

Access to water is an absolute prerequisite for the very existence of man in terms of his biological, economic, and manufacturing needs. Freshwater resources are often in short supply in many areas of the world, and are becoming an increasingly sought after strategic good. A large part of freshwater resources originate in headwater sections of rivers and streams; areas characterized by the high precipitation supply. Most freshwater resources in Poland originate in mountain areas in the south of the country. Polish mountain areas receive substantially more precipitation than the rest of the country. Runoff in mountain areas is also higher than elsewhere. However, water circulation patterns and the supply of water in mountain areas in Poland have not yet been studied extensively. Many questions and hypotheses have been posed by researchers who are puzzled by the fact that high precipitation in the Polish mountains is associated with high stream discharge or conversely low retention rates. Researchers generally believe that the groundwater storage capacity of Polish mountain ranges is quite low. While Poland does not experience a permanent water deficit, its two main mountain ranges – the Carpathians and the Sudetes – are often mentioned as being vulnerable to longer-lasting droughts primarily due to the low storage capacity of their water-bearing horizons and dependence on precipitation recharge.

Quantitative research studies on water circulation patterns in the natural environment employ the principle of the water balance, which is based on the assumption that there exists an equilibrium between the amount of water entering a system (catchment), mostly in the form of atmospheric precipitation, and the amount of water leaving a system in the form of surface and groundwater runoff as well as the loss of water via evaporation and discharge outside of the boundaries of the catchment. The equilibrium equation is also balanced by the difference in water storage at the beginning and end of the water balance period. All the described parameters are affected by a specific set of factors: hydrometeorologic conditions in the catchment, local geology determining slope cover type and retention capacity, hydrogeologic conditions (the presence and characteristics of aquifers), land use, local topography.

The research purpose of the project is to **analyze natural water circulation patterns in small experimental catchments in a semi-natural, flysch middle mountain environment on the example of the Polonina Wetlińska Massif in the High Bieszczady Mountains** – a range part of the Outer Eastern Carpathians. The selection of small catchments as study areas is consistent with international research practices focused on the utilization of such fields as basic research areas in the field of hydrology. A careful examination of the water balance in the studied catchment requires the identification and characterization of temporal and spatial features of the various components of the water balance: atmospheric precipitation, stream discharge at terminal catchment gauges, water loss (mainly evaporation), changes in water retention capacity. In addition, discharge measurements during low flow periods and the use of hydrograph separation based on environmental tracers for selected flood periods make it possible to evaluate the groundwater discharge component of total river discharge. The network of measurement and observation sites consists of rainfall gauges (precipitation measurements), water level loggers (runoff measurements) and air temperature and air relative humidity loggers (actual evapotranspiration assessment).

Until fairly recently, the only source of information on the hydrology of the Bieszczady Mountains consisted of review works at the national and regional scale in Poland. At the mountain range scale, studies focused on specific components of the water balance or other selected themes. Comprehensive research on water circulation in small catchments was not conducted due to a lack of an adequate number of meteorological and hydrometric sites in the area.

Research work on natural water circulation patterns in catchments found across the Polonina Wetlińska Massif will substantially help generate new knowledge and verify existing knowledge on the hydrologic conditions of the Bieszczady Mountains. In addition, this work will yield substantial knowledge on water circulation patterns in small catchments found in semi-natural mountain areas built of flysch rocks. It may be argued that this approach is innovative in that it goes beyond the scope of research performed in the past in mountain areas. The research is designed to substantially expand the knowledge base on the storage potential of flysch rocks – both in terms of accumulation and discharge. This is an important subject in Poland, where large parts of the Małopolska region and the Podkarpacie region are built of flysch rocks. This includes the entire Beskids and Bieszczady Mountains and densely populated foothill areas.