Drought vulnerability assessment for different hydrological conditions based on Standardized Runoff Index and flow duration curve in Lithuania

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INTRODUCTION

Over the past several decades the drought events became more frequent and severe (Wilhite, 2000). Drought risk is a combination of the likelihood of drought occurrence and vulnerability. Vulnerability is the degree of fragility of a (natural or socio-economic) community or a (natural or socio-economic) system towards natural hazards. (Schmidt-Thomé, 2006).
Here the Water Resources Vulnerability Function (WRVF) is presented as a simple and robust tool for proactive drought management.

METHODS

The Standardized Runoff Index (SRI) was derived using the method described in Shukla and Wood (2008) using the monthly runoff data in hydrological stations. Daily runoff data was used to calculate Flow Duration Curve (FDC). SRI is a standardized index; flow duration curve is based on empirical percentiles, thus the values of SRI and FDC in different basins can be comparable. 1, 3, 12 month SRI and FDC probability were used to reflect the hydrological conditions in different river basins: Minija, Merkys and Žeimena.

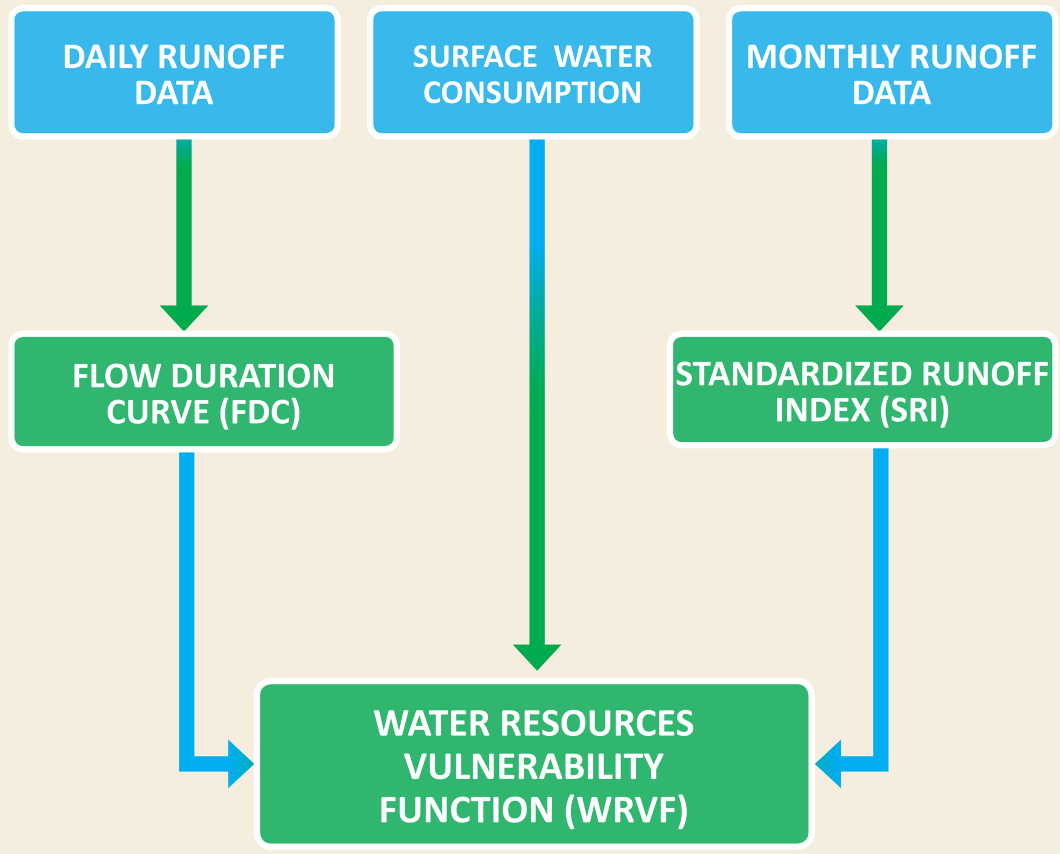
FINDINGS

Different river basin vulnerability functions may be compared to each other. Also such vulnerability functions able to represent the water demand coverage in different hydrological conditions.

SRI is standardized index, thus the same SRI values have the same probability in different basins. The FDC have the same properties. The usage of SRI and FDC to represent the hydrological conditions allows to compare the vulnerability between different rivers and to estimate the probabilities of different demand coverage.

Strengths (+) and weaknesses (-) of the vulnerability function method (WRVF)

+	The vulnerability is estimated using available data: river runoff and water consumption in administrative units
+	Vulnerability functions represent the water demand coverage in different hydrological conditions
+	The usage of SRI and FDC allows to the esmate the probabilities of different water deamand coverage
+	Different river basin vulnerability functions may be compared
-	The method covers only the vulnerability of surface water users. It covers only one part of total system vulnerability stimation
-	The water resources and water consumption are assumed to be evenly distributed in administrative regions, across river basin and in time. The inventory of major water users may increase the accuracy of the method



The water consumption compared to the discharge shows which part of water demand is covered. For example, the vulnerability functions based on SRI and FDC allows estimating how well the demand is covered during different conditions in different catchments.

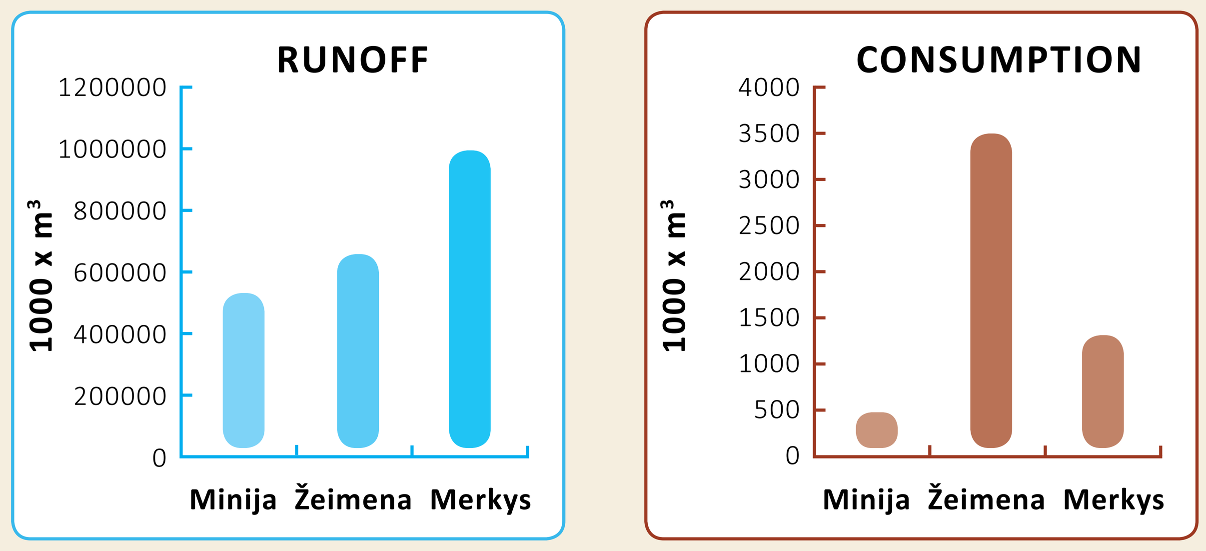


Figure 1. The mean annual runoff (left) and the surface water consumption (right) in the analysed river basins.

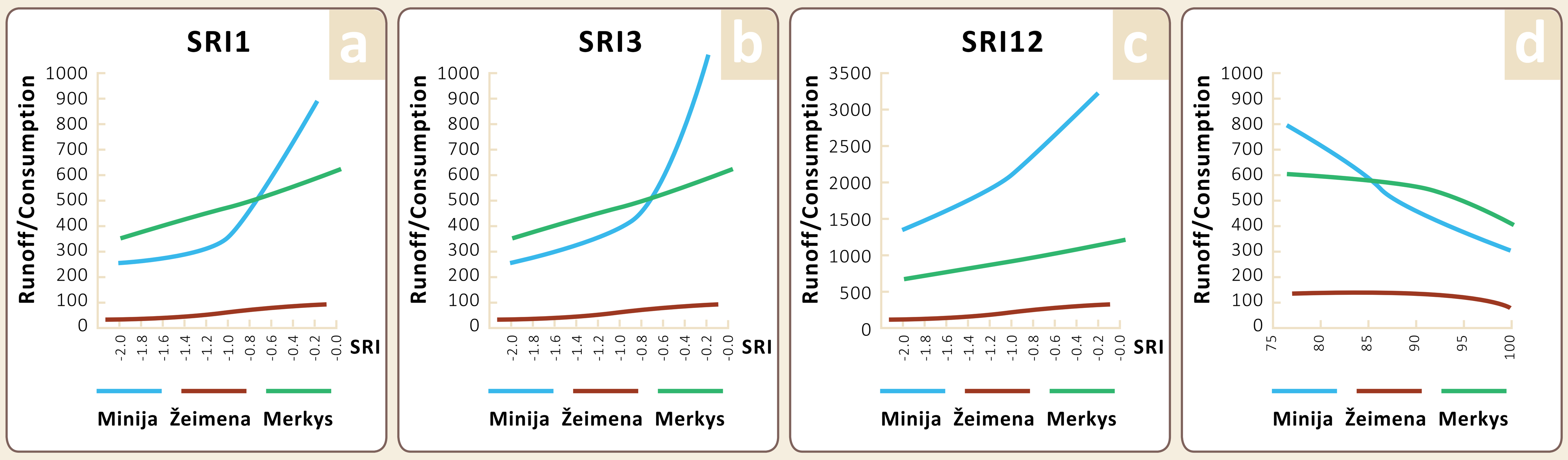


Figure 2. Vulnerability functions for different hydrological conditions (three different river basins) based on 1, 3, 12 month SRI (a, b and c respectively) and FDC (d).

The largest vulnerability is in Žeimena river basin. In this basin the water consumption is the largest, but even during very dry conditions the runoff is 14 times larger than water consumption. In other two rivers the consumption is exceeded several hundred times.
Žeimena river drains laky region within its basin and the seasonal runoff variation is relatively low. Because of the low runoff variability, the vulnerability function slope is gradual. The steepest vulnerability function slope is Minija basin. During dry conditions, SRI <-1 and FDC probability exceedance 90% (Figure 2a,b,d) the demand is better covered in Merkys river basin then in Minija one, however vulnerability of Minija river basin decreases more rapidly than in Merkys basin in wetter conditions.

The vulnerability functions based on SRI1 and SRI3 are very similar, therefore only one of these functions may be used. The SRI12 poorly describes the hydrological conditions during summer and winter low runoff periods when the systems are mostly vulnerable.

The decision on which SRI calculation period to use should be made accordingly to regional hydrological conditions. For example the SRI12 may be used only in regions with multi-year droughts probability.

Integrated Drought Management Programme in Central and Eastern Europe

OBJECTIVE

Increase the capacity of the Central Eastern Europe region to adapt to climatic variability by enhancing resilience to drought.

RESULTS

- **Guidelines** for preparation of the drought management plans within river basin management plans according to European Union Water Framework Directive
- **National consultation dialogues** to discuss preparation of drought management plans
- **Compendium of good practices**
- **Drought information exchange platform**
- **Demonstration projects** testing innovative solutions for better resilience to drought
- **Capacity building** trainings and workshops on national and regional levels

4 KEY PRINCIPLES OF THE PROGRAMME