

# Addressing Water Pollution as a Means to Achieving the Sustainable Development Goals

Fatine Ezbakhe\*

Department of Civil and Environmental Engineering, Barcelona School of Civil Engineering, Polytechnic University of Catalunya, Spain

\*Corresponding author: Fatine Ezbakhe, Department of Civil and Environmental Engineering, Barcelona School of Civil Engineering, Polytechnic University of Catalunya, Spain, Tel: (34)934017094; E-mail: fatine.ezbakhe@upc.edu

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## Abstract

Water pollution remains a major challenge in today's world and addressing it has become a top priority for sustainable development. The 2030 Agenda for Sustainable Development brings water quality issues to the forefront of international action by setting a specific goal (SDG 6: ensure availability and sustainable management of water and sanitation for all) aiming to respond to the pressing challenges posed by water pollution. However, how does water pollution relate to the rest of SDGs? The answer to this question-which is important to identify and understand key development concerns related to water quality-is the purpose of this paper. A descriptive research is undertaken to highlight the interdependencies between water pollution and the 2030 Agenda. The findings confirm two key points: (i) there are many pathways by which water pollution can hinder the realization of various SDGs and (ii) water quality can also benefit from the achievement of SDGs. Although not exhaustive, this descriptive analysis of the links between water pollution and SDGs can provide some insight to practitioners, researchers and policy-makers addressing the water pollution challenge.

**Keywords:** Water pollution; Water resources quality; Sustainable development goals; Sustainability relationships

industry and decline of amenities [1]. Sources of water pollution are diverse and include, amongst others: pipes or man-made channels containing waste matter or sewage, agricultural runoff containing chemicals such as herbicides and pesticides, river and marine dumping of waste materials, heavy metals from oil and gas exploration, thermal pollution from power plants [2].

Water pollution has been documented as a contributor to a wide range of hazards for human health and ecosystems. Polluted water is more likely to host disease vectors, such as cholera-causing *Vibrio* and parasitic worm-transmitted schistosomiasis [3]. It is estimated that 80% of all infectious diseases worldwide are linked to unsafe water [4] and that 3.4 million people, mostly children, die each year from polluted water [5].

Polluted water from industrial and agricultural activities can contain many metals (e.g. arsenic, cadmium and mercury) and synthetic organic compounds (such as pesticides and PCBs) that are toxic to people at high concentrations [6]. These pollutants can accumulate in groundwater, contaminate aquifers and cause human poisoning [7]. Water with excessive nutrient loading can lead to the eutrophication of water and soil, as well as harmful algal blooms threatening aquatic biodiversity [8]. Moreover, newly emerging pollutants like pharmaceuticals and personal care products present in water add more pressure to our water resources, with still undefined long-term effects on human health and ecosystems [9].

As the world's population grows and the sources for water pollution multiply, the quality of water is more likely to worsen, with the consequent human health and environmental risks as well as social and economic problems. As the UNESCO [10] states, water quality problems bring new threats to water security and sustainable development and represent a major challenge in both developed and developing countries. That is why addressing water pollution issue has become a top-priority in the international agenda. With the 2030 Agenda and the Sustainable Development Goals (SDGs), water quality issues are now at the forefront of international action. Goal 6 specifically aims to 'ensure availability and sustainable management of water and sanitation for all' to

## Introduction

Water pollution is a major challenge in the 21st century. In a world where freshwater demand is ever growing and water resources are limited, water pollution places an additional pressure to the already stressed water supplies. Water pollution means the introduction by man, both direct or indirectly, of substances or energy that result in adverse effects as: harm to living resources, hazard to human health, hindrance to aquatic activities, loss of water quality with respect of its use in economic activities like agriculture and

respond to the serious challenges posed by water quality issues.

Water quality is also explicitly addressed under other SDGs such as the goals on poverty reduction, health, sustainable consumption and production and life on land. In addition to these direct links, there are many indirect links between water quality issues and sustainable development. However, an effort to better understand these linkages and interrelationships has not yet been undertaken.

The purpose of this paper is to highlight the interdependencies between water pollution and the Goals in the 2030 Agenda. What this paper aims to do is describe the many pathways by which water pollution control can play a role in realizing the various goals and how achieving the SDGs can also impact water quality in a beneficial manner. Although not exhaustive, this descriptive research can serve as a first step of comprehending and raising awareness on critical linkages of water quality with other development aspects.

It is my belief that a better understanding of the potential connections between water pollution and SDGs is key to enhance and accelerate action to tackle water quality issues. The value added of this analysis resides in its attempt to start a process of connecting water pollution-related concerns to the 2030 Agenda, which can provide an insight for practitioners, researchers and policy-makers working towards water pollution control.

The remainder of this paper is built as follows. Section 2 summarizes the 2030 Agenda for Sustainable Development. In Section 3, I analyze and describe the linkages among water pollution and SDGs. Section 4 concludes the paper by discussing the importance of water pollution SDG connections identified.

## Sustainable Development Goals

The 2030 Agenda for Sustainable Development, adopted by world leaders in September 2015 at a historic United Nations summit, is underpinned by 17 Sustainable Development Goals (SDGs) and their associated 169 targets [11].

The idea behind these SDGs, illustrated in **Figure 1** is to promote human dignity and prosperity while protecting the planet from degradation.

They recognize that eradicating poverty and inequality must go hand in hand with policies that support sustainable economic growth; address fundamental social needs such as health, education and job opportunities; and do all this while also enhancing environmental protection and tackling climate change. The complete list of SDGs and targets can be found elsewhere [12].



**Figure 1** Sustainable Development Goals (SDGs) [13].

The 2030 Agenda for Sustainable Development is often referred to as an 'integrated agenda' or 'indivisible whole' [14]. This is because all three dimensions of sustainable development-economic, social and environmental are intertwined in the agenda. While most of the SDGs focus on one of these pillars, most address all three dimensions within their targets. Moreover, there are important interactions between SDGs, many leading to trade-offs and conflicts between goals. Understanding and articulating these inter-linkages is important to help policy-makers, investors and other stakeholders in identifying and managing the benefits and risks of achieving the different goals and targets [15]. This is seen as necessary to formulate better policies and strategies that foster synergies across goals and address potential tradeoffs amongst them [16].

Several efforts have been made to better understand the nature and dynamics of the interactions that exist among the SDGs. Studies of the relationships among one SDG and the others have been done for SDG 1 [17], SDG 4 [18,19], SDG 6 [20] and SDG 14 [16]. Other studies have been published documenting linkages amongst all SDGs [21,13]. This paper intends to develop a similar description for water pollution.

## Understanding the links between water pollution and SDGs

This section will take a first step in exploring and describing the inter-linkages between water pollution and SDGs. It is not, however, intended to be an exhaustive mapping of all potential links, but a starting point to inform and understand them.

**SDG 1. No poverty:** Goal 1 calls for ending poverty everywhere. In particular, it calls for eradicating extreme poverty (1.1), reducing the proportion of the population living in poverty in all its dimensions (1.2), implementing social protection measures to cover the poor and the vulnerable (1.3), ensuring universal access to basic services such as food, water and sanitation, energy and housing (1.4) and building the resilience of the poor to climate-related extreme events (1.5).

Water-associated diseases due to contaminated water affect people in similar ways, but poverty increases the exposure of the impoverished to water pollution. This is because the poor may lack access to improved sources of water and may be forced to use polluted water (not only with biological waste, but also industrial chemicals) for drinking, cooking and washing purposes [22]. The healthcare costs and income losses associated to the consumption of polluted water may further accentuate poverty [23]. Poverty can also be a source of water pollution itself: the lack of proper sanitation facilities amongst the poor can lead to fecal pollution, which constitutes a main source of water contamination. In Mumbai, for example, a study of 1,070 households in settlements of the urban poor revealed that water-related diseases were positively correlated with poverty related factors, such as low income and poor housing [24].

Poor water quality also has significant economic impacts, hindering the overall socio-economic development of communities and countries. In developing countries, it is estimated that USD260 billion per year are lost due to poor sanitation and water provision [25]. This does not only slow socio-economic development, but can also affect the activities that generate employment opportunities. For instance, in Africa, agriculture constitutes the main source of income and accounts for 60% of the labor force [26]. The degradation of natural resources such as land, soil and water due to water pollution could reduce the viability of agricultural activities, on which many poor people depend throughout the continent. Consequently, water pollution control can play a role in reducing the burden of disease and unemployment among the most vulnerable members of society and in contributing to the alleviation of poverty.

**SDG 2. End hunger:** Goal 2 aims to end hunger, achieve food security and improved nutrition, together with promoting sustainable agriculture, by: ensuring that everyone has access to safe and sufficient to food (2.1), ending all forms malnutrition (2.2), increasing the agricultural productivity and incomes of small-scale food producers (2.3), implementing sustainable and resilient agricultural practices (2.4) and maintaining the genetic diversity of seeds, plants and animals (2.5).

Unsafe drinking water has been found to be directly linked to adverse nutrition outcomes [27]. It is estimated that 50% of malnutrition in children under the age of five is related to diarrhea due to unsafe drinking water [28]. Controlling water pollution can thus help address under nutrition.

Besides, water pollution can be both the root and product of unsustainable agriculture. On one hand, overuse or contamination of water resources can threaten food production. In China, for example, inadequate quality of surface waters has led to the use of contaminated water for irrigation, resulting in severe food and agricultural land pollution, particularly from heavy metals [29]. On the other hand, unsustainable agricultural practices, where synthetic fertilizers and pesticides are over-applied, can cause serious environmental problems – including water pollution – which

ultimately undermine the quality of water for agriculture and other uses [30].

**SDG 3. Good health and well-being:** Goal 3 seeks to ensure health and well-being for all, at every stage of life. Nine different targets underpin this goal: reducing morbidity and mortality of vulnerable groups, such as mothers (3.1) and newborns and children under five (3.2), decreasing communicable (3.3) and non-communicable (3.4) diseases, reducing risk from substance abuse (3.5), road traffic (3.6) and hazardous chemicals and pollution (3.9) and providing health care coverage (3.8), in particular for sexual and reproductive services (3.7).

Targets 3.3 and 3.9 explicitly mention the need of reducing water-borne diseases and other illnesses and deaths caused by water pollution. Evidence shows that unsafe treatment and disposal of wastewaters, which leads to the contamination of water resources, diminishes health gains [31,32]. This can have severe repercussions, as 90% of all wastewaters in developing countries are released untreated into water effluents [33]. Water pollution is not only detrimental to the environment, but also to human health [34]. This is why tackling water pollution should be viewed as a priority for promoting healthy lives and well-being of all people.

**SGD 4. Quality education:** Goal 4 calls for ensuring inclusive and equitable quality education, as well as promoting lifelong learning opportunities for all. Targets go from ensuring that all children have access to quality education (4.1) and early childhood development (4.2), to increasing the number the adults with quality education (4.3), relevant skills for employment (4.4) and literacy levels (4.6), reducing gender disparities in education (4.5) and providing all learners with the needed knowledge for sustainable development promotion (4.7).

By improving access to safe water and sanitation, children may have more chance of a better education. In India, school-latrines construction programs were found to increase enrollment of girls and boys [35]. Furthermore, water pollution has been found to be linked to children's education. A study conducted on school children aged 9-12 in Jamaica found out that absenteeism was more frequent among Trichuriasis infected children, a disease strongly related to inadequate sanitation [36]. This study also showed that there was a direct correlation between the intensity of the infection in children and their cognitive abilities.

Achieving quality education can also help shift towards cleaner, more sustainable practices, including water quality, as it can enable the promotion of future engagement on pollution matters [22]. For example, water quality monitoring projects in Indian schools provided an opportunity for children to understand the effects of water pollution, which made them more able to participate in finding a solution [37].

**SDG 5. Gender equality:** In Goal 5, the aim is to achieve gender equality and empower all women and girls, by: ending all forms of discrimination (5.1), violence (5.2) and harmful practices (5.3) against women and girls, recognizing the value of unpaid care and domestic work (5.4) and ensuring equal

opportunity in decision-making (5.5) and access to sexual and reproductive health care (5.6).

Access to safe water and sanitation can expand the number and range of opportunities for girls and women, as they are the ones usually responsible for fetching water from distant sources [38]. Gender-disaggregated data on water collection shows that 40 and 90% of the households of rural Asia and sub-Saharan Africa depend on women and girls, respectively [38]. Hence, as stated by Jans and Wilbur [39], a gendered and rights-based approach to water, sanitation and hygiene could contribute to gender equality and women empowerment.

Gender relationships can also have consequences for the degree of exposure to water pollution. For instance, pesticide contaminated waters pose a particular risk for women because of their physiological characteristics (i.e. higher body fat levels and hormonally sensitive tissues where pesticides can accumulate) [40]. In particular, Watts [41] reports a link between breast cancer rates and exposure to pesticides. These gender differences should be taken into account when developing and implementing policies and interventions aimed at tackling water pollution.

**SDG 6. Clean water and sanitation:** Contrary to the Millennium Development Goals, water has been given its own dedicated goal in the Sustainable Development agenda. SDG 6 calls for ensuring availability and sustainable management of water and sanitation for all. In particular, it calls for achieving universal access to safe water (6.1) and sanitation (6.2), improving water quality by reducing water pollution (6.3), increasing water-use efficiency across all sectors (6.4), managing water resources in an integrated manner (6.5) and protecting water-related ecosystems (6.6).

Clearly, the target expressly dedicated water pollution reduction cannot be treated in isolation, but requires exploiting synergies between water uses and water quality [20]. For example, inadequate sanitation can play an important role in creating water pollution and maintaining harmful water quality. In Cambodia alone, it was found that poor sanitation caused nearly 188USD million in water costs [42]. These costs were associated to the need for cleaner water and the loss in fish production due to polluted water. Improving access to safe sanitation is thus crucial to minimize the release of hazardous pollutants to bodies of water. Furthermore, improving sanitation should involve all the 'sanitation chain': not only the technical aspects such as the toilet or the wastewater treatment plants, but also the experience of the user, the management of sewage and fecal sludge and its reuse or disposal [43].

Inadequate water quality due to contamination can also hamper the provision of safe drinking water. In Bangladesh, it was estimated that at least 35 million inhabitants were exposed to arsenic due to groundwater contamination, making the search of a better drinking water source a public health emergency [44]. This illustrates the importance of addressing water pollution in a coordinated and integrated manner with all other five SDG6 targets.

**SDG 7. Affordable and clean energy:** Access to affordable, reliable, sustainable and modern energy for all is the focus of Goal 7, aiming to ensure universal access to energy services (7.1), increase the share of renewable energy in the global energy mix (7.2) and improve energy efficiency (7.3).

Although not explicitly mentioned, SDG 7 can be linked to water pollution. The use of water in the energy sector has been reported to have adverse effects on water quality [45]. Some notable examples include: in fossil fuels, water used in resource extraction can result in product seepage into the soil, affecting groundwater resources; in biofuels, water employed in feedstock crop irrigation can produce a runoff highly concentrated in fertilizers, pesticides and sediments; in thermal power, the large quantities of water used for cooling and discharged in water bodies can harm aquatic ecosystems due to thermal pollution; in hydropower, dams built for electricity generation alter water temperatures and flow volumes, having negative environmental costs [46,47]

On the other hand, treatment of the large quantities of wastewater from the energy sector could also be beneficial to the sector. A recent review by Cao and Pawłowski [48] shows that energy recovery from sewage sludge – via anaerobic digestion and pyrolysis – could simultaneously address energy issues and the environmental concerns associated with conventional sludge treatment. In fact, in countries like the Netherlands, sludge digestion is already a common practice in many wastewater treatment plants and is helping to consume 40% less energy compared to those without sludge digestion [49]. In other like the USA, some wastewater treatment plants have achieved more than 90% energy self-sufficiency thanks to onsite energy generation from anaerobic digestion and nutrient recycling [50]. Another study by Heubeck, de Vos and Craggs [51] highlights the potential contribution of wastewater treatment to the water sector. According to them, algal-based treatment technologies are capable of recovering energy and improving energy efficiency, whilst providing improved wastewater treatment. For this reason, realizing SDG 7 could be connected to water pollution reduction.

**SDG 8. Decent work and economic growth:** Access to affordable, reliable, sustainable and modern energy for all is the focus of Goal 7, aiming to ensure universal access to energy services (7.1), increase the share of renewable energy in the global energy mix (7.2) and improve energy efficiency (7.3).

Although not explicitly mentioned, SDG 7 is closely can be linked to water pollution.

On one hand, the use of water in the energy sector has been reported to have adverse effects on water quality [45] by contamination. Some notable examples include: : in fossil fuels, water used in resource extraction results can result in product seepage into the soil, affecting groundwater resources; in biofuels, water employed in feedstock crop irrigation produces can produce a runoff highly concentrated in fertilizers, pesticides and sediments; in thermal power, the large quantities of water used for cooling and discharged in water bodies can harm aquatic ecosystems due to thermal

pollution; in hydropower, dams built for electricity generation alter water temperatures and flow volumes, having negative environmental costs [46,47].

On the other hand, treatment of the large quantities of wastewater from the energy sector does not only curtail water pollution, but could also be beneficial to the sector also contribute to the energy sector. A recent review by Cao and Pawłowski [48] shows that energy recovery from sewage sludge – via anaerobic digestion and pyrolysis – could simultaneously address energy issues and the environmental concerns associated with conventional sludge treatment. In fact, in countries like the Netherlands, sludge digestion is already a common practice in many wastewater treatment plants and is helping to consume 40% less energy compared to those without sludge digestion [49]. In other like the USA, some wastewater treatment plants have achieved more than 90% energy self-sufficiency thanks to onsite energy generation from anaerobic digestion and nutrient recycling [50]. Another study by Heubeck et al. [51] highlights the potential contribution of wastewater treatment to the water sector. According to them, technologies like anaerobic digestion and algal-based treatment technologies are capable of recovering energy and improving energy efficiency, whilst providing improved wastewater treatment [27]. For this reason, realizing SDG 7 is inherently could be connected to the fight against water pollution reduction.

**SDG 9. Industry, innovation and infrastructure:** Goal 9 focuses on building resilient infrastructure, promoting inclusive and sustainable industrialization and fostering innovation. Specifically, it seeks to develop sustainable and resilient infrastructure (9.1), encourage sustainable and inclusive industrialization (9.2), access to small-scale industries (9.3) and resource-use efficiency (9.4) and enhance scientific research (9.5).

The realization of SGD 9 will most likely demand the use of less polluting (cleaner) technologies in the industry sector. Sustainable industrial activities generally require more efficient water use in industrial processes and less pollutant loads discharged to the environment [22]. UNIDO programs in many countries have revealed that better water pollution control and water efficiency in the industry does not only increase productivity and competitiveness, but also reduces production costs [52]. Besides, according to UNIDO, the use of environmentally sustainable industrial technologies can create more opportunities for green/blue industrial employment. In a similar manner, enhancing scientific research and innovation in the industry sector can contribute to the minimization of the impact of water pollution.

**SDG 10. Reduced inequalities:** Goal 10 calls for the reduction of inequality within and among countries, by: sustaining income growth of the poorest 40% of the population (10.1), promoting social and economic inclusion (10.2), adopting policies to ensure equal opportunities (10.3) and social protection (10.4), improving the regulation of financial markets (10.5), ensuring the representation of developing countries in global decision-making (10.6) and facilitating the migration of people (10.7).

As explained in Goal 1, water pollution disproportionately affects the poorest and most vulnerable groups, which exacerbates existing inequalities within and across countries. According to Clement and Meunie [53], social inequalities are crucial in explaining water pollution. Their study detected a significant correlation between water pollution and the Gini index – which is commonly used as a measurement of inequality. Another study by Owusu [54] revealed that the burden of water pollution in poor neighborhoods had social implications (e.g. a sense of stigma) that further intensified inequality. In this context, water pollution control could support inequity reduction.

**SDG 11. Sustainable cities and communities:** The aim of Goal 11 is to make cities and settlements inclusive, safe, resilient and sustainable. Its targets call for: ensuring access to safe and affordable housing (11.1), transportation (11.2) and public spaces (11.7), enhancing inclusive and sustainable urbanization (11.3), protecting the world's cultural and natural heritage (11.4) and reducing the number of deaths (11.5) and environmental impacts (11.6) in cities.

Target 11.1 specifically calls for 'ensuring access for all to adequate, safe and affordable housing and basic services and upgrade slums by 2030'. This means that all people living in cities must have access to basic services, including water and sanitation and slums and other inadequate housing must be upgraded. Water pollution due to lack of proper sanitation is deemed one of the worse aspects of slums [19]. Several researchers have documented that inadequate access to sanitation creates severe disease-related hazards and environmental pollution [55-57]. Govender et al. [58] found out that water pollution from inadequate sanitation played a key role in the incidence of diarrheal disease amongst residents of low-cost housing settlements in Cape Town. That is why Govender et al. consider that an integrated approach is needed to improve housing quality and control water pollution.

**SDG 12. Responsible consumption and production:** Goal 12 seeks to ensure sustainable consumption and production patterns, by implementing a framework of programs on sustainable consumption and production (12.1), achieving sustainable management of natural resources (12.2) and chemicals throughout their life cycle (12.4), reducing the global food waste (12.3) and waste generation (12.5), encouraging companies to adopt sustainable practices (12.6), promoting sustainable public procurement practices (12.7) and raising awareness for sustainable development (12.8).

Target 12.4 explicitly mandates to reduce water pollution in order to minimize its damaging effects on human health and the environment. According to the International Resource Panel [59], control of water pollution will require a radical change in consumption and production patterns, as the current model of 'take-make-dispose' has shown to burden an already polluted planet. For instance, the 'solid waste culture' is reported to aggravate the crisis of water pollution [60]. Gunaruwan and Gunasekara [61] found a relationship between household income and total consumption pattern. Therefore, as the middle class expands worldwide, current consumption

patterns will likely lead to increased pollution and resources constraints. That is why, to deal with all types of pollution, responsible consumption and production patterns should be incentivized (e.g. extending products lifespans, promoting sharing-economy initiatives, driving reuse and recycling) [2]. Pollution control will be indispensable to reduce unsustainable use of resources, from water to land and air; and vice versa, cutting contamination will require managing our natural resources in a sustainable manner.

**SDG 13. Climate action:** Goal 13 aims to take action against climate change and its impacts by: strengthening resilience to climate-related hazards (13.1), integrating climate change measures in national policies (13.2) and raising awareness on climate change mitigation and adaptation (13.3).

It is evident that water and climate change are intrinsically linked: water related disasters (e.g. floods and typhoons) are intensified by climate change [62]. Some example of this intensification of the hydrological cycle include: more frequent and severe droughts in parts of Africa and Asia; more intense precipitation events in Europe, resulting in more numerous floods and landslides; and higher tropical cyclone wind intensities [63]. What is less obvious is the relationship between water pollution and climate change. Sheahan [64] provides some examples: rising temperatures can change the sedimentation rate of contaminants and their accumulation rate in aquatic organisms; increasing rainfalls are likely to result in more leaching of pesticides; heavy storm events can create flushing of untreated sewage effluent from surface runoff; increasing flood risk can cause more water pollution if the land inundated is contaminated. Therefore, climate change could deepen the magnitude of water pollution.

Conversely, water pollution control can help to build resilience for managing climate change induced hazards in the water sector [65]. Some adaptation technologies to address water quality issues that can make countries more resilient include: change in agricultural practices to limit nutrient leakage; water safety plans to mitigate pollution at source; improved storm water management to minimize flood risk; or constructed wetlands for water purification [65].

**SDG 14. Life below water:** In Goal 14, the focus is on conserving and using oceans, seas and marine resources in a sustainable manner. In particular, the targets strive to: reduce marine pollution (14.1), protect marine ecosystems (14.2), minimize the impacts of ocean acidification (14.3), end overfishing (14.4) and combat illegal fishing (14.6), conserve ocean and coastal areas (14.5) and increase the economic benefits to small island developing countries (14.7).

SDG 14 explicitly calls for a diminution in marine pollution, which can be done with effective water pollution control. It is claimed that 80% of marine pollution comes from land-based activities, such as agricultural run-off, untreated sewage, waste and discharge of nutrients and pesticides [66]. In Australia, for example, it has long been reported that declining marine and coastal water/sediment quality was a result of pollution from land-based activities [67]. Since a polluted river or groundwater eventually ends up flowing into the sea, any

contaminant or waste present in these effluents can negatively impact coastal and marine ecosystems.

**SDG 15. Life on land:** Goal 15 aims to protect, restore and promote sustainable use of terrestrial ecosystems, by: protecting inland freshwater ecosystems (15.1), promoting sustainable management of forests (15.2), combating desertification (15.3), conserving mountain ecosystems (15.4), reducing the degradation of natural habitats (15.5), ensuring fair and equitable sharing of benefits (15.6), ending trafficking of protected species (15.7), preventing the impact of invasive alien species (15.8) and integrating ecosystem values in planning (15.9).

Target 15.1 acknowledges the direct link between water quality (both surface and groundwater) and terrestrial ecosystems. Therefore, for the latter to be healthy and provide their services, water pollution control is needed [19]. In addition, Targets 15.4 and 15.5 refer to protecting mountain ecosystems and their biodiversity, which can be impeded if water resources are polluted or over-exploited. And vice versa: mountain ecosystems are considered to play a key role in water quality conservation, as they maintain the ecological balance of water resources [68]. In other words, implementing water pollution control measures and achieving SDG 15 can be mutually supportive.

**SDG 16. Peace, justice and strong institutions:** Goal 16 refers to the promotion of peaceful and inclusive societies for sustainable development, where violence is reduced (16.1), especially against children (16.2), equal access to justice is ensured (16.3), arm flows (16.4) and corruption (16.5) are cut, institutional transparency (16.6) and participation (16.7) is increased, particularly for developing countries (16.8) and legal identification is provided for all (16.9).

The link between water pollution and SGD 16 might be unclear a priori. However, some studies show that corruption affects water governance, as it drains the water sector by misappropriating water management resources [69,70]. The World Bank estimates that 20% to 40% of the world's water sector finances are lost to corrupt and dishonest practices [71]. The costs of corruption are disproportionately borne by the poor and the environment [69]. Jenkins [70] argues that corruption contributes to the failure of enforcing water protection laws meant to protect water resources from pollution. This, according to Jenkins, leads to poor water quality and undermines safe and fair access to water resources. Corrupted water governance, in conjunction with water shortage, can also increase the risk of social and political conflict [72]. For example, the conflict in Darfur has been linked to corrupted governance and local water scarcity intensified by climate change [73,74].

**SDG 17. Partnership for the goals:** Finally, Goal 17 calls for strengthening the means of implementation and revitalizing the global partnership for sustainable development. It is underpinned by nineteen different targets, related to finance (17.1-17.5), technology (17.6-17.8), capacity building (17.9), trade (17.10-17.12) and policy coherence (17.13-17.19).

In this sense, global partnerships for sustainable development are important in the context of water pollution. As 40% of the world's population lives in transboundary basins, international cooperation becomes necessary to manage water resources including water pollution control in a shared manner [75]. For instance, joint bodies can serve as a forum for: collecting and evaluating data in order to identify pollution sources; elaborating joint water quality monitoring programs; exchanging information on pollution sources; developing concerted plans for the reduction of pollution loads; establishing warning procedures; and encouraging scientific cooperation [76]. Furthermore, water pollution reduction could profit from the mobilization of financial aid, capacity building, strengthened technology exchange, better policy coherence and multi-stakeholder partnerships.

## Conclusions

Water pollution is one of the main challenges we are facing in the 21st century. Water quality degradation is a threat to not only human health and the environment, but also economic growth and social progress. And, as the world's population continues to grow and the pollution problem to worsen, more pressure will be added to the already stressed water resources. That is why addressing water pollution has become a top-priority for governments, international organizations and society in general.

Today, water quality issues are the forefront of international action thanks to the 2030 Agenda for Sustainable Development. Goal 6 specifically aims to 'ensure availability and sustainable management of water and sanitation for all' to give an answer to the pressing challenges posed by water pollution. Water quality is also explicitly addressed under SDGs of poverty, health, responsible consumption and production and life on land. The question now is: how does water pollution relate to the rest of SDGs?

This question, which remains unanswered in existing research, is the purpose of this paper. My aim was to describe the potential links between water pollution and SDGs, as I believe that understanding them is key to enhance and accelerate action towards tackling the water quality challenges. Although not exhaustive, the paper confirms two main points: (i) there are many pathways by which water pollution can hinder the realization of various SDGs and (ii) water quality can also benefit from the achievement of SDGs. More in-depth descriptive research is needed to better understand the linkages between SDGs and water quality issues and ultimately, help practitioners, researchers and policy-makers addressing the water pollution challenge.

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