

# Scarcity of Water Model Switzerland

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Switzerland is considered the water castle of Europe. Around 6% of the continent's freshwater reserves are stored in the small alpine country. However, climate change is altering these conditions. Thus, Switzerland will have to manage its water reserves more consciously in the future. A causal simulation model was built to map these intricate dynamics and derive policy recommendations for a positive management of the likely future scarce resource.

## Introduction

Water is a key resource for life. Not only nature, but societies are highly dependent on water. In the case of Switzerland, water seemed to be inexhaustible during the last decades. The availability has positively influenced the development of the Swiss society. This availability of water is so self-evident and natural that consumers often do not consider and worry about it. However, the Swiss water resource system is precisely balanced and should not be disturbed. For some years now, more severe climate change and its effects have occurred around the world. Due to this, there are changes in temperatures, meteorological conditions, and accelerated glacier melt resulting in alterations in water consumption patterns by humans, industry, agriculture, river flows, and evaporation. Overexploiting water reserves should therefore be avoided, and in a dry period, water use for agriculture and industry could be restricted. Households are also encouraged to save water. These recent developments create a new situation in Switzerland for where, when, and how much water will be available.

## Research Approach

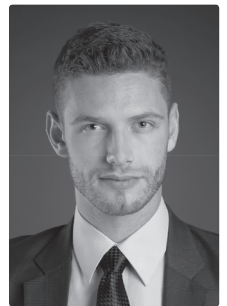
The goal of the Scarcity of Water Model Switzerland (SWMS) is to represent the dynamics of the water resource system in Switzerland. It is considered to represent the most important water stocks, flows and their dynamics. The model allows to detect probable situations in which water scarcities could occur. Water scarcity is an essential key performance indicator; it is indicated when the water demand is higher than the possible water for consumption. A system dynamics model calculates the long-term consequences of the system until 2100 and is validated by statistical data from the Federal Office for the Environment. Also, literature research has been conducted including papers of federal offices and the Swiss Academy of Science.

## Model

The model simulates the hydrological conditions of Switzerland between 1960 and 2100 and was created as a system dynamics model (see Figure 1). A key policy implemented in the model is "climate protection". This depends on the political decisions and its adopted maximum permitted temperature increases. There are three levels: no/barely climate protection, moderate climate protection and rigorous climate protection. Other policies are the residual amounts of water in surface water and groundwater. These are applicable laws that dictate the amount of water take out. The variances here are: Law on residual water volumes complied with, reduced complied with, or not complied with.

## Results

Climate change leads to an increasing average temperature in Switzerland. Directly affected by this are glaciers which are melting more rapidly. This means an important water stock will be shrinking towards insignificance. The higher average temperature leads as well to more evaporation. Especially agriculture and its water demand can be affected. The missing melting water combined with longer dry periods in summer and increased water demand can cause water adequacy in Switzerland to come under pressure. Restrictions on water usage for irrigation, to prevent the surface water and groundwater falling below a delicate balance, may scarce the water on fields even more. According to the model, less scarcity can be expected for the household's water demand. This is due to the higher priority in water distribution. The tested scenarios consider different intensities of climate change: the more climate protection is enforced, the less water scarcity will result.



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