

Review

Water pollution: Sources, Impacts on the Environment, and Health

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Abstract: Since the beginning of time, clean and fresh water has been essential for drinking, sanitation, supplying animals and crops, as well as for the development and maintenance of the ecosystems that support all life. The aim of this brief study is to outline the key health and environmental hazards associated with numerous harmful contaminants found in all forms of water, according to their sources and nature. The review indicates that, in the worst-case scenario, inhabitants might be at risk for developing cancer due to pollutants in the aquatic ecosystem. However, this sort of all-encompassing approach could assist in reducing such issues by optimizing and controlling pollutant remediation through the use of various wastewater treatment technologies, including adsorption, photocatalysis, etc.

Keywords: Water sources; Wastewater; Pollution; Health risk; Environmental risk.

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1. Introduction

Since the beginning of time, Carbon and water have been the fundamental elements of life on the planet. While the environmental circumstances on the surfaces of the other planets and satellites in the Solar System are not advantageous to life, the Earth is the only "habitable planet sensu stricto" in which water is stable at a planet's surface[1].



Figure 1. Water in nature: Mediterranean Sea, Algeria.

Groundwater is a practically ubiquitous source of typically excellent pure water on the face of the earth (Figure.2). These properties encourage broad development, which can be scaled and localized to meet demand without the need for extensive infrastructure. Groundwater accounts for one-third of all freshwater withdrawals globally, accounting for 36%, 42%, and 27% of water utilized for household, agricultural, and industrial uses, respectively[2,3]. Palaeohydrological evidence from local aquifer systems in semi-arid and arid regions of the world may be used to estimate the long-term responses of groundwater to climatic forcing, which are essentially independent of human activity. Figure.3 illustrates the large surface area of the so-called Northwest Sahara aquifer system in northern Africa (Algeria, Tunisia, Libya, Egypt, etc.)[4].

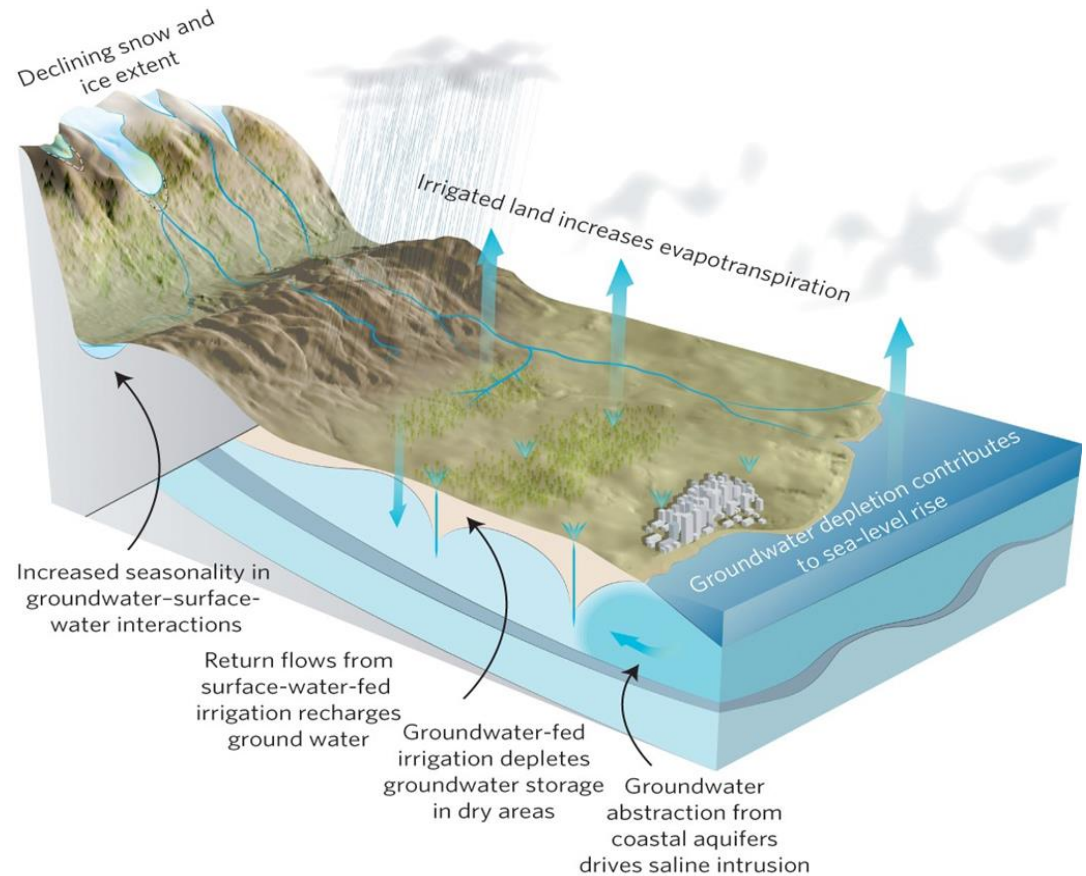


Figure 2. Graphical representation of the hydrologic cycle: fundamental interchanges between groundwater and environment [2].

2. Water Pollution, Pollutants

2.1. Water Pollution definition

2.1.1. definition 1

Water pollution occurs when pollutants contaminate water sources and render the water unfit for use in drinking, cooking, cleaning, swimming, and other activities. Chemicals, trash, bacteria, and parasites are all examples of pollutants. All types of pollutants ultimately end up in water. In general, a material is defined as a pollutant if it depletes resources or has negative impacts on the environment after being released into it. Pollutants may result in long- or short-term harm. Nonbiodegradable pollutants are the main environmental danger since biodegradable pollutants have only a short-term harmful impact [5].

2.1.2. definition 2

Water pollution occurs whenever harmful substances, most frequently chemicals or bacteria, enter a stream, river, lake, ocean, aquifer, or other body of water, their presence degrades the water's quality and makes it potentially toxic for humans or the whole ecosystem [6,7].

2.1.3. definition 3

The creation and/or introduction of chemicals or energy into the environment by humans, whether directly or indirectly, is referred to as pollution. Numerous human activities result in the release of different contaminants into aquatic habitats, endangering the health of living things and degrading the ecosystem by making water bodies unusable [8,9].

2.2. Sources of Water Pollution

Water pollution has a wide range of causes, but it may be divided into two primary classifications: direct and indirect pollutant sources. Additionally, pollutants may be generically categorized into organic, inorganic, radioactive, and acid/base groups, each of which can be directly tied to their origins [10-11].

Many human activities have the potential to degrade the quality of our rivers, lakes, oceans, and groundwater. Water quality is impacted by direct inputs, such as those from a factory or sewage treatment facility, which are referred to as "point sources of pollution." It is also impacted by pollution from several sources, including nutrients and pesticides from agricultural activities and pollutants emitted into the air by industry, which subsequently fall back to land and water, a phenomenon known as "diffuse pollution."

The major source of pollution to water is sewage and wastewater treatment, whereas the main sources of diffuse pollution are farmland and fossil fuel power plants (through the air). It is important to note that while sewage treatment plants are designated as a "point source," they are not the real source because they treat what we put down on our toilets and sinks.

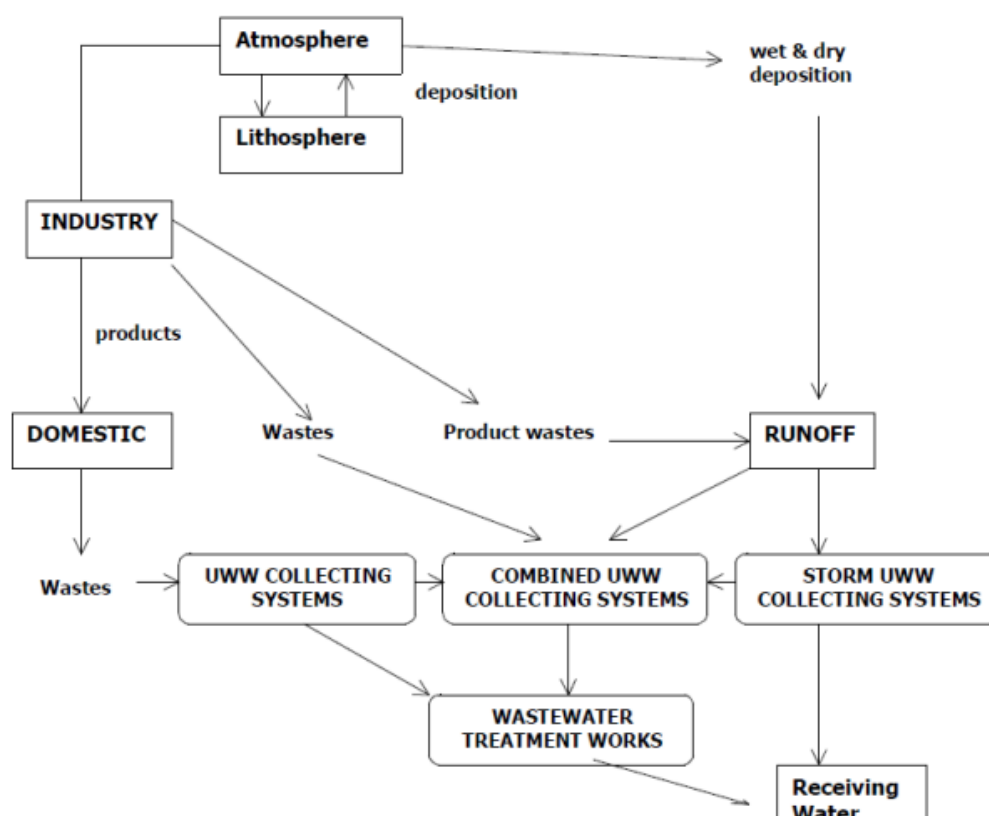


Figure 4. Graphical representation of sources of pollution [12].

2.3. Water quality standards

Various health institutions have recommended standards for all kinds of water. Specific instances of such organizations include the United States Public Health Service Drinking Water Standards (USPHS), the Indian Council of Medical Research (ICMR), and

the World Health Organization. Water quality has a direct impact on human health; hence standards are critical. Table 1 shows the water quality requirements imposed b

y several authorities for inland water [13].

Table 1. Water quality standards [13].

Parameter	USPHS	BIS	WHO	ICMR
Temperature °C	-	40.0	-	-
EC Sm ⁻¹	0.03	0.075	-	-
pH	6.0-8.5	6.5-8.5	7.0-8.5	6.5-9.2
DO mg.L ⁻¹	>4.0	>5.0	-	-
BOD mg.L ⁻¹	-	<3.0	-	-
COD mg.L ⁻¹	-	<20.0	-	-
Chloride mg.L ⁻¹	250	250	200	250
Alkalinity mg.L ⁻¹	-	-	-	81-120
Nitrate mg.L ⁻¹	10.0	50.0	45.0	20.0
Phosphate mg.L ⁻¹	0.1	-	-	-
Sulphate mg.L ⁻¹	250	150	200	200
Total hardness mg.L ⁻¹	500	300	100	300
Total solids mg.L ⁻¹	500	-	500	-
Calcium mg.L ⁻¹	100	75	75	75
Magnesium mg.L ⁻¹	-	30	-	50
Potassium mg.L ⁻¹	-	-	-	20
Sodium mg.L ⁻¹	-	-	50	-

- Not available; USPHS: U.S. Public Health Service Drinking Water; BIS: Business Integrity Services; WHO: World Health Organization; ICMR: Indian Council of Medical Research; EC: Electrical Conductivity; pH: Potential of Hydrogen; DO: Dissolved Oxygen; BOD: Biochemical Oxygen Demand; COD: Chemical Oxygen Demand.

3. Effects on the Environment and human health

3.1. Health risk of water pollution

In general, the largest concerns of water pollution are related to the human impacts of polluted water from various human activities. Table 2 and Figure 5 depict numerous human dangers induced by various types of pollution that really endanger human life and the future [14-16]. For the Organic pollutants, Although the pollutant concentrations do not exceed the permissible limits for drinking water, the carcinogenic risk assessment for the district's diverse communities and the overall population reveals an increased risk of cancer [17] as shown in Table 2. For the inorganic pollutants, Humans have serious health issues as a result of trace element emissions, and these pollutants build up in our bodies through the food chain [18]. The most hazardous section of these pollutants is heavy metal, which causes a variety of severe illnesses, as detailed in Table 2. To conclude, the organic contaminants in the water and their concentrations do not cause an increase in non-carcinogenic occurrences in the residents who utilize the monitored water sources.

3.2. Environmental risk of water pollution

More than 80% of dirty water has been utilized for irrigation in poor nations across the world, with just 70% to 80% food and living security in industrialized metropolitan and semi-urban regions. Water pollution has an impact on the health and quality of soils and vegetation; some of the impacts of water pollution are obvious but difficult to reverse; also, water pollution affects our seas, lakes, rivers, and drinking water, making it a widespread and worldwide problem [19].

4. Conclusions

In conclusion, this reviewed short-report gives a main health and environmental risk assessment of many harmful contaminants (Organic and/or Inorganic elements) in all types of water: tap water, well water irrigation water, etc; depending on their origins and characteristics. According to the analysis, toxins in the water environment may pose a carcinogenic danger to inhabitants in the worst-case scenario. However, this sort of generalized approach might assist minimizing such concerns by optimizing and controlling

pollutant removal via the use of various wastewater treatment processes such as adsorption, photocatalysis, etc.

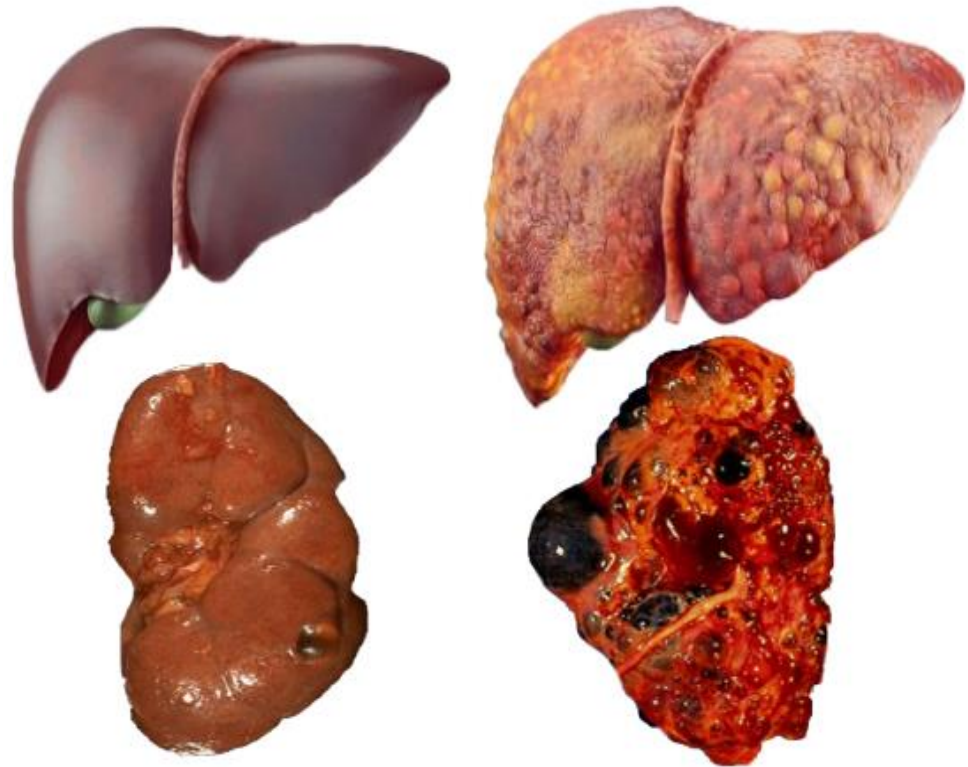


Figure 5. Effects of water pollution on human organs.

Table 2. Health effects of several water pollutants [14].

Pollutant	Health effects
Nitrate	Shortness of breath and blue baby syndrome for infants
Nitrite	Shortness of breath and blue baby syndrome for infants
Chromium tot	Allergic problems
Arsenic	Skin damage and circulatory system problems; increased risk of lung, bladder, or skin cancer
Fluoride	Bone fluorosis
Copper	Gastrointestinal effects, liver, and kidney damage
Lead	Children: delay in physical and mental development; Adults: kidney damage
Cadmium	Kidney damage
Mercury	Kidney damage
Manganese	Neurological effect
Nickel	Allergic effect
DDT	Liver cancer
DDD	Liver cancer
DDE	Liver cancer
γ -HCH	Liver and kidney problems

DDT: *p,p'*-dichlorodiphenyltrichloroethane; DDD: *p,p'*-dichlorodiphenyl dichloroethane; DDE: *p,p'*-dichlorodiphenyldichloroethylene; γ -HCH: gamma-hexachlorocyclohexane.

References

- Westall, F.; Brack, A. The importance of water for life. *Space Sci. Rev.* **2018**, *214*, 1-23.

2. Taylor, R. G.; Scanlon, B.; Döll, P.; Rodell, M.; Van Beek, R.; Wada, Y.; Treidel, H. Ground water and climate change. *Nat. Clim. Change* **2013**, 3, 322-329.
3. Döll, P.; Hoffmann-Dobrev, H.; Portmann, F. T.; Siebert, S.; Eicker, A.; Rodell, M.; Scanlon, B. R. Impact of water withdrawals from groundwater and surface water on continental water storage variations. *J Geodyn* **2012**, 59, 143-156.
4. Struckmeier, W. Groundwater Resources of the World (1:25,000,000); BGR & UNESCO World-wide Hydrogeological Mapping and Assessment Programme, 2008.
5. Chaudhry, F. N.; Malik, M. F. Factors affecting water pollution: a review. *J. Ecosyst. Ecography* **2017**, 7, 225-231.
6. Guide, Water Pollution: Everything You Need to Know. <https://www.nrdc.org/stories/water-pollution-everything-you-need-know#whatis>
7. Remmani, R. Illizi Groundwater treatment by Acacia gum: organic pollution removal. *JARA* **2022**, 14, 53-59.
8. Bashir, I.; Lone, F. A.; Bhat, R. A.; Mir, S. A.; Dar, Z. A.; Dar, S. A. Concerns and threats of contamination on aquatic ecosystems. *Bioremediat J.* **2020**, 1-26.
9. Remmani, R.; Makhloufi, R.; Miladi, M.; Ouakouak, A.; Canales, A. R.; Núñez-Gómez, D. Development of low-cost activated carbon towards an eco-efficient removal of organic pollutants from oily wastewater. *Pol. J. Environ. Stud.* **2021**, 30, 1801-1808.
10. Owa, F. D. Water pollution: sources, effects, control and management. *Mediterr. J. Soc. Sci.* **2013**, 4, 65.
11. Remmani, R.; Núñez-Gómez, D.; Makhloufi, R.; Miladi, M.; Sezgin, N.; Piccinetti, L. Adsorption of crystal violet dye from aqueous media by algerian clay: studies on equilibrium isotherm, kinetic and thermodynamic of interaction. *PONTE* **2021**, 77.
12. McMonagle, H. Evaluation of the Role of Advanced Wastewater Treatment in Removal of Priority Pollutants From Municipal Point-Discharges; Doctoral dissertation, Dublin City University. Oscail, 2013.
13. Dwivedi, A. K. Researches into water pollution: A review. *IRJNAS* **2017**, 4, 118-142.
14. Törnqvist, R.; Jarsjö, J.; Karimov, B. Health risks from large-scale water pollution: trends in Central Asia. *Environ. Int.* **2011**, 37, 435-442.
15. World Health Organization. Hardness in drinking-water: background document for development of WHO guidelines for drinking-water quality (No. WHO/HSE/WSH/10.01/10). World Health Organization, 2010.
16. World Health Organization. Guidelines for drinking-water quality: second addendum. Vol. 1, Recommendations. World Health Organization, 2008.
17. Pawełczyk, A. Assessment of health risk associated with persistent organic pollutants in water. *Environ. Monit. Assess.* **2013**, 185, 497-508.
18. Borah, P.; Kumar, M.; Devi, P. Types of inorganic pollutants: metals/metalloids, acids, and organic forms. In *Inorganic pollutants in water*; Publisher: Elsevier, 2020, pp. 17-31.
19. Khan, M. A.; Ghouri, A. M. Environmental pollution: its effects on life and its remedies. *RW-JASCR* **2011**, 2, 276-285.

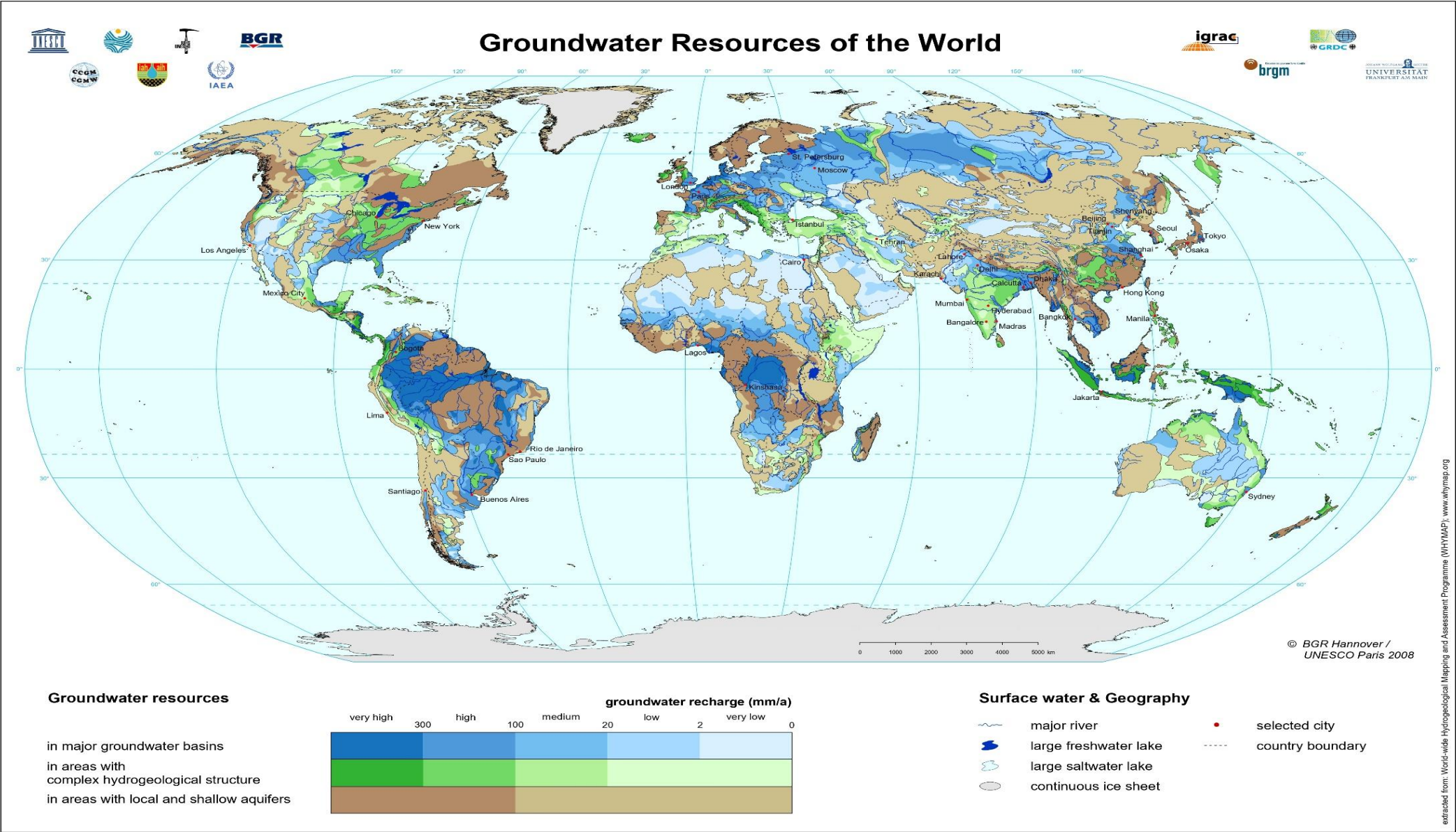


Figure 3. Simplified version of a global groundwater resources map showcasing local aquifer systems[4].