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WATER EROSION PROCESSES IN GEORGIA

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Abstract: *Georgia belongs to the countries, where the erosive processes are widespread and dangerous. According to the intensity of soil-erosive processes, the territory of Georgia can be divided into the 5 districts. In terms of the development of erosive processes, the situation is especially difficult in Upper Imereti, Adjara, Svaneti and other highlands of Georgia. On eroded lands the main damage to soil erosion brings agriculture. From the theoretical and applied points of view there are very interesting the changes in erosion factors associated with existing climate changes, as well as with technogenic impacts on components of the erosion geosystem. Qualitatively new opportunities in research, modeling and technologies to optimize the use of erosion dangerous lands are opened by modern geo-information systems (GIS) used in many spheres of human activity, but are not yet sufficiently used in erosion research.*

Key words: *water erosion; eroded lands; soil degradation; geo-information technologies.*

1. INTRODUCTION

Water erosion is one of the major environmental and economic problems that really determine the national security of many countries of the world.

According to the Global Assessment of Human-induced Soil Degradation (GLASOD) [1], conducted in 1988–1990 under the auspices of the United Nations Environment Program (UNEP), there were 1,093.7 million hectares of eroded soils in the world, that by a large margin brought water erosion to the first place among other sources of soil degradation (deflation, repackaging, salinisation, etc.). Deflation, which ranks second, accounted for 550 million hectares, or 28% of the total area of degraded soils. Thus, in total, the area of eroded and deflated soils was about 1.65 billion hectares. This is significantly more, than the previously mentioned areas of eroded and deflated

soils. Thus, in a number of works [2], it was noted, that out of approximately 1.5 billion hectares of arable land in the world, about 430 million hectares were eroded and deflated. It is likely, that a significant difference in these data is partly due to the imperfection of accounting for eroded soils at the early stage. However, there is no doubt, that the areas of eroded (and deflated) soils, in despite of the measures taken to warning and prevention this phenomenon, continue to increase. According to the Food and Agriculture Organization of the United Nations (FAO), the annual loss of productive land due to erosion is currently 5–7 million hectares.

According to the estimates of the specialists involved in the implementation of the GLASOD project (carried out under the auspices of UNEP), whose task was to assess the area of soils degraded by human activity, about 11 million km^2, or about 10% of the land free of ice from land mass of Earth is subject to water erosion [3]. From this eroded area of 9.2 million km^2 (920 million hectares), 1.7 million km^2 (173 million hectares) were destroyed by ravines [3].

According to the United Nations Environment Program (UNEP), it costs worldwide $ 9.8-10.4 billion per year.

Soil erosion is most intense in populous countries with developed agriculture. The global irrecoverable loss of soil under the action of erosion reaches 23 billion tons, of which the USA accounts for 1.5 billion tons, the countries of the former USSR - 2.3, India - 4.7, China - 3.3 billion tons [4].

2. THE BODY OF THE ARTICLE

Georgia belongs to the countries, where the erosive processes are widespread and dangerous. In mountainous regions of Georgia rarely finds a slope, that is not eroded and scarified with ravines. Intensive landslides and mudflows are observed.

One of the reasons for the increasing of erosion processes is the intensive agricultural usage steep slopes of mountainous areas. Usage for this purpose inappropriate agricultural techniques, instead of using these slopes, as cultural pastures, which would be much less dangerous for the development of erosion processes, started to grow corn, tobacco and other more profitable vegetable crops. Such an approach has caused great and irreparable damage to the land, where these events took place developed erosion processes, desertification, salinisation, withers, soil structural changes, reduction of humus content in the soil and accompanying processes.

According to the intensity of soil-erosive processes, the territory of Georgia can be divided into the following districts:

1. Landscapes of Colchis Lowland are characterized by weakly developed erosive processes, where lateral erosion prevails.
2. Landscapes of West Georgia, valley, hills and mountain pits are characterized mainly by chemical erosion processes with water erosion.
3. Landscapes of East Georgia, valley, hills and mountain pits are characterized mainly by chemical erosion, however, there are also water erosion processes.
4. The medium-sized landscapes are characterized mainly by linear erosion processes.
5. High mountain landscapes are characterized by surface washout intensive processes, with participation of deep erosion.

In terms of the development of erosive processes, the situation is especially difficult in Upper Imereti, Adjara, Svaneti and other highlands of Georgia. But we do not need to think, that erosive processes are developed in the only mountain regions. Erosive events have occurred even on the Colchis lowlands. Soil surface wash-out and ravine creating processes are particularly intensive and reaches dangerous scales in the mountainous parts of Georgia's wet subtropics and in hilly foot-hills of dry climate zones. It is estimated, that from the 10-20º slope hillside washing down 200-300 t / ha of soil per year. From the 20º slopes of the southern site of the Imereti Region, an average of 100 tons will be washed down, from 35º - slopes up to 150 t / ha and more in the year. Erosion traces observed almost everywhere on the steep slopes of the region. The depth of erosive gaps often reaches 0.5 m and more. In case of certain conditions, such gaps will gradually turn into ravines and canyons. Under the dry climate of the east Georgia, water erosion processes on the slopes without vegetation cover are more intense, than in other regions, as result of weak sustainability of the soils in the area of erosion. During the normal intensity rainfall in the region with 6-120º slopes, from 1 ha washed down an average of 30-40 t per year, while intense rains - up to 150-200 t.

Erosion in agricultural land is the most commonly in arable area.

54.1% of the arable land in Georgia is located on a slope with up to 2º, 22.5% - up to 2-5º, 14% - up to 5-10º, 6% - up to 10-15º, 3.4% - More than 15º slope.

The distribution of erosive areas according to separate administrative districts of Georgia is given in the chart 1.

Chart 1.

Distribution of erosive areas of Georgia According to administrative districts (thousand ha)

#	Districts	Arable entirely (A thousand hectares)	From here erosive		
			Weakly	Average	Strongly
1	2	3	4	5	6
1	Akhalkalaki	33.9	2.1	1.3	0.7
2	Ninotsminda	25.6	1.9	1.0	0.2
3	Akhaltsikhe	8.3	3.0	1.0	0.5
4	Adigeni	4.3	1.3	1.0	0.5
5	Aspindza	5.3	2.1	0.4	0.1
6	Khashuri	9.6	1.2	1.0	0.5
7	Kareli	14.1	4.3	0.8	0.4
8	Gori	20.0	3.4	2.5	0.2
9	Kaspi	10.9	3.0	1.9	0.2
10	Borjomi	3.6	0.8	1.0	0.5
11	Sagarejo	31.9	5.0	2.6	1.1
12	Gurjaani	11.8	3.6	3.7	0.9
13	Sighnaghi	37.2	6.3	3.0	0.5
14	Dedoplistzkaro	54.1	3.3	1.8	0.2
15	Telavi	7.2	2.6	0.5	0.2
16	Akhmeta	4.8	0.4	0.7	0.2
17	Kvareli	8.3	0.3	0.2	-
18	Lagodekhi	20.2	0.1	0.3	-
19	Gardabani	39.7	7.8	4.3	0.4
20	Mtskheta	10.9	2.7	1.7	0.3
21	Marneuli	26.9	4.5	2.1	0.5
22	Bolnisi	15.1	4.3	2.3	0.1
23	Tzalka	18.5	5.4	3.0	-
24	Dusheti	7.8	2.7	1.2	0.3
25	Tetritzkaro	19..	5.6	3.3	0.7
26	Dmanisi	8.8	2.8	0.6	0.1
27	Tianeti	12.3	4.1	2.1	0.3

28	Tskhinvali region	18.7	5.5	6.1	1.7
29	Completely east Georgia	486.4	80.1	51.1	11.5
30	Tzkaltubo city zone	12.5	2.2	0.6	0.1
31	Samtredia	10.3	0.3	1.0	-
32	Khoni	6.1	0.5	0.2	-
33	Vani	3.7	1.5	0.7	0.7
34	Baghdati	2.9	1.0	0.2	0.1
35	Zestaponi	3.9	1.3	1.1	0.7
36	Terjola	5.2	2.1	1.1	0.5
37	Tchiatur city zone	4.9	2.3	1.4	1.0
38	Sachkhere	6.0	2.1	1.1	0.8
39	Kharagauli	2.8	1.5	1.2	0.3
40	Tkibuli city zone	2.4	0.8	0.7	0.2
41	Oni	1.3	0.6	0.5	0.1
42	Abmrolauri	2.6	1.0	0.8	0.3
43	Tsageri	2.4	1.4	0.9	0.2
44	Lentekhi	1.3	0.6	0.5	0.2
45	Abasha	12.2	-	-	-
46	Tskhakaia	9.1	0.2	0.1	0.1
47	Martvili	6.1	0.3	0.2	0.1
48	Zugdidi	10.1	0.1	0.2	-
49	Khobi	12.2	-	-	-
50	Tsalenjikha	2.3	0.2	0.1	0.1
51	Chkhorotsku	3.7	0.3	0.3	0.2
52	Ozurgeti	5.0	0.8	0.2	-
53	Lanchkhuti	5.0	0.8	0.2	-
54	Chokhatauri	1.8	1.2	0.4	0.1
55	Mestia	0.9	0.3	0.5	-
56	Completely West Georgia regions	141.9	24.0	15.5	6.1
57	Apkhazeti	36.1	3.7	5.8	0.1
58	Adjara	8.8	2.7	2.5	0.1
59	Completely West Georgia	186.8	30.4	23.3	0.3
Completely in Georgia		673.2	110.5	74.4	20.8
Completely eroded		205.7			

On the eroded lands, due to washing away of the upper, most fertile soil layer, removal of humus and nutrients, deterioration of the physical properties of the soil, the yield of agricultural crops decreases. In this regard, the main damage to soil erosion does agriculture. In addition, the products of erosion destruction of soils, and along with them agrochemicals, nutrients, biological active substances, heavy metals, including radionuclides, entering the rivers, degrade the quality of water, cause eutrophication of water bodies, siltation of ponds, reservoirs and valleys of small rivers, which causes the complete disappearance of many of them. Due to the deterioration of the physical properties of the soil (an increasing density, decreasing of water retention and water absorption capacity), the intensity and frequency of floods on rivers increase and the soil cover dries. On eroded soils microbiological activity is also reduced.

Thus, soil erosion has a negative impact on almost all components of the landscape causing its degradation. The final and cumulative effects of soil erosion can lead to desertification [5].

3. CONCLUSION

Such a wide distribution and danger of manifestation of erosion processes, as well as the outlined tendency towards their intensification, make the problem of water erosion of soils increasingly relevant. It is necessary to intensify research on the erosion process itself, because despite the accumulated stock of theoretical knowledge and empirical material, the mathematical models of the slope erosion process used in anti-erosion design belong to the category of models with lumped parameters, or to profile models, that rather roughly take into account the main factors of the process. During the transition to adaptive-landscape and precision farming systems, significantly higher requirements are imposed on their justification, which is due to the need to take into account the complicated spatial differentiation of agro-landscape structures. From the theoretical and applied points of view there are very interesting the changes in erosion factors associated with existing climate changes, as well as with technogenic impacts on components of the erosion geosystem, first of all on the soil cover. Qualitatively new opportunities in research, modeling and technologies to optimize the use of erosion dangerous lands are opened by modern geo-information systems (GIS) and geo-information technologies, that are widely used in many spheres of human activity, but are not yet sufficiently used in erosion research.

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