Safe Reuse of Wastewater Irrigation

Subjects: Environmental Sciences
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Due to climate change, two-thirds of mankind will face water scarcity by 2025, while by 2050, global food production must increase by at least 50% to feed 9 billion people. To overcome water scarcity, 15 million m3/day of untreated wastewater is used globally for crop irrigation, polluting the soil with pathogens, heavy metals and excess salts. Since 10% of the global population consumes food from crops irrigated with wastewater, pathogens transmitted through the food chain cause diseases especially in young children and women. We emphasize that irrigation offers real perspectives for large-scale recovery of wastewater, helping to reduce the deficit and conserve water resources, and increasing food safety, with the express mention that investments must be made in wastewater treatment plants and wastewater must be properly treated before recovery, to limit the risks on human health and the environment.

Keywords: wastewater reuse ; irrigation ; health risks

1. Water Scarcity

As a result of the development of different industries and activities that contribute to the increase in greenhouse gas emissions, climate change has become a reality that humanity faces every day. Climate change has significant negative effects on the quality and availability of water resources, food security and human health throughout the world. According to the Intergovernmental Panel on Climate Change, in 2017, global warming due to human activities reached an average of 1 °C above the pre-industrial levels [1]. By 2100, global mean temperature could increase by 3.5 °C compared to the same period mentioned above [2], with regional average variations of global temperatures between 1.4–5.8 °C [3]. It is predicted that climate change will account for about 20% of the global expansion in water scarcity [4], and this would affect the development and functioning of communities worldwide, both in social and economic terms.

Earth contains approximately 1351 million km^3 of water [5], of which only 3% is available freshwater resources suitable for drinking and irrigation [6]. In the ideal situation when all available water on Earth would have been evenly distributed to a uniformly distributed population, a report by FAO [4] mentions that each person would have had access to 5000–6000 m^3 of freshwater/year. Since experts claim that people experience water scarcity below a threshold of 1700 m^3/person, the ideal situation would have meant access to abundant freshwater resources for each person. In reality, however, neither freshwater resources nor the population is evenly distributed globally. Variable densities of human communities and uneven distribution of water resources, are factors that determine the manifestation of water scarcity at several levels of risk.

The scarcity of freshwater resources is influenced, among others, by the growth of population, urbanization, consumption per person, water pollution and climate change. Water scarcity is an important indicator of health, and an issue of poverty, which mostly affects the people in rural areas, where high population densities are prevailing [7]. A presumed 1.2 billion people live in river basins facing physical water scarcity, and another 1.6 billion live in water-deficient areas, where affordable water supply works are not available [7].

The intensity of water scarcity, either in a region or at the country level, is assessed as the water stress index, which is estimated as the ratio between the annual water withdrawal from ground and surface water to the total renewable freshwater resources [8]. Worldwide, 40% of the total land area is arid, semi-arid and dry-subhumid [9]. Half of the European countries are facing water stress, as stated by Bixio et al. [10] (Figure 1), and a survey by Aquarec [11] classified the Member States into four categories of risk according to the water stress index, highlighting that 10% of the European territory and 14% of the population were subjected to water scarcity.

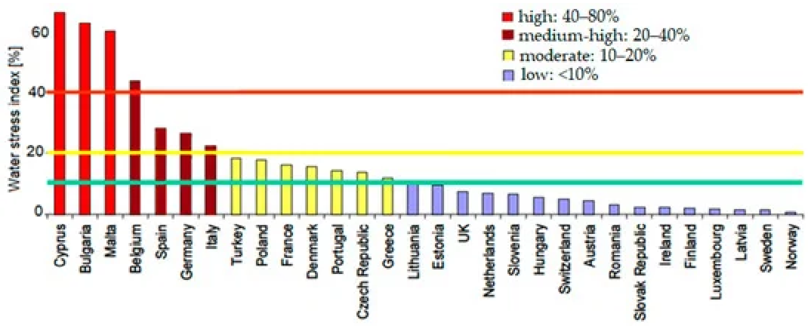

Figure 1. European Union member states ranked according to their water stress index (green, yellow and red horizontal lines represent the thresholds for low, moderate and high water stress, respectively) (adapted from [10]).

A report by FAO [12] explains that a country experiences water stress when it withdraws over 25% of its renewable freshwater resources; physical water scarcity occurs at over 60% withdrawals and severe physical water scarcity occurs at over 75% withdrawals. Thus, countries subjected to extremely high water stress (>80%) are Libya, Israel, Egypt, Jordan, Saudi Arabia, Turkmenistan and Uzbekistan, while high water stress (40–80%) affects China, India, Afghanistan and South Africa. The United States and Kazakhstan have low–moderate water stress (10–20%), and South America, Canada and Russia respectively, experience low water stress (<10%).

An analysis of data collected in 2019 by Aqueduct, a tool developed by World Resources Institute, was conducted by Hofste et al. [13] and found that water stress is extremely high in 17 countries, high in 27 countries, medium-high in 24 countries, low-medium in 32 countries and low in 63 countries. Nowadays, one-third of major cities are subjected to high or extremely high water stress [14] and at least 11% of the European population experiences water deficit [15]. Taking 2025 as a reference year, it was estimated that approximately 3.5 million people worldwide could experience water scarcity [16], while in developing countries 1.2 million people (with a risk of increase to 1.8 million) will live in water-scarce areas due to the absence of unreliable policies or convenient management strategies for reusing treated wastewater in crop production [7].

Water consumption registers a significant increase from year to year. A report released in 2017 by the European Environment Agency shows that in Europe, agriculture consumes 36% of total water use/year (and up to 60% during summer and to 80% in some southern European regions), public water demand consumes 32%, service sector 11% and other needs 21% [17].

Based on the evolution of freshwater withdrawals between 1960 and 2014 [14], it is concluded that agriculture is the largest global user of freshwater (70%) for crop cultivation and animal husbandry, registering an increase of 100% in the last century; the industry consumes 19%, meaning that industrial water demand increased three-fold in the last century; since the 1960s, the population grew by more than 4 billion and the withdrawals for domestic consumption increased by 600% (Figure 2).

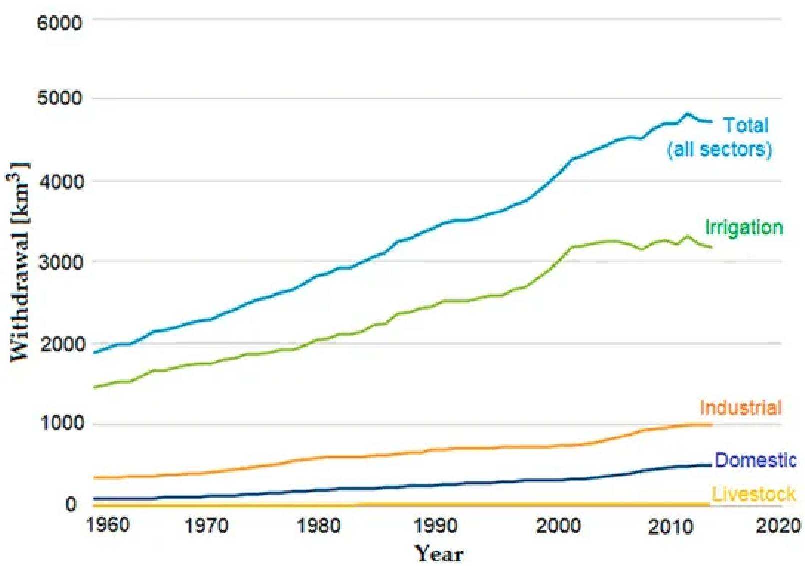

Figure 2. Global water withdrawals by sector, between the years 1960–2014 (data from [14]).

The economic and social well-being of any nation is in close correlation with the level of development in agriculture. Irrigation is the major consumer of fresh water in agriculture (70% of the overall withdrawal). An estimated 20% of the overall agricultural land is presently irrigated, contributing 40% of the total food production [18]. Worldwide, in 2011, the average cultivated cropland was 0.23 ha/person, with 0.17 ha/person in low-income countries, 0.23 ha/person in middle-income countries and 0.37 ha/person in high-income countries [19].

In 2010, about 16% of the world's cultivated cropland was equipped with irrigation systems [20], with shares of 70% in 15 Asian countries, 16% in America, 8% in Europe, 5% in Africa and 1% in Oceania [21], located thus: 70% in 15 Asian countries, 16% in America, 8% in Europe, 5% in Africa and 1% in Oceania. To the best of our knowledge, FAO has so far not published maps based on more recent or significantly different data than those in 2011. FAO reported that of the 219 million ha irrigated then in developing countries, 40 million ha were on arid and hyper-arid land, which could increase to 43 million ha by 2050 [19].

Worldwide, by 2050, the volume of water withdrawn for irrigation will increase to 2.9 thousand km^3, with most of the net increase arising in low-income countries [22] and the net global irrigated area will continue to increase by at least 20 million ha [23], almost entirely in land-scarce developing countries.

The increasing competition between the agricultural and domestic use of high-quality freshwater supply, mostly in arid, semi-arid and densely populated regions, will put even more pressure on the already scarce water resources. It was reported by FAO [4] that 2000–3000 L of water/person are consumed daily to ensure food needs, to which are added another 2–3 L necessary for drinking purposes and between 20–300 L for domestic purposes. For the latter category, it was estimated that in urban areas of developed countries, daily water consumption can vary from 15–55 L/person and up to 90–120 L/person [24]. By 2030, more than 160% of the total available water volume in the world will be needed to satisfy the global water requirements [25]. Demands for food production, water and energy are expected to expand by 35%, 40% and 50% respectively by 2030 [26], as consequences of demographic growth, economic development, improvement of living standards, pollution and climate change.

The growing scarcity of freshwater resources is currently one of the most important limiting factors for crop production and food security. The World Research Institute's Aqueduct tool [27] can predict the impact of irrigated or rain-fed agriculture (either at the global level or customized for a certain country), on each type of crop, under the influence of either water stress or seasonal variability, in terms of food demand for crops, total crop production, crop net trade, population at risk of hunger and kilocalories/person.

The diagram in Figure 3, generated using [27], shows the estimated situation at the global level, in areas with water stress, and in terms of total crop production, at a global level, when choosing the year 2040 as the baseline in the Aqueduct tool. The tool directly displays the percentage of all irrigated crop areas facing each level of water stress (vertical axis) and the volume of the demand (width of bars, delimited by the value intervals on the upper horizontal axis in Figure 3) for maize, rice, soybean and wheat. The interactive analysis of the diagram showed that the highest demand for food needs is estimated to be recorded for wheat crops. Thus, there is a projected 66.91% physical water risk (exposure to changes in water availability) for wheat to grow in areas with extremely high water stress. For maize crops, there is a 63.71% physical water risk to grow in areas with extremely high water stress, 19.43% for rice and 43.65% for soybean respectively, for the latter registering the lowest requirement for household use. Therefore, it is estimated that in 2040, there will be a reduced demand for soy to provide food at the household level, and the main crops will be wheat, rice and maize.

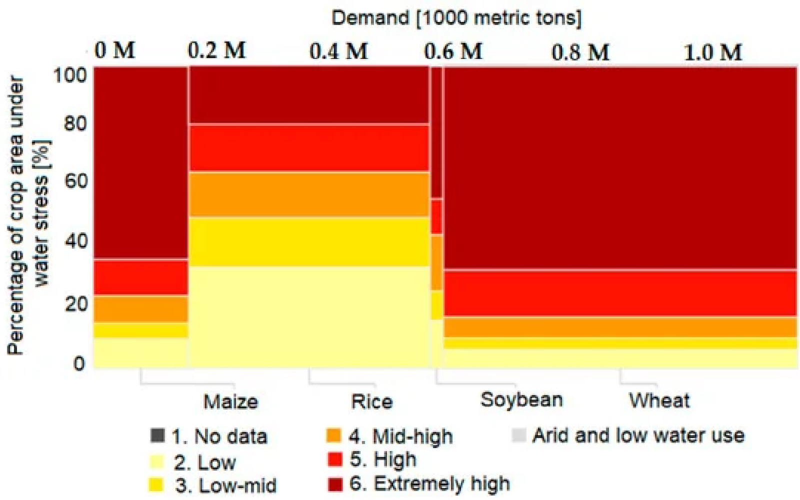

Figure 3. Projected percentage of irrigated crop area by water stress level and volume of demand in 2040, worldwide (diagram generated using [27]).

Studies in the literature mention different data for increasing the global food production needed to provide food for the 9 billion people [6] by 2015: 56% [28], 60% [7], respectively 70%[29] . Although some researchers [30][31] believe that this can be achieved through judicious distribution and use of freshwater resources, the farmers, who are typically very adaptable to changes, have already turned their attention to unconventional, alternative sources of water for crop irrigation, such as domestic and municipal wastewater (both treated and untreated). In order to control the current water deficit in Europe, the amount of municipal treated wastewater reused for crop irrigation should increase more than twice in 2025 compared to 2000 [15].

2. Recent Guidelines for the Safe Reuse of Wastewater Irrigation

Although the reuse of treated wastewater for agricultural crop irrigation is encouraged by governments and official entities around the world, only a few countries with higher income level have implemented different standards or directives on the physico-chemical and biological parameters of treated wastewater to protect human health and the environment when used in agriculture [32]. Low-income countries have no resources for wastewater treatment plants and no capacity to treat their wastewater properly, and hence they often use it as such, having no choice but to take the risks arising from these practices. Currently, in three out of four cities in developing countries, farmers are forced to use untreated or partially treated wastewater to irrigate their crops and provide their food needs [33]. It is estimated that in 2035, more than 5.5 billion people will live in areas without sewerage systems [34], and if we correlate with the water deficit, it is expected that in those areas, there will be an increase in the incidence of diseases caused by consumption of vegetables and fruits from crops irrigated with wastewater.

Usually, physico-chemical parameters including biological oxygen demand, chemical oxygen demand, nutrients, turbidity, pH, salinity (electrical conductivity and sodium absorption rate), suspended solids, heavy metals and microbiological parameters (Escherichia coli, Salmonella, Shigella, fecal coliforms, fecal enterococci, nematode eggs) are specified in guidelines regarding the capitalization of wastewater in agriculture. Regulations in various countries impose different limits for total coliforms (colony forming units/100 mL), fecal coliforms (colony forming units/100 mL), Escherichia coli (colony forming units/100 mL) and nematode eggs (number/L), and set the categories of crops and/or soils which can be irrigated with wastewater, depending on its quality.

In 2006, WHO provided a series of guidelines for the safe reuse of wastewater in agriculture, including treatment and non-treatment recommendations, covering the entire food chain. Worldwide, bacterial pathogens (Salmonella sp., Shigella sp., Legionella sp., Escherichia coli and Vibrio cholerae), helminths (Ascaris and Tenia sp.) and intestinal protozoans (Giardia and Crysptospridium) are of public health concern. Waterborne viruses like HAV, HEV, adenovirus and rotavirus pose the greatest risk of transmission through wastewater reuse [35]. Thus, the use of microbial indicators of fecal contamination has been considered by health and environmental authorities to be the most reliable method of monitoring water quality and the performance of water treatment systems [36].

The low uptake of water reuse practices is justified by the fact that until recently there were no unitary regulations at the European level regarding the recovery of wastewater [37]. However, to achieve unitary environmental and health standards in relation to food hygiene for agricultural products irrigated with treated wastewater, the quality of reclaimed water should not differ between the Member States.

On 25 May 2020, the European Commission published the new regulation on minimum requirements for water reuse for agricultural irrigation, which has entered into force but the new guidelines will be applied starting on 26 June 2023 and are expected to stimulate and facilitate water reuse in the European Union [38]. Table 1 presents the parameters that will be required for the quality of effluents used in crop irrigation.

Table 1. Quality requirements for reclaimed water intended for agricultural irrigation (data from [38]).

Minimum Quality Class	Indicative Technology Target	Quality Requirements			
		Escherichia coli [No./100 mL]	Biological Oxygen Demand [mg/L]	Total Suspended Solids [mg/L]	Turbidity [NTU]

In addition to the parameters specified in Table 1, regulation [38] also provides, for the four classes of effluent quality, the following: Legionella sp.: <1000 colony forming units/L, where there is a risk of aerosolization and intestinal nematodes (helminth eggs): ≤1 egg/L for irrigation of pastures of forage.

The implementation by the Member States of these minimum requirements will contribute to the achievement of the Sustainable Development Goals of the United Nations 2030 Agenda for Sustainable Development, where Goal 6 aims at ensuring the availability and management of water and sanitation for the global population, as well as a considerable boost in water recycling and safe water reuse globally [38]. Stronger guidelines and financial stimulus could help the European farmers to reuse more than 6000 million m^3 of water/year by 2025 [38].

To conclude, in the context of accentuating climate change and diminishing freshwater resources, wastewater can partially cover the need for water for irrigating agricultural crops. Although the reuse of wastewater brings many benefits in terms of reducing volumes discharged into receiving watercourses, as well as increasing crop yields and reducing the need for chemical fertilizers due to nutrients in wastewater, it should not be overlooked that untreated wastewater can have devastating effects on human health. Given the multitude of studies that address the growing practice of wastewater recovery, as well as the need to reduce risks to health and the environment, it is clear that the ideal option is to use only effluents of appropriate quality for crop irrigation. The newest and mandatory guidelines for the safe reuse of wastewater will significantly mitigate the risks to human health and the environment. Until their entry in force, the operators of wastewater treatment plants should improve their treatment methods and equipment so as to obtain polished effluents whose physico-chemical and bacteriological parameters fall within the regulated limits for reuse in agriculture.

In view of the above, the authors of this study strongly believe that supporting underdeveloped countries, which are most exposed to famine and serious diseases, in the construction of sewage systems, treatment plants to ensure effluents of appropriate quality from a microbiological and physico-chemical point of view and large-scale examples of good practices for the recovery of wastewater in irrigation that are currently implemented in developed countries, will contribute to the sustainability of water resources and the environment, agriculture and human life worldwide.

References

1. Allen, M.R.; Dube, O.P.; Solecki, W.; Aragon-Durand, F.; Cramer, W.; Humphreys, S.; Kainuma, M.; Kala, J.; Mahowald, N.; Mulugetta, Y.; et al. Framing and Context. In Global Warming of 1.5 °C—An IPCC Special Report on the Impacts of Global Warming of 1.5 °C Above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty; Masson-Delmotte, V., Zhai, P., Portner, H.-O., Roberts, D., Skea, J., Shukla, P.R., Pirani, A., Moufouma-Okia, W., Pean, C., Pidcock, R., et al., Eds.; IPCC: Geneva, Switzerland, 2018. Available online: https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_Chapter1_Low_Res.pdf (accessed on 17 October 2020).
2. Gerten, D.; Lucht, W.; Ostberg, S.; Heinke, J.; Kowarsch, M.; Kreft, H.; Kundzewicz, Z.W.; Rastgooy, J.; Warren, R.; Schellnhuber, H.-J. Asynchronous exposure to global warming: Freshwater resources and terrestrial ecosystems. Environ. Res. Lett. 2013, 8, 034032, doi:10.1088/1748-9326/8/3/034032.
3. DeNicola, E.; Aburizaiza, O.S.; Siddique, A.; Khwaja, H.A.; Carpenter, D.O. Climate Change and Water Scarcity: The Case of Saudi Arabia. Ann. Glob. Health 2015, 81, 342–353, doi:10.1016/j.aogh.2015.08.005.
4. Food and Agriculture Organization of the United Nations (FAO). Coping with Water Scarcity—Challenge of the Twenty-First Century, World Water Day. FAO: Rome, Italy, 2007. Available online: http://www.fao.org/3/a-aq444e.pdf (accessed on 16 September 2020).
5. Winpenny, J.; Heinz, I.; Koo-Oshima, S.; Salgot, M.; Collado, J.; Hernandez, F.; Torricelli, R. The Wealth of Waste. The Economics of Wastewater Use in Agriculture; FAO Water Reports 35; FAO: Rome, Italy, 2010. Available online: http://www.fao.org/3/i1629e/i1629e.pdf (accessed on 16 September 2020).
6. European Commission (EC). Water is Too Precious to Waste. 2018. Available online: http://ec.europa.eu/environment/water/pdf/water_reuse_factsheet_en.pdf (accessed on 2 September 2020).
7. Food and Agriculture Organization of the United Nations (FAO). Coping with Water Scarcity—An Action Framework for Agriculture and Food Security; FAO Water Reports 38; FAO: Rome, Italy, 2012. Available online: http://www.fao.org/3/a-i3015e.pdf (accessed on 15 September 2020).
8. Sofroniou, A.; Bishop, S.R. Water Scarcity in Cyprus: A Review and Call for Integrated Policy. Water 2014, 6, 2898–2928, doi:10.3390/w6102898.
9. Becerra-Castro, C.; Lopes, A.R.; Vaz-Moreira, I.; Silva, E.F.; Manaia, C.M.; Nunes, O.C. Wastewater reuse in irrigation: A microbiological perspective on implications in soil fertility and human and environmental health. Environ. Int. 2015,

75, 117–135, doi:10.1016/j.envint.2014.11.001.

10. Bixio, D.; Thoeye, C.; De Koning, J.; Joksimovic, D.; Savic, D.; Wintgens, T.; Melin, T. Wastewater reuse in Europe. Desalination 2006, 187, 89–101, doi:10.1016/j.desal.2005.04.070.
11. Aquarec. Report on Integrated Water Reuse Concepts; Wintgens, T., Hochstrat, R., Eds.; Sustainable Sanitation Alliance: Eschborn, Germany, 2006. Available online: https://www.susana.org/en/knowledge-hub/resources-and-publications/library/details/551.11 (accessed on 2 September 2020).
12. Food and Agriculture Organization of the United Nations (FAO). The Future of Food and Agriculture. Alternative Pathways to 2050; FAO: Rome, Italy, 2018. Available online: http://www.fao.org/3/I8429EN/i8429en.pdf (accessed on 17 September 2020).
13. Hofste, R.; Reig, P.; Schleifer, L. 17 Countries, Home to One-Quarter of the World's Population, Face Extremely High Water Stress; WRI: Washington, DC, USA, 2019. Available online: https://www.wri.org/blog/2019/08/17-countries-home-one-quarter-world-population-face-extremely-high-water-stress (accessed on 17 September 2020).
14. World Resources Institute. Aqueduct Country Rankings. 2020. Available online: https://www.wri.org/applications/aqueduct/country-rankings/ (accessed on 3 September 2020).
15. Lavrnić, S.; Zapater-Pereyra, M.; Mancini, M.L. Water Scarcity and Wastewater Reuse Standards in Southern Europe: Focus on Agriculture. Water Air Soil Pollut. 2017, 228, 251, doi:10.1007/s11270-017-3425-2.
16. World Resources Institute. Water. Mapping, Measuring, and Mitigating Global Water Challenge. 2020. Available online: https://www.wri.org/our-work/topics/water (accessed on 3 September 2020).
17. European Environment Agency (EEA). Is Europe's Freshwater Use Sustainable? 2017. Available online: https://www.eea.europa.eu/highlights/world-water-day-is-europe (accessed on 14 September 2020).
18. Food and Agriculture Organization of the United Nations (FAO). Irrigation Management—Factsheet; FAO: Rome, Italy, 2020. Available online: http://www.fao.org/3/a-i4591e.pdf (accessed on 13 September 2020).
19. Food and Agriculture Organization of the United Nations (FAO). The State of the World's Land and Water Resources for Food and Agriculture, Managing Systems at Risk; FAO: Rome, Italy, 2011. Available online: http://www.fao.org/3/i1688e/i1688e00.pdf (accessed on 13 September 2020).
20. Alexandratos, N.; Bruinsma, J. World Agriculture Towards 2030/2050 (The 2012 Revision); FAO: Rome, Italy, 2012. Available online: http://www.fao.org/fileadmin/templates/esa/Global_persepctives/world_ag_2030_50_2012_rev.pdf (accessed on 13 September 2020).
21. Siebert, S.; Burke, J.; Faures, J.M.; Frenken, K.; Hoogeveen, J.; Döll, P.; Portmann, F.T. Groundwater use for irrigation—A global inventory. Hydrol. Earth Syst. Sci. 2010, 14, 1863–1880, doi:10.5194/hess-14-1863-2010.
22. Bruinsma, J. The resources outlook: By how much do land, water and crop yields need to increase by 2050? In Looking Ahead in World Food and Agriculture: Perspectives to 2050; Conforti, P., Ed.; FAO: Rome, Italy, 2011.
23. Hertel, T.W.; Liu, J. Implications of water scarcity for economic growth. OECD Environ. Work. Pap. 2016, 109, doi:10.1787/19970900.
24. Nolde, E. Greywater reuse systems for toilet flushing in multi-storey buildings—Over ten years experience in Berlin. Urban Water 2000, 1, 275–284, doi:10.1016/s1462-0758(00)00023-6.
25. Vo, P.T.; Ngo, H.H.; Guo, W.; Zhou, J.L.; Nguyen, P.D.; Listowski, A.; Wang, X.C. A mini-review on the impacts of climate change on wastewater reclamation and reuse. Sci. Total. Environ. 2014, 494–495, 9–17, doi:10.1016/j.scitotenv.2014.06.090.
26. Endo, A.; Tsurita, I.; Burnett, K.; Orencio, P.M. A review of the current state of research on the water, energy, and food nexus. J. Hydrol. Reg. Stud. 2017, 11, 20–30, doi:10.1016/j.ejrh.2015.11.010.
27. World Research Institute. Aqueduct Food. 2020. Available online: https://www.wri.org/applications/Aqueduct/food/#/ (accessed on 10 September 2020).
28. World Research Institute. Supporting Agriculture, Environment, and Sustainable Development. 2020. Available online: https://www.wri.org/our-work/topics/food (accessed on 10 September 2020).
29. Cossio, C.; Perez-Mercado, L.F.; Norrman, J.; Dalahmeh, S.S.; Vinnerås, B.; Mercado, A.; McConville, J. Impact of treatment plant management on human health and ecological risks from wastewater irrigation in developing countries—Case studies from Cochabamba, Bolivia. Int. J. Environ. Health Res. 2019, 29, 1–19, doi:10.1080/09603123.2019.1657075.
30. De Fraiture, C.; Wichelns, D. Satisfying future water demands for agriculture. Agric. Water Manag. 2010, 97, 502–511, doi:10.1016/j.agwat.2009.08.008.

31. Springer, N.P.; Duchin, F. Feeding Nine Billion People Sustainably: Conserving Land and Water through Shifting Diets and Changes in Technologies. Environ. Sci. Technol. 2014, 48, 4444–4451, doi:10.1021/es4051988.
32. Ungureanu, N.; Vlăduț, V.; Zăbavă, B.Ș.; Andrei, P.; Constantinescu, M. Current state of wastewater use in irrigated agriculture. Ann. Univ. Craiova Agric. Montanology Cadastre Ser. 2018, 48, 417–424.
33. International Water Management Institute. Recycling Realities: Managing Health Risks to Make Wastewater an Asset; Water Policy Briefing 17; IWMI and GWP: Colombo, Sri Lanka, 2006.
34. Loufty, N.M. Reuse of wastewater in Mediterranean region, Egyptian experience. In The Handbook of Environmental Chemistry; Barcelo, D., Petrovic, M., Eds.; Springer-Verlag: Berlin/Heidelberg, Germany, 2010.
35. World Health Organization (WHO). Guidelines for the safe use of wastewater, excreta and greywater. In Wastewater Use in Agriculture; WHO: Geneva, Switzerland, 2006.
36. Chibuike, G.U.; Obiora, S.C.; Chibuike, G.U. Heavy Metal Polluted Soils: Effect on Plants and Bioremediation Methods. Appl. Environ. Soil Sci. 2014, 2014, 1–12, doi:10.1155/2014/752708.
37. Petousi, I.; Daskalakis, G.; Fountoulakis, M.; Lydakis, D.; Fletcher, L.; Stentiford, E.; Manios, T. Effects of treated wastewater irrigation on the establishment of young grapevines. Sci. Total. Environ. 2019, 658, 485–492, doi:10.1016/j.scitotenv.2018.12.065.
38. European Commission (EC). Regulation EU 2020/741 of the European Parliament and of the Council, on Minimum Requirements for Water Reuse; European Commission: Brussels, Belgium, 2020. Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020R0741&from=EN (accessed on 1 September 2020).