An assessment of the water footprint of the population and agricultural crops in the Natura 2000 site ROSCI0434 Siretul Mijlociu, Romania

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Keywords: water footprint, Natura 2000, aquatic habitat, conservation.
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Introduction

Water is the vital and reference natural resource for the quality of life of mankind, the sustainability and productivity of terrestrial ecosystems, being at the same time the habitat of aquatic ecosystems.

Beyond the indisputable economic value, the importance of water in maintaining the ecological balance must be taken into account, especially in this period of increasing climate change.

According to EUROSTAT data, Romania ranks 3rd in Europe, with an assessed quantity of 7389 million cubic meters of fresh surface and groundwater and data from the National Institute of Statistics (NIS), 70% of the country's population is connected to a public water supply system.

An important role in maintaining the ecological, social and economic value of water and aquatic resources is played by protected natural areas. In Romania, according to the NIS, there is an area of 1,108,880 ha occupied only by wetlands of international importance - RAMSAR sites (including the Danube Delta Biosphere) to which are added sites of community importance and special avifaunistic protection areas integrated in the European ecological network Natura 2000 located on watercourses, natural or artificial lakes, peatlands.

The paper proposes an assessment of the water footprint of the population and agricultural crops in the natural protected area integrated into the European ecological network Natura 2000, respectively ROSCI0434 Siretul Mijlociu.

We note that this material is only a part of a comprehensive study.

The site ROSCI0434 Siretul Mijlociu is located in the Siret hydrographic basin, the largest basin in Romania, which collect approx. 17% of the volume of water resources on the territory of Romania, tributary of the Danube and occupies an area of 2,969 ha. Of the nine types of ecosystems identified in Romania by Bodescu et al, within the MAES process in Romania, five of them are present in the study area. The existing habitat classes in the site are: rivers, lakes 43.04% (approx. 1,278 ha), swamps, peatlands, 21.91% (approx. 650.5 ha), crops (arable land), 10.50% (approx. 298.4 ha), pastures 18.68% (approx. 554.6 ha), deciduous forests 18.68% (approx. 554.6 ha) and is located on the surface of seven territorial-administrative rural units, with predominantly agricultural activities. For an efficient management of water and aquatic resources to support the establishment of effective management measures for a favourable state of conservation of species and habitats in the natural area, an ecological indicator can be the water footprint calculated for this area.

The water footprint concept was introduced by Hoekstra in 2002 (Hoekstra, 2003) and takes into account both direct and indirect water consumption (embedded in the product life cycle). The concept has three components: blue water (water from surface and underground water bodies); green water (water from precipitation, part of which is lost through evapotranspiration, and part of which is taken over by vegetation); gray water (water required for diluting pollutants from industry, household waste water, polluted water from agriculture, etc.).

Methods and materials

The water footprint of the population in the study area refers to the sum of direct and indirect freshwater use. Direct water use is the water used at home, while indirect water use refers to the total volume of fresh water that is used to produce the goods and services.

To calculate the water footprint of both communities and agricultural crops in the Natura 2000 site, ROSCI0434 Siretul Mijlociu, was used the methodology developed by Hoekstra et al. (2008, 2009, 2011), starting from the data taken from: the National Institute of Statistics, the National Meteorological Administration, the SIRET Bacău Water Basin Administration. A comparative analysis of the water footprint at the level of 1992 with that of 2022 was carried out.

Results &Discussions

The population of the seven rural communities in the period 1992-2022 increased (notable fact if we take into account the decreasing trend of the population at the national level) from 35,545 people to 36,694 people.

Water supply in a centralized system is provided only for 26.85% (at the level of 2022) of the population and of these 70.20% benefit from a sewage and treatment network.

At the level of 1992, only 19% of the population benefited from drinking water supply and there was no sewerage network and domestic wastewater treatment plant.

This fact is reflected in the percentage of gray water in the total water footprint. (Figure 2)

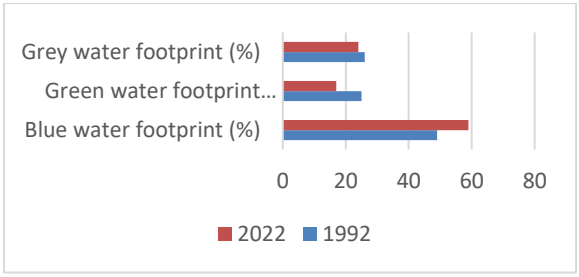

Figure 2. Water footprint, by category, of the human community

It should be specified that, at the level of 1992, runoff from household manure reached the phreatic and the surface water course (Siret River), a fact that was remedied by 2022 due to the conditions imposed by the legislation on the protection of water bodies at nitrate pollution. Also, the meteorological drought of 2022 reduced the green water footprint. Regarding the water footprint for agricultural production, its calculation took into account the fact that there are currently no irrigation systems in the study area. (*Figure 3)*

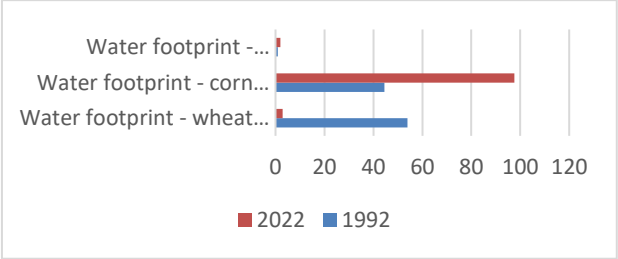

Figure 3. Crop water footprint relative to production

Conclusions

The Natura 2000 site ROSCI0434 Siretul Mijlociu is mainly located in a wet area, along the course of the Siret River and Galbeni Lake. The reason for the designation as a site of community importance was also for the presence of riparian habitats of conservation interest (92A0 Salix alba and Populus alba galleries), of some fish species : *Aspius aspius* (Linnaeus, 1758), *Barbus meridionalis all others* (Risso, 1827), *Cobitis taenia complex* (Linnaeus, 175), *Romanogobio kesslerii*, (Dybowski, 1862), *Sabanejewia balcanica* (De Filippi, 1863), but also of a mammal species, *Lutra lutra* (Linnaeus, 1758) and a species of reptile, *Emys orbicularis* (Linnaeus, 1758) both dependent on the presence of water. It is also an area in the migration path of many species of aquatic birds: ardeids (*Ardeola ralloides, Egretta garzetta, Ardea purpurea*), threskiornithids (*Plegadis falcinellus, Platalea leucorodia*), anatids (*Cygnus olor, Anser anser, Anas querquedula, Anas clypeata, Aythya ferina, Aythya nyroca*), etc.Therefore, the quality and quantity of water stored in surface and underground water bodies, the amount of precipitation are very important for maintaining a favourable state of conservation of these valuable habitats and species, and any input of pollutants can negatively influence their condition.

As seen in Figure 1, the water footprint for domestic users has a higher blue water component in 2022 compared to 1992; this fact is due both to the increase in the number of the population connected to centralized water networks and to the increase in water consumption due to the modernization of the rural area through the use of washing machines, the construction of bathrooms in houses, even if the water supply is made from own wells. In 1992, when the irrigation system still existed, the green water footprint was higher than in 2022. Also, the meteorological drought of 2022 reduced the green water footprint. However, the grey water footprint remains high, due to the increased volume of domestic wastewater from households. It should be specified that, at the level of 1992, runoff from household manure reached the phreatic and the surface water course (Siret River), a fact that was remedied by 2022 due to the conditions imposed by the legislation on the protection of water bodies at nitrate pollution.

Regarding the agricultural crops taken into analysis, although sunflower crops have the highest water consumption, their water footprint is very small due to the small areas and production, continuously decreasing after 1992, a fact also due to the dependence of this crop by weather conditions.

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