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Hydrological basis of possible water management measures for enhancing drought resilience

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Global warming and resulting climatic changes have altered the hydrological regime of Polish rivers, especially in winter season. Precipitation in the winter period may increase, but warming causes a greater share of rain in the total precipitation amounts, much shorter duration of snow cover and a disappearance of spring thaws, which are an important source of water at the beginning of the vegetation of plants. In Poland two types of low flows of different origin were observed. The summer low flows, preceded by atmospheric and soil drought, begin with a depletion of the catchment retention resources. Summer low flows are generally long-lasting, large-scale and dominant in the lowland part of the country. They often extend into the autumn period and are then called summer-autumn low flows. Winter low flows are characteristic mainly of mountain rivers, although they can also occur in lowland rivers. Their occurrence is associated with longer periods of negative air temperature. In those conditions the surface runoff is stopped, and inflows of groundwater to the riverbeds are severely limited. Ice phenomena in rivers - frazil, pans ice cover, frazil hanging dam, shore ice and anchor ice as well as ice cover and ice jam can block the flow. Winter low flows are usually short-lived and end with a thaw. Nowadays winter low flows rarely occur. Due to the changes in winter runoff processes a soil drought is frequently observed at the end of winter and the beginning of summer season which seriously threatens plants and yields. Summer or summer-autumn droughts do not change their character.

Enhancing drought resilience is a complex multidisciplinary task involving legal, organizational, technical, financial, research and methodological aspects, although the main measure to cope with drought is to increase basin retention. The use of various forms of retention allows for multifaceted effects because each method of collecting water allows for a different scope of its use. We focus here on micro- and small, soil and landscape retention with its main role to retain water in the environment and slow down its outflow from the catchment area. An equally important role of these forms of retention is to restore small water cycles when water that falls there sticks around and comes back to earth in the form of rain, dew, mist and fog.

In this study, we carry out the assessment and analysis of the amount of water that should be stored in vernal ponds to imitate to some extent the former winter runoff regime. Water deficits for the most severe summer-autumn hydrological droughts are calculated and analysed along the course of the River Vistula.

In Poland, there is no coherent policy for counteracting the effects of drought and building

retention. Competences are blurred, and drought as a natural disaster is not defined in Polish legislation.

Keywords: drought resilience, climate change

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