

## THE INFLUENCE OF THE ACCESSIBILITY GRADE UPON THE TECHNICAL-ECONOMICAL ESTIMATES FOR THE WOOD EXPLOITATION

Timofte Adrian Ioan, Timofte Claudia Simona Cleopatra

Department of Silviculture and Forestry Engineering, Faculty of Environmental Protection, University of Oradea, Oradea, Romania

[adi\\_timofte@yahoo.com](mailto:adi_timofte@yahoo.com)

Faculty of Law and Jurisprudence, University of Oradea, Oradea, Romania

[clau\\_timofte@yahoo.com](mailto:clau_timofte@yahoo.com)

**Abstract:** *The paper presents the importance of decreasing the collection distances with the occasion of the maintaining or extraction works of wood and the way the accessibility grade directly affects the expenses related to labour, fuel and working time. As a case study, eight auctioned felling areas have been chosen during the period 01.2016 - 02.2016 by Bihor Forest Administration, in which some tending operations will be performed. For them, there were prepared the exploitation estimates, thus, resulting the direct, indirect and total costs. Based on the time norms and hourly rates valid for the year 2016 taken from Bihor Forest Administration, the rates per cubic meter were determined for labour, hauling operations with tractors and specific consumption for hauling operation with forest tractor, in lei/cubic meter, on grades of accessibility and according to the average tree volume. A simulation was also performed for situations where stands would range from five to one in grades of accessibility, in other words, if secondary forest roads would be realized, the felling areas could become more accessible. Thus, the labour costs, fuel necessary for the hauling operation have been determined for the five situations given by the different grades of accessibility; in this situation the parameters change altogether with the felling areas becoming accessible. To compare the obtained values, the results were reported to the labour costs of wood collection, total labour costs for the whole process of exploitation and to the total operating costs. Tables and graphs capture the benefits of reducing the collection distance so that the felling area to become easily accessible. The average tree volume is less than the greater cost of extracting timber. Thus, in the absence of forest roads that minimize the internal distances within stands, including hygiene and tending works become very expensive and "unprofitable" for economic operators.*

**Keywords:** *exploitation estimates, grade of accesibility, expenses, norms, wood collection, tariffs, thinning operations*

**JEL classification:** Q23, Y10, K3,K32

### 1. Generally Introduction.

In the field of forest exploitation, the economic agents are interested mainly in the immediate profit that they can obtain by extracting and rendering of timber. Of course, it is necessary to have in view both the immediate economic efficiency of

each executed work and the global profitability achieved from the whole assembly of works applied to forest until the moment of its exploitation (Florescu & Nicolescu 1998).

In the countries with forest economy that have a high level of organization, the exploitations that inefficient from an economic point of view but necessary from a silvo-technical point of view are supported by subsidies (Oprea și Sbera, 2004).

In Romania, timber is rendered by law by the organizer as „standing wood” or „rough converted wood”. The grade of accessibility influences also the starting price during the actions for standing wood altogether with the market level of the reference prices on species, assortments and according to the exploitation technology, in accordance with GD 924/2015 – Regulation for the rendering of wood in the public forest stock.

The grades of accessibility are given by the average collecting distance of the timber, respectively by the distance from the barycenter of the felling area to be exploited till a permanent transport route. If the felling area is at an average distance of more than 1500m from the primary platform, then the accessibility will be given by the grade 5, marked with G5. For a distance of 1001-1500 m, the grade is G4, for 501-1000m is G3, for 251-500m is G2 and for the felling areas found very close to the permanent transport route, respectively under 250m, the grade of accessibility is G1.

Making accessible the forest stock can be done by making new roads (according to art. 5 paragraph 1 of Law 56/2010) but it still remains a problem in Romania as long as 35% of the forests are considered difficult to be accessible, being found at a distance of more than 2 km from a permanent transport route, thus being included in the grade 5 of accessibility. The lack of forest roads is obvious. The thickness index is higher than the European average (6.69m/ha in comparison to 30-40m/ha). Generally, many companies in the developed world started delocalizing or outsourcing production processes to them. The production based on intensive use of labor, some of it will be externalized or outsourced to countries where skilled labor is cheaper, thereby accumulating benefits from lower production costs (Negrea, 2014).

Among the production processes of wood exploitation, the most difficult one is its collection, because in this case, it is consumed 70% of the human energy, 100% of the animal energy, about 80% of the necessary fuel and there are recorded the highest expenditures – about 65...75% of the total production expenses necessary for the valuation of the timber from a felling area. (Ciubotaru, 1997).

Generally, the existent roads/routes must be improved and converted into auto forest roads to reduce the construction expenses and to make accessible the stands to be exploited. As a consequence of these investments, the collecting distances decrease, the value of the standing timber increases (value of the felling areas) becoming more accessible and very importantly, the expenses with timber exploitation decrease. To emphasize this fact, the way in which the expenses with labour and fuels are further presented when hauling with tractors when collecting the timber.

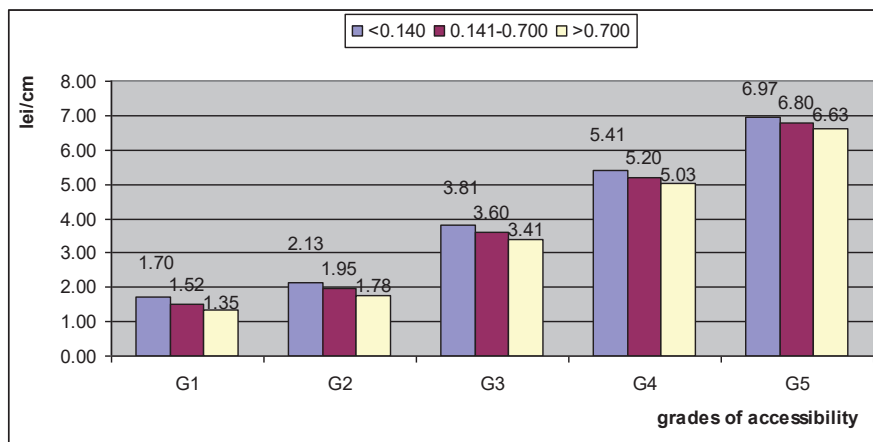
## 2. Material and Methods.

As a case study, eight felling areas have been selected that were auctioned during the period January-February 2016 by Bihor Forest Administration within Beius and Sudrigiu Forest Districts, with different volumes of the average tree, found on a high and very high slopes. At present, these felling areas are found in grade 5 of accessibility. Some thinning operations will be undertaken.

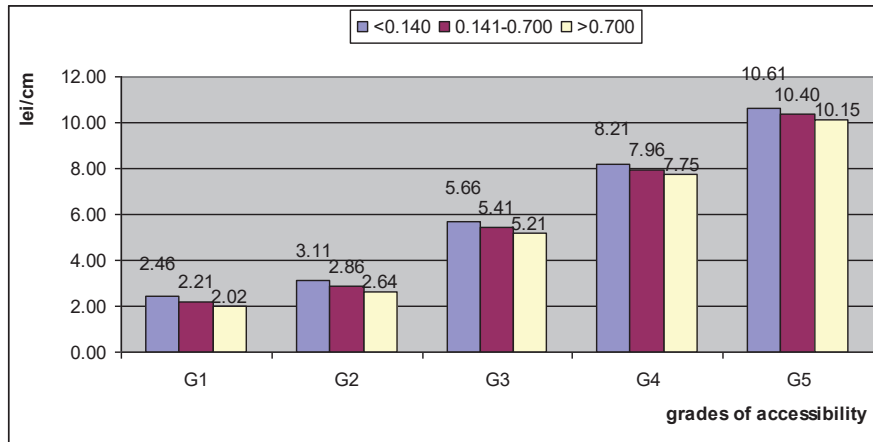
Based on the time norms and hourly rates, unit values corresponding to labour for the hauling operation with forestry tractor and the Diesel oil need while hauling with forestry tractor on grades of accessibility according to the volume of the average tree, according to Table 1, and their total is shown on groups of species in Figures 1 and 2.

**Table 1:** Labour and specific diesel oil consumption for the hauling operation with forestry tractor on grades of accessibility and according to the volume of the average tree.

Group of species	the volume of the average tree, cm/tree	The grade of accessibility of the felling areas				
		G1	G2	G3	G4	G5
<i>Labour consumption for the hauling operation with forestry tractor, in lei/cm</i>						
coniferous	<0.140	1.00	1.27	1.67	2.18	2.64
	0.141-0.700	0.82	1.09	1.46	1.97	2.47
	>0.700	0.65	0.92	1.27	1.80	2.30
deciduous	<0.140	1.39	1.79	2.39	3.26	3.98
	0.141-0.700	1.14	1.54	2.14	3.01	3.77
	>0.700	0.95	1.32	1.94	2.80	3.52
<i>Specific diesel oil consumption for the hauling operation with forestry tractor, in lei/cm</i>						
R	-	0.70	0.86	2.14	3.23	4.33
F	-	1.07	1.32	3.27	4.95	6.63



**Fig.1:** Representation of the unit tariffs regarding the expenses with forestry tractor when collecting (labour +diesel oil) on grades of accessibility and according to the volume of the average tree, in lei/cubic meter, for coniferous and soft wood (R+DM)



**Figure 2:** Representation of the unit tariffs regarding the expenses with forestry tractor when collecting (labour +diesel oil) on grades of accessibility and according to the volume of the average tree, in lei/cubic meter, for deciduous and hard wood (F+DT)

With the help of a programme realized in Microsoft Excel, the exploitation estimates were made on operations, based on the hourly rates available for 2016 taken from Bihor Forest Administration and with the help of the time norms used in the forest exploitation determined by Professor Ciubotaru (1996). Thus, for each felling area, direct, indirect and total costs have been calculated (see table 2) for the situations in which the felling areas could be in the five grades of accessibility, by the reduction of the average collecting distances.

**Table 2:** Expenses necessary for the exploitation of the felling areas on grades of accessibility

The grade of accessibility	Expenses necessary for the exploitation of the felling areas, in lei/cm							
	Beiuș Forest District, the felling area...					Sudrigiu Forest District, the felling area...		
	P517	P526	P530	P531	P538	P203	P204	P227
G1	55.82	39.39	61.15	77.57	89.81	66.78	118.03	79.85
G2	57.15	40.67	62.47	79.04	91.02	67.96	119.25	81.06
G3	59.05	42.59	64.37	81.14	92.74	69.71	120.99	82.78
G4	61.65	45.14	66.95	83.99	95.06	72.04	123.35	85.11
G5	64.07	47.48	69.37	86.66	97.27	74.20	125.57	87.31

The values are high because the stands are young and tending works are carried on. Thus, at present for felling area 204 Sudrigiu Forest District, the proposed

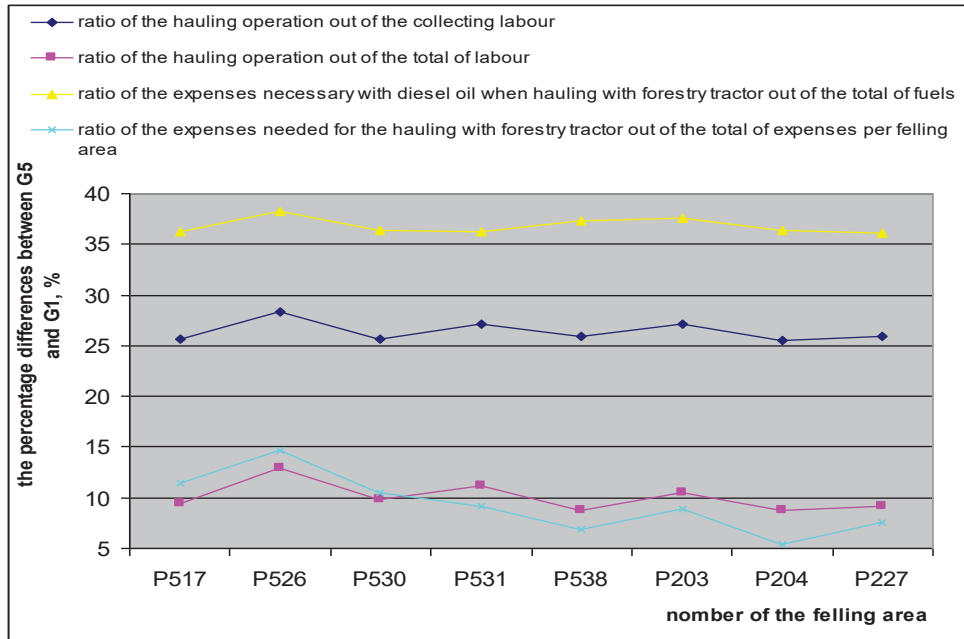
thinning activities cost very much (125.57 lei/cubic meter) and a reduction of the accessibility grade would mean a decrease with 6% of the expenses. The percent is pretty low because the stand is 36 years old now, but later the gain will be significant. For instance, for the felling area 526 the decrease is about 17%.

This simulation allowed the determination of ratios occupied by the activities that are influenced by the reduction of the accessibility grade from G5 to G4, G3, G2, G1. It is about the labour for the hauling with tractors operation, the need of diesel oil for the operation of hauling. To be more suggestive, the results are presented into lei/cubic meter or in %, the obtained values being compared to the total volume, labour when collecting the timber and total of labour, total of fuel and total of expenses. The obtained results were included in the table below:

**Table 3:** Situation of the 8 felling areas under study regarding the volume of the average tree, total volume, slope and labour, needed fuel, % of the total expenses on grades of accessibility

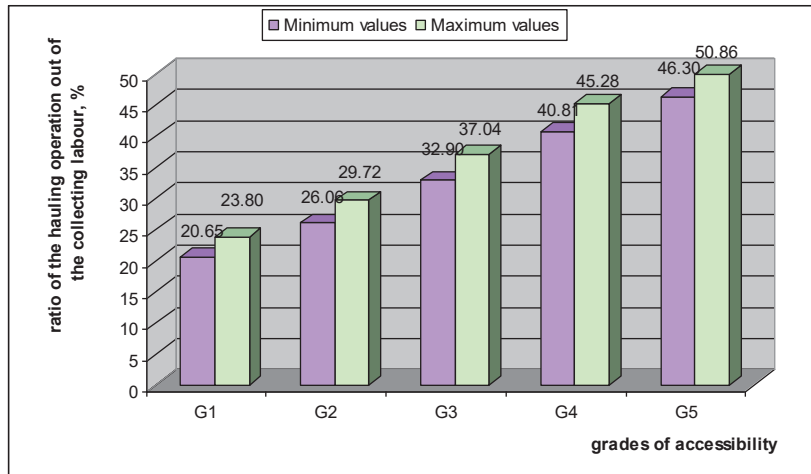
Characteristics of felling areas and calculated indices		Forest District, felling area...							
		Beiuș					Sudrigiu		
		P517	P526	P530	P531	P538	P203	P204	P227
The volume of the average tree, cm/tree	R+DM	0.57	-	1.11	0.90	0.47	0.25	0.16	0.26
	F+DT	0.28	1.29	0.30	0.42	0.18	1.00	0.23	0.20
	total	0.28	1.29	0.31	0.43	0.23	0.52	0.21	0.22
The total volume, cm		427	800	312	224	164	231	105	192
The slope, g		25.00	32.00	32.00	25.00	26.00	32.00	40.00	32.00
ratio of the hauling operation out of the collecting labour on grades of accessibility, %	G1	20.77	20.79	20.65	23.80	22.80	20.74	21.51	22.28
	G2	26.17	26.68	26.06	29.72	28.43	26.39	26.97	27.85
	G3	33.02	34.82	32.90	37.04	35.35	33.95	33.76	34.76
	G4	40.93	43.55	40.81	45.28	43.21	42.21	41.55	42.63
	G5	46.41	49.17	46.30	50.86	48.77	47.80	47.07	48.18
ratio of the hauling operation out of the total of labour on grades of accessibility, %	G1	4.79	5.94	5.02	5.79	4.54	4.96	4.50	4.71
	G2	6.37	8.05	6.68	7.68	6.01	6.67	5.97	6.24
	G3	8.64	11.39	9.06	10.38	8.09	9.30	8.05	8.41
	G4	11.74	15.65	12.29	14.01	10.91	12.71	10.89	11.35
	G5	14.25	18.87	14.91	16.92	13.29	15.44	13.26	13.81
ratio of the expenses necessary with diesel oil when hauling with forestry tractor out of the total of fuels, on grades of accessibility, %	G1	20.76	27.15	20.80	20.52	22.88	23.88	20.69	20.27
	G2	30.66	38.53	30.71	30.35	33.37	34.61	30.57	30.02
	G3	40.90	49.52	40.96	40.54	43.94	45.31	40.79	40.18
	G4	50.21	58.96	50.39	49.96	53.43	54.82	50.22	49.58
	G5	57.03	65.41	57.21	56.79	60.17	61.49	57.04	56.41
ratio of the expenses needed for the hauling with forestry tractor out of the total of expenses per felling area on grades of accessibility, %	G1	4.29	5.47	3.91	3.33	2.44	3.06	1.87	2.71
	G2	6.36	8.21	5.81	4.98	3.65	4.62	2.80	4.05
	G3	9.16	11.96	8.39	7.21	5.30	6.79	4.09	5.87
	G4	12.63	16.43	11.62	10.03	7.41	9.51	5.76	8.19
	G5	15.67	20.17	14.47	12.54	9.34	11.93	7.29	10.30

In Fig. 3 for each felling area the variation amplitude was determined between the maximum value (obtained from G5) and the minimum value (obtained from G1) for the 4 indicators (determined as ratios in %): labour costs when hauling/ labour costs when wood collecting, labour when hauling/total labour, expenditure on diesel/total fuel, costs when hauling/total expenses per felling area.

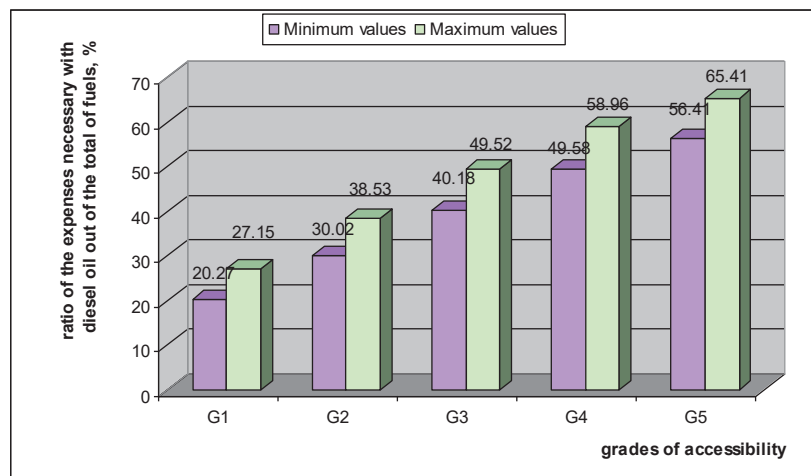


**Figure 3:** Representation of the percentage differences between G5 and G1 for the 8 analyzed felling area for the labour ratios when hauling, fuel and total expenses

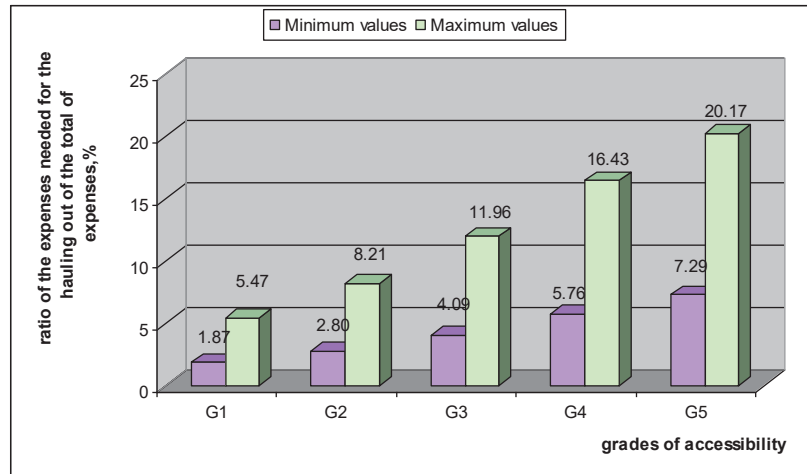
Analyzing the 8 lots, the minimum and maximum values on grades of accessibility for the calculated indicators were illustrated in Figures 4-6.



**Figure 4:** The ratio of labour when hauling from the labour when collecting, minimum and maximum values for all the 8 lots on grades of accessibility



**Figure 5:** The ratio of the hauling operation out of the total of labour, minimum and maximum values for all the 8 lots on grades of accessibility



**Figure 6:** The ratio of the expenses needed for the hauling with forest tractor out of the total of expenses per felling area, minimum and maximum values for all the 8 lots on grades of accessibility

### 3. Conclusions and Proposals.

Table 2 show the total operating expenses in the 5 situations when the felling areas would be classified in the five grades of accessibility. To be compared, the results were compared to the total volumes, resulting unit values in lei/cm. The gain that would be obtained according to the estimates would be 7.42 to 9.09 lei per each cubic meter exploited.

According to Table 3, the labour for the hauling operation with tractors has maximum value for the felling area P531, representing 50.86 % of the labour when collecting, and the minimum value is recorded for the felling area P530 and representing only 20.65 % of the labour when wood collecting. If a full accessibility (from G5 to G1) could be accomplished, the labour costs when collecting would be reduced by 25.65 % (for the felling area P204, P517 and P530) and with 28.37 % for P526 (see fig.3. Looking at Figure 3 it is noted that the biggest savings would be achievable for the fuel. Labour and the amount of fuel needed, relative to the total labour and the total expenditure for each felling area are reduced to approx. 5-15%, based on the volume average shaft; For high volumes(1.29 cm / tree P530) there are more significant reductions.

In conclusion, the analyzed felling areas are currently inaccessible, with average volumes of 0.21 to 1.29 cm /tree. A reduction in the accessibility grade could further cut the exploitation spending. Thus, the labour costs when collecting would be reduced by approx. 25 to 28%, total labour costs would be reduced with approx. 9-13%, the amount of diesel required for hauling with tractors would lower by approx. 36-38%, and the total spending would decrease by approx. 5-15%. To these expenses, there can be added those for maintenance, depreciation and other expenses (with personal indirectly productive) and indirect activities caused by a full functioning of machinery when collection, given by the long collection



distances leading to the increase of operation hours. A lot of time spent for the collection operation due to the long distances to be covered, reduces the number of routes that the tractor driver makes during one day, increase the number of machines so that the trader to fall in the operation period approved by the exploitation authorization (according to MO 1540/2011).

In the analyzed felling areas some tending-thinning works will be made this year. In general, it is recommended that the roads for hauling, if not sufficient, to be made since the time of thinning so that the felling area to be optimally covered. The failure in not making them in due time leads to the increase in spending both in the case of tending works and future cuttings, according to the proposed treatments. If at the level of felling area/plot/subplot the network of collection routes are very important, at the level of production unit/forestry district the proposed forest roads are very important to be achieved when planned and specified in the Forest Management Plans in Chapter 9 to achieve an optimal accessibility.

### **Bibliography**

Ciubotaru A., 1996 – Elemente de proiectare și organizare a exploatării pădurilor, Ediția a II-a. Editura Lux Libris, Brașov

Ciubotaru A, 1998 - Exploatarea pădurilor. Editura Lux Libris, Brașov

Florescu I. Ion, Nicolescu V. Norocel, 1998 - Silvicultura, Vol.I, II. Editura Univ. Transilvania, Brașov

Negrea A., 2014 - Terms of Trade Evolution, Causes and Effects. The Annals of the University of Oradea, Economic Sciences Tom XXIII 2 nd Issue

Oprea I., Sbera I., 2004 – Tehnologia exploatării lemnului. Editura Tridona, Oltenița  
HG 924/2015- Regulament de valorificare a masei lemnoase din fondul forestier proprietate publică.

Legea nr. 56/2010 - privind accesibilizarea fondului forestier național  
Ordinul 1540/2011 – Norme privind stabilirea termenelor, modalităților și perioadelor de exploatare a masei lemnoase din păduri și din vegetația forestieră din afara fondului forestier național