SLOPE INFLUENCES ON VEGETATION RECONSTRUCTION IN THE FORMER BAUXITE QUARRY FROM ZECE HOTARE, ROMANIA

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Abstract

The paper is based on the reserches carried out during 2006-2008 in a former bauxite quarry from Padurea Craiului Mountain, North-Western Romania. The bauxite esploitation ended in 1998 and in 2004 and in 2005 the complex reconstruction works were made and the spruce trees were planted.[1] Five variant for herbs vegetation reconstruction on the hillside were studied: hillside with slope of 10%, 20%, 31% and 44% with mattresses and with slope of 44%, without mattresses.Tussilago farfara and Calamiagrostis epigios were determined only in the varinats with slope of 10%, 20% and 31% and mattresses in the first year of the researchers after 8 years of the exploitation end. In the 10th year after the bauxite exploitation end on the hillside with slope of 44% and mattresses two species appeared: Tussilago farfara and Calamagrotis epigeios. On the hillside without maltresses and slope of 44% the Tussilago farfara was determined only. The number of plants increased from year to other, other species appeared: Calamagrostis epigeios; Tussilago farfara, Fragaria vesca; Euphorbia cyparisias; Viola adorata; Taraxacum officinale; Polytrichum commune; Cirsium arvense The number of plants decreased with the increase of the slope and the link is very significant statistically.

Key words: slope, erosion, vegetation, former bauxite, quarry, mattresses

INTRODUCTION

Pădurea Craiului Mountains have an important bauxite reserve and there were a lot of quarries in the 2nd parte of the XX century. The aluminium low content of the bauxite and others reasons determined to close a most part of quarriess.

Vegetation and soil reconstruction in the former bauxite quarries is based on the complex system of works. One of the most important probllem for quarries hillsides is the erosion. Erosion is a natural process produced under the rainfall (or wind) influence and consists of soil, land or rock detaching, their transport and sedimentation in other places. (Brejea R., Domuța C, 2009)

The slope is very important in the erosion process from former bauxite hillside quarries; in comparasion with the slope of 20%; the land losses from the hillside with slope of 31% increased with 65,3%; on the hillside with slope of 44%, the land losses increased with 196, 2 %. The matresses build on the hillside with slope of 10% determined the land losses of 3,9

t/ha during 2005-2008 in comparasion with 100, 6 t/ha in the variant without mattresses. (Brejea R et all., 2011)

MATERIAL AND METHOD

The Pădurea Craiului Mountains are located in the North – Western Romania and the research field is situated in the former bauxite quarry from Zece Hotare. The exploitation of bauxite ended in 1998; in 2004 and in 2005 a complex works were made: setting up levelling planting of the accacia tree on the levelled area and of the spruce tree on the hillside. [4]

The trees were planted at a 1 m distance on the row and at 2 m distance between the row. The holes dimensions were 40 x 40 x 40 cm and 6,0 Kg of manure and 16,0 l of water were used for every hole. For prevention of the land erosion on the hillside of the quarry, the oak mattresses at 2 m distance were placed. The experiment was realized on the hillsides with slope of 10% , 20%, 31%, and 44% with mattresses and on the hillside with slope of 44% without mattresses. (Brejea R. et.all, 2008)

Covering degree of the natural vegatation was established by counting. The results were processed by variance analysis method.

The multiannual average of the rainfall in the Zece Hotare area is 620 mm. During the research period the annual rainfall were of 815,8 mm in 2006, of 872,0 mm in 2007 and of 585,2 mm in 2008. The biggest quantity of rainfall felt in 24 hours were registered in August all the years; 36,4 mm in 2006, 23,4 mm in 2007 and 25,6 mm in 2008.

RESULTS AND DISSCUSIONS

The determination of the herb natural vegetation on the hillsides was made in 2006, in 2007 and in April 2008.

The number of plants increased every year. In 2006, there were not the plants in the variants with slope of 44%. In the variant with slope of 10% there were 6 plants/m^2; in the variant with slope of 20% there were 4 plants/m^2 and 2 plants/m^2 there were in the variant with slope of 31%. In 2007, the number of plants increased with 133% in the variant with slope of 10%, with 150% in the variant with slope of 20%; in the variant with slope of 44% and mattresses, 2 plants/m^2 were determined and the plants did`nt appear in the variant with slope of 44% without mattresses. In comparasion with the research start year, 2008, the number of plants increased with 333% in the variant with slope of 10%, with 450% in the variant with slope of 20%, with 800% in the variant with slope of 31% , with 12000% in the variant with slope of 44% with mattresses; the plants appeared in the variant with slope of 44% without mattresses, too: 1 plant/m^2. (table 1)

Table 1

The total number of plants determined on the studied variants, Zece Hotare 2006-2008

Year	The slope variant									
	10%		20%		31%		44%		44% without mattresses	
	No. plants	%	No. plants	%	No. plants	%	No. plants	%	No. plants	%
2006	6	100	4	100	2	100	0,1	101	-	-
2007	14	233	10	250	6	300	2	4500	-	-
2008	26	433	22	550	18	900	13	13000	1	-
LSD 5%	1.2		2.1		1.7		1.6			
LSD1%	2.1		3.7		2.9		3.8			
LSD0.1%	4.7		6.1		5.3		6.9			

In 2006, only two species were determined in 3 studied variant: coltsfoot (*Tussilago farfora*) in the variants with 10%, 20% and 31% with mattrersses and commons small-read (*Calamagrostis epigeios*) in the variants with slope of 20% and of 31%. The number of plants decreased with the increase of the slope: 6 plants/m^2 in the variants with slope of 10%, with 33% smaller in the variant with slope of 20% and with 67% smaller in the variant with 31%. (table 2)

Table 2

The influence of the slope on the natural vegetation from the former bauxite quarry from Zece Hotare, Bihor 2006

The slope	Total			Species 1		Species 2		Species 3		Species 4		Species 5		Species 6		Species 7		Species 8	
	No pl /m^2	%	%	No pl /m^2	%	No pl /m^2	%	No pl /m^2	%	No pl /m^2	%	No pl /m^2	%	No pl /m^2	%	No pl /m^2	%	No pl /m^2	%
10%	6	100	100	-	-	6	100	-	-	-	-	-	-	-	-	-	-	-	-
20%	4	67	100	3	75	1	25	-	-	-	-	-	-	-	-	-	-	-	-
31%	2	33	100	1	50	1	50	-	-	-	-	-	-	-	-	-	-	-	-
44%	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
44% without mattresses	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Species 1: *Calamagrostis epigeios*; Species 2: *Tussilago farfara*, Species 3: *Fragaria vesca;* Species 4: *Euphorbia cyparisias;* Species 5: *Viola adorata*; Species 6: *Taraxacum officinale*; Species 7: *Polytrichum commune*; Species 8: *Cirsium arvense*

New species apeared in 2007 *Cirsium arvense* in the variant with slope of 10% only, *Taraxacum officinallis* and *Fragaria vesca* in the variant with slope of 20%, only, *Polytrichum commune i*n the variant with slope of 31% only. *Tussilago farfara* and *Calamagrostis epigeios* appeared in the variant with slope of 44% and mattresses; there were not the plants in the variant with slope of 44% and without mattresses. The biggest total number of plants were determined in the variant with the smallest slope (10%), 14 plants/m^2 in the variant with slope of 20% the number of plants decreased by 29%, in the variant with slope of 31% the number of plants decreased with 58% and in the variant with slope of 44% the number of plants decreased with 86% (tabel 3).

Table 3

The influence of the slope on the natural vegetation from the former bauxite quarry from Zece Hotare, Bihor 2007

The slope	Total			Species 1		Species 2		Species 3		Species 4		Species 5		Species 6		Species 7		Species 8	
	No pl /m^2	%	%	No pl /m^2	%	No pl /m^2	%	No pl /m^2	%	No pl /m^2	%	No pl /m^2	%	No pl /m^2	%	No pl /m^2	%	No pl /m^2	%
10%	14	100	100	3	21	10	71	-	-	-	-	-	-	-	-	-	-	1	8
20%	10	71	100	5	50	2	30	1	10	-	-	-	-	1	10	-	-	-	-
31%	6	42	100	4	66	1	16	-	-	-	-	-	-	-	-	1	17	-	-
44%	2	14	100	1	50	1	50	-	-	-	-	-	-	-	-	-	-	-	-
44% without mattresses	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Species 1: *Calamagrostis epigeios*; Species 2: *Tussilago farfara*, Species 3: *Fragaria vesca;* Species 4: *Euphorbia cyparisias;* Species 5: *Viola adorata*; Species 6: *Taraxacum officinale*; Species 7: *Polytrichum commune*; Species 8: *Cirsium arvense*

In 2008 after 10 years from the end of the bauxite exploatation, on the hillside with slope of 44% and without mattresses appeared the species *Tussilago farfara*, 1 plant/m^2. Other new species appeared *Euphorbia cyparisias* in the variants with slope of 20% only *Viola adorata* in the variants with slope of 20% and 31%. The biggest value of the total number of plants were determined in the variant with the slope of 10%, 26 plants/m^2. In the variant with slope of 20%, the number of plants decreased with 15%, with 31% in the variant with slope of 31%, with 50% in the variant with slope of 44% and mattresses and with 96% in the variant with slope of 44% and without mattresses (tabel 4).

Table 4

The influence of the slope on the natural vegetation from the former bauxite quarry from Zece Hotare, Bihor 2008

The slope	Total			Species 1		Species 2		Species 3		Species 4		Species 5		Species 6		Species 7		Species 8	
	No pl /m^2	%	%	No pl /m^2	%	No pl /m^2	%	No pl /m^2	%	No pl /m^2	%	No pl /m^2	%	No pl /m^2	%	No pl /m^2	%	No pl /m^2	%
10%	26	100	100	6	23	18	69	-	-	-	-	-	-	-	-	-	-	2	8
20%	22	85	100	13	59	4	18	1	5	1	5	1	5	1	4	-	-	1	4
31%	18	69	100	11	61	2	11	1	6	-	-	-	-	-	-	4	22	-	-
44%	13	50	100	7	54	2	15	-	-	-	-	-	-	-	-	4	31	-	-
44% without mattresses	1	4	100	-		1	100	-	-	-	-	-	-	-	-	-	-	-	-

Species 1: *Calamagrostis epigeios*; Species 2: *Tussilago farfara*, Species 3: *Fragaria vesca;* Species 4: *Euphorbia cyparisias;* Species 5: *Viola adorata*; Species 6: *Taraxacum officinale*; Species 7: *Polytrichum commune*; Species 8: *Cirsium arvense*

The biggest percentage in the total number of the plants determined in the studied variant is differentiated: *Calamagrostis epigeios* in the variant with slope of 20%, *Tussilago farfara* in the other variants.

There are an inverse link between the slope size and number of plants determined. The link is very significant statistically in all the years studied (fig.1, 2, 3)

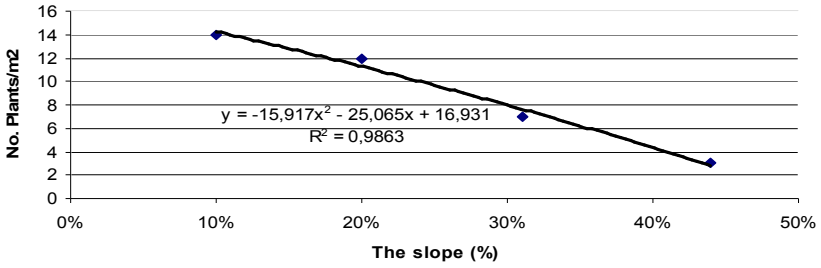

Fig.1 Correlation between hillside slope and vegetation, Zece Hotare, Romania, 2006

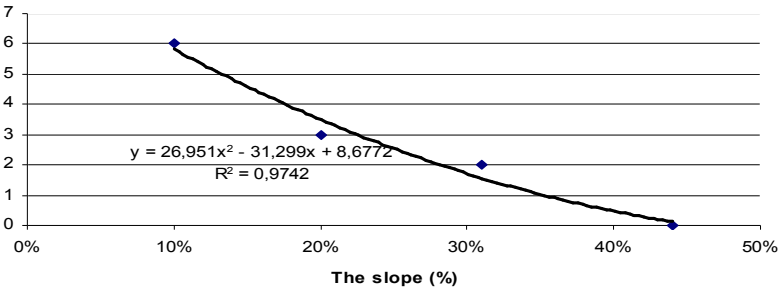

Fig.2 Correlation between hillside slope and vegetation, Zece Hotare, Romania, 2007

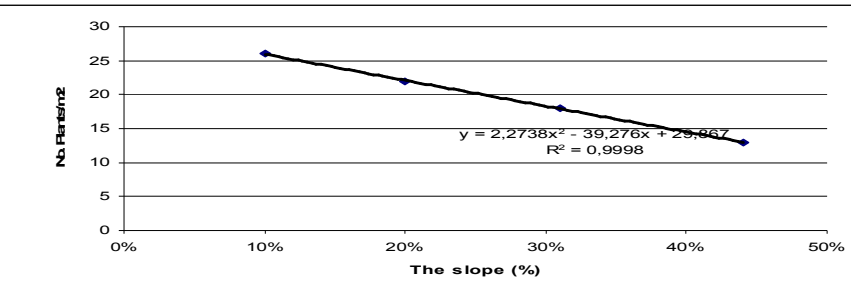

Fig. 3 Correlation between hillside slope and vegetation, Zece Hotare, Romania, 2008

CONCLUSIONS

The bauxite eploitation in the quarry from Zece Hotare Pădurea Craiului Mountain ended in 1998 and the researches carried out duiring 2006-2008 determined the following conclusions regarding the herb natural vegetation

Tussilago farfara and *Calamiagrostis epigios* were determined only in the varinats with slope of 10%, 20% and 31% and mattresses in the first year of the researchers after 8 years of the exploitation end.

In the 10^{th} year after the bauxite exploitation end on the hillside with slope of 44% and maltresses two species appeared: *Tussilago farfara* and *Calamagrotis epigeios*. On the hillside without maltresses and slope of 44% the *Tussilago farfara* was determined, only.

The number of plants increased from year to other, other species appeared: Calamagrostis epigeios; Tussilago farfara, Fragaria vesca; Euphorbia cyparisias; Viola adorata; Taraxacum officinale; Polytrichum commune; Cirsium arvense. The number of plants decreased with the increase of the slope and the link is very significant statistically.

The researches emphasize a process of natural vegetation reconstruction, new plants, species appeared every year. The need of the mattresses on the hillside of the former bauxite quarry is sustained too.

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