Estimation of Machinery Market Size for Industrial and Energy Wood Harvesting in Leningrad Region

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Abstract – Nacrtak

The recent and coming development of forestry practices in Northwest Russia includes fast implementation of cut-to-length (CTL) harvesting, transfer of technology, introduction of commercial thinnings and energy wood harvesting. The market size for industrial and energy wood harvesting machinery was assessed for the Leningrad region. The logging machines fleet consisted of about 700 machines for traditional tree-length technology and 120 harvesters and forwarders for CTL technology. The domestic machinery fleet is obsolete; manufacture of domestic forest machinery has dropped in both quantity and models, and thus imported CTL machinery is replacing domestic tree-length machinery. The results indicate that the market for CTL machinery could be 21 harvesters, 32 forwarders and 26 short-wood trucks per year and could increase to up to 30 – 40 machines each in the future. The maximum need for the machinery in the Leningrad region could be 50 – 60 harvesters, forwarders and short-wood trucks per year if allowable cut and commercial thinnings were realized in full scale. The market for energy wood harvesting machinery could be 4 biomass forwarders, 11 mobile chippers and 13 wood chip trucks per year and could be 6 and 15 – 20 machines per year in the future, respectively. The maximum need could be 30 – 40 biomass forwarders, mobile chippers and wood chip trucks per year. Only one third of the logging enterprises in the region had enough leased forest resources for applying the highly productive mechanized CTL technology. These 41 forest enterprises would need 270 machines, consisting of 90 harvesters, 100 forwarders and 80 short-wood trucks. Thirty-seven enterprises would need about 50 biomass forwarders and chippers and 60 wood chip trucks for energy wood harvesting. Sixty percent of the forest leasers had enough forest resources and could be users of Nordic CTL technology if allowable cut was utilized completely and if commercial thinnings were done in full scale. These 68 enterprises would need about 500 conventional logging machines, consisting of 160 harvesters, 190 forwarders and 150 short-wood trucks, and about 300 energy wood harvesting machines, consisting of 100 biomass forwarders, 100 chippers, and 110 wood chip trucks. In addition, the ten largest enterprises would need half of the total fleet.

Keywords: Russia, industrial wood, energy wood, harvester, forwarder, truck, mobile chipper

1. Introduction – *Uvod*

A remarkable growth is expected in Russian forest machine markets in the long run mainly because a thorough renewal of the current logging machines is required and because of a huge cutting potential within Russian forests. The development of using different logging methods, such as cut-to--length (CTL), full-tree (FT), and tree length (TL) method is going to have a significant influence on the share between Russian forest machine markets (Karvinen at al. 2011).

The Leningrad region is one of the key customers for wood harvesting machinery in Northwest Russia, as this region is one of the major producers of forest products. The total growing stock of the region is approximately 797.7 million m^3, of which at least 400 million m^3 is available for wood supply. Approximately 35% of the growing stock is pine, 29% spruce, 25% birch, 9% aspen and 2% other tree species.

Fig. 1 Location of the largest logging and forest industry enterprises in Leningrad region
Slika 1. *Položaj najvećih poduzeća za izvođenja radova pridobivanja drva i preradbu drva u Lenjingradskoj regiji*

About 2.1 million hectares of the region's forests are considered to be commercial forests, where harvestable crops can be grown for timber purposes, while 2.4 million hectares are protected from harvesting based on legislation and policy. The annual allowable cut has been about 7.9 – 9.6 million m^3 under bark (u.b.) in recent years; made up of 41% of coniferous and 59% of deciduous tree species. The actual harvest in 2006 was 8.2 million m^3, including 5.3 million m^3 from final felling, 1.4 million m^3 from thinnings, and 1.5 million m^3 from other fellings (Gerasimov et al. 2009, Kareliastat 2010).

The region produces 4% of the industrial round wood, 13% of the pulp and paper, and 5% of the sawn timber in Russia. The forest industry contributes significantly to the Leningrad region economy. The forest industry makes up over 16% of the region's total industrial production and employs 16% of the industrial workforce. The structure of forest industries for this region is quite diverse. There are vertically integrated holdings, including different combinations of pulp and paper mills, sawmills, and logging enterprises. There are also independent companies, including small and medium sized enterprises, supporting companies and organizations. The forest industry collapsed in 1990 after the dissolving of the USSR, and stabilized between 1995 and 1998. There was a growing period between 1998 and 2000 due to the local currency default but there has been stagnation since 2004 in products other than lumber and fiberboards.

Fig. 1 maps the key forest industry enterprises in the Leningrad region. Pulp and paper mills are located in Svetogorsk (ZAO »International Paper«), Sovetsky (OAO »Vyborgskaya tseluloza«) and Syasstroy (OAO »Syasky TsBK«). Svetogorsky P&P consumes 1.6 mill m^3 u.b. of pulpwood per year, »Vyborgskaya tseluloza« 0.4 million m^3 per year, and Syasky P&P 0.5 million m^3 per year, respectively. The sawmill industry includes approximately 100 companies. The three largest companies produce 80% of the total sawn timber in the Leningrad region. The most important sawmills are OOO »SvirTimber« (Metsäliitto-Botnia, Podporozhye), OOO »Swedwood-Tikhvin« (IKEA, Tikhvin), OOO »Mayr-Melnhof-Holz Efimovsky« (Efimovsky). The wood-based boards industry

in the Leningrad region includes fiberboard mill »Lesplitinvest« in Priozersk and particleboard mill »Zavod Nevsky Laminat« in Dubrovka. The energy wood industry in the Leningrad region includes wood pellet production. There are about 20 mills with a total capacity of over 700 thousand tons per year. Most of the forest industry capacity is concentrated in a few administrative districts with well-developed forest operations, such as Tikhvinsky, Vyborgsky, Priozorsky and Podporozhsky.

The recent development of forest operations in the Leningrad region includes a fast implementation of cut-to-length (CTL) harvesting, transfer of technology, introduction of commercial thinnings and energy wood harvesting. Traditional Russian wood harvesting systems have been used side-by-side with Nordic technology. Logging enterprises in the Leningrad region play an important role in wood procurement for relatively developed forest industry in Northwest Russia. They have been among the most important suppliers of the Russian regions for the European forest industry, exporting up to 3 million m^3 of industrial round wood annually (Gerasimov and Karjalainen 2006). Logging enterprises are deeply rooted in the local communities and involved in the socio-economic development of rural districts in the region.

This study has been prepared as a part of the project »Possibilities for Energy Wood Procurement and Use in Northwest Russia« at the Finnish Forest Research Institute. The aim of the project was to estimate the availability of different energy wood sources as well as their technical and economic availability in the Leningrad region, to design cost effective energy wood procurement systems, and to assess needs for technology development. In this paper the machinery market size for industrial and energy harvesting was estimated.

2. Methods and data – *Metode i podaci*

2.1 Identification of the market – *Identifikacija tržišta*

The total global market for forest machinery is likely to be 6 000 – 8 000 machines per year, of which 3 000 could represent CTL machines (Asikainen 2005). If the logging business in Europe and Russia is mechanized rapidly and if the marketing takeover in South and North America is successful, the annual volume may rise to 10 000 machines. The total Russian market for wood harvesting machinery is approximately $150 million per year; and imports account for half of the total market (Belikov 2007). Domestic machinery production has collapsed after the collapse of the USSR in both quantity and models (Eremeev 2010) e.g. from over 20 000 harvesting machines per year in the Soviet time to 758 in 2008. Therefore, importing of machinery has been increasing substantially and was estimated to reach 500 machines or over 200 million Euros in the near future (Grishkovets 2006). Relief of customs duties on the imported high-tech equipment further improves opportunities to sell overseas machinery to Russia.

The fleet of tree-length forest machines in Russia was estimated to be 23 000 machines including the machines imported from North America (Eremeev 2007, 2010). There are 22 enterprises producing wood harvesting and supportive equipment in Russia (Nekhamkin 2007), but the market has an oligopoly character: over 90% of the machines were produced by Onego (37%) and Altay (54%) tractor plants. There were 26 domestic models of skidders and 16 models of feller-bunchers and delimbers. Western forest machines for the full-tree method were available on the Russian market, such as John Deere and Caterpillar with 12 models of feller-buncher, skidder and delimber. However, the share of western machinery in the total Russian tree-length fleet was small; only 8% (Eremeev 2010). The traditional producer of wood harvesting machines, mostly cable skidders, for Northwest Russia and Leningrad region was Onego tractor plant. Between 1970 and 1988, Onego tractor plant produced 10 – 12 thousand skidders per year (50% of the total production in the USSR). Production dropped dramatically during the »perestroyka« period. According to Derfler et al. (2003) the average age of machines increased from 5 to 12 years between 1992 and 2000. Eighty percent of machines were utilized over a standard lifetime (Eremeev 2010). As a result, the availability rate of the machinery has decreased from 0.9 to 0.5. This means that only half of the total Russian harvesting machine fleet was in a good state, i.e. that their operating/working conditions met the common requirements. The wear rate of domestically made machines (depreciation loss) is 0.7 – 0.8.

The harvesting technology has been reorganized all over Russia. The CTL method is getting more and more common due to economical, ecological and social pressures from both inside and outside of Russia. The traditional Russian wood harvesting systems are used side-by-side with Nordic technology. Nowadays in Russia more than 24% of wood is harvested with the CTL method including 18% harvested with a harvester and forwarder. The fleet of CTL technology in Russia was estimated to be 2 000 machines; mostly imported machines (Nekhamkin 2007) including about 1 000 harvesters and forwarders in Northwest Russia. The share of fully mechanized

CTL technology has been increasing since 2000. The reason was the increasing import of harvesters and forwarders mainly produced in Nordic countries. Interchangeability of harvesters and forwarders was constantly growing and machines were working in 2 – 3 shifts. Approximately 500 harvesters and forwarders were imported to Russia annually (Belikov 2007). Three manufacturers dominated on the CTL machinery market in Northwest Russia: John Deere Forestry with 55%, Ponsse with 20% and Komatsu Forestry with 16% of the total market (Belikov 2007, Nekhamkin 2007). Medium sized purpose-built machines such as John Deere Forestry (harvester 1270 and forwarders 1010/1410), Ponsse (harvesters Ergo and Beaver, forwarders Buffalo) and Komatsu Forest (harvesters Valmet 911/901, forwarder Valmet 860) were the most common CTL machinery. Light or small sized harvesters were not that common. Heavy harvesters were usually based on excavators (Volvo EC210B, Kobelco SK 135, Hitachi Zaxis 230) (Gerasimov and Sokolov 2008). Russian forest machine manufacturers have tried to design and produce domestic harvesters and forwarders, but have been unsuccessful.

2.2 Identification of the customers *Identifikacija korisnika*

Once the key markets for wood harvesting technology in the Leningrad region were identified, the next step was to identify segments and customers that make up a large potential for forest machine sales in the region. Russian end-users of forest harvesting machines were generally logging enterprises with leased forests and in some cases contractors. Some large enterprises had wood harvesting employees within the firm. Most of the enterprises that contract out or hire wood harvesting employees were large firms that specialized in producing sawn timber, pulp and paper, or both. Due to productivity and environmental pressures, those end-users need mobile, versatile, efficient, and environmentally friendly wood harvesting machinery. Technological and environmental changes and requirements mean continuing growth and development of this market. The challenge of adhering to strict environmental regulations in the face of intense competition has increased the demand for new CTL machinery systems for wood harvesting in the region.

The total number of logging enterprises officially registered in the Leningrad region was about 1 000 with over 12 000 employees (Kareliastat 2010); however, only 113 enterprises leased forests for wood supply. Harvesting operations were concentrated into large and medium-sized enterprises, which usually belong to international pulp and woodworking mills.

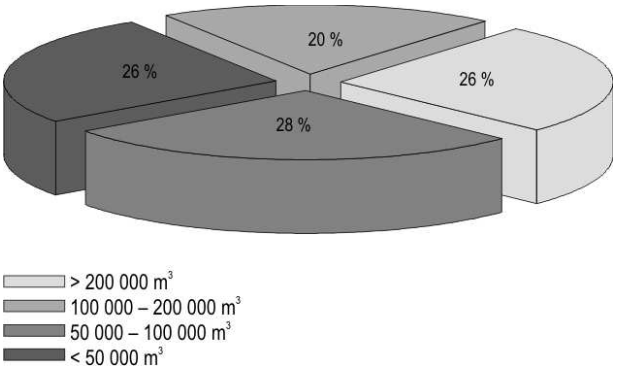

Fig. 2 Distribution of logging enterprises (forest leasers) based on their actual annual harvest

Slika 2. *Podjela poduzeća za izvođenje radova pridobivanja drva (koncesionari šuma) s obzirom na njihov stvarni godišnji etat*

The annual allowable cut of the 30 largest forest leasers was about 5 million m^3 with the actual harvest of 3 million m^3. The four largest logging companies accounted for the annual harvest volume of more than 200 000 m^3, OAO »Svetogorsk« (International Paper) and OOO »Metsyaliitto Podporozhje« (Metsäliitto) representing the key players in pulp and paper industry. They harvested about 26% of the actual annual cut in the Leningrad region. The companies with 100 – 200 thousand m^3 of harvested wood per year, i.e. OOO »Svedwood-Tikhvin« (IKEA) and ZAO »Efimovsky KLPKh« (Mayr-Melnhof-Holz), represented the largest players in sawmilling. The share of these companies was approximately 20% of the actual annual harvest in the Leningrad region. This means that only 9 key companies procured approximately half of the region's annual harvest. The next 14 companies with 50 – 100 thousand m^3 of harvested wood per year provided about 30% of the actual annual harvest in the region. Approximately 50 small companies harvested the remaining 20% of the wood (Fig. 2). Fig. 1 maps the operation areas of the largest logging enterprises in the Leningrad region. Most of the logging capacity was concentrated among a few forest districts with well developed forest industry, such as Tikhvinsky, Priozorsky and Podporozhsky.

2.3 Scenarios for the estimation of machinery market size – *Scenariji za procjenu veličine tržišta strojeva*

Gerasimov and Karjalainen (2011) have analyzed the development of industrial and energy wood resources based on trends in logging and woodworking in Northwest Russia including the Leningrad region. The overall development of wood procurement in the Leningrad region and woodchip pro-

duction in particular will require a large amount of forestry machines and wood transport vehicles. The estimation of machinery market size for industrial and energy harvesting in the region was based on three scenarios (Gerasimov et al. 2007): »Actual«, »Allowable«, and »Potential«.

Scenario »Actual« assumed continuing the current level of wood harvesting. It means the current utilization of annual allowable cut with a 40% use of the CTL method. The estimated potential for energy wood from logging operations was 3.5 million m^3/year based on 7.9 million m^3 of the actual harvest. About 2.3 million m^3 was non-industrial round wood and felling residues in the cutting areas and 1.2 million m^3 derived from the central processing yards. The volume harvested with CTL technology was 3.2 million m^3 within 40% of the total annual cut.

Scenario »Allowable« assumed increasing availability of energy wood resources based on full utilization of the annual allowable cut, utilizing the current logging technology and increasing production of sawn timber in accordance with the green-field projects, such as Svir-Timber sawmill, Mayr-Melnhof-Holz Efimovsky, etc.; see Fig. 1. The Allowable scenario means that the volume of the annually harvested stem wood in the final felling would increase from 5.1 million m^3 to 9.5 million m^3. It is assumed that the current proportions in logging technologies will remain the same, i.e. 40% of the CTL method, but that the share of felling by harvesters will increase from 1/3 to 2/3. The amount of energy wood available from logging could be as high as 5.3 million m^3 if the entire annual allowable cut of 9.5 million m^3 were utilized, if collected. About 3.3 million m^3 is non-industrial round wood and felling residues in the cutting areas. The volume harvested by CTL technology is 4.9 million m^3 (40% of the total allowable cut).

Scenario »Potential« assumed increasing availability of energy wood due to the implementation of intensive forest management; resulting from a significant increase of commercial thinnings, full utilization of annual allowable cut with CTL technology, and increasing production of sawn timber in accordance with the available sawlog output in the region (no export). According to the Potential scenario, commercial thinnings would increase from 1.5 million m^3 to 4.6 million m^3 with 100% implementation of mechanized CTL technology (harvester and forwarder). The amount of energy wood available from logging could be as high as 7.2 million m^3 if thinnings were also done in full scale, if collected. The assumption is that all harvesting is carried out with CTL technology, i.e. 15.3 million m^3 of which 40% is from thinnings.

The annual average productivity of wood harvesting machines was obtained from different statistical and companies' data in Russia and Finland (Goltsev et al. 2010a, Goltsev et al. 2010b, METLA 2010, Gerasimov et al. 2011). Assumptions about the annual productivity of CTL and energy wood harvesting machines are presented in Fig. 3.

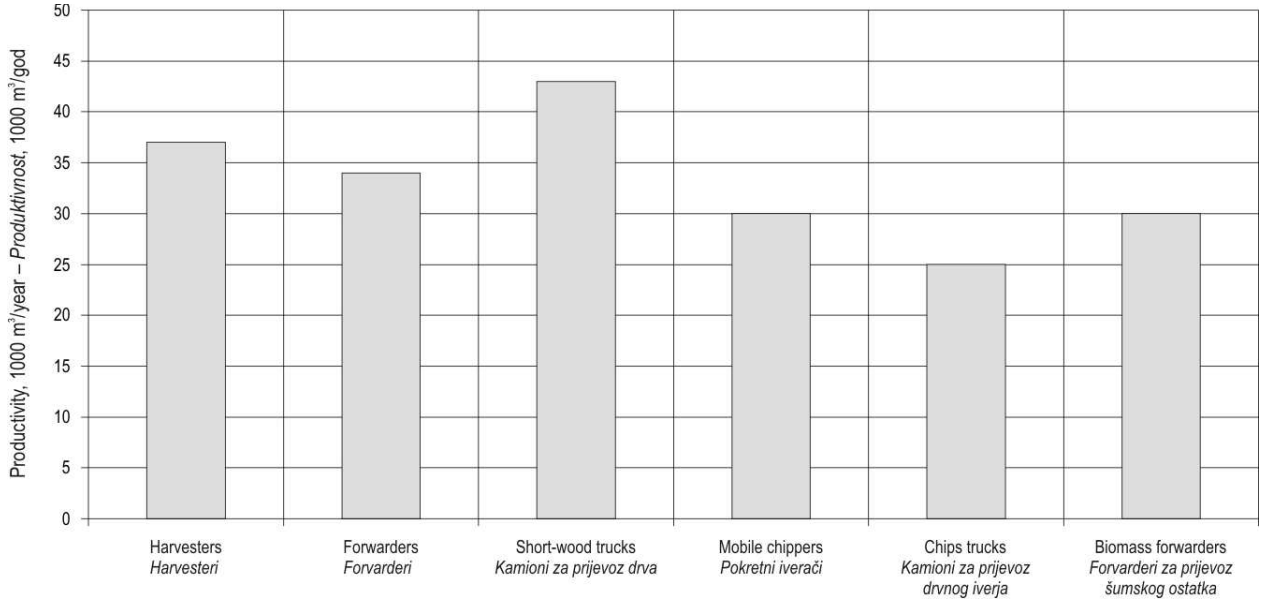

Fig. 3 Average annual productivity of CTL industrial and energy wood harvesting machines used to estimate the machinery market size
Slika 3. *Prosječna godišnja proizvodnost strojeva za pridobivanje industrijskoga i energijskoga drva sortimentnom metodom koja se koristila za procjenu veličine tržišta strojeva*

Table 1 An estimation of the wood machinery fleet with three scenarios for the Leningrad region
Tablica 1. *Procjena broja šumskih strojeva prema trima scenarijima za Lenjingradsku regiju*

Source – *Sredstvo*	Scenario for harvesting round wood (RW) and energy wood (EW) *Scenarij za pridobivanje obloga drva (RW) i energijskoga drva (EW)*					
	Actual – *Trenutni*		Allowable – *Dopustivo*		Potential – *Moguće*	
	RW	EW	RW	EW	RW	EW
Logging, mill. m^3 – *Drvni obujam,* mil. m^3	3.2	2.3	4.9	3.3	15.3	7.2
Mobile chipper, units/year – *Pokretni iverači,* kom./god.	–	77	–	110	–	240
Chip trucks, units/year – *Kamioni za prijevoz drvnoga iverja,* kom./god.	–	92	–	132	–	288
Forwarders for round wood and loose logging residues, units/year *Forvarderi za oblo drvo i šumski ostatak,* kom./god.	93	31	144	44	451	240
Harvesters, units/year – *Harvesteri,* kom./god.	28	–	88	–	417	–
Trucks, units/year – *Kamioni,* kom./god.	74	–	114	–	356	–

3. Results – *Rezultati*

3.1 Estimation of machinery market size for the region – *Procjena veličine tržišta strojeva za regiju*

Table 1 shows the CTL machinery fleet for industrial wood harvesting, which was 93 for forwarders, 28 for harvesters and 74 for short-wood trucks for the actual harvest, according to the average annual productivity. The energy wood machinery fleet for full utilization of the available energy wood resources at the cutting areas could be 77 for mobile chippers, 92 for chip trucks and 31 for forwarders for loose logging residues.

If the allowable cut were realized in the Leningrad region based on the current degree of mechanization in the industrial wood harvesting, the need for CTL machinery fleet would be about 144 forwarders (+50%), 88 harvesters (+200%) and 110 short-wood trucks (+50%). The theoretical energy wood machinery fleet in the Leningrad region would be 114 mobile chippers, 132 chip trucks and 44 forwarders for loose logging residues.

The maximum theoretical need for CTL machinery in the Leningrad region could be about 400 units of forwarders, harvesters and short-wood trucks, plus about 250 units of mobile chippers, chip trucks and forwarders for loose logging residues.

Table 2 shows the estimated market size for the CTL and energy wood machinery when the need to renew traditional tree-length machinery is also taken into account and replaced by CTL machinery:

⇒ Scenario »Actual«. Actual annual harvest is stable; a traditional technology was replaced by CTL technology according to machinery wear out; the felling process was mechanized by 1/3; forest machines were replaced every 7^{th} year;

⇒ Scenario »Allowable«. Actual annual harvest grew from 7.9 to 15.3 million m^3 by 5% per year; traditional technology was replaced by CTL technology according to machinery wear out; the felling process was mechanized by 2/3; forest machines were replaced every 7^{th} year;

Table 2 An estimation of the wood machinery fleet with three scenarios for the Leningrad region
Tablica 2. *Procjena veličine tržišta šumskih strojeva prema trima scenarijima za Lenjingradsku regiju*

Source – *Sredstvo*	Scenario for harvesting of round wood (RW) and energy wood (EW) *Scenarij za pridobivanje obloga drva (RW) i energijskoga drva (EW)*					
	Actual – *Trenutni*		Allowable – *Dopustivo*		Potential – *Moguće*	
	RW	EW	RW	EW	RW	EW
Logging, mill. m^3 – *Drvni obujam,* mil. m^3	3.2	2.3	4.9	3.3	15.3	7.2
Mobile chipper, units/year – *Pokretni iverači,* kom./god.	–	11	–	16	–	34
Chip trucks, units/year – *Kamioni za prijevoz drvnoga iverja,* kom./god.	–	13	–	19	–	41
Forwarders for round wood and loose logging residues, units/year *Forvarderi za oblo drvo i šumski ostatak,* kom./god.	32	4	40	6	64	34
Harvesters, units/year – *Harvesteri,* kom./god.	21	–	30	–	60	–
Trucks, units/year – *Kamioni,* kom./god.	26	–	30	–	51	–

⇒ Scenario »Potential«. Actual annual harvest of 15.3 million m^3; traditional technology was totally replaced by CTL technology; fully mechanized felling process with harvester; forest machines were replaced every 7^{th} year.

According to the Actual scenario, the use of CTL machinery would require an annual purchase of 32 forwarders, 21 harvesters and 26 short-wood trucks. The annual market for energy wood machinery could be 11 mobile chippers, 13 chip trucks and 4 forwarders for loose logging residues, if energy wood from the current logging operations were collected.

If the allowable cut is realized in the Leningrad region based on the current level of mechanization, the annual market for CTL machinery could be 40 forwarders (+20%), 30 harvesters (+40%) and 30 short-wood trucks (+20%). In this case, the market for energy wood machinery in the Leningrad region could be 16 mobile chippers, 19 chip trucks and 6 forwarders for loose logging residues per year.

If thinnings were also done in full scale, the market for energy wood machinery in the Leningrad region could be 50 – 60 units/yr of forwarders, harvesters and short-wood trucks, plus 30 – 40 units/yr of mobile chippers, chip trucks and forwarders for loose logging residues.

3.2 Estimation of machinery market size for logging enterprises with leased forests
Procjena veličine tržišta strojeva za poduzeća za izvođenje radova pridobivanja drva s koncesijom nad šumama

Many small size enterprises with minor leased forests are operating in the Leningrad region without financial possibilities to make investments into modern CTL technology. Therefore, it is useful to make the detailed estimation of the harvesting machinery fleets for a company level. Tables 3 – 5 show the need for CTL and energy wood machinery fleets based on assumptions in Table 1, but at the company level, i.e.:

⇒ Number of harvesters, forwarders and short-wood trucks (CTL machinery) and mobile chippers, biomass forwarders and chip trucks (energy wood machinery), calculated based on Actual (Table 3), Allowable (Table 4), and Potential (Table 5) scenarios in the leased forests of individual enterprises,

⇒ Energy wood potential of forest units of the Leningrad region where leased forests are taken into account (Gerasimov et al. 2007),

⇒ Data about leased forests provided by the Federal Forest Agency of Russia,

⇒ Whole volume harvested by fully mechanized CTL technology (using harvesters and forwarders),

⇒ Annual productivity of machines as presented in Fig. 3,

⇒ Number of machines (rounded).

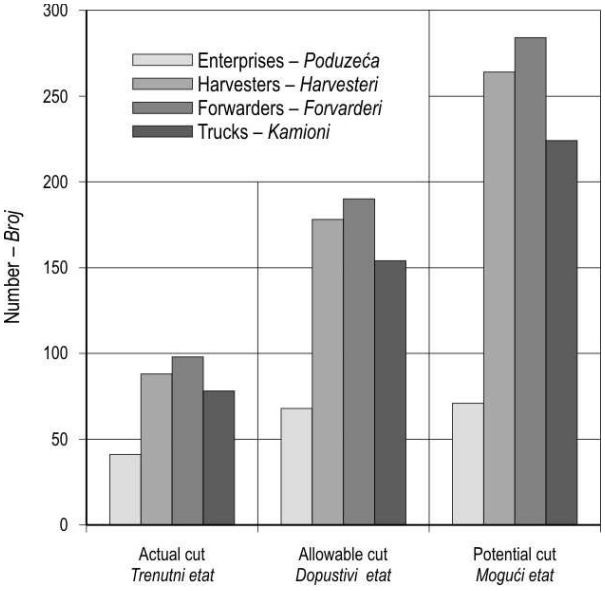

Fig. 4 Number of perspective forest leasers in Leningrad region and their need for CTL machinery fleet in three scenarios

Slika 4. *Broj koncesionara šuma u Lenjingradskoj regiji i njihova potreba za šumskim strojevima za pridobivanje drva pri sortimentnoj metodi izrade drva prema trima scenarijima*

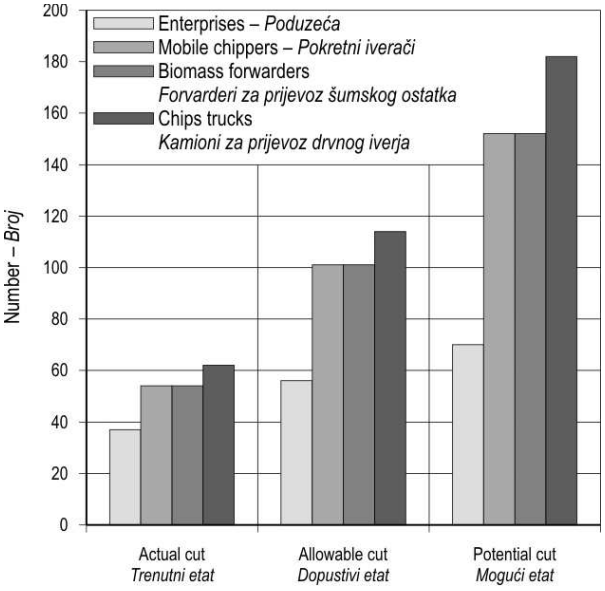

Fig. 5 Number of perspective forest leasers in Leningrad region and their need for energy wood harvesting machinery fleet in three scenarios

Slika 5. *Broj koncesionara šuma u Lenjingradskoj regiji i njihova potreba za šumskim strojevima za pridobivanje energijskoga drva prema trima scenarijima*

Fig. 4 shows the number of perspective forest enterprises with leased forests in the Leningrad region and their need for CTL machinery fleet in three scenarios. Fig. 5 shows the number of perspective forest enterprises and their need for an energy wood machinery fleet.

Table 3 Estimation of the machinery fleet by forest leasers according to »*Actual*« scenario
Tablica 3. *Procjena brojnosti šumskih strojeva kod koncesionara šuma prema »trenutnom« scenariju*

Number of leasers *Broj koncesionara*	AC, 1000 m^3	Harvesters *Harvesteri*	Forwarders *Forvarderi*	Timber trucks *Kamioni za prijevoz drva*	Mobile chippers *Pokretni iverači*	Biomass forwarders *Forvarderi za prijevoz šumskoga ostatka*	Woodchip trucks *Kamioni za prijevoz drvnoga iverja*
3	> 200	21	23	18	12	12	15
5	100 – 200	20	22	17	11	11	13
14	50 – 99	27	32	23	15	15	18
19	30 – 49	20	21	20	16	16	16
Total: 41	**–**	**88**	**98**	**78**	**54**	**54**	**62**

AC – Actual harvest in leased area – *Stvarni etat na površini šuma pod koncesijom*

Table 4 Estimation of the machinery fleet by forest leasers according to »*Allowable*« scenario
Tablica 4. *Procjena brojnosti šumskih strojeva kod koncesionara šuma prema »dopustivom« scenariju*

Number of leasers *Broj koncesionara*	AAC, 1000 m^3	Harvesters *Harvesteri*	Forwarders *Forvarderi*	Timber trucks *Kamioni za prijevoz drva*	Mobile chippers *Pokretni iverači*	Biomass forwarders *Forvarderi za prijevoz šumskoga ostatka*	Woodchip trucks *Kamioni za prijevoz drvnoga iverja*
3	> 400	36	39	31	20	20	24
1	300 – 399	9	10	8	5	5	6
5	200 – 299	32	35	28	20	20	24
8	100 – 199	27	28	22	17	17	17
24	50 – 99	47	51	38	24	24	28
27	30 – 49	27	27	27	15	15	15
Total: 68	**–**	**178**	**190**	**154**	**101**	**101**	**114**

AAC – annual allowable cut in leased area for final fellings – *Godišnji dopustivi etat dovršnih sječa na površini šuma pod koncesijom*

Table 5 Estimation of the machinery fleet by forest leasers according to »*Potential*« scenario
Tablica 5. *Procjena brojnosti šumskih strojeva kod koncesionara šuma prema »mogućem« scenariju*

Number of leasers *Broj koncesionara*	AAC, 1000 m^3	Harvesters *Harvesteri*	Forwarders *Forvarderi*	Timber trucks *Kamioni za prijevoz drva*	Mobile chippers *Pokretni iverači*	Biomass forwarders *Forvarderi za prijevoz šumskoga ostatka*	Woodchip trucks *Kamioni za prijevoz drvnoga iverja*
1	> 700	20	21	17	9	9	11
2	600 – 699	34	38	30	21	21	25
2	400 – 499	25	27	21	14	14	17
4	300 – 399	37	40	32	23	23	27
2	200 – 299	13	14	11	6	6	8
20	100 – 199	72	74	61	39	39	47
24	50 – 99	47	54	36	25	25	32
16	30 – 49	16	16	16	15	15	15
Total: 71	**–**	**264**	284	224	152	152	182

AAC – annual allowable cut in leased area for final fellings and commercial thinnings – *Godišnji dopustivi etat dovršnih sječa i proreda na površini šuma pod koncesijom*

4. Conclusions – *Zaključci*

The results indicated that the annual market for CTL machinery in the Leningrad region can be approximately 20 – 30 medium sized purpose-built harvesters/forwarders and short-wood trucks, respectively. The market could be 30 – 40 units per year in the future, if the allowable cut were utilized or even 50 – 60 harvesters, forwarders and short-wood trucks per year, if commercial thinnings were also done on a full scale. The current market for energy wood machinery can be approximately 4 biomass forwarders, 10 mobile chippers and wood chip trucks per year. The market could be about 15 – 20 units per year in the future, if allowable cut were utilized or 30 – 40 biomass forwarders and mobile chippers per year, if commercial thinnings were also done on a full scale.

The total number of enterprises registered for wood harvesting operations in the Leningrad region was about one thousand, but only one hundred enterprises had leased forests and could be taken into account as major customers of CTL machinery manufacturers. Only one third of the current forest leasers in the Leningrad region had enough leased forest resources and could be the users of fully mechanized CTL technology based on the Actual scenario. These 41 enterprises needed 270 CTL machines altogether – 90 harvesters, 100 forwarders and 80 trucks. Thirty-seven companies needed 50 chippers, 50 biomass forwarders, and 60 woodchip trucks for energy wood harvesting. The share of the 10 largest enterprises would be half of the total fleet.

Sixty percent of forest leasers in the Leningrad region had enough leased forest resources and could be the users of fully mechanized CTL technology based on the Allowable scenario. These 68 enterprises needed 500 CTL machines altogether – 160 harvesters, 190 forwarders and 150 trucks. Fifty-six companies needed 100 chippers, 100 biomass forwarders, and 110 woodchip trucks for energy wood harvesting. The share of the 10 largest enterprises would be half of the total fleet.

Sixty percent of the current forest leasers in the Leningrad region had enough leased forest resources and could be the users of fully mechanized CTL technology based on the Potential scenario. These 71 enterprises would need 770 CTL machines altogether – 260 harvesters, 280 forwarders and 230 trucks. Seventy companies would need 150 chippers, 150 biomass forwarders, and 180 woodchip trucks for energy wood harvesting.

The wood harvesting machinery fleet in the Leningrad region was estimated at about 700 logging machines for the traditional tree-length technology and approximately 120 harvesters and forwarders for CTL technology. In the Leningrad region the fleet of domestic logging machinery was obsolete; the wear rate of fixed assets was about 50% and needs an improvement.

The actual harvest in the Leningrad region has been about 8 million m^3 in recent years and may not increase in the near future. This study presented the most recent publicly available official governmental statistical data on wood harvesting and forest leasing in the Leningrad region in 2006. However, the actual harvest volume is not a constant for various reasons. In the period 2008 – 2010, the actual harvest volume slightly decreased due to challenges in implementation of the new Forest Code, increasing custom duties for round wood export, the financial crisis of 2008 and environmental impacts (Gerasimov and Karjalainen 2008, Karvinen et al. 2011). The same statement is true for the annual allowable cut. Nevertheless, considering that the scenario of forest use can have variants, the methodology of using the techniques described in this study gives some flexibility for determining the need for harvesting machines.

The wood harvesting industry in Northwest Russia continues at the Onego tractor plant with the production of two models of traditional caterpillar skidders, but the production dropped in 1988 from 12 000 to 100 machines per year. The imported CTL machinery is replacing domestic tree-length machinery supporting the recent development of forestry practices in the Leningrad region including fast implementation of CTL harvesting, transfer of technology, introduction of commercial thinnings and energy wood harvesting.

The economic indexes of technology development in wood harvesting showed positive signs, as the renewal rate for harvesting machinery has been increasing since 2005 from 14% (2005) to 36% (2009) (Kareliastat 2010). This means that logging enterprises are now in a better position to renew machinery and technology than in the past. Nowadays there are also better possibilities to finance the purchase of new technology. This means that the methodology, presented in the study, is timely and able to support the development of strategies, concepts and programs related to the forestry mechanization in both the Leningrad region and other regions of Russia.

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Sažetak

Procjena veličine tržišta strojeva za pridobivanje industrijskoga i energijskoga drva u Lenjingradskoj regiji

Lenjingradska je regija jedna od najvećih proizvođača šumskih proizvoda u Rusiji te je stoga najveće tržište šumskih strojeva za pridobivanje drva. Ukupna je drvna zaliha u regiji oko 797,7 milijuna m^3. Godišnji dopušteni sječivi etat je oko 7,9 – 9,6 milijuna m^3, od čega na crnogorične vrste drva otpada 41 %, a na bjelogorične vrste drva 59 % etata. Stvarni sječivi etat u 2006. iznosio je 8,2 milijuna m^3, od toga 5,3 milijuna m^3 iz dovršnih sječa, 1,4 milijuna m^3 iz proreda te 1,5 milijuna m^3 iz ostalih vrsta sječa (Gerasimov i dr. 2009, Kareliastat 2010).

Regija proizvodi 4 % industrijskoga obloga drva, 13 % celuloze i papira i 5 % od piljene građe u Rusiji. Poduzeća, koja se bave pridobivanjem drva, godišnje izvezu 3 milijuna m^3 te stoga imaju značajnu ulogu na drvnu industriju u sjeverozapadnoj Rusiji i na europsku drvnu industriju (Gerasimov i Karjalainen 2006). Šumarstvo i drvna industrija Lenjingradaske regije čine više od 16 % ukupne industrijske proizvodnje i zapošljavaju 16 % radne snage.

Zbog potrebe za obnovom šumske mehanizacije te zbog golemih mogućnosti ruskih šuma očekuje se velik rast tržišta šumskih strojeva. Razlike između metoda izrade drva (sortimentna, stablovna, deblovna metoda) imat će značajan utjecaj na raspodjelu tržišta šumskih strojeva u Rusiji.

Daljnji razvoj sustava pridobivanja drva u Lenjingradskoj regiji razumijeva uvođenje sortimentne metode izrade drva i komercijalnih proreda te veće pridobivanje energijskoga drva. Usporedno s novim sustavima primjenjuju se i tradicionalne metode pridobivanja drva.

Na svjetskom tržištu šumskih strojeva i opreme godišnje se proda 6000 – 8000 strojeva, od čega 3000 otpada na strojeve koji se koriste pri sortimentnoj metodi izrade drva (Asikainen 2005). Ako se nastavi ubrzano mehaniziranje šumskih radova u Europi i Rusiji, te ako se tržištu pridodaju Sjeverna i Južna Amerika, godišnje bi se moglo prodavati i do 10 000 šumskih strojeva. U Rusiji se godišnje troši oko $150 milijuna eura na kupovinu šumskih strojeva, a polovica te vrijednosti otpada na uvoz (Belikov 2007). Domaća industrija šumskih strojeva i opreme naglo je propala raspadom SSSR-a – proizvodnja je pala s 20 000 proizvedenih strojeva godišnje na samo 758 strojeva u 2008. godini. Stoga je uvoz bitno rastao te se procjenjuje da bi mogao doseći vrijednost od 200 milijuna eura/god. odnosno 500 strojeva/god. (Grishkovets 2006).

Procjenjuje se da sada u Rusiji ima 23 000 šumskih strojeva, uključujući uvezene strojeve iz Sjeverne Amerike koji su većinom prilagođeni za deblovnu metodu izrade drva (Eremeev 2007, 2010). Prema Derfleru i dr. (2003) strojevi imaju prosječno između 5 i 12 godina. Osamdeset posto strojeva koristi se dulje od amortizacijskoga roka (Eremeev 2010).

Krajnji su korisnici šumskih strojeva uglavnom poduzeća koja imaju koncesiju nad šumama ili privatni izvođači radova. Zbog potrebe za povećanjem proizvodnosti i strožih ekoloških propisa povećava se potreba za raznovrsnijim, učinkovitijim i okolišno pogodnijim šumskim strojevima. Zbog toga u posljednje vrijeme sortimentna metoda izrade drva postaje sve učestalija. Procjenjuje se da u primjeni sortimentne metode izrade drva u Rusiji ima 2000 većinom uvezenih strojeva. Njihov je broj od 2000. godine u stalnom porastu te se procjenjuje da se danas u Rusiju uveze oko 500 harvestera i forvardera na godinu.

Za potrebe procjene veličine tržišta šumskih strojeva u ovom su radu postavljena tri scenarija: »trenutni«, »dopustivi« i »mogući«.

- ⇒ *»Trenutni« se scenarij zasniva na postojećem stupnju pridobivanja drva, tj. na godišnjem etatu od 7,9 mil. m^3/godišnje od čega se 40 % etata izrađuje sortimentnom metodom, a 3,5 mil. m^3 odnosi se na energijsko drvo.*
- ⇒ *»Dopustivi« se scenarij temelji na povećanju pridobivanja energijskoga drva te time povećanju godišnjega etata na 9,5 mil. m^3, a da se 40 % etata izrađuje sortimentnom metodom uz veću uporabu harvestera.*
- ⇒ *»Mogući« se scenarij temelji na primjeni isključivo sortimentne metode izrade drva i povećanju količine drva iz proreda, što će rezultirati godišnjim etatom od 15 milijuna m^3 (od čega bi 40 % etata trebalo biti iz proreda, odnosno 7,2 mil. m^3 energijskoga drva).*

Proizvodnost strojeva s kojom su rađene procjene dobivena je iz raznih statističkih podataka te iz podataka koje su ustupila šumarska poduzeća iz Rusije i Finske (slika 3).

U tablici 1 prikazane su potrebe za šumskim strojevima prema svim trima predloženim scenarijima. Najveći mogući broj strojeva za rad pri sortimentnoj metodi izrade drva procjenjuje se na 400 forvardera te isto toliko harvestera i kamionskih skupova za prijevoz drva, te dodatno po 250 komada pokretnih iverača, forvardera i kamiona za privlačenje i prijevoz drvnoga ostatka.

Tablica 2 također prikazuje potrebu za šumskim strojevima prema svim trima predloženim scenarijima kada se uzme u obzir zamjena starih strojeva za rad pri stablovnoj metodi izrade drva s nabavom novih strojeva za primjenu sortimentne metode izrade drva te uz zamjenu strojeva svakih 7 godina.

U tablicama 3 – 5, na temelju procjena iz tablice 1, prikazane su potrebe poduzeća (koncesionara šuma) za šumskom mehanizacijom.

Rezultati pokazuju da je godišnja potreba za šumskom mehanizacijom u Lenjingradskoj regiji između 20 – 30 komada srednje velikih forvardera, harvestera i kamiona za prijevoz drva. Potreba bi se u budućnosti mogla povećati na 30 – 40 strojeva godišnje, ako se siječe planirani godišnji etat ili čak 50 – 60 strojeva godišnje ako se intenzivno provode prorede. U proizvodnji energijskoga drva sadašnja je potreba 4 forvardera, 10 iverača i 10 kamiona za prijevoz drvnoga iverja. Kada bi se izvršio planirani etat i kada bi se provodile intenzivne prorede, potreba za strojevima iznosila bi 30 – 40 strojeva godišnje.

Od približno tisuću poduzeća, koja se bave poslovima u šumarstvu, samo njih stotinu imaju koncesiju na šumama te dovoljno sredstava za nabavu nove mehanizacije i primjenu sortimentne metode. Samo trećina koncesionara ima mogućnosti za potpunu primjenu sortimentne metode izrade drva. Njihova je potreba prema »trenutnom« scenariju 270 strojeva: 90 harvestera, 100 forvardera, 80 kamiona za prijevoz drva. Samo se 37 poduzeća bavi proizvodnjom energijskoga drva i imaju potrebu za 50 iverača, 50 forvardera i 60 kamiona za prijevoz drvnoga iverja.

Prema »dopustivom« scenariju 60 % koncesionara šuma ima dovoljnu površinu šuma i u mogućnosti je potpuno primijeniti sortimentnu metodu izrade drva. Njihova potreba za šumskim strojevima ogledala bi se u 160 harve-

stera, 190 forvardera i 150 kamiona za prijevoz drva. Ukupno 56 poduzeća koja se bave proizvodnjom energijskoga drva imalo bi potrebu za 100 iverača, 100 forvardera i 110 kamiona za prijevoz drvnoga iverja.

Prema »mogućem« scenariju 60 % koncesionara šuma, uz dovoljnu površinu šuma i potpunu primjenu sortimentne metode izrade drva, imalo bi potrebu za 260 harvestera, 280 forvardera i 230 kamiona za prijevoz drva. Broj poduzeća koja se bave proizvodnjom energijskoga drva povećao bi se na 70, a imali bi potrebu za 150 iverača, 150 forvardera i 180 kamiona za prijevoz drvnoga iverja.

Ekonomski pokazatelji u tehnološkom razvoju pridobivanja drva pokazuju pozitivne rezultate kako se od 2005. godine sve više obnavlja šumska mehanizacija u Rusiji. Iz toga se zaključuje da se metode opisane u radu mogu koristiti kao podloga za razvoj nabavnih strategija i programa šumske mehanizacije i u Lenjingradskoj regiji i u ostatku Rusije.

Ključne riječi: Rusija, industrijsko drvo, energijsko drvo, harvester, forvarder, kamion, pokretni iverač

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