

ASSESSMENT OF INTENSITY OF EROSION AND NATURAL COVERAGE OF TRACTOR ROADS IN POST-EXPLOITATION PERIOD

Procjena intenziteta erozije i prirodnog obrastanja traktorskih puteva u posteksploatacionom periodu

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Abstract

Tractor roads are often, due to un-implementation of appropriate rehabilitation measures, exposed to erosion processes of various intensity. These processes can be particularly expressed upon completion of forest harvesting works if natural conditions also have such character which favors intensification of erosion process. Intensification of erosion processes on tractor roads in post-exploitation period most often occur in cases when surface water appears on ruts. More intensive coverage occurs in cases when tree crowns do not cover tractor roads, i.e. if larger opening (of forest crop) is in close vicinity of tractor road, which enables larger presence of light and more intensive vegetation growth. This document applies erosion process intensity degree method and assessment of degree of coverage or coverage by litter. For assessment we used a scale from 1 to 5 (REBULA, 1991). Erosion intensity degree on observed locations goes from 1,86 to 3,73. Coverage of tractor roads by grass vegetation or coverage by litter is in range from 4,91 to 1,86.

Key words: *tractor roads, post-exploitation period, erosion degree, natural coverage.*

INTRODUCTION - *Uvod*

Need for construction of dense network of tractor roads and skid roads is constantly present in modern forest management. Primary function of tractor roads and skid roads is in forest harvesting, i.e. in phases of oncoming and drawing-in of logs. Inability to access each individual cut tree by tractor conditions construction of relatively dense network of tractor roads and skid roads whose density could be even up to 200 m/ha (JELIČIĆ, 1988).

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The construction of tractor roads (similar as during construction of truck roads, but in significantly smaller volume) causes particular aggression on the environment. If this type of forest roads is built in accordance with generally accepted principles and rules, than these should not be considered as „alien items“ in forest ecosystem, and those represent one of the chain loops in proper forest management. Benefits from construction of tractor roads are larger than their negative impacts. However, this claim is justified only in cases when, during construction, all norms of forestry profession, and also the requests, which get more weight in a sense of environment protection, are completely respected.

Construction of tractor roads disturbs natural stability of surface soil layers. Also, very often it disturbs the very parent substrate whereby it opens space for initiation of erosion process action. During construction of tractor roads most often one more or less cuts the soil, whereby skid routes in longitudinal sense have significant elevation/slope, even up to 50 %. Tractor road construction technique is pretty simple, and does not require special works related to construction of driving route. Most often works include only wide excavation without formed cut-in slope, drainage objects (except recommended cross section slope of 3 – 5%, JELIČIĆ, 1985) and road construction, which with utilization of relatively large longitudinal slopes and usual appearance of surface water significantly increases a danger from appearance of erosion processes.

RULE BOOK ON VOLUME OF MEASURES ON ESTABLISHMENT AND MAINTENANCE OF FOREST ORDER AND IMPLEMENTATION MANNER (2002) in article 9. prescribes that upon completion of works on extraction of forest wood assortments from forest section, contractor is obliged to rehabilitate extraction skids, whereby this rule book does not prescribes the method of rehabilitation to be used. Although rule book defines obligation to rehabilitate tractor roads upon completion of harvesting, this in up-to-date practice is most often not applied, whereby danger of appearance of erosion processes in post-exploitation period is additionally intensified. Forest truck and tractor roads according to GRUSHECKY ET AL (2007) are the largest sources of sedimentation, and it is recommended to forestry profession to focus its research to this area.

In the period after exploitation of tractor roads and skid roads, the most significant role on erosion processes lies on natural factors which act in combination, whereby it is not possible simply to individually separate one factor from another and analyze it independently from one another. This claim lies in the fact that it is not simple to determine factors which in specific case dominate in relation to appearance of erosion process, particularly since none of the factors that can lead to erosion process on tractor roads acts independently; it is influenced by interaction of multiple factors (BAJRIĆ, 2012).

In practice we often see cases when tractor road natural coverage by vegetation cover or larger presence of litter has positive effect on appearance of erosion processes. By establishment of vegetation cover on tractor/skid roads which are exposed to erosion processes prevents sedimentation and washing out of nutritive substances (BROOKS ET AL, 2011). Vegetation cover has significant role in erosion control, specifically on tilted slopes (AKBARIMEHR, M., NAGHDI, R. 2012). Amount of

erosion depends on vegetation cover percentage. Vegetation cover can increase soil stability on more sloped terrain and during high intensity precipitation and prevents soil erosion (FU ET AL, 2010. BYBLYUK ET AL, 2010.).

During erosion process research one uses numerous methods for assessment of potential or actual/real danger from soil erosion. Most of used methods have more significant application for erosion risk assessment when agricultural land is in issue, considering that the one is exposed to significantly larger erosion process risk (lack of vegetation which has a crucial role in erosion process protection). All known methods for erosion danger assessment require relatively large number of entry parameters, based on which in most cases we get maps of potential or actual/real erosion danger. Mentioned methods mainly provide danger assessments for wider area and very often assessment does not coincides with situation on the field. Considering that in our case erosion processes are caused by human influence, i.e. works in forest done by man, it is necessary to use such data collection method which enables acquiring data for specific cases of tractor roads. To get quantitative indicators on erosion process intensity on tractor roads it is necessary to perform measurements throughout certain time period in order to be able, based on received measurement differences, to determine values of eroded soil (m³). With mentioned survey method, one can use one of the methods which treat specific status on tractor roads, as used in REBULA method (1991b), which will be used for this document as well.

RESEARCH OBJECTIVES AND TASKS – *Ciljevi i zadaci istraživanja*

Main objective of this research is, based on appropriate data gathering and processing methodology, to gain data on erosion process intensity for tractor roads of chosen locations, as well as intensity of natural coverage of tractor roads upon completed exploitation.

Through subject research we will try to determine how time period after forest exploitation work completion affects erosion processes on tractor roads, i.e. whether and under which conditions intensification of erosion processes will occur or there natural coverage will occur or appearance of litter, and which are the influence factors which influences these processes.

RESEARCH AREA – *Područje istraživanja*

For research area we have selected three locations within CFMC „Sarajevo šume“ – Sarajevo.

Narrow location of chosen sections is located at:

- MU „Vogošća – Buložić“, Section 9;
- MU „Gornja Rakitnica“, Section 28;
- MU „Igman“, Section 91.

Position of chosen research locations is presented in Photo 1.

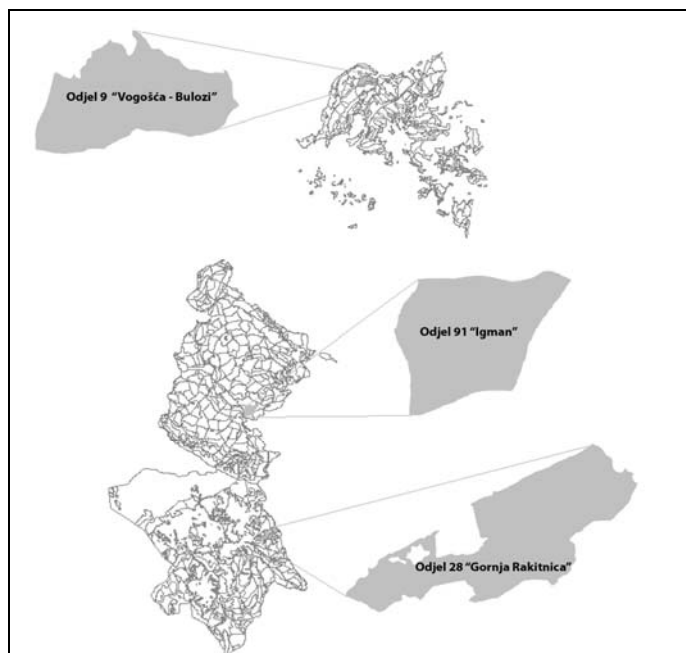


Photo 1. Spatial position of research locations
 Slika 1. Prostorni položaj istraživanih lokaliteta

WORK METHOD – Metod rada

On chosen research area we will conduct tractor roads, with various longitudinal slopes, status survey according to REBULA methodology (1991b). Assessment of erosion intensity according to this methodology is conducted on a basis of assessment scale (from 1 to 5) of each individual profile which results in average erosion intensity for observed section. Assessments are provided based on values presented in table 1, and erosion intensity is gained as weighted mean of individual values measured on all profiles.

Table 1. Data entry Manual on erosion and profile coverage degree
 Tabela 1. Manual za unos podataka o stepenu erozije i obraslosti profila

Profile ordinal number	Profile erosion intensity degree					Profile coverage degree				
	1	2	3	4	5	1	2	3	4	5

Codes mentioned in manual on erosion and coverage degree have following meanings:

Erosion intensity degree:

1. *No erosion. Erosion (taken-out material, washing out) is not noticed.*
2. *Small erosion. Ruts or tractor road areas are ribbed. Water ways (flutes/grooves, shallow grooves) barely noticeable.*
3. *Medium erosion. Water ways are designed on ruts, noticeable shallow dikes through which water runs.*
4. *Strong erosion. Furrows washed out, already turned into dike (water flow, flute/groove). Dikes are long, partially deep. In most cases everything washed out all the way to foundation.*
5. *Very strong erosion. Foundation is already so much washed out and reduced, maybe there will be no more split ruts, already everything is just one deep dike.*

Profile coverage degree:

1. *Whole profile is covered, or is covered in litter.*
2. *Good coverage. Profile covered over 60% or covered in litter.*
3. *Medium coverage. Profile covered up to a half (40 - 60%) or covered in litter.*
4. *Bad coverage. Profile covered below half of the area or covered in litter.*
5. *Not overgrown. Profile is bare.*

In order to get as clearer image of intensities of erosion processes as well as natural coverage of tractor roads, we will use data from tractor roads gathered in period from April to November in 2010 (around 18 months after completion of works on exploitation/harvesting), and new data gathered during May and June 2013. Mutually comparing gained results, and through statistics processing we shall determine dynamics in development of erosion on tractor roads and intensity of natural coverage.

In order to determine whether longitudinal slope has impact on intensity of erosion processes and natural coverage, on each of selected locations we shall place three experimental plots each, with different longitudinal slope (<10%, 10 – 20% and > 20%), with lengths of 110 m each. On chosen sections on each 5 meters along axis of tractor road we shall perform assessment of intensity of erosion and natural coverage according to given methodology. With mentioned data we shall record coverage of tractor roads with tree crowns (left and right from the road axis), determine exposition of the terrain (using application ArcGis 10.0 and DTM). Also, for each of the subjected tractor roads we shall record data whether, in the meantime, the one is used, i.e. was this road exploited since the last survey on it.

RESULTS AND DISCUSSION – *Rezultati i diskusija*

Erosion intensity on tractor roads - *Intenzitet erozije na traktorskim putevima*

As emphasized earlier, there are numerous methods used to assess danger from erosion processes on certain area or basin. However, those methods cannot provide specific (quantitative) indicators on intensity of erosion process, as it is the case in this research. One of rare methods that deal with assessment of erosion degree directly on tractor roads is used method according to Rebula (REBULA, 1991b).

Resulting values according to Rebula method indicate possibility of using this method in receiving reliable data on intensity of erosion processes. This method can only provide indicator which points out intensity of erosion processes, i.e. assessed value of intensity of erosion on tractor roads according to scale from 1 to 5 (1 – no erosion to 5 very strong erosion). In case one wants to gain precise data on quantities of taken-out, i.e. brought-in material on specific profiles, it is necessary to conduct specific measurements on profiles.

Table 2. Assessment of tractor road erosion degree according to Rebula method (first survey in year 2010)

Tabela 2. Ocjena stepena erozije traktorskih puteva prema metodi Rebula (prvi snimak 2010. godine)

Erosion degree	Location I			Location II			Location III		
	< 10%	10 – 20%	> 20%	< 10%	10 – 20%	> 20%	< 10%	10 – 20%	> 20%
1	0	0	1	0	0	0	0	0	0
2	1	0	9	15	19	14	17	18	13
3	15	9	12	7	3	8	5	4	9
4	6	13	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0
average	3,23	3,59	2,5	2,32	2,14	2,36	2,23	2,18	2,41

Table 3. Assessment of tractor road erosion degree according to REBULA method (control survey, 2013)

Tabela 3. Ocjena stepena erozije traktorskih puteva prema metodi REBULA (kontrolni snimak, 2013)

Erosion degree	Location I			Location II			Location III		
	< 10%	10 – 20%	> 20%	< 10%	10 – 20%	> 20%	< 10%	10 – 20%	> 20%
1	0	0	3	0	1	1	4	3	1
2	0	0	11	11	19	17	15	19	17
3	13	6	9	9	2	4	3	0	4
4	9	16	0	2	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0
average	3,41	3,73	2,09	2,59	2,05	2,14	1,95	1,86	2,00

Control survey indicates that in three out of nine cases in period between two control assessments of erosion intensity on tractor roads there was intensification of erosion processes.

Maximum value of erosion degree is recorded on Location I (10 – 20%) in amount of 3.73. Reason for intensification of erosion processes can be found in visible presence of surface water along ruts of tractor roads, whose presence has probably caused ruts to deepen, and thereby intensify erosion process. Appearance of water, as the reason for intensification of erosion processes, is mentioned in works of REBULA (1991a and b), TOMAŠIĆ (1998), BAJRIĆ (2012). Along mentioned reason, on Location II with slope of < 10%, with the presence of water, we recorded movement of tractor in period between two surveys which probably could be one of the causes of intensification of erosion processes.

If locations are observed as a whole, it is visible that the intensity of erosion processes is largest on Location I with flysch as parent substrate, and recorded appearance of water along ruts of tractor roads, average assessment is 3.08. The weakest intensity of erosion processes is on Location III (Igman) where limestone dominates with complete absence of surface water, where average assessment is 1.94.

During surface drainage/flow-off, large numbers of micro flows appear, which interconnect with one another. Concentrated surface water possesses significant erosion power, and causes ribbing of area it flows over, which creates furrow erosion (KOSTADINOV, 2008). In cases of untimely undertaking of appropriate measures and further concentration of surface water, causes next level of accelerated erosion to appear– dike erosion (JAHIĆ, 2008, KOSTADINOV, 2008.). Mentioned phases of development of water erosion happens on tractor roads in cases when rehabilitation measures are not done, where in some extreme cases tractor road can turn into flooding flow.

Negative action of surface water on tractor road is clearly presented on photo 2.



Photo 2. Impact of surface water on intensification of erosion processes (photo: BAJRIĆ, 2011.)

Slika 2. Uticaj površinske vode na intenziviranje erozionih procesa (foto: BAJRIĆ, 2011.)

Degree of natural coverage of tractor roads

Stepen prirodnog obrastanja traktorskih puteva

According to method which is very similar to assessment of erosion intensity on tractor roads, we performed assessment of degree of natural coverage or coverage of tractor roads by litter.

Table 4. Assessment of natural coverage of tractor roads according to Rebula method (first survey in 2010)

Tabela 4. Ocjena prirodne obrastlosti traktorskih puteva prema metodu Rebula (prvi snimak 2010. godine)

Degree of coverage	Location I			Location II			Location III		
	< 10%	10 – 20%	> 20%	< 10%	10 – 20%	> 20%	< 10%	10 – 20%	> 20%
1	0	0	0	0	2	0	2	0	0
2	0	0	0	0	9	0	12	13	4
3	0	0	4	0	8	6	6	4	6
4	0	9	13	0	3	11	2	5	8
5	22	13	5	22	0	5	0	0	4
Average	5	4,59	4,04	5	2,55	3,95	2,45	2,64	3,54

Table 5. Assessment of natural coverage of tractor roads according to Rebula method (control survey in 2013)

Tabela 5. Ocjena prirodne obrastlosti traktorskih puteva prema metodu Rebula (kontrolni snimak 2013. godine)

Degree of coverage	Location I			Location II			Location III		
	< 10%	10 – 20%	> 20%	< 10%	10 – 20%	> 20%	< 10%	10 – 20%	> 20%
1	0	0	0	0	9	4	6	8	3
2	0	0	6	0	12	13	13	12	13
3	0	1	8	1	1	3	3	2	4
4	2	9	8	2	0	2	0	0	2
5	20	12	0	19	0	0	0	0	0
Average	4,91	4,50	3,09	4,82	1,64	2,14	1,86	1,73	2,23

After first phase of measurements of natural coverage according to Rebula method, it is visible that coverage, if locations are observed as a whole, is largest on Igman, where limestone dominates, while coverage is smaller on Location I, with parent substrate flysch. Also, coverage on Location II (10 – 20%) has coverage value of 2.55 which influenced on almost complete stoppage of erosion processes regarding longitudinal transport of material, but also on side dispersal of material from cut-in section of tractor road which is also significantly covered in grass vegetation. Reason for faster coverage of tractor skids on Location III could be somewhat larger opening (of forest crop) in close vicinity of skid roads, which enables better illumination of skid roads themselves, i.e. direct exposure to

sunlight which precipitates grass growth. Besides mentioned, impact can also be made by somewhat better grass coverage in close vicinity to skid roads, and most likely grass seed by the power of wind found its way to skid roads, while smaller coverage of skid roads on Location I, could be explained by more intense erosion processes which disabled natural regeneration (impact of water flow per skid). Natural coverage and holding up of litter have important role in prevention of intensification of erosion processes on tractor roads (Photo 3).



Photo 3. Natural appearance of grass vegetation and litter in function of prevention of erosion processes on tractor roads (photo: BAJRIĆ, 2011)

Slika 3. Prirodna pojava travne vegetacije i stelje u funkciji sprječavanja erozionih procesa na traktorskim putevima (foto: BAJRIĆ, 2011)

Control measurement conducted in May and June 2013, indicates that on all tractor roads intensity of natural coverage is larger comparing to the first measurements. Smallest intensity of natural coverage is on locations I (< 10%) – 4.91, I (10 – 20%) – 4.50 and II (< 10%) – 4.82. Weaker intensity of coverage can be explained by more intense erosion processes caused by appearance of water as well as movement of tractor in period between two measurements on tractor roads.

As in first measurement (year 2010), natural coverage, if locations are observed as a whole, is largest on Location III (Igman) with average assessment of coverage of 1.94 where more significant increase in coverage of tractor road by grass vegetation has occurred. The smallest coverage (coverage or coverage by litter is smaller, as average assessment is higher) is in location I, with average assessment of coverage of 4.17.

Coverage by grass vegetation is more intense on sections of tractor roads where opening (of forest crop) is higher, i.e. on sections of tractor roads less covered by tree crowns. Coverage of tractor roads by litter is larger on sections which are more covered by tree crowns, this particularly relates to sections of tractor roads on locations II (10-20%), II (> 20%) and I (> 20%) with presence of broadleaved species (beech and oak).

Resulting values of coverage of tractor roads indicate that as time passes after exploitation, coverage intensifies, which has significant role in protection from erosion processes, which is in accordance with earlier research work (ПОТОЧНИК, 2010) on natural regeneration on slopes of forest truck roads. Similarly is claimed by LOTFALIAN AND BAHMANI (2011), which conclude that increase in coverage on tractor roads appears as time passes after those roads have been used.

CONCLUSIONS - *Zaključci*

After performed research on assessment of status of erosion processes and natural coverage on tractor roads throughout appropriate time period after exploitation/harvesting, we can make the following conclusions:

- Intensity of erosion processes in post-exploitation period on tractor roads is larger on those sections where surface water appears, which deepens ruts and intensifies erosion;
- Erosion processes are more intense on locations located on parent substrates susceptible to erosion (Location I – flysch), where in the case where as parent substrate we have limestone (Location – III) intensity of erosion processes is lower;
- When we observe natural coverage of tractor roads or their coverage by litter, in all cases when water did not appear on the surface, there was intensification of natural coverage;
- More intense natural regeneration appears in cases where tree crowns do not directly cover tractor road, which favors grass vegetation which requires presence of light for growth;
- Appearance of litter is registered when tree crowns cover tractor road in non-conifer forests, as it is a case on locations II (10-20%), II (> 20%) and I (> 20%) with broadleaved species (beech and oak).

REFERENCES - *Literatura*

- AKBARIMEHR, M., NAGHDI, R. (2012): Reducing erosion from forest roads and skid trails by anagement practices. *Journal of Forest Science*, 58: 165–169.
- BAJRIĆ, M. (2012): Razvoj erozionih procesa na traktorskim vlakama različitog uzdužnog nagiba, Šumarski fakultet Sarajevo, Disertacija, str. 1 – 163.
- BROOKS, R., MCFARLAND, A., SCHNEPF, C. (2011): Grass Seeding Forest Roads, Skid Trails, and Landings in the Inland Northwest, A Pacific Northwest Extension Publication.
- BYBLYUK N., STYRANIVSKY O., KORZHOV V., KUDRA V. (2010): Timber harvesting in the Ukrainian Carpathians: ecological problems and methods to solve them. *Journal of Forest Science*, 56: 333–340.

- CURRAN, M., DYKSTRA, P. (1997): Skid road rehabilitation techniques for restoring productivity in the B.C. interior, Proceedings of the 21st Annual British Columbia Mine Reclamation Symposium in Cranbrook, BC.
- FU B., NEWHAM L.TH., RAMOS-SCHARRON C.E. (2010): A review of surface erosion and sediment delivery models for unsealed road. Environmental Modeling and Software, 25: 1–14.
- GRUSHECKY, S. T., MCGILL, D. W., GRAFTON, W., EDWARDS, J., TAGER, L. (2007b): Vigorous Establishment of Native Vegetation on Landings and Skid Roads in the Upper Elk River Watershed, FINAL REPORT to West Virginia Division of Forestry State Headquarters.
- JAHIĆ, M. (2008): Uređivanje bijica, Šumarski fakultet Univerziteta u Sarajevu.
- JELIČIĆ, V. (1985): Pravilnik o uslovima i elementima za projektovanje i izgradnju šumskih puteva, Načrt – interni materijal, Šumarski fakultet Sarajevo.
- JELIČIĆ, V. (1988): Otvaranje šuma i savremeni transport drveta, Jugoslovenski poljoprivredno šumarski centar Beograd.
- KOSTADINOV, S. (2008): Bujični tokovi i erozija, Šumarski fakultet Univerziteta u Beogradu.
- LOTFALIAN, M., BAHMANI, H. (2011): Effects of Ground Based Skidding System on Soil Compaction and Herbaceous Species in a Hyrcanian Forest, European Journal of Scientific Research, Vol. 61 No.4, pp. 601-606.
- POTOČNIK, I. (2010): Natural revegetation of forest road slopes, Glasnik Šumarskog fakulteta Univerziteta u Banja Luci, br. 13, str. 49 – 60.
- PRAVILNIK O OBIMU MJERA O USPOSTAVLJANJU I ODRŽAVANJU ŠUMSKOG REDA I NAČIN NJIHOVOG PROVOĐENJA (2002): Službene novine Federacije BiH, 02/02.
- REBULA, E. (1991a): Posljedice gradnje vlakova u šumi, Zagreb, Mehanizacija šumarstva, god.16, br. 1-4, str. 3–10.
- REBULA, E. (1991b): Erozija na vlakah, Zbornik gozdarstva in lesarstva, 37, str.53-81.
- TOMAŠIĆ, Ž. (1998): Erozija tla na pokusnoj traktorskoj vlaci različitih uzdužnih nagiba, Zagreb, Mehanizacija šumarstva, god. 23(1), str. 15 – 24.

Sažetak

Erozioni procesi na traktorskim putevima su vrlo česta pojava. Stepennost intenziteta erozionih procesa zavisi od velikog broja prirodnih faktora, a vrlo često glavni uzročnik istih je čovjek. Ne provođenje mjera sanacije nakon završetka radova na eksploataciji šuma u značajnom broju slučajeva dovodi do intenziviranja erozionih procesa, što je posebno izraženo u slučajevima kada dolazi do pojave površinske vode koja produbljuje, razara i odnosi materijal sa traktorskog puta.

U radu je korišten metod procjene stepena erozije i obraslosti vegetacijom traktorskog puta ili prekrivenosti stjeljom (Rebula, 1991). Sama ocjenjena stepena erozije je izvršena na osnovu skale od 1 do 5 (1 – nema erozije do 5 – vrlo jaka erozija). Na sličan način je izvršena i procjena intenziteta prirodnog obrastanja ili

prekrivenosti steljom, pomoću skale gdje ocjena 1 predstavlja potpunu obraslost profila vegetacijom ili prekrivenosti steljom, dok ocjena 5 predstavlja neobrasao profil. Mjerenje je izvršeno na devet eksperimentalnih ploha dužine po 110 m, u dva navrata, i to 2010. i 2013. godine u periodu nakon završenih radova na eksploataciji šuma.

Maksimalna vrijednost stepena erozije zabilježena je na Lokalitetu I (10 – 20%) u iznosu od 3,73. Intenziviranje erozionih procesa se može vezati sa prisustvom površinske vode po kolotrazima traktorskih puteva, čije prisustvo je vjerovatno dovelo do produblivanja kolotruga, a samim tim i intenziviranju procesa erozije. Najmanja vrijednost evidentirana je na Lokalitetu III (10 – 20%) u iznosu od 1,86. Minimalna vrijednost stepena erozije se može pojasniti propusnošću matičnog supstrata (krečnjak) te potpuni izostanak površinskih tokova na ovom području.

Na istim lokalitetima (I i III) su zabilježene i najveće i najmanje prosječne vrijednosti stepena erozije, odnosno za Lokalitet I – 3,08 i Lokalitet III – 1,94.

Kada je u pitanju stepen obraslosti ili pokrivenosti traktorskog puta steljom, najveći stepen obraslosti je na Lokalitetu II (10 - 20%) - 1,64, što se može objasniti minimalnim brojem prolaza mehanizacijom, kao i većom progaljenošću u neposrednoj blizini traktorskog puta. Najmanja obraslost je na Lokalitetu I (< 10%) – 4,91, na kojem je intenzitet obrastanja niži zbog intenziviranja procesa erozije i stalnog prisustva vode na traktorskom putu.

Ako se posmatra prosječan intenzitet obrastanja ili pojave stelje, na traktorskom putu, isti je najveći na Lokalitetu III -1,94 gdje je došlo do značajnijeg porasta obraslosti traktorskih puteva travnom vegetacijom. Najmanju obraslost (obraslost ili prekrivenost steljom je manja što je prosječna ocjena veća) ima Lokalitet I, sa prosječnom ocjenom obraslosti 4,17.