



Utilization of local water resources to reduce vulnerability of urban areas for climate change

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Climate change and urbanization affect water resources of urban areas and will put these water resources further under strain in the future. In this paper possibilities to store and utilize local urban water resources for water use are explored. A future concept which is symbolically called 'The Closed City' uses local urban rainfall as the only source of water supply. The 'Closed City' can decrease the water dependence of urban areas on (1) the surrounding rural areas that are diminishing in size and increasingly under strain and (2) river water resources that will probably be less constant and reliable in the future as a result of climate change.

Presently, the amount of precipitation is 750 mm a year in urban areas in the Netherlands, additionally several hundreds of millimeters of water is supplied to urban areas artificially by piped networks. This amount of water is extracted from surrounding areas or from major rivers (external water resource). Stormwater in urban areas (local water resource) is a relatively clean source which is not yet used for drinking water supply. Instead, it is mostly converted to wastewater in combined sewer systems.

Looking at the future, there is both the necessity and the possibility to take local urban resources into account. The rural hinterlands, on which urban areas now have to depend for urban water supply, are increasingly under strain because of urbanization and competing land uses. The increasing pressure on space in the urbanized lowland area of the Netherlands is often mentioned. For instance, the estimated amount of required new houses in the period until 2030 varies from 1 million to 1.5 million in various scenarios. This is a massive additional pressure on an area which is already under strain; additionally space is needed for industrial sites and water.

Climate change brings more variability and uncertainty in water resources. At present

large rivers, in particular the Rhine, generate a relative constant supply of water to the Netherlands during summer. This constant flow consists for a considerable part of snowmelt from the Alps. However, the mean temperature in Europe is expected to increase which will increase the possibilities of water shortages in summer. This makes urban areas more vulnerable if they continue to depend solely on external water resources and disregard their own internal water resources such as stormwater. Contrary to the 19th century, presently the technologies to treat wastewater locally are available. Stormwater has become much cleaner because of decreasing industrial pollution loads, cleaner car engines and sustainable building materials.

For greenfield developments in the Netherlands we will elaborate that local rainfall could compensate water use in an average year. This 'Closed City' uses no external water supply and does not need water resources from other areas. Dry years could be covered by large inter annual storage reservoirs or water recycling which will become more feasible as wastewater treatment technology will continue to improve. Also existing urban areas could implement the 'Closed City' concept to be more robust for uncertain future developments and reduce both their impact on surrounding rural areas and their dependence upon these areas.