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ASSESSMENT OF ENVIRONMENTAL CONDITIONS WITHIN THE LIMIT OF THE RIPARIAN WATER PROTECTION STRIPS USING THE WEBGIS TECHNOLOGY

Abstract. The purpose of this research is the assessing of the current conditions of water protection strips in their role as an effective buffer that prevents water bodies from deteriorating due to the soil erosion and pollution. In the base of this study, the action plan is developing to improve the conditions of the water protection strips for the lakes. The approach is focused on the idea of an empirical study (based on observations and field measurements) of the environmental quality. An integral analysis of the territory of the protection strips is proposed, as well the processes and phenomena which are taking place within them, in order to obtain a clear picture of the state of the environment. In order to administrate, and to assure the visualization and transparency of this study the project blog on the "blogspot.com" platform was created with properly configured geographic interest patterns. Cartographic data were published on Google Maps and were integrated in blog. Thus, by accessing the blog, the views of the lake, the points of interest, with the necessary attributes for the spatial analyses. The preliminary results show the positive effects and high interest of the stakeholders concerning of WebGIS technology for the assessment of environmental conditions of water protection strips along the Costesti- Stinca reservoirs. Scientific novelty consists in the optimal combination of the blogspot application on the google maps by integration of spatial data with different software (QGIS, Mapinfo, ArcGIS) and geospatial database – PostGIS. The simplicity of this article, its visualization and monitoring. The practical significance is expressed by objective reflection of a type of activity that takes place in space, including environmental phenomena, vizualisation and monitoring of them.

Key words: water protection strips, monitoring,WebGIS technology, blogspot platform.

Introduction

This study presents the results of assessing the current conditions of water protection strips in their role as an effective buffer that prevents water bodies from deteriorating due to the soil erosion and pollution and action plans to improve the conditions of the water protection strips for the Costeşti-Stânca reservoir, located on the cross border of Prut river, located on the territory of the Republic of Moldova, carried out in close cooperation with the local and central decision-makers.

The study is necessary for the following considerations:

- It was not carried out during the construction and commissioning period (1978):
- There is no permanent monitoring system regarding the evolution of the protection zone,
- Various unfavorable phenomena are observed as well (erosion, pollution, chaotic anthropic use),
- Unclear relationships between local and central public authorities regarding physical limitation and the use of protection zone.
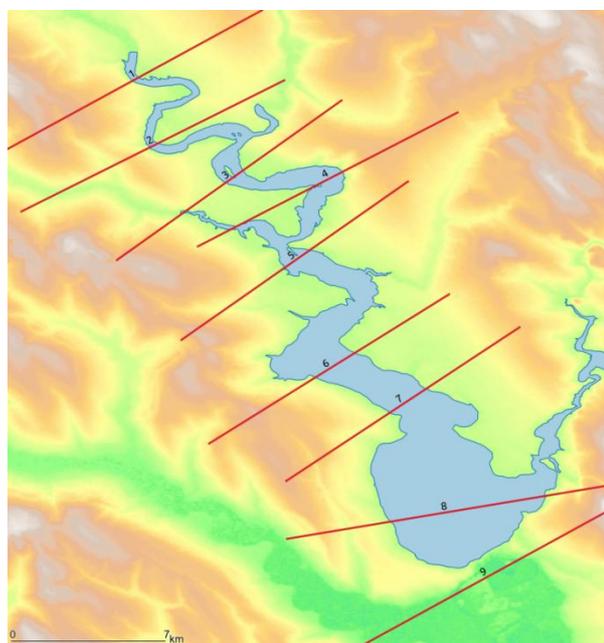
Fig. 1. Reservoir Costeşti-Stânca

The reservoir Costeşti-Stânca (Fig. 1) was arranged in 1978 on the Prut River, the filling of the lake took place from April 1978 until April 1979. The lake dam is 576 km from the mouth of Prut

river. The length of the lake is 60–90 km, the average width – 1 km, the average depth – 12.5 m (near the dam – 41.5 m), the volume – 735 mln. m^3 – 1.1 billion. m^3, with the area of the aquarium of 5–9 thousand ha, and the water catchment area – 12000 km^2. It ensures the seasonal regulation of Prut river run, especially in the mitigation of the floods, the river waters being used for the production of electric energy, for irrigation of land, for industry and for fish farming.

The Prut River is a cross-border river starting from the slopes of Mount Hoverla, 15 km southwest of Vorohta village, on the Carpathians Forest. The Prut River is the last important tributary of the The Danube, spilling 174 km from the mouth of the river. The length of the river is 967 km, the surface of the river basin is 27540 km^2, the total water fall is 1577 m, the average inclination – 1.63 % [Biali, & Popovici, 2000; Cerbari, 2010].

Purpose

In this study, we aim to elucidate the state of affairs regarding the processes of pollution and clogging of lakes. The process of polluting lakes can occur as a result of human activity, the main risks are the following [Grama, et al., 2016; Cerbari, 2010; Morariu, & Velcea, 1971; Cazac, et al., 2008]:

1. pollution with pathogens;
2. chemical pollution;
3. thermal pollution;

Coastal geomorphological risk processes include:

1. shore erosion;
2. clogging by deposition of sediment by sloping;
3. shore gravitational processes (surges, crashes, landslides).

Objectives of environmental status assessment to be achieved are:

- assessment of the fundamental properties of the environment: normal state, existing resources and services, variability, variation, change, relationships of interdependence between components and relations with the surrounding systems. Physical-geographic, hydrogeological, hydrological and bio-ecological parameters will be taken into account.

- highlighting of existing environmental quality problems and defects of the protection strips (eg existing/potential sources of pollution and sediment sources);
- developing proposals to improve the status of lakes protection strips so that they correspond to the functions for which they are envisaged (including the level of natural protection and self-sufficiency of water resources);
- to develop a monitoring system of environmental condition for the water protection strips on the basis of Web GIS technologies.

Methodology

Our approach is focused on the idea of an empirical study (based on observations and field measurements) on the environmental quality in the protection strips of the Costeşti-Stânca lake, so that the obtained results are also transferable to other spaces, processes or phenomena of the same type [Morariu, & Velcea, 1971; Sîrodoev, 2003]. We have proposed an integral analysis of the territory of the protection strips, the processes and phenomena taking place within them, in order to obtain a clear picture of the state of the environment. It is insisted on highlighting cause and effect relationships, while the study has benn both descriptive and relational (determining relations that were established between the components of peri-coastal ecosystems). The analysis of the state of the environment is focused on the current state of the protection strips, while trying to give the study and a temporal perspective, by trying to predict the evolution of the state of the environment under current conditions and under conditions of changing environmental factors.

The following steps have been envisaged in the study:

1. Study of cartographic and bibliographic materials;
2. Data collection in field conditions;
3. Processing and interpretation of collected data and developing GIS applications;
4. Developing proposals and finding solutions;
5. Suggestions for an monitoring system.

The environmental data collection has taken into account the target objectives and the availability of the information, and the approach scale has been selected in line with them. Thus, environmental data from the administrative flow, existing studies

and research, maps, photographs, satellite imagery etc. and were used data collected during the course of the study using an own methodology. The data collected is accompanied by metadata in order to be able to be properly processed. The collection of environmental data was done by measurements, sampling, analysis and interpretation of field samples, mapping, observation and questioning.

The study was based on legal issues, especially the Law no. 440 of 27.04.1995 "on the protection zones and strips of water of rivers and water basins" also regulates the water protection regime regarding the:

- Use of land in water protection areas;
- the limitation of economic activity in water protection areas and what is forbidden etc.

The subject of this study is represented by riparian strips of water protection of rivers and water basins as defined by Law no. 440 of 27.04.1995 (Fig. 2).
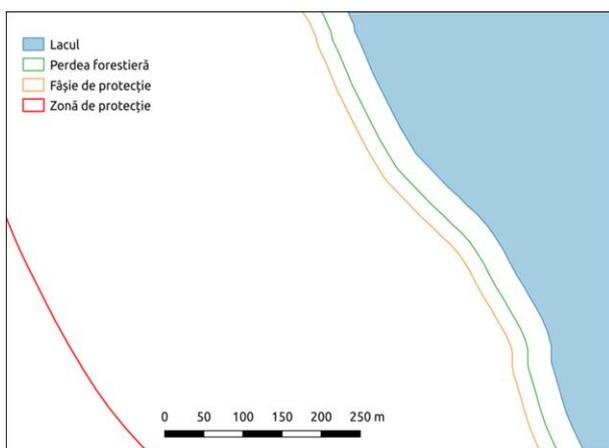

Fig. 2. Scheme for the delimitation
of protection zones, windbreaks

The technology which was used for interactive cartographic reflection is the Blogspot platform in combination with The Google Maps. Blogger is a platform that allows free blog publishing and the construction of websites with their own address. Blogger was launched on August 23, 1999 by Pyra Labs, which was bought in 2003 by Google. Blogger blogs and sites are hosted by Google.

Blogs that assigned a free internet address are integrated into the blogspot.com subdomain. Until 2010, Blogger allowed users to publish blogs and sites hosted on other servers through the File Transfer Protocol (FTP) system. Starting on May 1, 2010, all of this has been moved to Google's servers.

The Google Maps is an online service developed by the US company Google. It specializes in the online mapping of the earth globe and allows the maps viewing, satellite images with the Earth's surface and even the return of lost objects.The Google Maps special geocoding interprets the addresses in a country in the language of that country. This service is available for the United States, Canada and most European countries (including Romania). The service also allows you to mark a personalized journey for a particular journey. The route can be drawn freely between two locations, or automatically designed. An approximate travel time is also added. The route can be divided into several stages (also customizable). SEs can search for different destinations using the latitude and longitude of these (for example, accessing the coordinates of the Parliament Palace in Bucharest) – 44 25 39 N; 26 5 15 E [Grama, et al., 2016; Geodatabase POSTGIS http://www.postgis.org; QuantumGIS software http://www.qgis.org].

In order to familiarize the public with the results of the project, it was decided to use the blog format for publishing the results, events and maps of the project. The blog was created on the Blogspot platform at apelemoldovei.blogspot.com (Fig. 3).

The data mapping was performed using QuantumGIS software (Fig. 4), Mapinfo, ArcGIS, etc. These software allow advanced analysis of collected and existing data.

The significant progress of the qGIS [Grama, et al., 2016; Castraveţ, et al., 2013; Geoportal NSDI of Moldova, http://www.inds.gov.md/ geoportal_inds] software (an open-source software developed by the OGC community), which currently allows a wide range of operations to work with geospatial data and geospatial databases – PostGIS, is mentioned.

Created maps have been converted to KML and uploaded to Google Maps. Currently, Google Maps (Google Maps) has only simple features like:

- Publish maps on Google Map Cartography;

- Vectoring point, polyline, or polygon objects from Google Maps cartographic support and saving them in KML with the ability to enter text and photo description of the object;

- importing KML files. They allow you to load geodata / theme themes developed in desktop software in Google Maps. The maps themselves have been incorporated into the project blog. We can also download vector data in KMZ format, which can be used by Google Earth etc., from the project blog.

Fig. 3. Blog http://apelemoldovei.blogspot.com

Fig. 4. QGIS software interface, Lake Costesti- Stânca

Following the "Blogspot" technology on the http://apelemoldovei.blogspot.com platform, properly

configured geographic interest patterns can be created as well. Thus, by accessing the blog you can view the lake, the deck of interest, with the necessary attributes (Fig. 4).
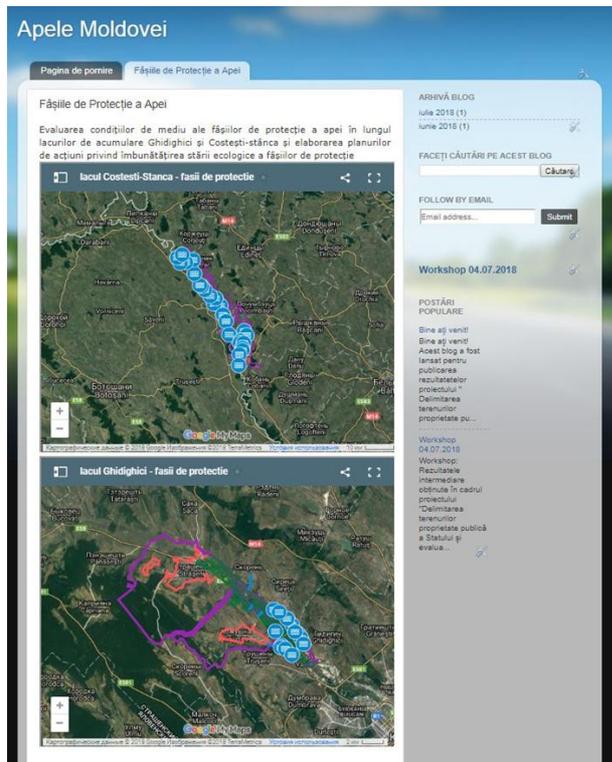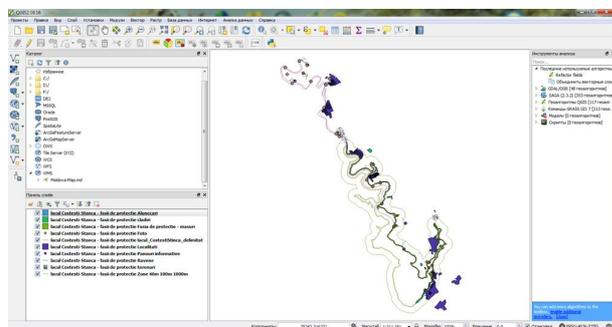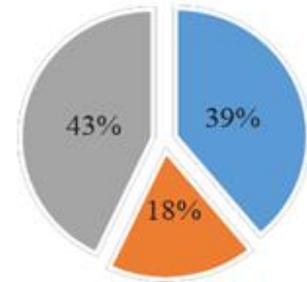

■ până la 100   ■ 101–1000   ▨ peste 1001

Fig. 5. Distribution of forest land according to the protection zone

Results
Finding out the situation

In order to evaluate the environmental conditions of the water protection strips along the Costesti-Left reservoir, the study is being focused on the analysis of the forest lands on a distance of 100 m, 101–1000 m, and over 1000 m from the surface of the water (Fig. 5).

In the case of the Costeşti-Stânca reservoir, 39 % of the forest lands are located 100 m from the water, 18 % – 101–1000 m and 43 % over 1000 m.

From a geomorphological point of view, the forests that constitute the riparian protection strips are mostly situated on the slopes with a configuration varying from wavy to kinked. Other topographic facilities are the high meadow and the low meadow [Morariu, & Velcea, 1971; Cazac, et al., 2008; Sîrodoev, 2003].

As a result of the site review of existing riparian protection strip, the length of about 11.5 km is located on the territory of Duruitoarea Nouă and Dumeni commune. The strip was created with the creation of the Costeşti-Stânca reservoir and is currently discontinuous in its length (Fig. 6). The species that constitute the protection strip are the Euro-American poplar, the willow and the sail. The willow have regenerated naturally over time. Natural grassland regenerations are also found in the meadows in the immediate vicinity of the coastal protection strip.

*Fig. 6. Protected coastline
in the Duruitoarea Noua village*

The water catchment area and the forests near the Costeşti-Stânca reservoir are composed of the following species: willow (SA – 36 %), acacia (SC – 24%), American maple (ARA – 12 % white poplar (PLA – 8 %), gray poplar (PLC – 7 %), tremulous poplar (PLT – 3%), tartar maple (AR – 2 %) and various hardwoods – 8 %). The distribution of the occupied area of the species is shown in Fig. 7. Of the above, it is noted that predominantly the following species predominate in the composition of the arboretums: the willow, the acacia and the American maple. The other species are in a smaller proportion.
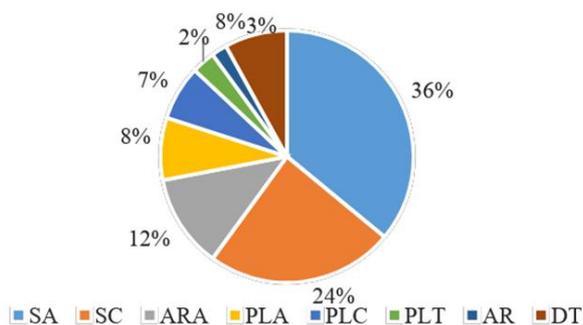

Fig. 7. Composition of river protection strips

The state of species vegetation on some sectors is currently satisfactory with a normal vitality. The consistency of the protection strip ranges from 0.3 to 1.0. On sectors with low consistency (up to 0.6) there is a need to intervene with works to regenerate it.

The age of Euro-American poplar is advanced in comparison with the age of technical exploitation. Thus, interventions are needed to regenerate coastal protection strips. The acceleration of the regeneration works of the riparian protection strip is also due to the shores of the banks due to the erosion caused by the waves and the weight of the trees (Fig. 8).

*Fig. 8. Degradation of shores due
to wave erosion and tree weight*

Describing the coastal protection strip as it is currently being constructed, there is a lack of consolidation band. Here it is necessary to intervene with bank consolidation works and, if necessary, to create the consolidation band.

Action Plan to improve the ecological status of the protective strips of Costesti-Stânca reservoir

Using the GIS mapping [References of Law number,…, 2016; Geoportal NSDI of Moldova, http://www.inds.gov.md/geoportal_inds] the localization of the actions on rehabilitation creation of protection strips was made (Fig. 9, Fig. 10) and location of solid waste landfills requiring action (Fig. 11).

Applying the blogspot technology, layers on the blog apelemoldovei.blogspot.com are configured such as:

- General data layers;
○ Buildings – the graphical information of buildings registered in the Real Property Register;
○ Land – the graphical information of the land registered in the Real Property Register;
○ Localities – the boundaries of localities in the Administrative-Territorial Units Register;

- o Commune – the boundaries of communes from the Register of Administrative-Territorial Units;
- • Layers with project data;
- o Informative panels – de facto location of informative panels with attached pictures;
- o Sliding – areas subject to landslides;
- o Ravens etc.
- o Areas – are windbreaks, protection strips and protection zones according to the normative framework in force [Hofer, et. al., 2009; Donisă, V., Donisă, I., 1998].

Figure 12 shows the location and picture (photos) of the information panel on the protection zone of Lake Costesti-Stinca.

Fig. 10. Localization of measures to strengthen the shores of reservoir
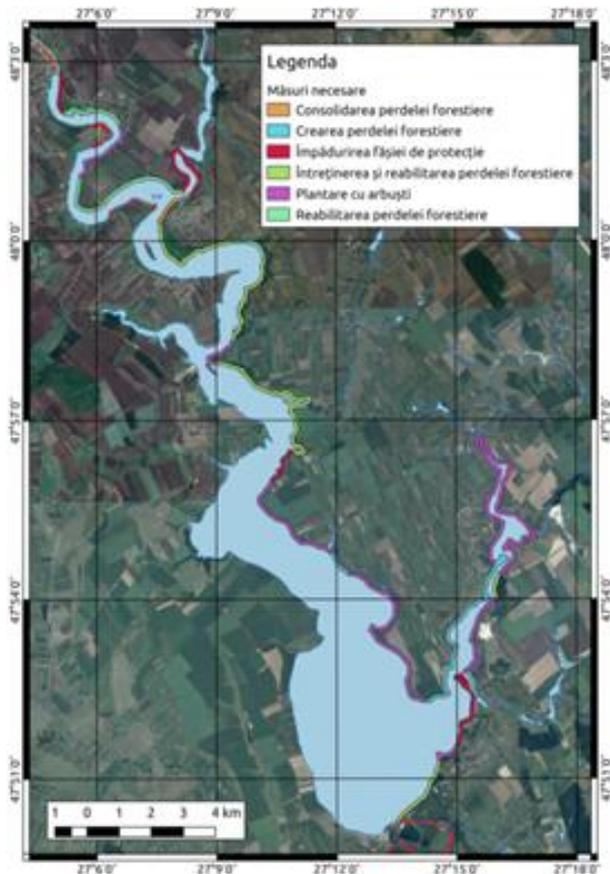
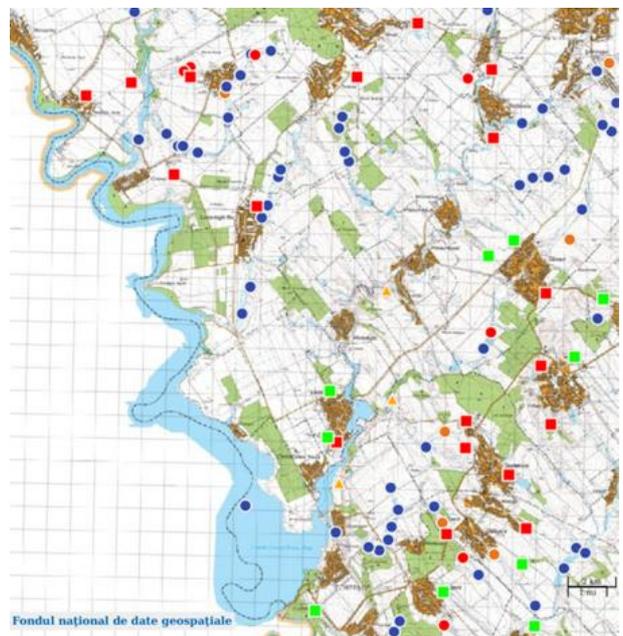Fig. 9. Localization of measures to improve the state of protection strips of Lake

Fig. 11. Localization of solid landfills in the vicinity of Costesti-Stânca Lake (green squares – authorized warehouses, red squares – unauthorized landfills)

*Fig. 12. Viewing the information panel
for the protection zone of Lake Costesti-Stinca*

Conclusions

It stands out the presence of the anthropic impact that is manifested especially through:

- The discharge of polluted water without treatment;
- The presence of unauthorized solid landfills;
- The protective strip is old and requires hygienic cuts and rejuvenation;
- The activity regarding the information campaign, including the installation of information panels is supported by the LPA, being aware of the mutual benefit;
- Blogspot advantages are expressed by free hosting, good Page Rank, achieved within months, easy to modify template, built from a single .xml + widgets, indexing your site within less than 24 hours of when it's created, Easy-to-use interface, customized website address using one of the international domains, such as.com; The Blogspot application, offers the possibility of simplicity and transparency in environmental activities, land relations, urban planning, agriculture, etc.

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ОЦІНКА УМОВ НАВКОЛИШНЬОГО СЕРЕДОВИЩА В МЕЖАХ ПРИБЕРЕЖНИХ ЗОН ОХОРОНИ ВОДИ З ВИКОРИСТАННЯМ ТЕХНОЛОГІЇ WEBGIS

Метою цього дослідження є оцінка сучасних умов водозахисних смуг в їх ролі як ефективного буфера, що запобігає погіршенню стану водойм внаслідок ерозії та забруднення ґрунту. На основі цього дослідження розробляється план дій щодо поліпшення умов водоохоронних смуг для озер. Підхід був зосереджений на ідеї емпіричного дослідження (на основі спостережень та польових вимірювань) якості навколишнього середовища. Запропоновано інтегральний аналіз території охоронних смуг, процесів та явищ, що відбуваються на них, з метою отримання чіткого уявлення про стан навколишнього середовища. З метою адміністрування та забезпечення візуалізації та прозорості цього дослідження, був створений блог проекту на платформі " blogspot.com" з правильно налаштованими географічними моделями інтересів. Картографічні дані були опубліковані на Картах Google та інтегровані в блог. Таким чином, отримуючи доступ до блогу, вид на озеро, визначні місця, з необхідними атрибутами, отримуємо доступ із можливістю просторового аналізу. Попередні результати показують позитивні ефекти та високий інтерес зацікавлених сторін щодо технології WebGIS для оцінки екологічних умов водозахисних смуг вздовж водосховищ Костешті-Стінка. Наукова новизна полягає в оптимальному поєднанні програми blogspot на картах GOOGLE шляхом інтеграції просторових даних з різним програмним забезпеченням (QGIS, Mapinfo, ArcGIS) та геопросторовою базою даних PostGIS. Простота публікації, візуалізація та моніторинг.

Ключові слова: водозахисні смуги, моніторинг, технологія WebGIS, платформа blogspot.