Evaluation and Comparison of Ecological Efficiency of the Forest Company Productive Units

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Abstract:
In the introduction paper shows the preliminary concept of companies' eco-efficiency, and advocates "green growth" as a strategy for achieving sustainable development, through a relatively new procedure for reporting on environmental performance of the company expressed as a ratio of: a) the specific fuel consumption and b) the quantity of production units or business financial indicators. Conventional approach to economic growth and development of forest and other companies, which does not meet environmental and social functions of the company, is described as the "grow now, clean later" motto. Therefore, this paper illustrates the measurement of the effective use of company resources and the impact of economic activities on the environment expressed in the form of eco-efficiency indicators. Such approach to business reporting is crucial for future economic and environmental strategy and company image through efficient use of companies' resources and a lower rate of pollution.
The central part of the paper provides SWOT analysis for the application of eco-efficiency indicators in forestry. Guided by the recommendations and guidelines for identifying, measuring and monitoring environmental indicators in the business via methodologies and models adopted in different countries and companies, applicable indicators of eco-efficiency are calculated from the profit and loss account at the level of production units (forest offices) of the forest enterprise for a specific conditions and time period of three year. Obtained eco-indicators for each forest office are put in relation with the descriptive parameters of individual forest office.
In the final part of the paper, ranking of forest offices is carried out regarding obtained ecological efficiency indicators and descriptive parameters. Based on the obtained results the guidelines for the development of internal indicators in the forestry sector are indicated, and the need for standardization of the methodology of determining the proper calculation and reporting of company environmental efficiency is highlighted within the national framework, so companies in the forestry sector could act responsibly on behalf of business improvement and development of public awareness of the green economy.

Keywords: eco-efficiency indicators, eco-efficiency, forestry, forest enterprises

1 Introduction

In the last decade, environmental degradation as a result of anthropogenic activity receives a great attention of media, public and policy through advocacy of "green growth" as a strategy for achieving sustainable development and the introduction of relatively new procedures for monitoring and reporting on ecological performance of business enterprises. This approach is reflected in the increased public and legislative pressure on economic subjects to implement appropriate methods and measures of environmental protection in their strategies.

The limitations in utilization of natural resources and the conventional approach to economic development and growth under the motto "grow now, clean later" encouraged companies to a new production approach where with the lower amount of inputs they want to achieve the same or higher outputs. Such a production approach involves less energy consumption per unit of product which ultimately leads to conservation and environmental protection, and also to rationalization of production activities. Keeping in mind the growing trend in energy prices, large companies submit more attention and more money to the described strategy and the researches related to improving ecological and energy

efficiency of the company. The elements of ecological efficiency of enterprises rely on investigations related to material productivity:

- reduced consumption of energy and materials per unit of product
- reduced waste, emissions and releases per product
- improved recycling of products and packaging as much as possible

These elements represent a turning point in the understanding of 21st century productivity: from work productivity toward productivity of material and energy.

Inspired by numerous problems, scientists and practitioners for the first time on the broad public plan promoted the concept of sustainable development as simple and attractive definition that reads: "this is one aspect of development or progress that meets our current needs, and does not prevent future generations to satisfy their own" (WCED 1987). Decision makers in companies perceive sustainable development as a global pressure to build their long-term business strategies around three interrelated goals: economic growth, environmental value and social responsibility. The business concept in the form of "green growth" represents a key upgrade of sustainable development strategy and it includes a relatively new procedure for reporting on environmental performance of the company expressed as a ratio of: a) the specific fuel consumption and b) the quantity of production units or financial performance score.

1.1 Ecological efficiency in general

Ecological efficiency is defined as (WBCSD 2000) "delivery of goods and services that satisfies human needs and brings quality of life at competitive prices, with progressively decreasing pressure on the environment and resources during the life cycle, at least to a level that is consistent with the estimated reception capacity of the Earth".

WBCSD (1996) describes the goal of eco-efficiency as "the increasing value on the one side and reducing resource utilization and adverse impacts on the environment on the other side". In order to enable measurability of the company success in the way of environmental efficiency, WBCSD has defined a set of general indicators that can be applied regardless of business or company size (Tab. 1).

Table 1: Indicators of ecological efficiency

Indicator of value	The impact on the environment
• Quantity of goods or services sold • Sale value	• Total energy consumption • Consumption of water • Material consumption • Emissions of greenhouse gases • The emission of substances that damage the ozone layer

Ecological efficiency is the ratio of the enterprise environmental burden and the quantity or value of products or services (Term 1).

$$\textbf{Ecological efficiency} = \frac{environment\ burden}{quantity\ or\ value\ of\ products\ \therefore\ services} \quad (1)$$

The ratio of these two items (Term 1), should measure the environmental burden per unit of economic value of products, for example, a kilogram of carbon dioxide emissions per monetary unit of sales or megajoule (MJ) of energy per monetary unit. This is similar to measuring the energy intensity at national level (e.g. megajoule (MJ) of energy per unit of production, or the megajoule (MJ) of energy per unit of GDP).

1.2 Application of eco-efficiency indicators in the business of forestry enterprises

The problem of environmental pollution and the consumption of large material and energy quantities in the production process affect the growing awareness of top and middle management of forestry companies about the problem of forest ecosystems conservation, need to reduce environmental pollution and rationalize production processes. From the viewpoint of forest sector, issues on ecological efficiency so far have mostly been directly related to logging problems and environmental impacts when performing forest work operations (damage of stands, soil, trees etc.). Ecological efficiency of forestry enterprises in terms of energy intensity use, water use and waste treatment in the production process and services has not been the subject of more serious considerations in Croatian forestry (Šporčić et al. 2011).

The focus of reporting on forestry company environmental performance should be an energy component that is expressed through the indicator of energy intensity that puts in the relationship consumption of solid, liquid and gaseous fuels, and also electricity at the work place, against the total volume of produced wood and / or profit of individual production units in forestry company.

Efficient use and lower consumption of energy and materials, reduced emissions of gas and toxic substances, less waste and its better management are the elements that have the ultimate goal of reducing costs and increasing efficiency of the company. By achieving a satisfactory level of ecological efficiency, in the eyes of the public, consumers and investors, company is also developing the image of an environmentally conscious enterprise what can provide a competitive advantage in a dynamic national or global market (Šporčić et al. 2011).

2 Materials, methods and objective of research

During the processing and data analysis in the paper, method of predictive induction, generalization method, methods of description and measurement were used. Measured, collected and summarized data needed for the assessment of ecological efficiency of forest offices (fuel, lubricants, wood volume, electricity and gas), using adequate conversion factors, were calculated into environmental burden expressed as megajoules (MJ) of consumed energy. Work process description was carried out in the light of energy intensity indicators for respective forest production units. Given the individual observations and results, generalized conclusions were made based on the analysis of a limited number of forestry production units in relation to the location rent of company forest offices and three-year time period data. The object of the research was the national forest company "Croatian Forests" Ltd Zagreb, i.e. its chosen forest offices.

Materials used in construction of paper include secondary information related to the financial statements of individual forest offices, annual and quarterly records of energy consumption (fuels and lubricants) from the production processes. Internal documents related to the review of expenses and revenues, business analysis and reports on production for the year 2009, 2010 and 2011 were also used. Source used as a calculative model for the paper was taken from a document titled "Indicators of eco-efficiency and environmental economics" (source: The National Round Table on the Environment and the Economy, NRTEE 2001). Another relevant source refers to the manual entitled "Ecological effectiveness and business strategy" (Matutinović 2000).

2.1 Objective of research

Bearing in mind the contribution and significance of eco-efficiency indicators and the importance of their implementation as indicators of organizational units' ecological performance, it was considered useful for the national scientific and professional community to provide information on the possible application of energy intensity indicators as a standard part of the forest office effectiveness report on a concrete example.

The aim of paper is to show and compare the level of ecological efficiency in the productive units of forest company (forest offices) using the energy intensity indicator where the environmental burden expressed in megajoules (MJ) of energy consumed was put in a relation with production and financial

indicators for specific conditions, technology and methods.

3 Results

Results include a number of indicators collected from data on production, data on energy consumption at individual forest production units and also a comparison of calculated energy intensity indicator towards a production and financial performance for the years 2009, 2010 and 2011. SWOT analysis of eco-efficiency indicators application in forestry was made with the aim of shaping the future strategy of the organizational units in forest company.

3.1 SWOT analysis of eco-efficiency indicators application in forestry

Analysis of the situation and identifying all the advantages and disadvantages of possible eco-indicators applications in forestry is important for determining the proper strategies and responsible actions in favor of proactive business upgrading in forestry sector. For this reason the SWOT analysis was made, and it should enable us to make a standpoint regarding the acceptance and implementation of ecological efficiency indicators in forestry (Tab. 2).

Table 2: SWOT analysis of eco-efficiency indicators in forestry

STRENGHTS	WEAKNESSES
• Better company image • Less environmental pollution • Company modernization and computerization • Better and more systematic monitoring of inputs and outputs in the production process	• Increase in bureaucratic procedures and paperwork • Lack of knowledge on methodology, implementation process and monitoring of eco-indicators • Lack of skilled staff • Possibility of incorrect readings, monitoring and interpretation
OPPORTUNITIES	**THREATS**
• Advantage in winning the tender for the execution of certain works • Need for employment of highly educated and skilled staff • Rationalization of energy consumption and resources • Development of innovative solutions in waste management	• Loss of business due to low environmental awareness • Loss of income and jobs (workers loss) • Lower efficiency because of the paperwork

3.2 Production indicators for forest offices

Natural indicators of production were obtained from internal documents of individual Regional forest office (RFO), and they refer to felled, cut down and skidded / forwarded timber volume (Tab. 3) and also on the percentage of work being done by the type of subcontractor (Gra. 1 and 2).

Table 3: Total felled, cut down and skidded / forwarded timber for the three year period

Forest office	Felling and cutting, cubic meter (m^3) 2009 - 11	Skidding / forwarding, cubic meter (m^3) 2009 - 11
Vrbovsko	159 245.23	159 705.50
Mrkopalj	149 441.00	148 810.00
Novoselec	141 104.00	111 178.00
V.Gorica	136 878.52	102 229.91
Cerna	84 275.00	47 674.00
Vrbanja	162 474.00	116 284.00

Viewed through volume in relation to location rent, the largest volume of wood is felled, cut down and skidded / forwarded (Tab. 3) in the forest offices which are located in mountainous areas of Croatia and where the forests are managed with selection system (Mrkopalj and Vrbovsko). Regarding the observed three years period, increasing trend of allowable cut is visible in all forest offices except forest office Cerna and the trend of reduced skidded / forwarded wood volume is also visible in forest office Cerna. Negligible differences in the felled and skidded wood volume at the level of forest offices (Tab. 3) are the result of field and weather conditions, i.e. the fulfillment of the annual plan and the extension of deadlines for the work activities at individual forest sites.

In the observed three-year period, the largest percentage of felled wood with their own capacities (Fig. 1) has forest office Novoselec (70.59%), while most of service in the process of felling and cutting (internal service and private contractors) has forest offices Vrbovsko and Mrkopalj which manage selective forests in the demanding field conditions of mountain Croatia.

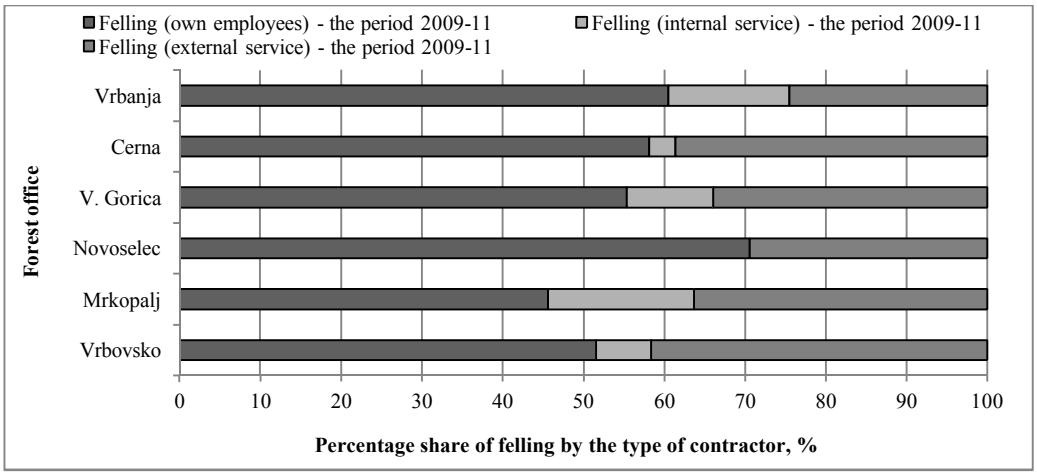

Figure 1: Percentage share of felling operators for three year period

Fig. 2 shows that in the observed three-years the highest percentage of wood volume skidded with its own capacities is recorded in the forest office Novoselec (78.49%) and forest office Cerna (74.23%), while forest office Vrbanja has the lowest percentage (27.94%). Forest offices that manage regular forests in the eastern part of the Croatia (Vrbanja and Cerna) accept its own capacities also use the internal service of other work units within company, without engaging private contractors. The largest share of external services at the skidding process (private contractors) is used by the forest offices Vrbovsko and Mrkopalj which manage the selective forests in mountainious parts of Croatia.

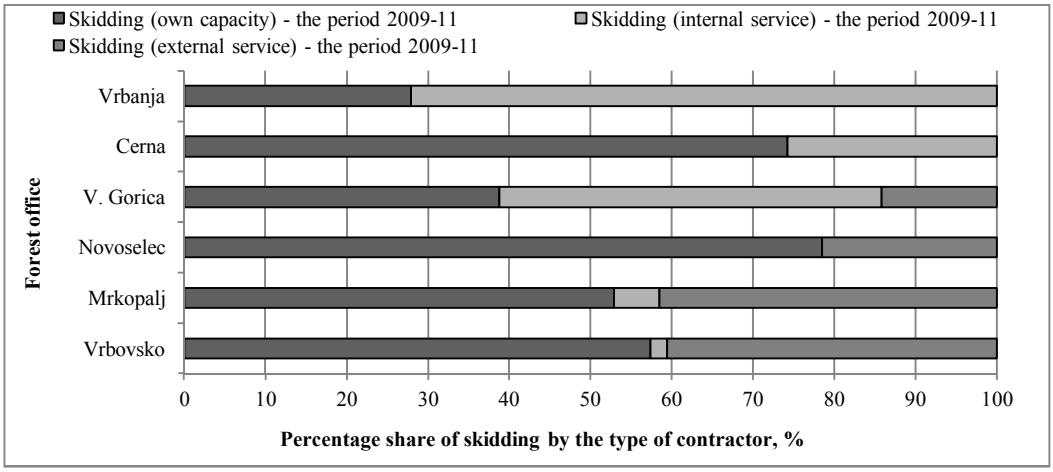

Figure 2: Percentage share of skidding operators for three year period

3.3 Annual energy consumption indicators for forest offices

Indicators of energy consumption (Tab. 4) on a yearly basis are taken from the internal forms and delivery notes related to the consumption of fuel, oil and other energy sources. Energy conversion factors (Tab. 6) used for the calculation of the energy intensity indicators, regarding particular forest offices and certain work processes, have been taken from the appropriate literary sources (see bibliography).

Table 4: Consumption of fuels and lubricants by work processes for the period 2009-11

Forest office	Felling and cutting, liter (l)		Skidding/forwarding, liter (l)		Silvicultural work, liter (l)		
	Gasoline	Lubricants	Diesel	Lubricants	Gasoline	Diesel	Lubricants
Vrbovsko	24 538.40	6 473.35	73 952.10	590	1 264.12	0	579.75
Mrkopalj	15 342.00	3 425.00	55 258.00	1 570	2 181	0	506
Novoselec	22 114.00	6 261.00	69 134.00	2902	6 222	13 217	2 897
V. Gorica	19 260.55	9 970.75	51 494.73	3 162	3 618.40	44 809	2 133.50
Cerna	24 046.00	8 004.00	127 615.00	8 808	90	71 054	2 613
Vrbanja	25 552.00	7 554.00	45 267.00	2 881	2 518	32 353	507

The quantity of liquid fuels consumed in skidding / forwarding is 3.5 times the amount of energy consumed on felling trees. Forest office Cerna in the observed period increased consumption of fuel and lubricants for the cutting and skidding / forwarding of wood volume despite the constant decline of the annual felling volume quantity (Tab. 3). Such a result in case of forest office Cerna is a consequence of providing services of felling trees (approximately 10 000 m^3/year) and skidding (about 20 000 m^3/year) in other Regional forest offices. Forest offices in mountain areas (Vrbovsko Mrkopalj) have a trend of increasing consumption of fuels and lubricants in the tree felling and / or skidding process (Tab. 4) due to increasing amounts of felled and skidded wood volume (Tab. 2).

Selective approach of management in the forest offices in mountain Croatia (Vrbovsko and Mrkopalj), because of its specificity does not require large silvicultural operations, unlike other forest offices in which the forests are managed regularly and the work of felling trees and silvicultural work is separated in place and time. Different consumption of fuel (diesel and gasoline) is the result of applying various means and methods of work in individual forest offices (Tab. 4). Forest offices in mountain Croatia that practice selective approach of management have about 13 times lesser fuel and lubricant consumption on the silvicultural work.

Table 5: Annual energy consumption for cool section and official vehicles at the level of forest office

Forest office	Official vehicles of forest offices			Cold section of forest offices			
	Gasoline	Diesel	Lubricants	Fuel oil	Wood	Natural gas	Electricity
	Liter (l)	Liter (l)	Liter (l)	Liter (l)	m^3	m^3	kWh
Vrbovsko	14 183.15	29 540.58	0.00	0.00	175.41	100.50	48 636.00
Mrkopalj	14 537.77	23 933.47	196	11 309	30	0.00	0.00
Novoselec	10 240	57 293	0.00	0.00	0.00	14 712.77	11 576.72
V. Gorica	10 032.98	36 883.92	7	23 037	0.00	0.00	191 436.40
Cerna	5 461	46 086	395	36 700	30	747.33	93 894.50
Vrbanja	14 060	43 318	276	0.00	0.00	31 460.03	222 552.20

Total consumption of energy for cold section of forest offices and official vehicles is shown in Table 5. The average energy consumption of forest office vehicles expressed in percentage and in relation to the total amount of energy consumed by the cold section is between 46.94% at the forest offices whit the selective forest management and 55.77% at the forest offices with a regular management approach.

Energy conversion factors for calculating the indicators of energy intensity in production units of forest enterprise are located in Table 6. The recorded amount of energy expressed in absolute terms is multiplied by the conversion factor to obtain the amount of energy consumption expressed in megajoules (MJ).

Table 6: Energy conversion factor for calculating the energy intensity in forestry

Type of energy source	Unit	The conversion factor (MJ)	Type of energy source	Unit	The conversion factor (MJ)
Solid fuels			Liquid fuels		
Anthracite	kg	27.70[1]	Gasoline	l	34.66[1]
Stone coal	kg	29.03[2]	Diesel	l	38.68[1]
Brown coal	kg	29.3[2]	Biodiesel	l	-
Lignite	kg	12.56[2]	Fuel oil	l	41.73[1]
Cokes	kg	28.83[1]	Liquefied petroleum gas	l	25.7[3]
Gaseous fuels			Petroleum	l	42.38[1]
Natural gas	m^3	37.78[1]	Lubricants	l	40.00[4]
Propane	L	25.53[1]	Biomass		
Butane	l	28.62[1]	Wood biomass	kg	18.00[1]
Electricity	kWh	3.6[1]			

[1] Calculating eco-efficiency indicators: a workbook for industry. National Round Table on the Environment and the Economy, 2001, Canada; [2] Goić, R., 2006/07: General Energy - a collection of presentations, Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, Split (source: http://www.fesb.hr/~rgoic/oe/p1.pdf); [3] Dobovišek, Ž., Hribernik, A., Samec, N., Kokalj, F., 2005: Emissions of carbon dioxide during combustion of fuels. Fuels and lubricants, 44, 2, 109-131; [4] Natural Gas delivered by Envestra (source: http://www.natural-gas.com.au/about/references.html#)

3.4 Total energy consumed at the level of forest office

Environmental burden is shown as the totally consumed energy expressed in gigajoules (GJ) at the level of individual forest production unit. Multiplying the conversion factors (Tab. 6) of each fuel and the total amount of consumed fuel, the conversion value of the environmental burden is obtained. Overall (Fig. 3), forest office Cerna which is located in the Croatian lowland area has the highest average energy consumption of 4545.70 gigajoules (GJ) annually.

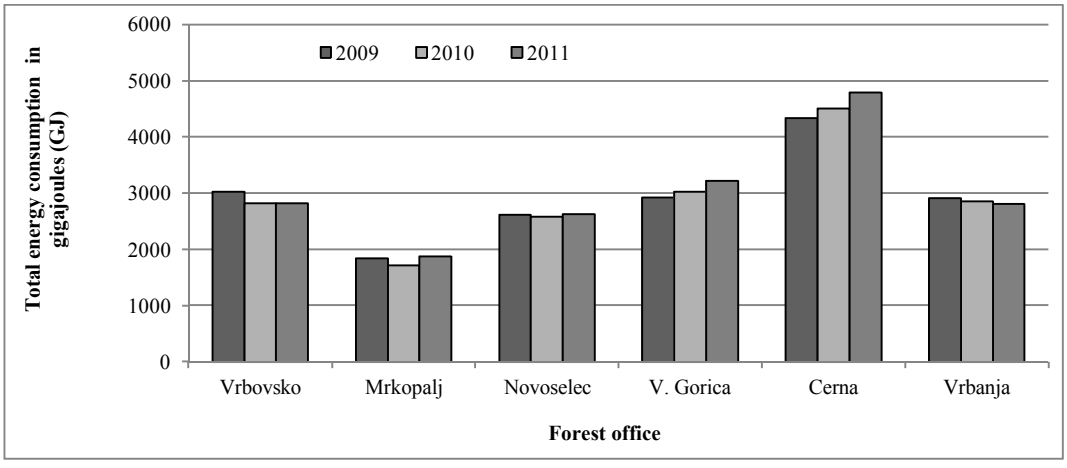

Figure 3: The total consumed energy expressed in gigajoules (GJ) per forest office

The reason for such result is the large amount of work conducted in other Regional forest offices. The above-mentioned forest office also leads at the energy consumption for the silvicultural works and cold section because of people and machinery transport. Although located in a very demanding territory with extremely difficult conditions and cold winters, forest office Mrkopalj has the lowest overall average energy consumption of 1810.31 gigajoules (GJ) for the observed three-year period. Noticeably the lowest average energy consumption is the result of very little energy spent on silvicultural works.

3.5 Energy intensity indicator of work processes at the level of forest office

Analyzed results of the calculated energy intensity indicators for production units (Fig. 4, 5 and 6) show the relationship of environmental loads, i.e. the energy consumed in megajoules (MJ) and numerical indicators of forest offices production. Energy intensity indicators are represented by the average energy consumed per cubic meter (m^3) made in production for the selected work processes.

Forest office Mrkopalj which is located in an extremely difficult terrain of mountain Croatia has the lowest energy intensity indicator (4.63 MJ/m^3) at felling trees (Fig. 4), and the second best is forest office Vrbovsko (6.94 MJ/m^3). The result of the minimum energy intensity of these two forest offices is directly linked to the large amount of used internal and external service at the forest offices i.e. the smallest share of felled wood volume which is done with their own capacities (Fig. 1). Minimum average energy intensity at felling in selection management system forest offices Mrkopalj and Vrbovsko is also contributed by the felling of only mature trees i.e. main volume production at which the statute of piece volume needs to be acknowledged. The highest average energy intensity at felling trees has forest office Cerna (14.07 MJ/m^3) because of considerable amount of felling and processing work in the forests of preliminary volume production and smaller breast height diameters.

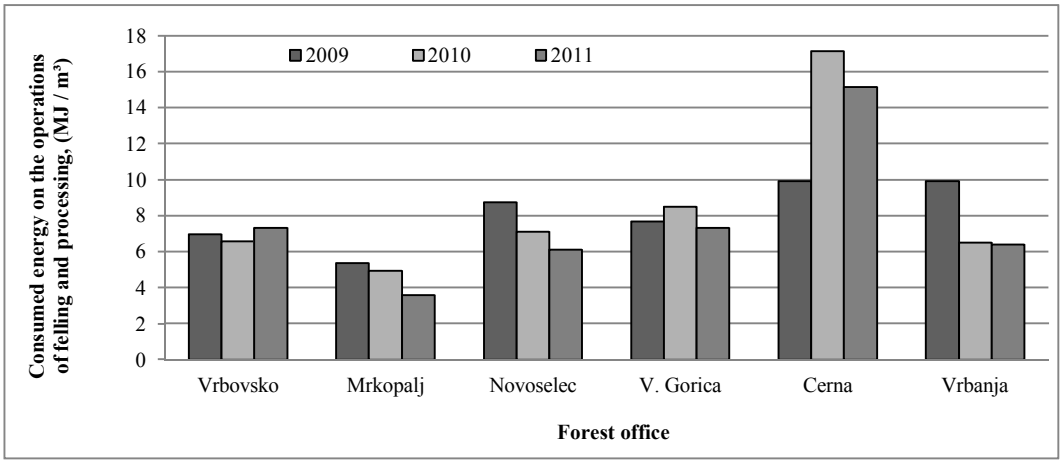

Figure 4: Energy intensity indicator of felling and processing tress expressed in MJ/m^3

Forest office Mrkopalj, in the observed period, has the lowest energy intensity indicator (Fig. 5) at the operations of skidding / forwarding (15.21 MJ/m^3), and the second best is forest office Vrbanja (17.70 MJ/m^3). The highest average energy intensity at skidding and forwarding of tree volume is recorded in forest offices Cerna (115.28 MJ/m^3) due to large amounts of internal services performed in other regional forest offices. Generally (Fig. 5), forest offices which conducted the selective forest management system have, in relation to the forest offices that practice regular management system (Novoselec, V. Gorica, Vrbanja and Cerna), smaller average energy intensity at the operations of skidding / forwarding tree volume.

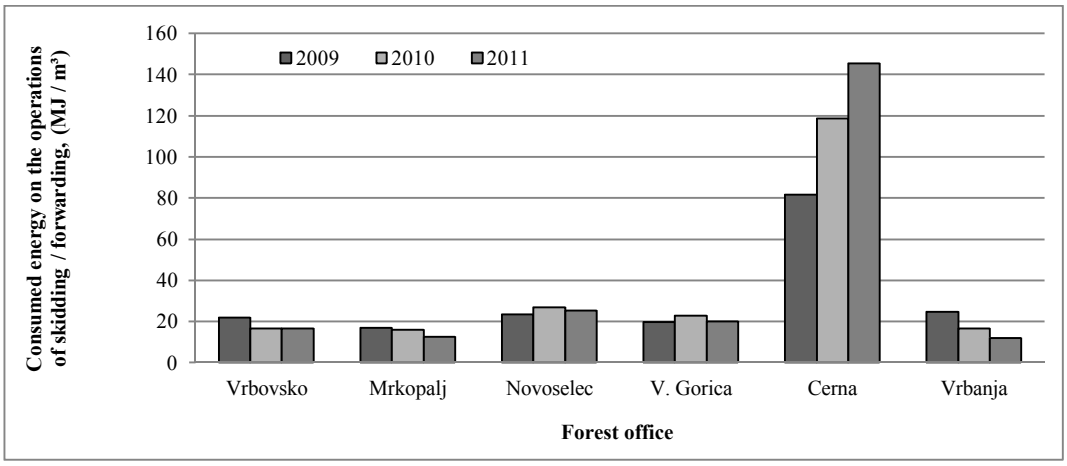

Figure 5: Energy intensity indicator of skidding / forwarding tree volume expressed in MJ/m^3

Extremely small value of the average energy intensity indicators at the silvicultural work, in the observed period and in relation to felled and processed wood volume (Fig. 6), is recorded in the forest offices with selection management system (Vrbovsko and Mrkopalj). The highest average value of energy intensity indicators in silvicultural work, and in relation to felled and processed wood volume, is noticed in forest offices Cerna (34.11 MJ/m^3) and V. Gorica (14.21 MJ/m^3).

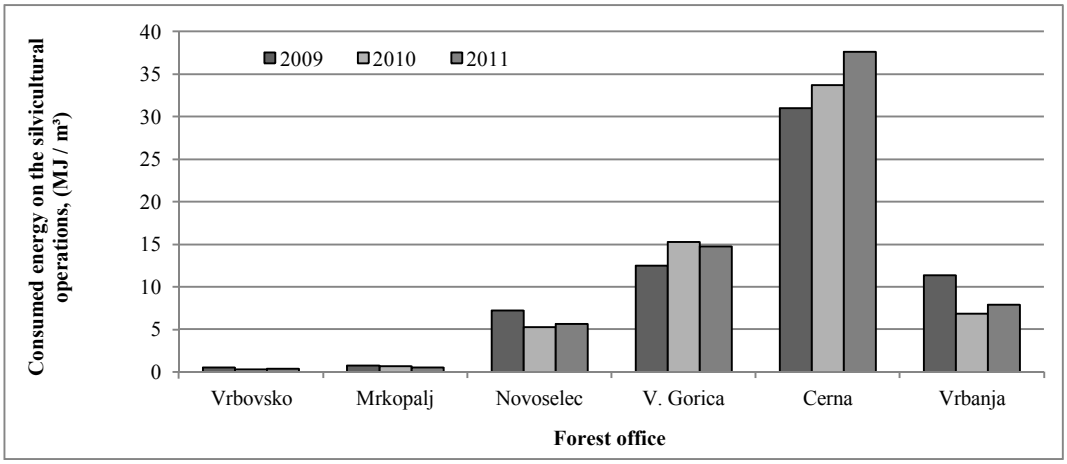

Figure 6: Energy intensity indicator at silvicultural operations expressed in MJ/m^3

3.6 Energy intensity indicators of forest office's financial results

The observed three-year time period shows an increasing trend of generated income per year in all forest offices except forest office Cerna which in 2010 generated the lowest income and business losses. Trend of decreasing load on the environment, expressed through the amount of energy consumed, is visible in all forest offices except V. Gorica and Cerna (Figure 7). Top ranked forest offices, in the observed period, viewed through mean values of energy intensity indicators for total revenue are Vrbanja (0.07 MJ / HRK) and Mrkopalj (0.09 MJ / HRK), and the worst ranked forest offices are Vrbovsko with 0.13 MJ / HRK and Cerna with 0.19 MJ / HRK (1 € = 7.5 HRK).

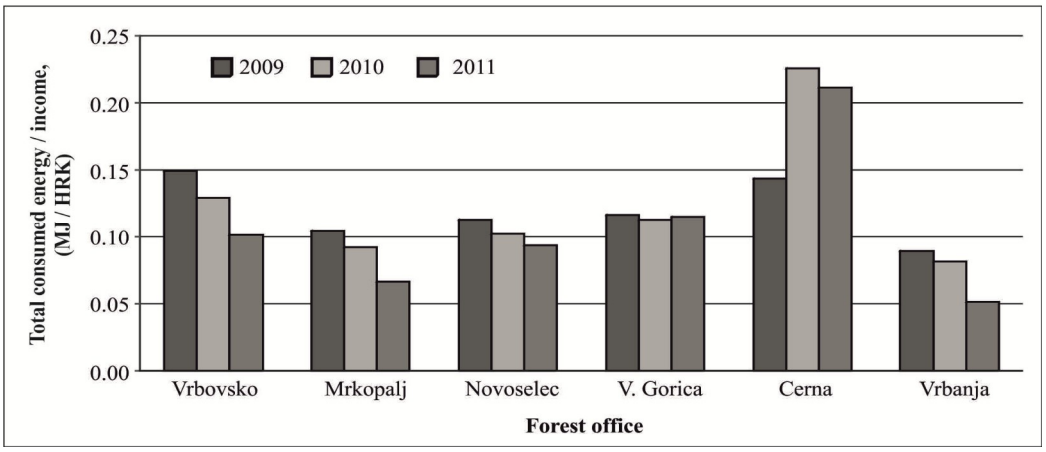

Figure 7: Energy intensity indicator of income expressed in MJ/HKR

Reported increase in income for the observed period positively correlated with the increase in costs for all forest offices except Cerna which noted a significant reduction of expenditures in 2010 and 2011 but also reduction of generated income. Top ranked forest offices, in the observed period, viewed through mean values of energy intensity indicators for total costs (Fig. 8) are Cerna (0.21 MJ / HRK) and Vrbovsko (0.15 MJ / HRK), and the worst ranked forest offices are Mrkopalj (0.11 MJ / HRK) and Vrbanja (0.09 MJ / HRK).

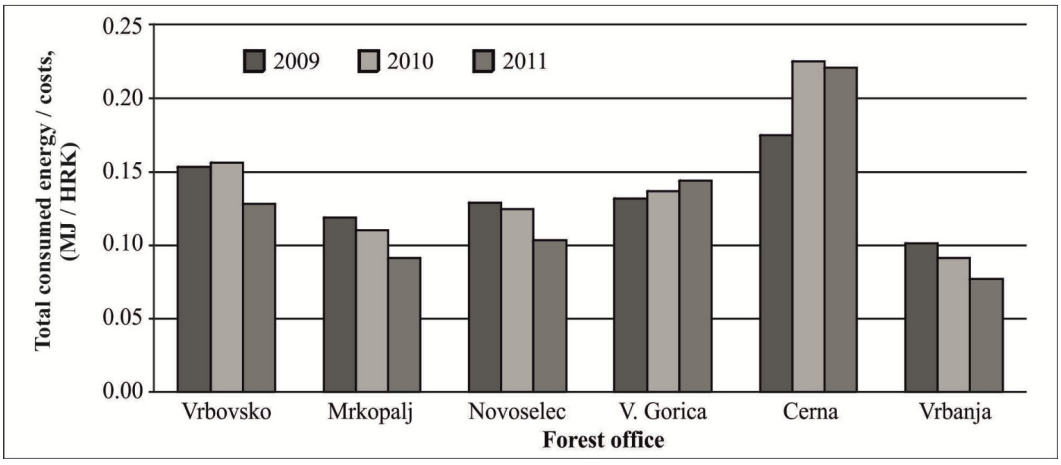

Figure 8: Energy intensity indicator of costs expressed in MJ/HKR

Achieved profit in the observed period has a growing trend in all forest offices except in forest office Novoselec and especially forest office Cerna which in the year 2010 generated the lowest income and operated with business loss. Top ranked forest offices, in the observed period, viewed through the average value of energy intensity indicator for total profit / loss (Fig. 9) are Mrkopalj (0.53 MJ / HRK) and Vrbanja (0.56 MJ / HRK), and the worst ranked forest offices are Vrbovsko (2.1 MJ / HRK) and Cerna which in years 2009 and 2011 had an average energy intensity of 1.98 MJ / HRK, and in 2010 operating loss resulted with 101.54 MJ of energy consumption per HRK of loss.

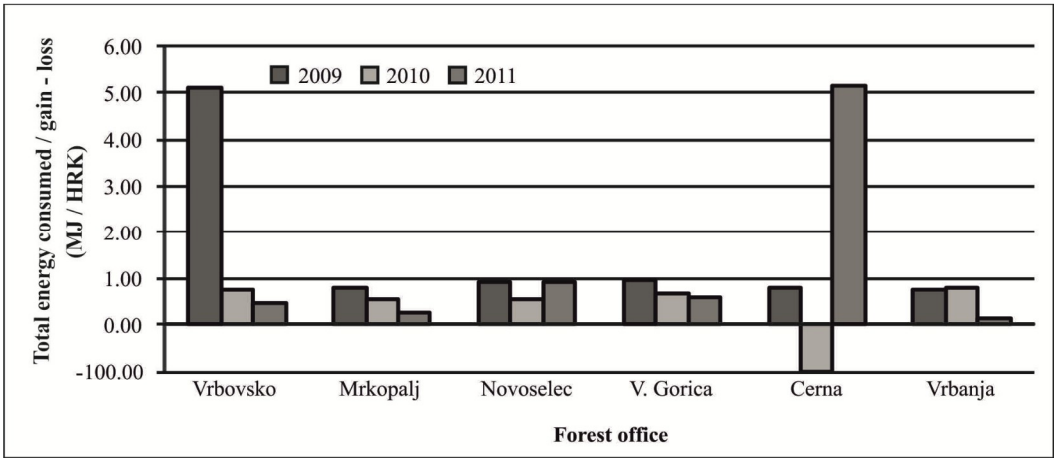

Figure 9: Energy intensity indicator of business gain – loss expressed in MJ/HRK

4 Discussion and conclusion

Competitiveness of forest companies, but also the whole Croatian industry, must be based on the assumption that arises from concerns about the environment as a byproduct of the implementation of material productivity and the concept of "green growth". Material productivity with its elements (reducing consumption of material and energy per unit of product, reducing waste and emissions per product and recyclable products) has a high importance in implementing the strategy of sustainable forest management and clear financial implications on companies' business conduct through the concept of "green growth". Understanding the ecological acceptability in managing forest resources which are of national interest and recognizing the ecological dimensions of conducting business in Croatian forestry sector represent a milestone and a crucial link in understanding productivity of 21st century.

From the viewpoint of forest sector, issues on ecological efficiency have so far mostly been directly related to the direct logging aspects and environmental impacts when performing forest work operations (damage of stand, soil, trees, etc.). Ecological effectiveness of forestry companies in terms of energy intensity use, water and waste management in the production process so far has not been the subject of more elaborate considerations in Croatian forestry. In the process of evaluating ecological performance of forest company production units with applied energy intensity indicator, and viewed from a point of environmental burden, material productivity and business efficiency, a set of quantitative data with qualitative explanation is obtained and following conclusions are adopted:

- Noted trend of an increasing annual cut, in the three-year reporting period, for forest offices positively correlated with the increase in total energy consumption;
- Forest offices that manage selection forest stands have a significantly lower energy consumption at the silvicultural operations than forest offices that manage regular forest stands;
- Total energy consumption expressed in gigajoules (GJ) was higher in the forest offices which have the largest share of felling and skidding operations performed with their own capacities;
- Best results of the forest office ecological efficiency and the lowest average value, seen through the energy intensity indicator on the operations of felling and skidding (MJ/m^3), depends on the share of used internal and external services and also depends upon the statute of piece volume at annual cut;
- Best result of forest office ecological efficiency, seen through business profit / loss depends upon the location rent of forest offices and the proportion of internal and external services at the operations of skidding / forwarding wood volume.

Efficient use and lower consumption of energy and materials, reduced emissions of gases and toxic substances, less waste and its better management are the crucial elements that have the ultimate goal of reducing costs and increasing efficiency of the company. By achieving satisfactory level of ecological performance, the company is in the eyes of the public, consumers and investors, also developing the image of an environmentally conscious company what can provide a competitive advantage in a dynamic national or global market. Weaknesses in reporting on ecological performance using the energy intensity indicators come from limitations in a non-systematic approach in keeping of the internal records on energy consumption and also the passive approach to the issue of environmental protection in this form.

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