TAKE THE CHALLENGE AND START THE 3R's

Reduce, Reuse, Recycle.

Promoting zero-waste lifestyle among adults.

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SAVING WATER

IMPORTANCE OF WATER

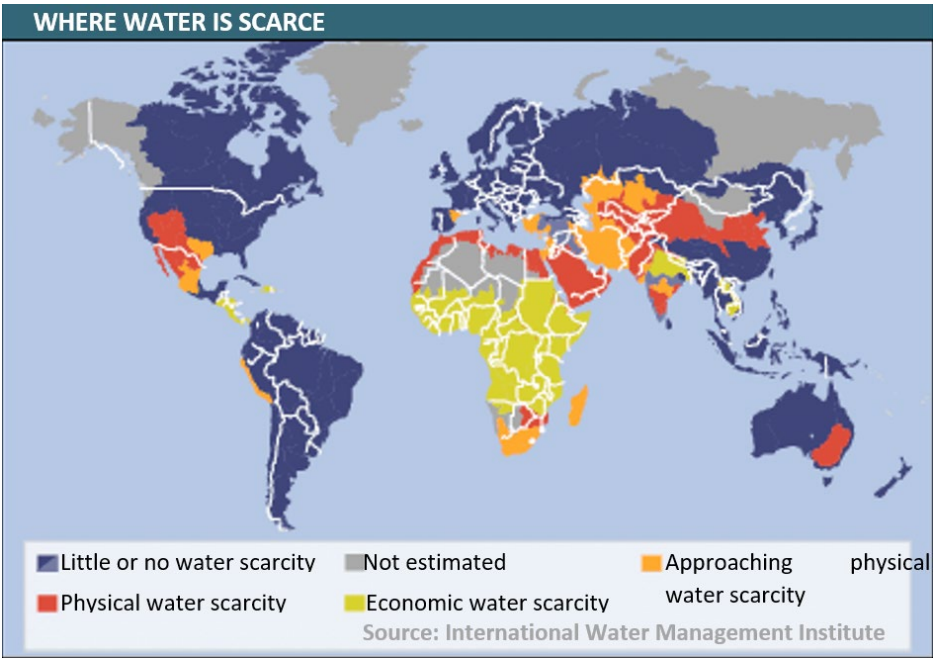
The aim of the module called saving water is to introduce the forms of saving water through the use and reuse of greywater, rainwater and blackwater, which is a very current topic today. The topicality of this issue can be seen regarding the environment, the financial situation of households and as an effective tool against the long-term problem of drought.

Within rainwater can replace up to half of the rare drinking water used and thus prevent its shortage. The use is very diverse, these are common activities such as cleaning the household, washing, flushing toilets or, perhaps most typically, watering the garden. It may not seem so, but up to 50% of the daily household water consumption can be replaced by rainwater. As a standard, each person consumes up to 100 litres of water per day

Water can be wasted in every day's small tasks which we even don´t realize. In total, a dripping tap can waste a total of 1 litre of water per hour, i.e. 90 litres of water per week. A similar calculation is with a shower or bath. It certainly doesn't matter to take a bath occasionally, but regular and frequent bathing in the bath is not optimized at all. In comparison: taking a bath means 200 litres per bath, the shower adds about 50-70 litres. A very similar system can be found in older washing machines vs. new, old washing machines consume 80-90 litres of water per wash cycle, new only half, i.e. 40-45 litres. When brushing teeth, washing hands or hair, it is necessary to turn off the water, otherwise 15 litres of water per minute will flow.

According to the World Economic Forum, wasting water is, in terms of impact, the biggest global risk in the next decade, which is compounded by the lack of freshwater resources. This is reflected in partial satisfaction or absolute non-satisfaction of needs, competition for water quantity or quality, disputes between users, irreversible depletion of groundwater resources and negative environmental impacts. One fourth of the world's population (2 billion people) live in conditions of severe water shortage for at least 1 month a year. Half a billion people worldwide face severe water shortages

throughout the year. Half of the world's largest cities are facing water shortages. Although only 0.014% of all water on Earth is readily available fresh water (the remaining water is made up of 97% salt water and slightly less than 3% difficult-to-access water), technically there is enough fresh water for all of humanity worldwide. However, due to the uneven distribution (exacerbated by climate change), there are some very humid and some very dry geographical areas on Earth and the sharp increase in world demand for fresh water in recent decades, especially for industrial purposes, is leading to a water crisis in 2030, if current trends continue, demand will exceed supply by 40% (United Nations Environment Programme, 2016).



Source: http://news.bbc.co.uk/2/hi/science/nature/5269296.stm

WATER SCARCITY

The basis of global water scarcity is the geographical and temporal mismatch between freshwater demand and availability. The main drivers for growing global water demand are a growing world population, improved living standards, changing consumption patterns and the expansion of irrigated agriculture. Climate change, such as weather changes (including droughts or floods), deforestation, increased pollution, greenhouse gases and inefficient use of water are the main causes of water shortages. At the global level and on an annual average, there is enough fresh water to meet this demand, but the spatial and temporal differences in water demand and availability are large, leading to (physical) water shortages in several parts of the world during certain times of the year. Most of causes of water scarcity are related to human interventions in the water cycle. The scarcity varies over time due to natural hydrological variability, but changes even more, as a function of the prevailing approach to economic policy, planning and management. Deficiencies are expected to intensify in most forms of economic development, but with the correct identification of causes, many of its causes can be foreseen, avoided, or at least mitigated.

Some countries have already shown that it is possible to separate water use from economic growth. In Australia, for example, water consumption fell by 40% between 2001 and 2009, while the economy grew by more than 30%. The most effective way to separate water intensity from economic growth is to create holistic water management plans that consider the whole water cycle: from source to distribution, economic use, treatment, recycling, reuse and return to the environment.

The total amount of easily accessible fresh water on Earth in the form of surface water (rivers and lakes) or groundwater (e.g. in aquifers) is 14,000 km3. Of this total, humanity uses and recycles "only" 5,000 km3. In theory, therefore, more than enough fresh water is available to satisfy the world's current population of 7 billion people and even to support population growth of 9 billion or more. However, due to uneven geographical distribution and especially uneven water consumption, water is a scarce resource in some

parts of the world and in some groups of the population. The lack of water due to consumption is mainly due to its widespread use in agriculture and livestock farming and in industry. People in developed countries generally use about ten times more water a day than people in developing countries. A large part of this consumption is made up of indirect uses in the production processes of consumer goods, such as fruit, oilseeds and cotton, which are water intensive. As many of these production chains have been globalized, much water is used and polluted in developing countries to produce goods for consumption in developed countries. Water scarcity can result from two mechanisms:

- physical (absolute) lack of water,
- economic water shortage.

Physical water scarcity results from insufficient natural water resources to supply demand in the region, and economic water scarcity is the result of poor management of sufficient available water resources. According to the United Nations Development Program, economic scarcity is more often considered to be the cause of water scarcity in some countries or regions, as most countries or regions have enough water to meet domestic, industrial, agricultural, and environmental needs but lack the means to provide it in an accessible way. Approximately one-fifth of the world's population currently lives in regions affected by insufficient physical water supply, where there are insufficient water resources to meet demand in the country or at the regional level, including the water needed to meet the efficient functioning of ecosystems. Arid areas often suffer from physical water shortages. It also occurs where water appears to be sufficient water, but where resources are over-depleted, such as through the overuse of irrigation. Symptoms of physical water scarcity include environmental degradation and declining groundwater, as well as other forms of overuse.

Economic water scarcity is caused by a lack of investment in infrastructure or technologies to pump water from rivers, watercourses, or other water sources, or by insufficient human capacity to meet water demand. A quarter of the world's population is affected by economic water shortages. Economic water scarcity includes a lack of infrastructure, which means that people without reliable access to water must travel long distances to bring water that is

often contaminated from rivers for domestic and agricultural purposes. Much of Africa suffers from economic water shortages; the development of water infrastructure in these areas could therefore contribute to poverty reduction. Critical conditions often arise in economically poor and politically weak communities living in an already arid environment. Consumption increases in most developed countries with the growth of GDP per capita, the average consumption is about 200-300 litres per day. In less developed countries (e.g. in African countries such as Mozambique), the average daily water consumption per capita was less than 10 litres, in connection with its transport of 1km to the place of household from the place where it is possible to obtain water. Increased water consumption is related to growing income, measured by GDP per capita. In countries that suffer from water scarcity, water is often the subject of speculation.

WASTEWATER TYPES AND LEGISLATION BACKGROUND

There are three types of wastewater, which can be reuse and recycle to some degree:

- Greywater
- Blackwater
- Rainwater

Each wastewater type must be treated differently and can be used in various ways.

Greywater is ideal for garden watering, with the appropriate precautions, such as using low or no sodium and phosphorus products and applying the water below the surface. Appropriately treated greywater can also be reused indoors for toilet flushing and clothes washing, both significant water consumers.

Blackwater requires biological or chemical treatment and disinfection before reuse. For single dwellings, treated and disinfected blackwater can be used only outdoors, and often only for subsurface irrigation. Check with your local council or state health department on local requirements.

Blackwater is the mixture of urine, feces and flushwater along with anal cleansing water (if water is used for cleansing) and/or dry cleansing materials. Blackwater contains the pathogens of faeces and the nutrients of urine that are diluted in the flushwater.

Characteristics of rainwater functionality in numbers:

It is not the same in the whole of europe, but as an example in the middle of europe, on a roof with a vertical diameter of 100 square meters in the Czech Republic at an altitude of 300 meters, 70 cubic meters of water fall annually. Of this, only about 49 cubic meters can be used for the toilet, because November to March cover the need only partially and about 6 cubic meters must therefore be supplied from the water supply. This results in a total surplus of about 21 cubic meters of water per year, which is enough to water a garden of 600 square meters (calculated for grass that consumes during the growing season up to 70 litres / square meter, half of which gets rain).

Graywater got its name from the inevitable color change that occurs during longer storage. It is usually defined as wastewater from bathrooms (washbasins, showers, baths and sometimes also washing machines) that does not come into contact with black water (ie water from toilets).

The primary problem arises in legislation that is not completely comprehensive. Greywater legislation in the EU says that Greywater management in the European Union is not yet addressed by a single piece of legislation (Regulation of the European Parliament and of the Council of the EU), although the use of treated greywater is happening more and more frequent. Each country addresses the issue individually by using the recommended ISO standards in its legislation and using Regulation (EU) 2020/741 of the European Parliament and of the Council on minimum requirements for water reuse, implementing EU directives into their legislation. These are mostly Council Directive 91/271 / EEC concerning urban waste water treatment (Guidelines on the integration of water reuse into water planning and management in the context of the Water Framework Directive) and Directive 2006/7 / EC of the European Parliament and of the Council of 15 February 2006 on the management of bathing water quality and repealing Directive 76/160 / EC.

Water reuse can be considered in many sectors and includes both the recycling of urban and industrial water to irrigate land; industrial use; to use non-potable and recycled water in cities for flushing toilets; for firefighting; for environmental and recreational use, for the operation of ornamental water features, replenishment of water bodies and car washing. Last but not least, the use of greywater from households, apartment buildings, hotels and shopping centres for reuse for flushing toilets or for irrigating urban greenery or gardens.

HOW TO REUSE AND RECYCLE WASTEWATER

- Non-wasting water - within households and company buildings, it is necessary to avoid the following difficulties, which at first glance may not show such losses. During long-term, repeated activities, it can be even a weekly loss of 90 litres. Suitable and effective seals for water taps are essential. Within the household, it is recommended to shower instead of taking a bath. The reason is simple, saving up to about 150 litres of water. The use of new technologies is "green" in terms of water savings. In comparison, older washing machine technology is less economical by up to 40 litres topicality washing program. Daily brushing of teeth, washing hands several times a day, or washing hair is necessary to turn off the water in the meantime. With a constant flow of water, up to 15 litres of water flow in 1 minute. Other possible measures are to install a dual flush or low flow toilet or put a conversion kit on your existing toilet, or use perlizers in all taps of your house.
- Recycling - using various tools. The wastewater flows through the mechanical dirt filter of the reaction tank, where the water is biologically treated. A membrane module is fitted in the reaction tank, in the lower part of which an aeration system is fitted. Above the membrane module, a pump is located, which sucks the water through the membranes under vacuum and drains the already purified water into the purified water storage tank. Water from the storage tank is pumped into the process water distribution system. The reaction tank is equipped

with an emergency overflow. The system can be topped up with drinking water.

- Rainwater - using by common activities such as cleaning the household, washing, flushing toilets or, perhaps most typically, watering the garden. Up to 50% of the daily household water consumption can be replaced by rainwater. The solution is large tanks located near, for example, for water falling from the roof.
- Natural well - A well, in some European regions, means a reliable source of drinking water, thanks to which water supply costs can be reduced. According to valid legal regulations, a natural person can only dig to a depth of three meters, which is usually not enough to achieve quality water. Therefore, it is a suitable investment to hire a well company, which usually offer a comprehensive service from obtaining the relevant documentation and permits through finding a suitable place for the well and installing pumping equipment to the approval of the finished well. This solution is not possible in all European countries since the use of wells might be highly regulated for the control of aquifers (current situation in Spain).
- Water saving tools - Today's market offers countless options and tools for saving water. The market is diverse, where accessories range from adapters to adapters. The principle is simple; the accessory works in the form of a limiter, in several stages of setting. Up to 50% water savings can occur, i.e. up to 14 litres of water flow through the water faucet in one minute, the limitation means that only 11 litres or even only 5 litres per minute flow.

BLACKWATER RECYCLE/REUSE PROCESS

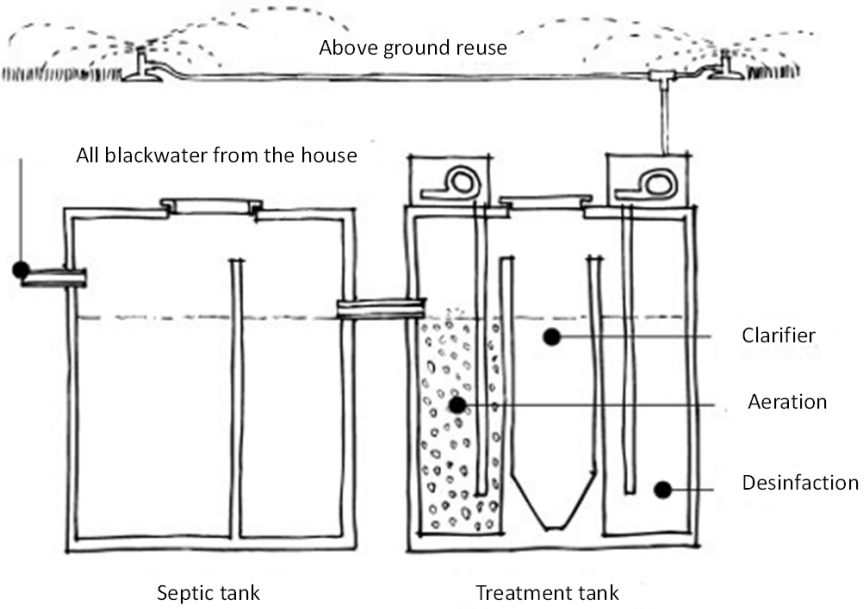
Blackwater, which is sometimes referred to as sewage is the wastewater that comes from toilets, garbage grinders, and dishwashers. How to minimise the production of black water:

- Minimise the use of cleaning chemicals. Use natural cleaning products where possible.
- Do not dispose of household chemicals down the toilet.
- Use a sink strainer in the kitchen to help prevent food scraps and other solid material from entering your wastewater.
- Blackwater treatment systems for outdoor reuse

Outdoors is the only place where treated and disinfected blackwater can be safely reused. There are many different types of blackwater treatment systems suitable for outdoor use.

Currently the most common wastewater treatment and reuse system is the aerated wastewater treatment system and many commercial models are available. After the wastewater solids have settled, the effluent is aerated to assist bacterial breakdown of organic matter, followed by a further stage of disinfection, usually using chlorine pellets.

On-site wastewater treatment systems using microfiltration are now available for domestic use in certain types of homes as individual homes. These systems require no chemicals but do need energy. Some treatment systems use worms and microbes, and little energy and no chemicals, to treat all household wastewater. They produce effluent suitable for subsurface irrigation and compost as a by-product.



In a blackwater recycling system, all of the blackwater is routed to an initial tank via gravity. The blackwater is given time to settle and a primary colony of bacteria goes eats away at the waste for 24 hours similar to a normal septic system. Then the settled blackwater goes into another tank that is divided into 3 chambers; Aeration, Clarifier and Disinfection (Green Living Tips, 2009).

- **Aeration stage: water and air are injected into the tank at timed intervals so that the contents of the tank are churned. Bacteria in the tank then settle so they can feed on the sludge in the tank. When that is finished, the water is moved to the sludge settling chamber**
- **Sludge Settling Chamber: the results of the aeration stage are then piped into a sludge settling chamber. A bacteria biomass mechanism forces sludge downwards and the partially treated water upwards to be collected and sent on to the irrigation chamber stage**
- **Irrigation Chamber: The remaining effluent passes into the irrigation chamber. Here, it is clarified and chlorinated, which is the last step of the process. The water can then be piped into ground irrigation systems for use in gardens.**

The water that is recycled from blackwater recycling systems should never be used as drinking water or on food crops because they could still contain harmful bacteria. It can be used for watering lawns or non-food gardens.

Watering lawns and non-food gardens are not the only benefits of a blackwater recycling system. It is also benefits the environment in many ways such as:

- Energy conservation: The removal of harmful bacteria from blackwater in processing plants is expensive and uses a lot of energy.
- Water conservation: Using recycled blackwater to water lawns and non-food gardens helps to conserve the fresh water that would otherwise be wasted.
- Natural resource conservation: Plants that are grown using recycled blackwater do not need fertilizer because the water is already nutrient rich and the plants feed off of them, this eliminates the need for polluting the environment with fertilizing chemicals.
- Habitat protection: Recycling blackwater lessens the chance of the wastewater seeping into natural habitats.

Just as there are advantages of recycling blackwater, there are also some disadvantages. These disadvantages include: these systems can be expensive, the process can produce a bad smell and it requires on-going maintenance.

RAINWATER CATCHMENT AND REUSE

Harvesting rainwater has gained attention in recent years. Rainwater harvesting systems conserve water and help with storm water management. Use of collected rainwater reduces the use of potable water for outdoor water uses, such as watering landscape plants and washing vehicles. By collecting rainwater, homeowners divert the water away from their home's foundation and reduce the amount of water that runs off the roofs, over the land and into creeks and storm drain systems that ultimately discharged into our rivers and lakes.

Rainwater catchment systems are not difficult or expensive to install on a home or other buildings. A system can be retro-fitted to existing buildings or integrated into new building design. The system consists of two basic components: the collection and the storage. Parts for both can be purchased from many sources, such as farm and building supply stores, as well as online.

- Collection - the gutters on building collect and move rainwater from the roofs, through a downspout to the rain barrel. A diverter can be added to the downspout to direct the water flow into the rain barrel or away from the building in the normal discharge.
- Storage - the average residential rain barrel holds 50 gallons (189 litres) of water. They are typically a food grade barrel made of high density polyethylene. Homeowners sometimes find used barrels of various sizes for sale from businesses or use new heavy duty garbage cans. Always use caution and know the history of the contents of the used barrels. Do not use barrels that contained anything other than food material or water; never use a barrel that contained industrial chemicals, petroleum products or pesticides. All used barrels should be scrubbed with soap and water or power washed and triple rinsed. To collect as much of the rainwater as possible, install a larger tank or connect several rain barrels together so that the overflow from a full barrel can be routed into empty barrels. An overflow outlet at the top of the barrel can be designed to channel the excess water when the barrel is full. A spigot near the bottom of the side of the barrel fitted with hose will enable easier access. A cover on the rain barrel will reduce mosquitos and contaminants from entering the water. Set the water collection tank on a solid level surface. It is a good idea to elevate the tank a few feet off the ground so that a watering can or bucket can fit under the spigot.

RAINWATER USES

Harvested rainwater can be safely used for non-potable activities, such as yard and landscape irrigation, watering potted plants and washing vehicles. Collected rainwater should NOT be used for drinking or other potable purposes if it is not filtered and disinfect-

ed before use. Gardeners often collect water in a rain barrel with little to no protection from the roof's "first flush" of runoff. The first flush water is the initial rainwater that drains off an impervious surface, such as a driveway, parking lot or roof and has shown to have the highest levels of contaminants.

Primary substances of concern in roof runoff include heavy metals, polycyclic aromatic hydrocarbons (PAH's) microbes, pathogens and pesticides. Birds, insects, and small mammals deposit faecal matter on rooftops and in gutters, contributing to bacteria and pathogens in the runoff water. On metal roofs, water can react with the roof surface and absorb metals, such as zinc, copper, and aluminium. Roofs with wooden or asphalt shingles can increase concentrations of chemicals used for waterproofing/weathering treatments. The question is whether these levels are high enough to be of concern for a gardener who uses a rain barrel to water a vegetable garden. A certain amount of caution should be taken when using harvested water to water a vegetable or herb garden to reduce the risk of exposure to a harmful contaminants, like E. coli. The best practices when using rainwater for food crops are:

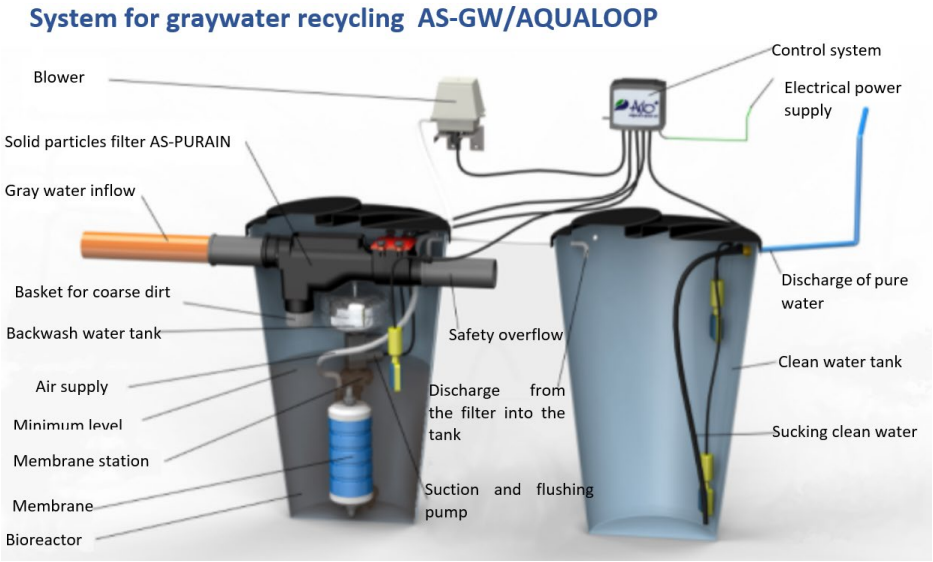
- Use of a drip irrigation is the best way to utilized harvested rainwater in a food garden to avoid getting water on the plant itself.
- Always wash produce under cool running water before consuming.
- Treat the tank monthly to reduce the risks caused by pathogens.

FUTURE OUTLOOK

Based on saving water primarily in households (dripping taps, showering, washing water when brushing hands, brushing teeth or hair) it is noticeable, according to research (World Health Organization, 2017), savings of almost half of running water are expected.

In the long run, the most effective form is saving and recycling water using tools such as:

Graywater recycling system



It is also worth mentioning the forms of water saving in individual industries. In the food industry, water consumption is significant. It also pays attention to its quality. One kilogram of beef is balanced by the consumption of 15 thousand litres of water, one kilogram of chocolate to 17 thousand litres of water. The paper industry consumes water mainly in the process of washing, filtering, bleaching, or shaping paper. One litre of paper consumes 300 litres of water. The location of large chemical companies is also often located near watercourses, due to their significant demand for water consumption. Water is used to produce products, but also for cooling or washing gases. This creates a large amount of wastewater, which is often suitable for recycling, up to 50%.

It is therefore necessary to treat water, its filtration, and other technologies, thanks to which it is possible to significantly reduce water consumption today.

RESOURCES

- 4 billion people face water shortages, scientists find [online]. World Economic Forum, 2016-02-17, [Accessed: 2018-08-15]. Available online.
- Coping with water scarcity. An action framework for agriculture and food stress [online]. Food and Agriculture Organization of the United Nations, 2012, [Accessed: 2018-08-15].Available online.
- ERCIN, A. Ertug; HOEKSTRA, Arjen Y.. Water footprint scenarios for 2050: A global analysis. Environment International. 2014-03, roč. 64, s. 71–82. Available online [Accessed: 2018-08-16]. ISSN 0160-4120. DOI:10.1016/j.envint.2013.11.019.
- Global Water Shortage Risk Is Worse Than Scientists Thought [online]. Huffingtonpost.com, 2016-02-15, [Accessed: 2018-08-15]. Available online.
- Half the World to Face Severe Water Stress by 2030 unless Water Use is "Decoupled" from Economic Growth, Says International Resource Panel | capacity4dev.eu. europa.eu [online]. [Accessed: 2018-08-16]. Available online.
- How do we prevent today's water crisis becoming tomorrow's catastrophe? [online]. World Economic Forum, 2017-03-23, [Accessed: 2018-08-15]. Available online.
- Human Development Report 2006 | Human Development Reports. hdr.undp.org[online]. [Accessed: 2018-08-16]. Available online.
- MCKIE, Robin. Why fresh water shortages will cause the next great global crisis. The Guardian [online]. 2015-03-08 [Accessed: 2018-08-16]. Available online.
- MEKONNEN, Mesfin M.; HOEKSTRA, Arjen Y.. Four billion people facing severe water scarcity. Science Advances. 2016-02-01, roč. 2, čís. 2, s. e1500323. Available online [Accessed: 2018-08-15]. ISSN 2375-2548. DOI:10.1126/sciadv.1500323. PMID 26933676.

- POSTEL, Sandra L.; DAILY, Gretchen C.; EHRLICH, Paul R.. Human Appropriation of Renewable Fresh Water. Science. 1996-02-09, roč. 271, čís. 5250, s. 785–788. Available online [Accessed: 2018-08-16]. ISSN 0036-8075. DOI:10.1126/science.271.5250.785.
- PROKURAT, Sergiusz. Drought and water shortages in Asia as a threat and economic problem.. Journal of Modern Science. 2015, roč. 26, čís. 3, s. 235–250. Available online[Accessed: 2018-08-16]. ISSN 1734-2031.
- SAVENIJE, H.H.G. Water scarcity indicators; the deception of the numbers. Physics and Chemistry of the Earth, Part B: Hydrology, Oceans and Atmosphere. 2000-01, roč. 25, čís. 3, s. 199–204. Available online [Accessed: 2018-08-16]. ISSN 1464-1909.DOI:10.1016/s1464-1909(00)00004-6.
- VÖRÖSMARTY, Charles J.; GREEN, Pamela; SALISBURY, Joseph. Global Water Resources: Vulnerability from Climate Change and Population Growth. Science. 2000-07-14, roč. 289, čís. 5477, s. 284–288. PMID: 10894773. Available online [Accessed: 2018-08-16].ISSN 0036-8075. DOI:10.1126/science.289.5477.284. PMID 10894773.
- Water, bron van ontwikkeling, macht en conflict [online]. 2012-01-08, [Accessed: 2018-08-16]. Available online.
- Water Scarcity | Threats | WWF. World Wildlife Fund [online]. [Accessed: 2018-08-16]. Available online.
- Water scarcity, risk and vulnerability. [s.l.]: UN Available online. ISBN 9789210576956. DOI:10.18356/6a10efec-en. S. 131–170.
- Water crises are a top global risk. World Economic Forum [online]. [Accessed: 2018-08-15]. Available online.
- Water recycling. [online]. [Accessed: 2018-10-07]. Available online.
- FANE, Simon. Wastewater reuse. [online]. [Accessed: 2018-10-07]. Available online.
- NAEVE, Linda. Rainwater Catchment and Reuse. [online]. [Accessed: 2018-10-07]. Available online.

- How does rainwater recycling work. [online]. [Accessed: 2018-10-07]. Available online.
- DOLEJŠ, Petr. Opětovné využií vody v ČR. Včetně odpadní. [online]. [Accessed: 2018-10-07]. Available online.
- Ministerstvo životního prostředí. Studie problematiky recyklace šedých vod v sídlech ČR. [online]. [Accessed: 2018-10-07]. Available online.
- HAVLOVÁ, Nina. Recyklace vody: Jeden z nejefektivnějších nástrojů v boji proti suchu.
- [online]. [Accessed: 2018-10-07]. Available online.
- Map details global water stress. [online]. BBC [Accessed: 2018-10-07]. Available online.
- 2.1 billion people lack safe drinking water at home, more than twice as many lack safe sanitation. [online]. WHO [Accessed: 2018-10-07]. Available online.

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