Application of the Water Footprint Concept for Quantification of Water-related Ecosystem Services

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The quantification of water-related Ecosystem Services (ES) is a difficult task, since water is integrated in the human-environmental system in a very complex manner. The provisioning, regulating and cultural ES related to water contributing to human well-being, are diverse and we are highly dependent on them. This dependence is often related to the service quantity, especially in the case of provisioning and regulating services. Therefore, the precise quantification of ES plays an important role in environmental management in order to create and maintain a sustainable service supply. Furthermore, it is important to know how existing management practices influence the services quantities.

Scientists and practitioners have been working on the development of quantitative ecological approaches for many years. Still, those approaches have rarely been applied for ES quantification. One approach is the Water Footprint (WF), which provides a methodology for quantitative assessments of water amounts needed for a certain product, used by consumers, business sector, a nation or geographic area. The WF considers not only the used water but also the resulting polluted water.

In this study, we apply the WF concept for the quantification of two ES: freshwater provision and water purification. Both services are quantified for the case study area of the upper Ogosta river

watershed in northwest Bulgaria. For the quantification of the freshwater provisioning service, the *blue* and *green* WF are calculated, representing the freshwater in the watershed used by humans and the environment. The SWAT hydrological model is applied to estimate the actual evapotranspiration in the watershed. For the regulating service water purification, the *grey* WF is used. It indicates the volume of freshwater needed to dilute the present contamination of trace elements in the floodplain. The ability of the watershed to supply these quantities of water is estimated based on the runoff results from the SWAT model using data for the period 2000-2005. Additional data from previous studies and statistical data are used to set up the full analyses.

The results show the supply quantities of the two analyzed ES for each land cover class present in the case study area. Furthermore, an ES matrix-based mapping approach is applied in order to map areas of low and high supply in a relative scale from 0 to 5. The resulting maps represent the spatial distribution of ES supply. The presented approach can supplement the activities related to Action 5 of the European Commission's Biodiversity Strategy 2020.