

SEDIMENTS AS A PART OF THE SOIL PROTECTION LEGISLATION

SEDIMENTY AKO SÚČASŤ LEGISLATÍVY NA OCHRANU PÔDY

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I. Introduction

The word sediment is a special term for an expert practice. In general, the sediment could be seen as various material deposited on the bottom of the environs over sedimentation. Their official definition can be found in the Slovak Act no. 188/2003. Bottom sediments, according to the actual version of presented Act, are "sediments of hydraulic structures and watercourses originated by erosion from the soil". This formulation, however, does not cover the sediments in reservoirs originated by material sedimentation from industrial sources in the catchments, materials in the watercourses from municipalities or waste water treatment plants or sediments originated by internal processes in water units, e.g. by banks erosion or sedimentation of dead planktonic and other organisms.

Why we need the term sediment, when according to the definition in act it is in fact only removed soil – the soil removed by water erosion from the agricultural soil fund into the water bodies. According to this definition, it is only original soil from specific parcels, transported to other place. Why is then this soil, as a basic part of the environment – created by the atmosphere, water, rocks, organisms⁽¹⁾ – called sediment? Can we possibly this soil transported by natural processes⁽²⁾ compare and consider as somewhat similar to wastewater sludge? Wastewater sludge originates as a result of human activity. The soil is considered as a natural unit originated directly on the earth surface as a product of mutual influence of climatic con-

Abstract (EN)

The soil protection has a long tradition in Slovakia. Slovakia has a good and strict legislation on the soil protection. It also includes protection against erosion and degradation. However, there is a certain gap in the legislation in addressing the relationship between the lost soil and the land ownership. It is not clear how the land ownership is changed with soil particles movement along the slope, on which erosion occurs. Even more uncertainty regarding the land ownership occurs if the soil is transferred to the watercourses or water reservoirs, where the soil is transformed into sediments. On the European level, sediment management is not covered by specific regulations. The sediment management is partially addressed in several European directives directly or indirectly. The current legislation in Slovakia is creating economic and legal barriers to the return of the soil from the rivers and the reservoir to its original owners. The paper deals with the current state of explaining the problem with the soil erosion and sediment transport in relation to the valid legislation in Slovakia and the European Union. Legislation addressing the erosion and sediment is not just based on land ownership but also on principles for protection of the environment as the transfer of harmful substances to the soil or water.

Keywords (EN)

sediments transport, soil protection, erosion, landscape, soil ownership

Abstrakt (SK)

Ochrana pôdy má na Slovensku dlhú tradíciu a na ochranu pôdy existuje aj dobrá legislatíva. Jej súčasťou je aj ochrana pred eróziou a degradáciou. Určitá medzera v legislatíve však existuje pri riešení vzťahu vlastníctva pôdy a odnesenej pôdy. V legislatíve nie je jasne upravené, ako sa mení vlastníctvo pôdy pri jej pohybe po svahu, na ktorom je erózia. Ešte väčšia nejasnosť je v riešení vlastníctva pôdy po jej prenesení do vodných tokov alebo do vodných nádrží, keď sa z pôdy stávajú sedimenty. Na úrovni Európskej únie nie je hospodárenie so sedimentmi riadené špecifickou reguláciou. Čiastočne sa problém sedimentov rieši priamo alebo nepriamo v niekoľkých iných smerniciach. Súčasná legislatíva na Slovensku vytvára ekonomické a právne prekážky pri návrate pôdy z tokov a nádrží jej pôvodným majiteľom. Príspevok sa zaoberá súčasným stavom riešenia problematiky erózneho odnosu pôdy a sedimentov vo vzťahu k platnej legislatíve na Slovensku a v Európskej únii. Legislatíva riešiaci eróziu a sedimenty nevychádza z vlastníctva pôdy, ale z ochrany životného prostredia pred prenosom škodlivých látok do pôdy a vody.

Kľúčové slová (SK)

prenos sedimentov, ochrana pôdy, erózia, krajina, vlastníctvo pôdy

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ditions, organisms, man, relief and parent rock⁽³⁾. But legislation in the Slovak Republic has an Act – Act No. 188/2003 Coll. on the application of sludge and bottom sediments to soil, where the sediment and sewage sludge are considered as the same material for their application to the soil, the soil after erosion and the rests from treatment processes in the wastewater treatment plant. Naturally, there are different sediment properties in large rivers and dams, and in small watercourses and small water reservoirs. Legislation, however, does not distinguish this aspect of sediments. Sediments are basically inorganic parts of the soil, while sludge are organic substances – residues of microorganisms that have been eliminated from wastewater.

II. Soil water erosion and soil ownership

When applying the Act no. 220/201⁴, the erosion of the agricultural soil is characterized as the decrease of surface of the most fertile layer of agricultural soil, decrease of nutrients, humus and organic matter, reduction of microbiological life and loss of the soil functions. Further, the Act is dealing with restraining of this process by protecting the characteristics and functions of the agricultural soil, by sustainable maintenance and agricultural utilization and also by the protection of the agricultural soil area against the unauthorized change of soil on the property with uses for non-agricultural purposes.

The unauthorized soil change includes also the change of soil position and change of ownership. The soil particles, when moving and driving downhill, are changing not only position but also the ownership. Soil particles are transported from the first plot owner to the other owner and the whole process is repeated several times. The process ends when the soil particles reach a river or a reservoir. Soil particles turn into sediment particles. Soil owners turn into sediment owners.

The soil at the agricultural land plots has its owner and the Act No. 40/1964 Coll. Civil Code defines the ownership laws. According to the act, the relations, where soil is the object, are considered as ownership relations. Legislation handling the ownership is defined in the Second part of the Civil Code⁽⁴⁾, §123 and following. Each parcel, in the Slovak conditions, has its owner(s) registered in the Land Cadastre. This owner has, according to the Civil Code, together with other Acts, wide competencies, as it is presented in paragraph §126. According to this paragraph, the owner has the responsibility to protect the soil against a person, who without authorization, interferes to its ownership law; especially the owner can request to release the matter from person, who unlawfully retains it.

Transported soil from the registered owner gets on the land parcel of another owner until it finally reaches water bodies, where the soil is restrained, even marked by a changed term – sediment. This reality is conflicting with legislation about the ownership law protection.

Nature and landscape protection, according to the valid legislation, is the matter of state. State is an owner of all free grow-

ing plants, free living animals and their communities, natural biotopes, ecosystems, minerals, fossils, geological and geomorphological units, and it also cares about complexion and utilization of the country. The nature protection is implemented especially by limiting and regulating of interventions into the nature and the landscape, by supporting and cooperating with owners and users of the plots and also by the cooperation with the public administration bodies⁽⁵⁾.

When dealing with the protection of soil, as the basic part of the landscape, one should cooperate with the landowners or the owners of the soil transported by erosion in order to help them to keep and maintain their ownership. However, Slovak legislation states otherwise, as it is complexly based on unified approach to solve “waste treatment sludge and bottom sediments”.

In the Act No. 188/2003 Coll. there is a definition of the producer of bottom sediments as a natural person or legal entity performing bottom sediments production. As it was mentioned above, bottom sediments originate by erosion transport from the soil of registered owners and their deposition in the water units. Does it mean, that the person who subsequently releases them is their owner or he is the owner of the transported soil? Is the owner of water units the sediments owner? Slovak Water Management Enterprise Banská Štiavnica, State Forests Enterprise Banská Bystrica and other forest authorities are the owners of the majority of water units in our country. Bottom sediments are temporarily stored on their plots registered in the Cadastral books.

From the viewpoint of ownership, as it is stated in §126 of the Civil Code, the owner can claim to issue the matter from the person, who holds it unlawfully, but how it is then with the soil issuance temporarily held in the water units.

It is regulated by the Act No. 188/2003⁽⁶⁾ Coll. on application of waste treatment sludge and bottom sediments into the soil in §5 regulating the restriction of application of waste treatment sludge and bottom sediments. It is stated there, that only treated waste treatment sludge with minimum of 18% content of dry matter or bottom sediments with minimum 18% content of organic materials in dry matter can be applied on the agricultural soil. The owner cannot demand return of his soil in case that during the erosion transport, the organic and inorganic soil parts were separated and it was only the inorganic part from the eroded plot, which stayed in the stream and the organic part drained to other place. Furthermore, the rest of this deposited soil needs to be analysed in order to identify risk substances according to the Act annexes. Only an accredited laboratory can analyse the samples.

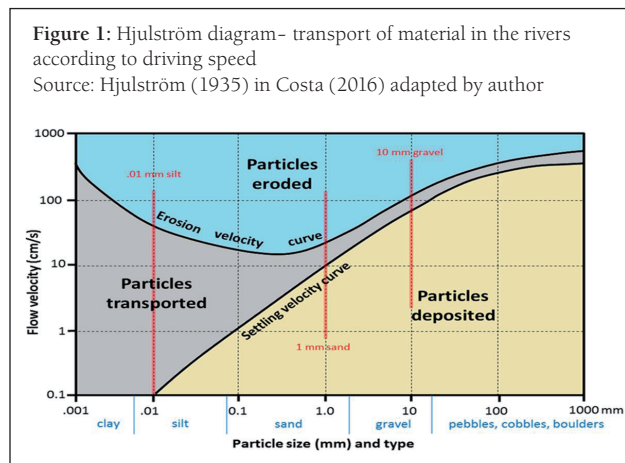
Essential deficiency of the actual definition of the bottom sediments is the awareness about the fact that the streams alone create their own sediments and that the stream has 3 areas. Upper stream is created by big slope; it is characterized by the erosion process and material transport. Middle stream is the place, where transported parts are partly deposited, but based on the slope, there are transported the parts from the upper stream and the water energy does not erode new parts

⁽³⁾ Act No. 220/2004 Coll. on the conservation and use of agricultural soil

⁽⁴⁾ Act No. 40/1964 Coll. Civil code

⁽⁵⁾ Act No. 543/2002 Coll. on the nature and landscape protection
Act No. 188/2003 Coll. on application of waste water sludge and bottom sediments into the soil and about completing of some acts in version of later direction

from the river-basin and banks. And finally, the lower part of the stream, where the materials created in the stream are deposited and assorted according to water speed (Figure 1). Firstly, the biggest parts are deposited and then smaller and smaller. Clay minerals are transported to the farthest place and they often flow to the stream.



The organisms living in water bodies naturally die and the transported parts of the bottom material are mixed with the organic matter of their dead biomass. These are natural processes of the stream, which are complemented by the transported material from the landscape - eroded soil - and their movement is then common. Definition of the sediment transport states, that it is a transport of grainy material of different greatness, not the transport of polluting materials. Only in anthropogenic landscape the materials in water are from urbanized territories or from territories with industrial activity and they accumulate in the sediments.

We should separate the sediments according to their place of origin and possibility of connection with other materials in water environment, for example lake's sediments, sediments of small water reservoirs, brooks, rivers and dams. It could be essential to create evaluation criterions for their possible treatment. Especially, we should restrain to move eroded sediments into the cities, where they are mixed with materials transported from industry and communities. Deposited materials caught in small streams and small water reservoirs, often with only natural character of catchment, without influence of the communities or production, are according to the act defined as sediments. Their identification should be changed to so called transported soil, as it is required by legislation to protect this soil against consequent pollution, and their returning to previous owner on previous plot should be secured. The protection starts by separation of this soil from the mix of heterogeneous materials on the bottom of the streams and reservoirs, which could be called contaminated sediments and especially from waste treatment sludge. European Union legislation regulates the application of waste treatment sludge on the agricultural soil, as it is important for preventing pollution by chemical substances. On the other hand, it does not cover soil protection in the landscape against the soil removed by heavy rains or wind into the water streams and reservoirs. Soil protection against the soil is not necessary, unless the soil is coming from areas damaged by human activity or chemical accidents.

II. Bottom sediments

The term "bottom sediments", in Slovakia, is connected with big rivers passing through important industrial centres. Different chemical materials are deposited in these rivers and reservoirs, since they were not removed due to the missing or insufficient wastewater treatment. Within this context, deposited chemical or synthetic organic materials, not the soil from erosion transport, are assessed. That is why in practice, there is used the term sediments of dams or big streams as a term for deposited gravels, sands, soil mineral materials and mix of dangerous materials polluting the environment or the materials endangering man, which got on the bottom of water units in process of deposition.

Nowadays, sediments evaluation is more important considering their practical water management consequences. However, in case of these sediments, their removal is almost negligible due to uncertain legislation, difficult and financially demanding way of their disposal and uncertainty with their ownership (Figure 2).

Figure 2: Reservoir filled by sediments.
Photo: Jurik, 2017



At the same time, the sediments of water streams and reservoirs, similarly as waste treatment sludge, offer an alternative for contribution of organic matter and nutrients into the agricultural and forest soils. From the legislative viewpoint, it is a question of erosion prevention and determination of real removed amount.

Direction No. 59/2013 Coll. of Ministry of Agriculture and Rural Development of the Slovak Republic, by which §27 of the Act No. 220/2004 Coll. on protection and utilization of the agricultural soil contents is executed, contains the tables stipulating limit values of removed soil for water erosion. Erosion of the agricultural soil is respectable unless it does not exceed determined amounts for different deep soil. Safe soil removal is very high. It is presented in the Table 1.

Based on the presented tables, it is possible to say that around 1 162 022 ha of the soil in Slovakia is endangered by erosion (Table 2). In case of the lowest removal, the assumed yearly removal into the streams or rivers is about 5 810 110 tons of the soil or in average 2 324 044 m³ of specific weight. Specific weight in evaluated soil samples is in interval 2,40 - 2,75 t·m⁻³.

Table 1: Limit values of the soil erosion in Slovakia

Soil depth	t/ha per year
Shallow soils (0,3 m)	5
Medium deep soils (0,3 - 0,6 m)	10
Deep soils (0,6 - 0,9 m)	15
Highly deep soils (over 0,9 m)	20

Source: Decree of the Ministry of Agriculture and RD of the SR No. 59/2013 Coll.

Table 2: Potential threat of the agricultural soils in Slovakia by water erosion

Category of erosion threat	Acreage in ha	% of agricultural soil fund
1 - no erosion to poor erosion	1 274 857	52,3
2 - medium erosion	217 487	9,0
3 - strong erosion	368 704	15,1
4 - extreme erosion	575 831	23,6

Source: Kobza et al. (2005)

It is possible that in the areas with strong or extreme erosion there is 7,5 million m³ of soil after erosion removal at territory of Slovakia.

As an example, we can state the measured values for the water reservoir Horné Kozmálovce⁽⁷⁾, where the volume of water reservoir is changed during the period of 10 years, from 3.230 mill. m³ to 1.883 mill. m³. It means that 13 470 000 m³ of material from soil in the catchment is deposited of the total catchment area 401 567 ha, what is about 3,3 tons from 1 ha of the catchment. It needs to be said that the agricultural area forms only 45% of the catchment and the other part is composed by the forest soil fund and built territories where the calculated soil erosion removal retain in the reservoir is about 7 m³ from 1 ha (17,5 t).

The literature presents also the term sediment delivery ratio (SDR)⁽⁸⁾ - the rate of transported sediment material, while for big catchment only a small part of eroded soil is deposited in the streams and reservoirs. The SDR expresses the rate of deposited material for calculation or measured erosion. It is about 0,1 of the catchment dimension over 1.000 km² and therefore, the real erosion is essentially higher as the theoretical assumptions. Assumed removed amount can be in tens of t/ha for given catchment. This can be confirmed or denied only by more extensive study.

III. Prevention of erosion transport and sediments origin

Agriculture and forest soil care is the prevention for sedimentation of removed material from catchment in water streams and reservoirs. To prevent the erosion, it is necessary to reconsider the present maintenance of the plots with arable soil through

⁽⁷⁾ Ivan et al. (2017)

⁽⁸⁾ Halaj (2010)

agrotechnics and to reconsider the size or shape of the plots. Contour ploughing is an example of typical recommendation stated in the literature. However, every day we are the victims of opposite practice - fall line maintenance. This practice is implemented due to increasing of economic benefits, by simplification of maintenance, but on the other hand, it reduces the soil depth and by that its price and production ability.

IV. Who, in fact, is threatened by the soil erosion?

According to the presented facts it harms mostly the water management staff. The reality, however, is much wider. At the first place, it is the soil owner who is affected, as the value of his plot is reduced. The legislation in our country protects the plot and its acreage, which in fact is not changed. Additionally, the thickness of the soil horizon is protected only indirectly, via erosion protection solution. In case of evaluation via soil ecologic units, it changes not only the soil profile thickness but also the main soil unit - black soil, haplic regosol or brown soils. This causes the change of plot price. Other people influenced by the erosion are the owners of plots situated lower, where the removed soil is transported temporarily or for long time period.

Further impact can be seen when it gets into the stream especially into the stream biota. Soft soil particles create water fogging and cover algae, microscopic plants and also benthonic organisms. It causes reduction of primary and secondary production in the stream or reservoirs. Every single river transports suspended and soluted particles as an important part of its flow regime. These particles tend to settle down on the river ground if the flow velocity is small (Fig. 3). Erosion by flow hydraulics is working the other way. When water flow velocity is higher, water is taking more particles from riverbanks and bottom of the river. Usually over the year sedimentation and erosion level each other out. But the sediments from suspended particles are changing position down in river.

As it was already mentioned, it causes also problems to the water management staff mainly due to the sedimentation of the streams and reservoir. Sediment content in reservoirs, especially in small water reservoirs, is today of high importance, but difficult to evaluate. In the past, during the existence of the State amelioration administration, in each water reservoir the deposits of fixed materials were periodically degreased. The time of the contact of soil parts with other materials was reduced and it was not problematic to return them on the territories affected by erosion.

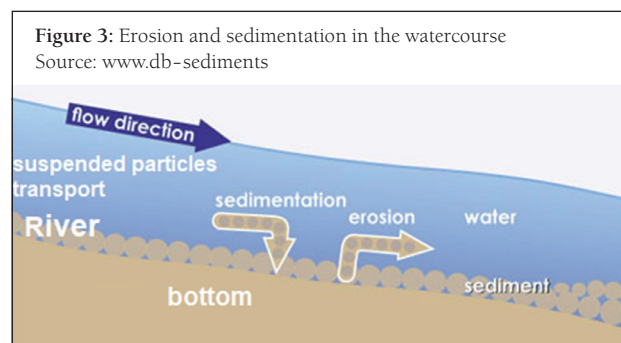


Figure 3: Erosion and sedimentation in the watercourse
Source: www.db-sediments

Table 3: Recommended sizes and dimensions of grounds or soil units on arable soil from the viewpoint of the erosion protection

Category of erosion threat	Category of slope	Ground length	Ground width	Ground area
1 - no erosion to poor erosion	0° - 3°	750 m	100 m	30 ha
2 - medium erosion	3° - 7°	550 m	250 m	10 - 20 ha
3 - strong erosion	7° - 12°	400 m	250 m	5 - 10 ha
4 - extreme erosion	over 12°	Delimitation into grass cover		

Source: Vilček (1999)

V. Solutions

The sediments have been transported in the landscape for millenniums. However, today's activities in the cultural landscape have accelerated them. Minimizing of these unfavourable influences can be considered as a solution. From a point of view of water streams, it lies for example in removal of erosion. Legislatively it is simple. Decree of the Ministry of Agriculture and Rural Development of the Slovak Republic No. 199/2008 Coll., which constitutes the Programme of Agricultural Activities in Declared Vulnerable Territories, divides Slovakia into three parts according to vulnerability or agricultural utilization⁽⁹⁾:

1. territories with the inclination up to 7°, where any regular agricultural production is possible,
2. territories with the inclination from 7° to 12°, where erosion measures are necessary in case of the agricultural activities on the soil,
3. territories with the inclination over 12°, where it is not possible to use the arable soil. It is the territory for long lasting grass cover, pastures (Table 3).

The role of soil protection against erosion on the slopes of agricultural land is currently taken up in the amendment to the Act No. 136/2000 Coll. on Fertilizers in the amended Article 10c. Article 15 of the Act deals with penalties for failure to comply with the conditions for the management in vulnerable areas. The amendment to the Act came into force in the year 2016.

Inspection of the soil maintenance is especially in form of grant provisions for cultivation of the field crops. In the application, an applicant has to identify the plot on the map. The map contains the evaluated soil ecological units, where it is possible to find out if it is an arable land, or if the farmer should describe the erosion measures. The information about the inclination and erosion measures are not required according to the published manual for grants - Direction of the Ministry of Agriculture and Rural Development of the Slovak Republic to governmental instruction of Slovakia No. 342/2014 Coll., which provides the regulations of grant support in agriculture in connection with the schemes of decoupled direct payments. Therefore, in conditions of Slovakia, it is not a problem if maize, sunflower or other root crops, which are cultivated also on the slopes with the inclination of more than 12°, where the arable land with paid state allocations should not be at all (Table 3).

In case there would be an inspection of support allocation according to the actual plots classification into the evaluated soil ecologic units⁽¹⁰⁾, the number of sludge after storm rainfalls

decreases on minimum, but also the sediments volume in the streams and reservoirs would be significantly reduced.

The second measure is to keep the width of the shore plots of the streams and reservoirs within the scope given by the Act on water, §49, which is 10 m for water management important streams and 5 m with vegetation for small streams. An important measure is also the creation of so called "buffer zones" - with slowing down of water flow and at the same time, the sedimentation of suspended solids and other materials, e.g. nutrients.

VII. Conclusion

The presented paper is oriented on the sediments, whose volume is essentially higher in water medium. Their transport has been happening through millions of years, while the problem of waste treatment sludge is, in our conditions, only 60 years old.

The soil of concrete owners became sediment on the parcels in state ownership; therefore, their liquidation is financed from the state budget. Consequently, it is necessary to pay attention to these owners, who with the objective to gain profit, are ready to risk losing their soil - the basic production factor. These losses are almost always irreclaimable.

Sediments are created at territories with agricultural use or in forested areas. But through erosion, water transport and gravity they are changing the location to other plots or to rivers and reservoirs. This is physical description of sediment transportation. But with the new location, the soil is changing also ownership. This alternative is not discussed and solved by the legislation or practical discussions. The problem of river sediments brings the possibility of different explanations, and also the advances for water units' protection, but especially the prevention in form of better and more purposeful erosion protection.

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⁽⁹⁾ Jurík, Paľšová (2012)

⁽¹⁰⁾ Džatko (1976)

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Legislation:

1. Act No. 220/2004 Coll., on the Conservation and Use of Agricultural Land, amending the Act No. 245/2003 Coll. on Integrated Pollution Prevention and Control, amending and supplementing of certain acts, as amended.
2. Act No. 140/2014 Coll. on Acquisition of Ownership of Agricultural Land and amending and supplementing certain laws.
3. Act No. 543/2002 Coll. on Nature and Landscape Protection.
4. Act No. 40/1964 Coll. Civil Code.
5. Act No. 136/2000 Coll. on Fertilizers.
6. Act No. 188/2003 Coll. on Application of the Waste Treatment Sludge and Bottom Sediments on the Soil.
7. Act No. 442/2002 Coll. on Public Water Pipe Systems and Public Sewage Systems, amending the Act No. 276/2001 Coll. on Regulation of Network Industries.

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