forwarding technologies:

- Cutting by man and chainsaw (manual method);
- Cutting by Russian prototype harvester;
- Cutting by Scandinavian harvester;
- Forwarding by Russian forwarder;
- Forwarding by Scandinavian forwarder.

This study is alike alternative calculations which were widely made during last decade in the Scandinavia [2-4].

MATERIAL AND METHODS

Data of costs and outputs were obtained from the Karelian Research Institute of Timber Industry, FEG Ltd and Ladenso joint venture. Due to variations in Russian harvesting conditions and habits, all facts are not based on research but educated guesses and assumptions.

Method was a widely used cost calculation approach [5], [6]. The specific designing into computer models and formulation of machine productivity models was caried out by Metsдteho, in Finland. In calculation fixed and variable costs were defined at the year level. According to output of machines in different conditions, the unit costs were calculated as follows:

$$Uc = (Vc + Fc) / Q, \quad (1)$$

where:
Uc = Unit costs, FIM/m^3;
Vc = Annual variable costs;
Fc = Annual fixed costs;
Q = Output of the machine.

In fixed costs the depreciation allowance was calculated so that same amount was depreciated every year [5].

$$D = (P - R) / Y, \quad (2)$$

where:
D = depreciation allowance;
P = purchasing price;
R = reselling value;
Y = using time, years.

The effect of interest in fixed costs was taken into account by the following simplified formula [5]:

$$Ci = (p/100) \times ((P + R)/2), \quad (3)$$

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where:
Ci = interest cost;
p = interest, %;
P = purchasing price;
R = reselling value.

RESULTS

Presumptions

Calculations were based among the others on the following presumptions in the input settings:

Harvesters:

Annual harvesting: 22 000 m^3 (all from thinnings)
Species: pine 30%, spruce 30%, birch 40%
Average size of stem: 200 dm^3
Removal: 450 stem/ha
Average output:
Scandinavian 11.0 m^3/h
Russian 10.0 m^3/h
Mechanical availability:
Scandinavian 75%
Russian 70%
Price: Scandinavian FIM 1 640 000
Russian FIM 485 000
Depreciation time:
Scandinavian 7.4 (3.7) yrs.
Russian 4.5 (2.0) yrs.
(the depreciation time of harvester head in parantheses)
Reselling value:
Scandinavian FIM 220 000
Russian FIM 25 000
Salary of operator: FIM 10/h

Forwarder:

Annual forwarding: 22 000 m^3
Average forwarding distance: 400 m
Sortiments: softwood logs 25%
softwood pulpwood 45%, hardwood logs 10%, hardwood pulpwood 20%.
Output:
Scandinavian 10.0 m^3/h
Russian 7.5 m^3/h
Mechanical availability:
Scandinavian 82 %
Russian 75%
Price: Scandinavian FIM 990 000
Russian FIM 350 000
Depreciation time:
Scandinavian 7.3 yrs.
Russian 4.5 yrs.
Reselling value:
Scandinavian FIM163 000
Russian FIM 20 000
Salary of operator: FIM 8/h

Cutterman:

Output: 6 - 20 m^3/d
Wage: 5 - 15 FIM/m^3
Chainsaw costs (Scandinavian chainsaw): FIM 3000/a
Fuel and lubrication: FIM 3500/a
Safety equipment: FIM 1000/a
Travelling compensation: FIM 11 000/a
Labour payments to the state: 65% of gross salary.

Cutting

Cutting costs are strictly dependent about size of the stem (Fig. 1). With small trees (less than 100 dm^3) the Scandinavian harvester was about FIM 15 more expensive than the manual cutting and cutting with Russian prototype harvester. The difference will decrease the bigger stems are cutted. With larger trees (over 400 dm^3) the difference was about FIM 5. With stems from 75 dm^3 up to 450 dm^3 Scandinavian harvester was more expensive alternative with respect to input data mentioned in chapter "Presumptions".

Forwarding

When forwarding was done by "average" Russian forwarder, the unit costs of forwarding varied from FIM 8.5/m^3 (forwarding distance under 100m) to FIM 13/m^3 (distance 800m) (Fig 2.). With the same distances the unit costs of Scandinavian forwarder varied from FIM 10 up to FIM 15.

In forwarding after manual cutting the output is about 20% smaller than after harvester [7]. Therefore, we have to add to costs about FIM 1 when forwarding is done after cuttermen and the same annual amount (22 000 m^3 is forwarded).

Total Costs and Sensitivity Analysis

Total costs of harvesting chains are formulated by combining costs of cutting and forwarding. The total unit costs with average size trees and forwarding distance varied from FIM 26.3/m^3 (Russian prototype harvester and Russian forwarder) up to FIM 37.1 /m^3 (Scandinavian harvester and forwarder) (Table 1).

Table 1. Total unit costs (FIM/m^3) of harvesting with methods investigated in this study with average tree size and forwarding distance.

	Forwarding method	
Cutting method	Russian forwarder	Scandinav. forwarder
Scandinavian harvester	35.2	37.1
Russian harvester	26.3	28.2
Manual	29.3	31.9

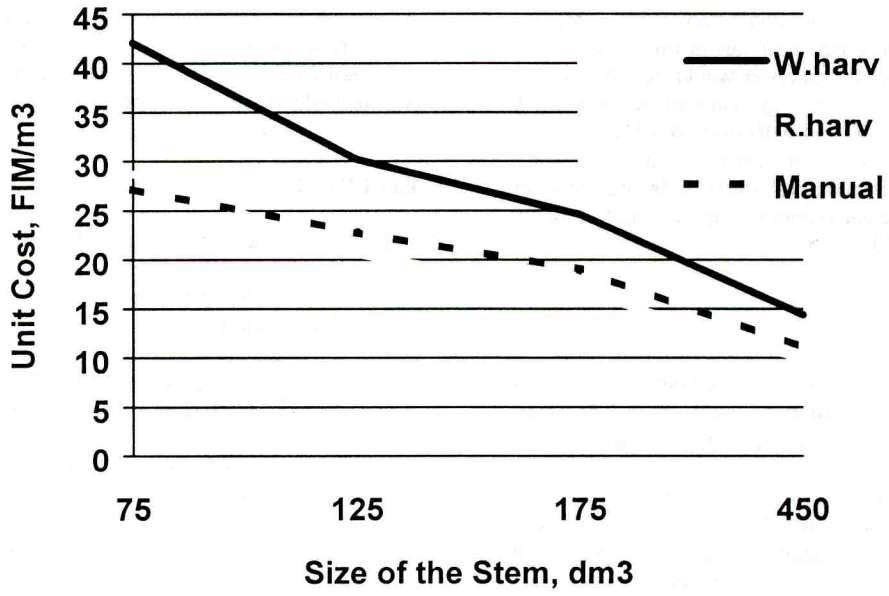

Figure 1. Unit costs of cutting with different technologies as a function of stem size.

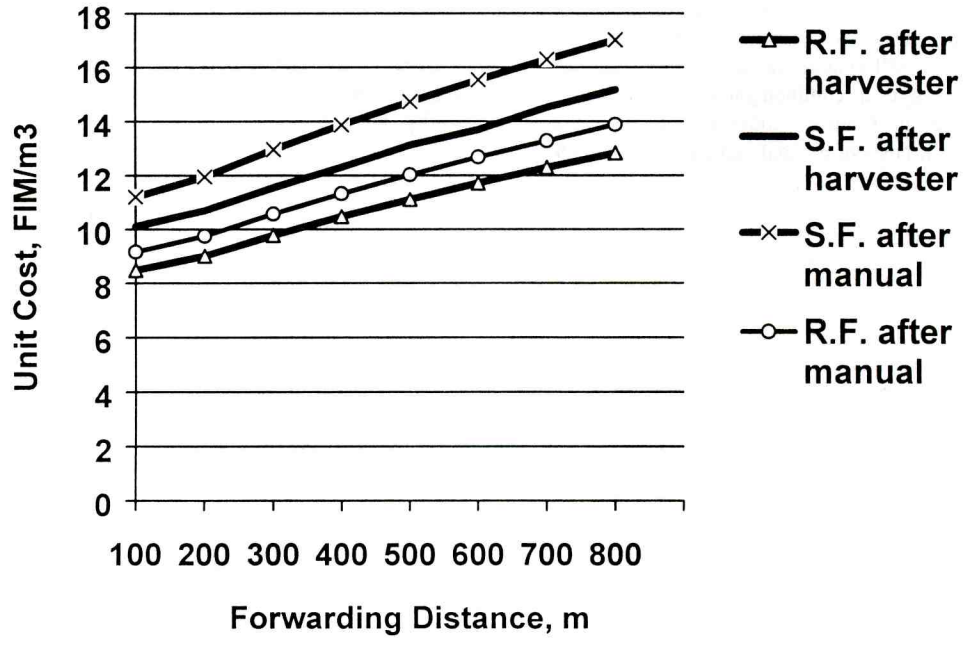

Figure 2. Unit costs of forwarding with Russian (R.F.) and Scandinavian (S.F.) forwarders after harvester cutting and manual cutting.

The data of the Russian prototype harvester is more unsure than data with other machines in this study. If the output of the prototype harvester would be 20% smaller (8 m^3/h instead of 10) the total unit cost in the Table 1 would be FIM 28.3/m^3 with Russian and FIM 30.2/m^3 with Scandinavian forwarder, if the same annual amount is still harvested. If the annual output is also decreased in the same scale, the corresponding figures would be FIM 30.2/m^3 and FIM 32.1/m^3.

DISCUSSION

Cost and productivity analysis have been made also in Russia. The problem of high price of western technology in forest operations was pointed out already 1990 [8].

One has to remember that Russian prototype harvester, used in this study, is not widely used or for sale for timber enterprises and the reliable data of real work is not yet available. The most important conclusion to be drawn is that when salary level is relatively low, and on the other hand, foreign machines are quite expensive, manual cutting can be appropriate technology even though western machines are available. If Russian harvester can be taken into wide use and it works like assumed in this study, it may also be more appropriate technology, than Scandinavian harvester.

This kind of cost calculation is sensitive to input data. That is why these results can not be applied to circumstances, where conditions are remarkably different, for example, in final cutting conditions. Moreover the ranking of technologies will change due to technological development and changes in common salary level of workers. For example, in Finnish timber procurement the break-even point of costs of manual cutting and harvester cutting according to stem size (i.e. the point where cost curves of compared technologies cross each other [1]) has moved from about 250 dm^3 to 150 dm^3 between the years 1988 and 1990 [3], [4]. The situation in Russian Karelia will likely develope to the same direction.

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