

DEVELOPMENT AND IMPLEMENTATION OF A SYSTEM TO COLLECT AND USE RAINWATER AS DRINKING WATER FOR ANIMALS IN ROZTOCZE NATIONAL PARK

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Keywords: rainwater, water quality, climate change, Roztocze National Park, Polish Koniks.

Summary

Climate change around the world is making the provision of water for drinking and other purposes an increasing problem, which is why measures have been taken in recent years to make use of rainwater. The Roztocze National Park (RNP) is also experiencing climate change, resulting in falling groundwater levels, rising air temperatures – especially in the autumn-winter half of the year, an earlier start to the growing season, and a variable distribution of precipitation throughout the year. These changes necessitate rainwater harvesting in order to meet the ever-increasing demand for freshwater experienced in the RNP.

The main scientific objective of the dissertation is to assess the possibility of using rainwater for watering animals, including mainly Polish Koniks (in Polish: *konik Polski*, i.e. a Polish breed of small horses) in the catchment area of the Świerszcz stream in the RNP. The specific objectives of the dissertation include: 1) determination of climate change and the possibility of using rainwater in the RNP; 2) determination of physicochemical and microbiological properties of rainwater, lotic water and groundwater in the Świerszcz stream catchment in relation to applicable legal standards; 3) determination of the effectiveness of rainwater treatment in a pilot installation and the possibility of its practical application. The implementation objective of the dissertation involves the conceptual framework for the implementation of a system for the transport, storage, redistribution and treatment (disinfection) of rainwater for breeding as well as sanitary, technical and fire protection purposes, with the discharge of excess water to amphibian breeding sites in former ponds in the RNP Conservation Breeding Centre in Florianka. The scientific objective of the dissertation was expressed in the form of the question: “Does the quantity and quality of rainwater in the RNP and its collection and treatment allow its use for breeding purposes?”

The research and analysis of the results for the PhD dissertation covered the period from 2021 to 2024. Quantitative and qualitative studies of rainwater were carried out in 2021–2022, while the effectiveness of the test installation for rainwater treatment was analysed in 2023. In order to determine climate change in the RNP, data from the Integrated Environmental Monitoring Base Station (ZMŚP) “Roztocze” operating as part of ZMŚP of the Chief Inspectorate for Environmental Protection (GIOŚ) from 2001–2020 were used. Quantitative studies, i.e., sampling and statistical analyses of rainwater, surface water, groundwater, were carried out based on the methodology adopted in the ZMŚP guidelines. Qualitative studies –

organoleptic, physicochemical and microbiological analyses of collected water samples – were carried out in accordance with the currently applicable methods in the accredited Research Services Laboratory of the Lublin Dairy Services Cooperative (*Lubelska Spółdzielnia Usług Mleczarskich*) in Lublin.

On the basis of the research carried out, it was determined that a total of 9,109 m³ of water can be collected annually from the roofs of buildings in forest villages belonging to the RNP. It has been evidenced that the quality parameters and quantity of rainwater greatly vary in time and space. It has been found that raw rainwater generally has a favourable organoleptic, physicochemical and microbiological composition, but the concentrations of some parameters do not comply with the standards specified for drinking water (e.g., total hardness, ammonia, turbidity, or microbiological indicators). Increased levels of ammonia or microbiological indicators are probably due to contamination of roof surfaces with bird droppings. It has been shown that rainwater in the RNP does not contain heavy metals, and the content of iron, manganese, nitrogen and phosphorus compounds is low. The rainwater was also found to be very soft and devoid of calcium compounds and, therefore, should not be recommended for drinking in large quantities. Reduced values of pH < 6.5 were periodically recorded in rainwater, mainly during low rainfall in the winter season, which could probably be ‘acid rain’. It has been observed that the collection of rainwater in underground concrete tanks has a beneficial effect on the stabilisation of water temperature, which prevents uncontrolled chemical and biological changes. It has been shown that the test installation for rainwater treatment based on a filtration and disinfection process (UV lamp), installed at the RNP Directorate, effectively removed physical, chemical and microbiological pollutants.

The study shows that rainwater, after being treated through filtration and disinfection processes, can be used for watering Polish Koniks in the Animal Breeding Centre (OHZ) in Florianka in the RNP, as well as for washing vehicles, watering green areas or flushing toilets. It can also be used to fill fire water tanks and feed amphibian breeding sites. Based on the average precipitation totals for the 2001–2020 period, it was determined that the largest amounts of rainwater in the Florianka OHZ occur during the spring–summer period (May to August), which is when the demand for water is the highest. During this period, rainwater will cover 100% of the water demand for the various purposes mentioned above. In the other months, rainwater will cover 54–90% of the water demand in the Florianka OHZ.

The results obtained from the research and field measurements allowed us to design a new rainwater management system, which will be implemented in 2025–2026 at the RNP Animal Breeding Centre. This system will allow rainwater to be used, among other things, for watering Polish Koniks – the emblem animal of the Roztocze National Park.

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16.09.2024