

## **EVALUATION OF THE WATER USE IN COMPARISON TO THE SURFACE WATER RESOURCES FOR SELECTED PERIOD BASED ON THE RESULTS OF WATER RESOURCE BALANCE (WRB)**

**Lubica Lovásová, Katarína Melová, Zuzana Danáčová, Lotta Blaškovičová**

Slovak Hydrometeorological Institute, Jeséniova 17, 833 15 Bratislava, **Slovak Republic**

*Corresponding author: Dr. Melová Katarína, Slovak Hydrometeorological Institute, Jeséniova  
17, 833 15 Bratislava, Slovak Republic, katarina.melova@shmu.sk*

### **ABSTRACT**

Harmonization of water requirements with water resources is a key prerequisite for a rational use of water resources. It is therefore very important to identify water resources in terms of quantity, quality, time and space, as well as to assess their use in terms of water needs.

**Keywords:** water resource balance, runoff, water use (abstraction and discharge)

### **1. INTRODUCTION**

In the document called “Water resources balance of surface water for the previous year”, we assess the quantitative relationship between water resources and water demand annually in the water resource balance in Slovakia. Also we determine when and where the water resources do not cover the water needs.

### **2. THE WATER RESOURCE BALANCE**

The water resource balance in Slovakia is used as a basis for water management planning since 1973. After the implementation of the WFD into the national legislation, the methodology of water resource balance has been modified in this context as well and it has been used as a basis for quantitative assessment of water resources. Water resource balance is done on annual basis, and evaluates the previous calendar year. The processing is done in monthly step spatially for the whole territory of Slovakia.

For the evaluation of the water resource balance a specific method is used. The method allows to assess the detailed surface water use with calculated influence of groundwater use.

Water requirements are represented by the actual consumption of surface and groundwater and discharging of wastewater and special water, which are derived in accordance with § 20 and § 22 of Decree No. MPŽPaRR SR. 418/2010 Coll. on the implementation of certain provisions of the Water Act.

Among the water management measures in the water resource balance, we assess the impact of dams and water transfer.

In the water resource balance equation on the side of water sources, there are discharges in rivers, precipitation totals and inflows from countries situated at upstream of river basins (in case of Danube River it represents an important part). It makes a significant

difference in calculations if we assume the own country water sources or we calculate with the inflow from neighboring countries as well.

The assessment of the water balance and determination of the resource capacity are calculated in two alternatives:

1. under the conditions of natural discharges when we are considering the water demand and also the recharges of the wastewater (BSC),
2. under the conditions when we taking into consideration the impact of water reservoirs or water transfer too (BSENP).

The basic equation of the water balance takes into account the sources with needs and the basic formulas for the balance evaluation in order to calculate the balance rate and the usable water capacity. In case of balance status, we calculate the ratio of the resources to requirements. In case of usable water capacity, the calculation is based on the difference between the water sources and requirements.

Water resources represents natural flows and the flows affected by water reservoirs, water transfer and distribution facilities, and water requirements include surface water abstractions, groundwater abstraction, waste water discharges and minimum flow rates that together represent the minimum required discharge in the river.

Based on the calculated value of the balance status, it could have three positions:

- $BSC (BSENP) > 1.1$  - Category A - active balance
- $1.1 > BSC (BSENP) > 0.9$  - Category B - stressed balance
- $0.9 > BSC (BSENP) > 0$  - Category C - passive balance.

### **3. WATER RESOURCES IN SLOVAKIA**

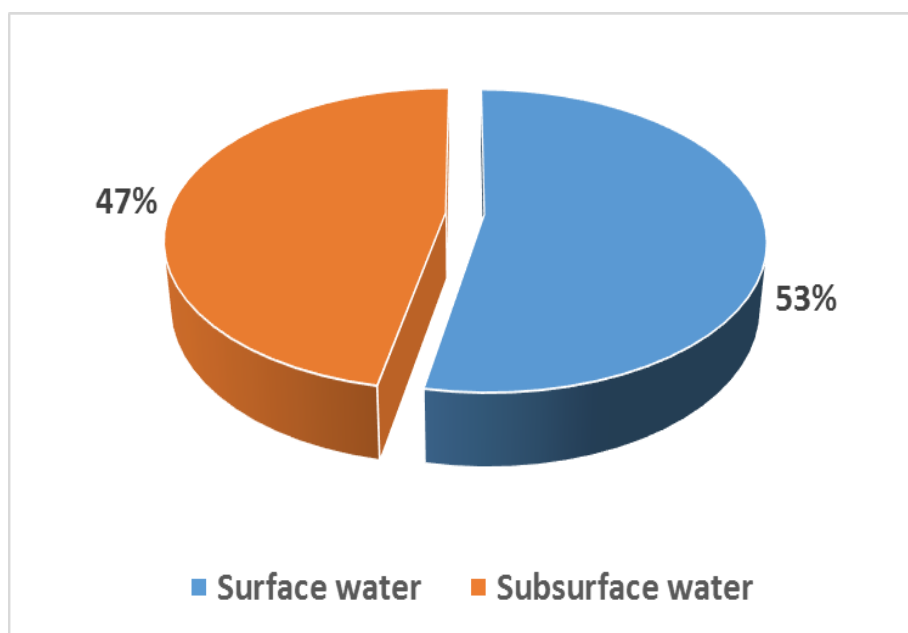
Within the water balance of the previous year, precipitation and runoff for the entire territory of Slovakia is also assessed for individual sub-basins.

The territory of Slovakia has sufficient water resources, which are much higher compared to the annual drainage of the Slovak Republic. This is because the boundaries of the Slovak Republic are not identical to the hydrological sub-catchments of individual river basins. The Danube (from the territory of Austria Fig. 1), which has a long-term flow rate of  $2061 \text{ m}^3 \cdot \text{s}^{-1}$ , has the largest share in our territory. The area of the river basin, which forms the total available water resources of Slovakia represents 21% the Slovak territory.

The long-term average annual outflow from the territory of Slovakia is  $363.7 \text{ m}^3 \cdot \text{s}^{-1}$  (234 mm), and this is only 14% of the total amount of the water sources. The catchment of River Vah and its tributaries contribute 38% of the average annual runoff, where as Hron and Bodrog consist 14% and the rest is contributed with other basins of Slovakia. The only water source of our rivers is coming from the atmospheric precipitation. The total precipitation amount gives us about 31% of the surface runoff of SR.

#### 4. RESULTS AND DISCUSSION

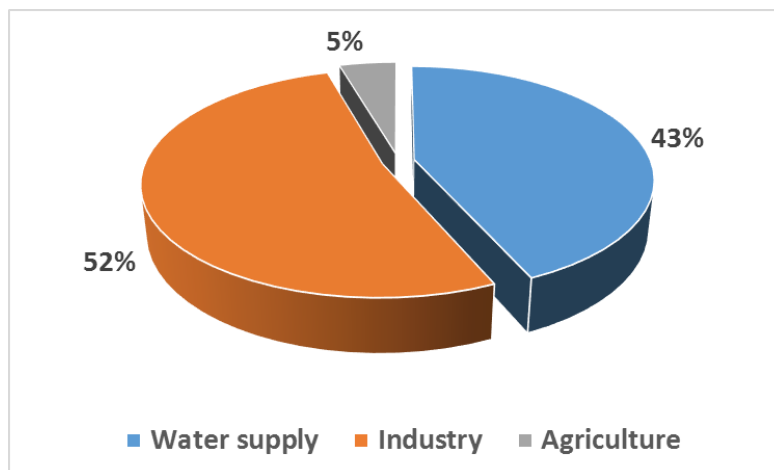
The long-term average annual runoff from the territory of Slovakia is  $363.7 \text{ m}^3 \cdot \text{s}^{-1}$  (234 mm) and this amount represents only 14% of the total available outflow from Slovak territory. Out of the total average annual runoff of the Slovak territory, Váh River contributes 38%, Hron and Bodrog 14%, and the remaining percent is contributed by other basins of the country.



**Fig. 1: Water abstraction for the period 2001 – 2015 in %**

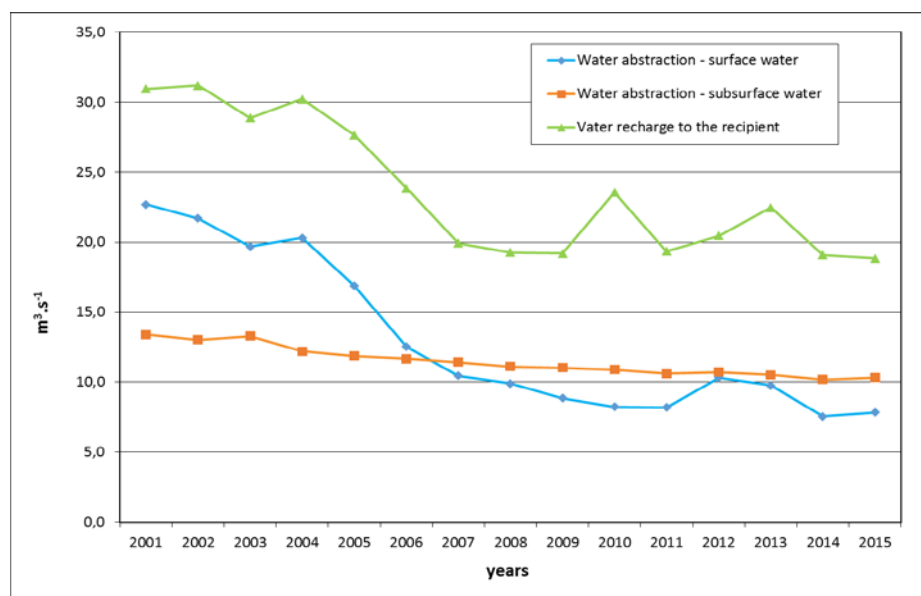
The amount of the runoff is affected by water use, i.e. abstractions from surface waters, groundwater and by discharge of waste or special waters. Basically, water abstractions are intended to satisfy different demands; water supply, industry and agriculture. Figure 1 below illustrates that the amount of abstracted groundwater (53%) was higher than the surface water (47%) for the period between 2001 and 2015.

The total abstracted water for the mentioned period was used for different purposes: industry (52 %), water supply (43 %) and agriculture (5 %) as shown in Fig. 2. However, the water which is abstracted from the subsurface water is mainly used for water supply (77%) and the water which is abstracted from the surface water is mainly used for industrial demand (82%).



**Fig. 2: Water abstraction for the period 2001 – 2015 in % divided to main categories**

The water use in the Slovak Republic has in the recent period a downward trend in all of above-mentioned categories (Fig. 3). We have been experiencing this change since the early 1990s, mainly as a result of changes in the economy, which resulted in the extinction of many users, and other users were divided into separate smaller users.



**Fig. 3 Water use during the period 2001 – 2015 in Slovakia**

In Fig. 3, we can also see some increased values of the water recharge in years 2010 and 2013. This is because of that these two years were very wet from hydrological point of view, and the water recharge values include huge amount of the rain “recharged” from different users. At that time we had not differentiated the rainwater inflow from industrial areas into the rivers. The calculated results of the water use on the river basin level has shown, that the water abstractions from all river basins over the evaluated

period has declining trend in all categories with the exception of three sub-catchments i.e. the Malý Dunaj, Bodva and Poprad catchments.

In case of calculation of the water balance status under the natural conditions (BSC) in yearly step in all our balancing profiles the balance status is active except the river basin of Malý Dunaj, where is a huge donation of surface water from the main stream of the Danube. It is necessary to mention, that yearly steps of the calculation eliminates the effects of shorter water scarcity periods, and sometimes the monthly step is not enough for the identification of some local short-term problems. On the other hand, the water resource balance in Slovakia gives us information about the water management in our country and can define some problems related proper use of water.

## **5. CONCLUSIONS**

We can declare, that the water balance serves to verify whether the expected water management objectives have been met in the past year – quantifying water status, assessing water use, and then assessing water coverage. It specifies the areas in which there have been problems with securing the minimum required discharge and determines the stressed and passive river sections in monthly step.

We have to realize, that not just the quantity is important but also the annual distribution of water resources as well as the requirements on these waters. The other possibilities are to make the estimation with use of selected ecological limits, what can have important outputs for setting the appropriate ecological measures.

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