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Interactive dialogues

Interactive dialogue 2: Water for sustainable development: valuing water, water-energy-food nexus and sustainable economic and urban development (Sustainable Development Goal targets 6.3, 6.4 and 6.5 and Goals 2, 8, 9, 11 and 12)

Concept paper prepared by the Secretariat

Summary

The present concept paper was prepared pursuant to paragraph 9 (d) of General Assembly resolution 75/212, in which the Assembly requested the Secretary-General of the 2023 United Nations Conference on the Midterm Comprehensive Review of the Implementation of the Objectives of the International Decade for Action, "Water for Sustainable Development", 2018–2028, to prepare a concept paper on each of the themes of the interactive dialogues, taking into account the relevant water-related processes of the Assembly and other possible contributions. The paper relates to interactive dialogue 2, entitled "Water for sustainable development: valuing water, the water-energy-food nexus and sustainable economic and urban development (targets 6.3, 6.4, 6.5 and SDGs 2, 8, 9, 11, 12)". The structure of the paper is based on the three main topic areas of the dialogue noted above.

* A/CONF.240/2023/1.

I. Introduction[1]

1. Water is a key socioeconomic driver of sustainable growth, livelihood, justice, food security and labour. Access to clean and sustainable sources of water is currently gravely imbalanced. However, without equitable and secure access to water for all, there can be no sustainable development. Water availability is a global challenge, yet one whose solutions must be understood and implemented at the local, national, regional and global levels.

2. Globally, over 2 billion people live in countries that experience high water stress. As water becomes scarcer and more polluted, it becomes more valuable and thus subject to competition and conflict among uses and users. Today, more than 50 per cent of the world's cities and 75 per cent of all irrigated areas are experiencing recurring water shortages. Water scarcity data indicate that trends of increases in such scarcity are widespread and continuing, including in transboundary settings. Severe water scarcity has caused an increase in desertification, as well as in migration from rural to urban areas, with impacts on arable land loss and farming. This influx is a challenge for local authorities to absorb.

3. The Sustainable Development Goals, as enshrined in the 2030 Agenda for Sustainable Development, are intricately linked to access to water, the reliability of the water supply, impacts on shared water resources and innovations to support the co-management of shared water resources in a way that does not diminish the ability of current and future generations to benefit from this fragile resource. In the present concept paper, the ability to (a) value water resources and services meaningfully; (b) successfully apply the synergies inherent in the Water-Energy-Food-Ecosystem Nexus; and (c) consider the role of water access and management for sustainable economic and urban development as key to addressing the international community's challenges in the water sector are all emphasized. The paper is focused on these issues through the lens of the accelerators of the Sustainable Development Goal 6 Global Acceleration Framework.

II. Valuation of water resources and services

4. The way in which water is valued affects the way in which governments, businesses and the public use, conserve and manage it. Valuing water and water valuation are not the same thing. Valuing water cannot be limited to economic values. In economic theory, it is asserted that the value of a good is determined by scarcity. Water is currently used as if it is limitless, but fresh water is scarce and becoming more so. A review of the economics of water helps to determine the cost of inaction to society, as well as to justify concessional financing for better development outcomes. The objective of valuing water is not to reduce the access of society's poorest members to it; it is the opposite. Valuing water is not merely a financing issue; it is also about its use, protection, and allocation when it is scarce. The Valuing Water Initiative[2] includes a call for water to be prioritized in decision-making through the

[1] The present concept paper has benefited from contributions from Member States, the United Nations system and a diverse group of stakeholders. See https://sdgs.un.org/conferences/water2023/documentation and www.un.org/sites/un2.un.org/files/final_water_consultation_report_19_oct.pdf.

[2] See https://valuingwaterinitiative.org/.

application of five "valuing water principles"[3] to encourage governments, industries and civil society to bring about the systemic change required to understand, value and manage water.

5. Water's current price rarely reflects its economic, social or environmental value or the true costs of treatment and distribution. Low water prices result in inefficient use and reduced provision and expansion of services, in particular for the poor, making the sector less attractive to investors and imposing high costs on the economy, society and the environment. Governments play a significant role in the creation and regulation of water pricing systems. Tariffs are essential but are not the only pathway to recovering costs, addressing affordability and managing water conservation. To maximize their potential, they must be well designed, complemented by appropriate instruments, adequately regulated and understood by customers.

6. Other economic instruments, such as quotas and buy-back rights, present opportunities to influence users' behaviour in managing and conserving water. Developing a financially sustainable basis for the water sector requires establishing the appropriate balance and relationship between tariffs, taxes and transfers. Resistance to tariff reform is reduced by strong political leadership, improved service quality and increased stakeholder engagement. To properly value water, clear, honest and reliable data are needed, which the sector is often lacking. Strong water rights regimes, inclusive social support programmes and enforcement mechanisms need to be in place to support water pricing.

7. For too long, the thinking on water has been polarized into a rights-based approach to the issue and an approach that, without accurately pricing the cost of collecting, maintaining and distributing water, communities cannot fund the vast improvements required by ageing infrastructure. The two approaches can and must be reconciled through a focus on equitable outcomes, through government policies and incentives to ensure that no one is left behind.

8. Amid increasing scarcity and unreliability in water as a resource, a diverse set of values drives the economic and financial considerations in water-related decision-making. Water has multiple values: trade-offs inevitably arise and are best addressed through more robust measurement and valuation methods. Multivalued approaches to water governance require the active participation of a diverse set of actors, including those whose voices are not always heard.[4] This, in turn, enables stakeholder processes that recognize and reconcile a comprehensive mix of values, including benefit-sharing in water governance and tenure, as well as integrating ecological and environmental values into climate-resilient water management. Lastly, in valuing water, the reflections in the Global Sustainable Development Report of 2019 on protecting the global environmental commons as an entry point to achieving the Goals should be borne in mind. The 2023 version of report is again focused on this entry point, noting that achieving the entire 2030 Agenda will depend on protecting shared resources: the atmosphere, the hydrosphere, global oceans, the cryosphere, polar regions, forests, land, fresh water and biodiversity. The report also calls for the valuation of natural capital, noting that current dominant economic accounting systems severely

[3] (a) Recognize and embrace water's multiple values to different groups and interests in all decisions affecting water; (b) reconcile values and build trust: carry out all processes to reconcile values in ways that are equitable, transparent and inclusive; (c) protect the sources, including watersheds, rivers, aquifers, associated ecosystems and used water flows, for current and future generations; (d) educate to empower: promote education and awareness among all stakeholders regarding the intrinsic value of water and its essential role in all aspects of life; and (e) invest and innovate: ensure adequate investment in institutions, infrastructure, information and innovation to realize the many benefits derived from water and to reduce risks.

[4] United Nations Educational, Scientific and Cultural Organization (UNESCO), *The United Nations World Water Development Report 2021: Valuing Water* (Paris, 2021).

undervalue the contribution of natural capital – including soils, air, water and living organisms – and its economic contribution through ecosystems goods and services.

Financing for water services valuation

9. A key challenge before the water community is how to ensure that development, climate and biodiversity finance serve water needs. Water must be affordable, but, as patterns of high wastage are not sustainable, change must be encouraged. Thought leadership from government and development partners, including the private sector and industry, regarding circular ecosystems that reduce water pollution is necessary. International and national financing institutions have a critical role to play in financing water for sustainable development.

10. There is a need to focus on enabling conditions that are necessary at the national level to attract private finance in support of water investment. Such an enabling environment would combine water policies and institutional arrangements, which would include the broader policy framework for investment, capacity to develop projects and an economy-wide water lens (a focus on water that ensures that investments in other sectors contribute to the broader water agenda).

11. With additional financial commitments must come a rapidly scaled-up pipeline of water investment opportunities that contribute to data and information, capacity development, innovation, and governance. Intensified focus on increasing the supply of financial resources (public and private) is much needed and would be a welcome development. Here, it is important to acknowledge the breadth and diversity of private sector involvement in the water sector, whose role goes beyond financing to carrying out works on the ground. There is a need to increase due diligence with regard to environmental and social safeguarding when seeking financing in support of water projects. Credit risks and water resource protection need to be more fully understood and supported by those issuing credits for all investments. Anchoring water financing in an integrated approach allows for discussions on water in the context of trade within and between countries.

How to close the water financing gap

12. Although estimates vary, financing needs in the water sector are colossal, between $182 billion and $664 billion annually,[5] a deficit that comprises shortfalls in water supply and sanitation ($116 billion to $229 billion per year), flood protection ($23 billion to $335 billion per year), irrigation ($43 billion to $100 billion per year) and financing of water resources management implementation – crucial to Sustainable Development Goal indicator 6.5.1 – and 60 per cent of countries report that they have little or no active fee systems in place to levy financing for water resources management. Estimates suggest that $6.7 trillion is needed by 2030, and $22.6 trillion by 2050, to achieve Goal 6.[6] See box 1.

13. There is much to be done on the demand side of the equation. To become more creditworthy and able to tap into new sources of investment, water services providers, whether utilities, irrigation agencies, or local or national governments, need to become more technically and financially efficient. Governance arrangements need to become clearer and more transparent. Similarly, the economic regulation of water services has a role to play in enhancing the performance and creditworthiness of service providers.

[5] Julie Rozenberg and Marianne Fay, *Beyond the Gap: How Countries Can Afford the Infrastructure They Need While Protecting the Planet* (World Bank, Washington, D.C., 2019).

[6] Organisation for Economic Co-operation and Development (OECD), *Financing a Water Secure Future*, OECD Studies on Water, OECD Publishing (Paris, 2022).

Economic regulation of water services

14. Incentives to improve performance and attract private finance require the economic regulation of water services. Such regulation can: (a) set performance standards; (b) monitor and compare performance; (c) provide incentives for better performance through tariff policy and privileged access to public finance, among others; and (d) promote transparency. This can include incentives to agglomerate service providers to reach economies of scope and scale.

Box 1
Closing the financing gap: the Continental Africa Water Investment Programme

Formally launched during the ninth World Water Forum, held in Dakar in March 2022, the International High-level Panel on Water Investments for Africa was established to help to close the gap in water financing in Africa. Its purpose is to drive global political mobilization to meet the socioeconomic needs of Africa, including those related to Sustainable Development Goal 6. It is also expected to address the twin challenge of climate change and the coronavirus disease (COVID-19) pandemic. The Panel supports the implementation of the Continental Africa Water Investment Programme, which is aimed at leveraging at least $30 billion per year by 2030 and at closing the existing investment gap in the water sector, estimated at between $11 billion and $20 billion per year.

Data and information for water services valuation

15. Data generation, validation, standardization and information exchange across sectors make an important contribution to water services valuation, not least by building mutual trust and confidence in leaders seeking to make informed decisions regarding the security of access to water. High standards in data gathering, validation and information exchange ensure that high-quality information on Goal indicators is shared and that access to it can easily be gained by any decision maker. The creation of incentives for data-sharing could usefully be linked to access to financing. There is work to be done in terms of data shared among United Nations agencies. The quality of data on groundwater lags behind that of data available on other parts of the water sector.

Capacity development

16. Capacity development must play a central role in building a global understanding that water is a finite, limited, fragile resource and that pragmatic and equitable approaches to valuing water services are needed. The training of professional water resource managers – including those in industry and across sectors including energy and agriculture, as well as of municipal and environment authorities, stakeholder groups, decision makers, and the public sector – will benefit from curricula designed specifically for their needs and in their own languages. Such capacity development will, in turn, build an enabling environment for innovative practices in water services valuation.

Innovation

17. Governments alone cannot provide innovation. The private sector, including smaller enterprises, plays a particularly fundamental role. Innovation emerges from complex interactions between the public and private sectors, shaped by institutional frameworks to support human capacity development, research and development, and business support.

Governance

18. Creating enabling environments for continued innovation, adjustment and recalibration is a key catalyst for transformative change. It includes exploring how governance structures and processes can identify, implement and scale innovation. Governments can ensure that new technologies support local water management priorities in respect of water services valuation and that the technologies contribute to global solutions.

19. Competition for water resources is intensifying owing to population growth, economic development, degraded water quality and climate change. Growing pressures are rendering existing inefficiencies in water allocation regimes more costly; conversely, water allocation regimes that perform well and can adapt to changing conditions are now much prized.

20. Well-designed water allocation regimes contribute to multiple water policy objectives. They generate economic efficiency by allocating resources to higher-value uses. In addition, they contribute to innovation and investment in water use efficiency and to environmental performance by securing adequate flows to support ecosystems services. Lastly, they contribute to equity by sharing the risks of shortages fairly among water users.[7] However, consistency across geographical scales remains a challenge for policymakers. What may be sound water management in a subcatchment may be suboptimal in the larger basin.

21. The water sector is generally underfunded, and the situation has been exacerbated by low water tariffs. As a result, investment in innovation for water is low. In the period from 2000 to 2013, global investment in innovation in clean energy was approximately $139 billion compared with $8 billion in innovation in the water sector.[8]

22. Well-designed economic and environmental regulation can be an important driver of investment in water infrastructure, generating new markets for innovations such as the fit-for-purpose reuse of urban wastewater and nutrient reclamation for irrigated agriculture and forestry. Regulations can increase investment in secure means of gaining access to water and the demand for treatment technologies. Regulations that impose limits on water extraction can generate increased investment in water conservation and alternative sources of water supply, such as wastewater reuse, desalination and non-conventional water sources, along with increased demand for related technologies. At the same time, certain regulatory barriers currently exist that inhibit investment, such as a lack of a clear regulatory framework for wastewater reuse.

23. Innovative thinking is needed to decouple the idea of water valuation from the pervasive but outdated narrative that such valuation will lead inexorably to water privatization. Given that water is perhaps the most vital global commons, hostility to any perception of its commercial distancing from those in need is completely understandable. The economic valuation of water services is key to correcting the water access imbalance. Innovative approaches both to dispelling suspicion of the motive behind water valuation and to better articulating, measuring and appreciating the value of ecosystem services and water are needed.

[7] See https://www.oecd.org/environment/resources/Water-Resources-Allocation-Policy-Highlights-web.pdf.

[8] Cleantech Group, “Water and wastewater”, *i3 Quarterly Innovation Monitor*, 2014. Available at www.cleantech.com/wp-content/uploads/2014/11/i3QIM_WaterWastewater_3Q14.pdf.

III. Integrated management of the water-energy-food nexus

24. Water, food and energy form a nexus at the heart of sustainable development. Agriculture is the largest consumer of the world's freshwater resources (over 70 per cent of global freshwater withdrawals), and water is used to produce most forms of energy. Demand for all three is increasing rapidly, driven by a rising global population, rapid urbanization, changing diets and economic growth. Rising incomes in many countries is boosting demand for more water-intensive meat and dairy, displacing mainly starch-based diets. To withstand current and future pressures, governments must ensure the integrated and sustainable management of water, food and energy to balance the needs of people, nature and the economy. As water becomes scarcer and an increasingly stretched resource, its ability to support progress for several of the Goals, in particular regarding poverty, hunger, sustainability and the environment, is being reduced.

25. Food production and energy are highly water-intensive. Agriculture is also the largest employer of the world's poor. Approximately 75 per cent of the extreme poor live in rural areas and depend on agriculture for their livelihoods. Food security, broad-based rural development and the wide sharing of the benefits of agriculture are the most effective means of reducing poverty and food insecurity.[9] Responsible agricultural water management, including climate resilience and pollution control, is a major and necessary priority for future global water and food security. More than one quarter of the energy used globally is expended on food production and supply. The vast majority of energy generation is water-intensive, such as its use in coal-fired power plants and in nuclear reactors, as well as in biofuel crop production.

26. Over the past decade, as a complementary framework to the water-energy-food nexus, the ecosystem element has been added to the three resources, thereby creating the Water-Energy-Food-Ecosystem Nexus. This method has risen to prominence as a systematic approach to better understanding interconnectedness and trade-offs, given that natural resources and human activities depend on ecosystems. Effective cross-sectoral consultation mechanisms, such as the Water-Energy-Food-Ecosystem framework, are needed on local, national and global scales to ensure the development of concerted efforts. Understanding and harnessing the potential of the Water-Energy-Food-Ecosystem Nexus is key to reconciling often-competing sectoral objectives and attaining sustainable development. The Water-Energy-Food-Ecosystem has emerged as a powerful concept to describe and address the complex and interrelated nature of global resource systems needed for humankind to achieve social, economic and environmental goals.[10]

27. The Water-Energy-Food-Ecosystem approach is integrated across all sectors, and its holistic vision of sustainability is aimed at attaining a balance between the various goals, interests and needs of people and the environment. For instance, efficiency measures throughout the entire agrifood chain, such as precision irrigation based on information supplied by water providers, can help to save water and energy, and the protection of ecosystems, along with agriculture and energy production, can ensure environmental integrity.

[9] Food and Agriculture Organization of the United Nations (FAO), *The State of the World's Land and Water Resources for Food and Agriculture: Systems at Breaking Point – Synthesis Report 2021* (Rome, 2021) and *The State of Food and Agriculture 2020: Overcoming Water Challenges in Agriculture* (Rome, 2020).

[10] Sasha Koo-Oshima and Virginie Gillet, "Integrating ecosystems in the Water-Food-Energy Nexus for greater sustainability", 27 October 2022. Available at www.openaccessgovernment.org/integrating-ecosystems-in-the-water-food-energy-nexus-for-greater-sustainability/145217/.

28. As a transformative approach, the Water-Energy-Food-Ecosystem Nexus encourages restructuring the network of decision-making and partnerships to focus on inclusion and equity among partners.[11] To that end, successful partnerships can be built on existing institutions (e.g. river basin organizations and Water-Energy-Food-Ecosystem resource user associations) and their knowledge, capacity, competencies and social capital.

29. Governments must increase renewable energy sources. There needs to be much more support for the development of less water-intensive renewable energy, such as hydropower and wind. Geothermal energy has great potential as a long-term, climate-independent resource that produces little or no greenhouse gases and does not consume water.[12] Significant parallels exist between equitable access to sustainable energy and equitable access to sustainably managed water; in their rapid shift from centralized to decentralized models, water services mimic the pattern of renewable energy infrastructure, and both must overcome the challenge of reaching decentralized populations.

30. The relationship between water governance and sustainable economic development calls for integrated consideration of patterns of sustainable production and consumption. Integrated water resources management is the key to successful governance for water services valuation, the Water-Energy-Food-Ecosystem Nexus, and sustainable economic and urban development. Integrated water resources management occurs when multiple sectors work together to manage water demand in a way that engages with differing sets of values and meets everyone's needs without depriving anyone – including nature – of access. Integrated water resources management is a tool for managing land and water resources to maximize economic and social welfare in an equitable manner, without compromising the sustainability of vital ecosystems.

Financing

31. Financing alone is insufficient to achieve water-related goals. Successful investments in the water sector require a robust enabling environment with effective policies, sound regulation, evidence-based operational reforms, and well-governed and accountable institutions. To achieve sustainable development, stronger water management, sector reform and greater efficiency and coherence across the Water-Energy-Food-Ecosystem Nexus are essential. A fundamental shift is needed to adopt a cross-sectoral and interdisciplinary approach to reach the Goals. For instance, additional finance is needed to minimize water demand in agriculture while also supporting energy conservation to reduce overall resource demands.

Data and information

32. Data and information have an important role to play in support of the Water-Energy-Food-Ecosystem Nexus. The first step is a stocktaking of a country's sources of water – rivers, glaciers, cryosphere, groundwater supplies and hydropower capacity – and a full understanding of how these resources are distributed geographically and temporally. Next comes an analysis of water needs (water to fuel the ecosystem, for agriculture, for hydropower and energy, and for municipal and

[11] FAO has developed its own conceptual approach to the Water-Energy-Food-Ecosystem Nexus, which distinguishes between the resource base and the various goals and interests that are to be achieved, but with limited resources. The approach involves understanding and managing the different resource user goals and interests while maintaining the integrity of ecosystems. Effective partnerships are key in Nexus-based decision-making, along with structured stakeholder dialogues in managing the Nexus through evidence, scenario development and response options.

[12] Koo-Oshima and Gillet, "Integrating ecosystems".

industrial use) and consideration of how to meet all these needs while retaining water downstream for transboundary use.

33. Data on water quality and groundwater remain sparse, especially at the global level, owing in large part to weak monitoring and reporting capacities.[13] Information on water supply and use is vitally important to national Governments, which need reliable and objective information on the state of water resources and their use and management.

34. National-level water data collection and analysis needs further investment to enhance reliability and reach. The plethora of various institutions involved at the national level in water-related data collection, standardization and publication is a key challenge as countries work to improve accounting on the Water-Energy-Food-Ecosystem Nexus. Targeted funding for national water data at all steps, from generation to sharing, would greatly improve monitoring of the Goals and general water resources. In addition, there is a need to collect and disseminate more regular and disaggregated data (e.g. by gender, age, source, sector and location) to support the formulation of responsive policies and programmes that ensure that no one is left behind.

35. Recent developments in cloud storage, application programming interfaces and globally agreed metadata classification, such as the Statistical Data and Metadata Exchange, ease water data-sharing and understanding between the sectors of the Water-Energy-Food-Ecosystem Nexus through standardization and interoperability, with the goal of having data that are findable, accessible, interoperable and reusable.

Capacity development

36. Capacity development for the Water-Energy-Food-Ecosystem Nexus requires strong local buy-in to integrate more sustainable water management practices, in particular for food production. Innovative technologies that respond to Water-Energy-Food-Ecosystem challenges, such as solar power irrigation, bioenergy crops or crops that reduce methane emissions, or multiple-use schemes, should be introduced with capacity development not only at the technical level but also at the institutional level to fully unlock their respective cross-sectoral benefits, make their trade-offs explicit and avoid the unintended consequences of large-scale development.

37. Partnerships for capacity development are also to be broadened to strengthen and coordinate governance across water, energy, food and ecosystems, including land, forestry, livestock, aquaculture and biodiversity, while ensuring livelihoods, food and nutrition security, and gender and social inclusion. Water-Energy-Food-Ecosystem capacity development strategies would benefit greatly from identification of interconnections and synergies for the Water-Energy-Food-Ecosystem Nexus from Indigenous and traditional cultures.

Innovation

38. Agricultural water use must be highlighted, including crop and cropping patterns adaption, agroecology approaches, and the use of digital and remote sensing data to monitor on-farm water management and basin-wide water use since agriculture is a land-based activity.

39. It is worth noting that efforts to increase water savings by introducing more efficient on-farm irrigation technology will not necessarily lead to real water savings, as irrigating farmers may opt to increase the area irrigated if new technologies allow

[13] UNESCO, *The United Nations World Water Development Report 2022: Groundwater – Making the Invisible Visible* (Paris, 2022) and *The United Nations World Water Development Report 2023: Partnerships and Cooperation for Water* (Paris, 2023).

them to use less water (the Jevons paradox)[14] or increase water productivity. Thus, adequate water management policies, including water accounting and functional water allocation regimes, as well as enforcement of the water use cap, are required, along with efficiency and productivity improvements, to lead to real water saving at the basin level.

40. Policymakers need to pilot, test and then upscale and replicate transformative applications of water management systems that fully incorporate all elements of the Water-Energy-Food-Ecosystem Nexus, including adaptation, to meet the mounting pressures on and competition over water resources resulting from the expanding needs of agriculture.

IV. Sustainable economic and urban development

41. Universal and equitable access to safe and affordable drinking water has not been achieved, and water infrastructure and governance in many parts of the world are no longer fit for purpose to make such a goal a reality. Water-related risks, including the risk of too much, too little or too polluted water, as well as risks to the resilience of freshwater ecosystems, demand mitigation. The impacts of climate change compound the urgency and scale of the task that lies ahead.

42. Water scarcity continues to drive migration, including climate-induced migration, and generate conflict. The need to achieve sustainable production and consumption patterns for water has never been more acute. It is only by incorporating water valuation into applied integrated water resources management that a path to more equitable distribution of water resources to users and across time, as well as to meet the growing needs of different users, can be found.

Water and urbanization

43. By 2050, 70 per cent of the global population is expected to live in cities.[15] Urban planning will need to integrate system-wide water management approaches to limit the footprint that cities have with regard to water quality and quantity, as well as with respect to energy and agrifood systems, including food loss and waste. Unmanaged urbanization can result in cities that perpetuate environmental degradation, poverty, inequality, informal activity, pollution and unemployment and that encroach on fertile agricultural lands and biodiversity while releasing unmitigated pollutants into fragile water supplies. By contrast, multilevel governance and integrated regional and urban planning can conserve and rehabilitate water resources, water storage and retention and promote investment in climate-resilient infrastructure that supports storm water management and disaster mitigation while also contributing to the blue economy.

Water pollution

44. Untreated wastewater results in poor water quality and stalls economic progress, reduces food production, spreads disease and limits human potential. Recent research shows that upstream pollution lowers growth in downstream regions. It also reveals that some of the most ubiquitous contaminants of water, such as nitrates and salt, have

[14] In the Jevons paradox, in the long term, an increase in efficiency in resource use will generate an increase in resource consumption, rather than a decrease. In 2020, Carlos Dionisio Pérez Blanco conducted a comprehensive review of the theoretical and empirical literature on water conservation technologies that includes more than 230 studies. It was concluded in the review that, if the ultimate objective is to save water (and possibly to transfer it to other users), it is essential to concomitantly implement water demand management policies, including water accounting and functional water allocation regimes, as well as enforcement of the water use cap.

[15] *World Urbanization Prospects: The 2018 Revision* (United Nations publication, 2019).

wider and deeper impacts – including stark implications for crop yield and food security – than have previously been acknowledged.[16] Poor wastewater management is making significant contributions to greenhouse gas emissions and climate change. Globally, the most prevalent water quality problem is eutrophication, a result of high-nutrient loads, owing to agriculture. Once water is contaminated, it is difficult, costly and sometimes impossible to remove the pollutants. Confronting the scale of the world's water quality challenge will be key to its resolution, which will in turn require a paradigm shift that combines newer technologies and smarter policymaking.[17]

Nature-based solutions

45. Nature-based solutions are an important part of sustainable economic development and, to a perhaps unexpected extent, they have great relevance to urban development planning as well.[18] A key governance opportunity is offered by collaboration with urban planners to take into consideration natural ecosystems, such as in the development of climate-resilient infrastructure and sustainable drainage systems. Governments should harness the power of nature, rather than allowing its destruction and degradation, in the pursuit of food and energy. Examples of green infrastructure,[19] such as land dams to capture run-off in arable fields or planting forests to protect soil and assist in groundwater recharge, demonstrate the creation of a more sustainable water-food-energy nexus and a sustainable economy.

Climate change

46. Climate change adds to pre-existing challenges by increasing the variability and unpredictability of precipitation. Effective emissions reduction strategies require a coordinated approach for land and water management while including factors such as disaster risk reduction, biodiversity recovery and sustainable community livelihoods.

47. It would be important to coordinate and strengthen joint water and climate governance to mainstream freshwater concerns into all climate mitigation planning and action. To do so, policymakers need to embrace an integrated approach to climate mitigation, in particular when setting nationally determined contributions. This would help to facilitate the participation of all relevant ministries and other actors and move away from siloed problem-solving.

48. Furthermore, it would be crucial to adapt water and climate governance frameworks and instruments to different contexts. For instance, the provision of drinking water and sanitation services requires decentralized solutions based on local governance, while the management of aquatic environments and forests requires basin-level governance. Governance frameworks and instruments need to be adapted to fit local circumstances. Better coordination and collaboration between stakeholders, sectors and transboundary basins will help to address trade-offs.

[16] See https://openknowledge.worldbank.org/handle/10986/32245.

[17] Ibid.

[18] The European Commission defines nature-based solutions as those that are inspired and supported by nature, are cost-effective, simultaneously provide environmental, social and economic benefits, and help to build resilience. Such solutions bring more and more diverse nature and natural features and processes into cities, landscapes and seascapes through locally adapted, resource-efficient and systemic interventions.

[19] Green infrastructure refers to the natural or semi-natural systems that provide services for water resources management with equivalent or similar benefits to conventional built "grey" water infrastructure. See United Nations Environment Programme, *Green Infrastructure: Guide for Water Management* (Nairobi, 2014).

Financing for sustainable economic and urban development

49. Approximately 35 per cent of treated water is currently lost in urban water systems.[20] Roughly 45 million m^3 of water are lost daily in the developing world, with the global estimate of physical water losses at about 32 billion m^3 per year.[21] Water utilities suffer from the huge financial costs of treating and pumping water only to see it leak back into the ground, and the lost revenues from water that could have otherwise been sold.[22]

50. All countries face a growing funding gap as they try to keep up with the rehabilitation, operation and maintenance of ageing water infrastructure. Public spending is the main source of spending in the water sector, constituting roughly 86 per cent of the sector's total spending during the period 2009–2020, followed by official development assistance to developing countries and State-owned enterprises at a distant 7 per cent and 6 per cent, respectively, while the private sector accounts for only 2 per cent of total spending.[23] Investments are needed not just for water supply and sanitation services but for irrigation and integrated water resources management as well. Increasing financial support and creating new financial mechanisms to boost and sustain investment in water infrastructure are a part of the challenge (see para. 12). However, a dearth of bankable water infrastructure projects – with clearly defined revenue streams and viable business models – is a further obstacle.[24]

51. Investments in water management infrastructure, both natural and built, are needed to provide public goods, such as flood attenuation, drought mitigation, groundwater recharge and bulk water supply for domestic purposes.[25] For instance, consistent strategies and data-informed tools for the prioritization of irrigation investments are required to maximize financial efforts and deliver the highest impacts. In addition, capturing increased land value around water canals, rivers and coasts is important for sustainable urban development.

52. Financing alone is insufficient to achieve the Goals. Successful investments in the water sector require a robust enabling environment with effective policies, sound regulation, evidence-based operational reforms, and well-governed and accountable institutions. To achieve Goal 6, stronger water management, sector reform and greater efficiency are essential. In essence, service providers need to be more technically and financially efficient, and policy, institutional and regulatory arrangements need to be clearer and more transparent.

53. Increasing and improving the efficiency of spending in the water sector requires making public sector water service providers financially sustainable and creditworthy. Specifically, this means addressing: (a) improving the technical and financial viability of the providers; and (b) improving the governance and enabling environment comprising policies, institutional arrangements and regulations. Water providers that

[20] The International Benchmarking Network for Water and Sanitation Utilities, referenced in Bill Kingdom, Roland Liemberger and Philippe Marin, *The Challenge of Reducing Non-Revenue Water in Developing Countries: How the Private Sector Can Help – A Look at Performance-Based Service Contracting*, Water Supply and Sanitation Sector Board Discussion Paper 8, December 2006, World Bank, Washington, D.C.

[21] Bill Kingdom, Gerard Soppe and Jemima Sy, "What is non-revenue water? How can we reduce it for better water service?", World Bank Blogs, The Water Blog, 31 August 2016.

[22] Ibid.

[23] George Joseph and others, "Public spending in the water sector", World Bank, Washington, D.C. (forthcoming).

[24] OECD, *Financing a Water Secure Future*.

[25] In the most recent indicator 6.5.1 monitoring report, 35 to 40 per cent of countries reported that a limited amount of financing had been allocated for planned integrated water resources management investments, with far less allocated for ongoing maintenance or subnational investment projects.

collect only 70 per cent of their allotted tariffs or have non-revenue water rates of 40 per cent are simply not financially viable or creditworthy – they rarely attract sorely needed public finance, and they certainly are not attracting private finance. Moreover, such inefficiencies must be significantly reduced for climate mitigation and adaptation.

54. The private sector should be mobilized as a key partner in financing debt and equity, including commercial financiers and institutional investors. Investment priorities should be assessed strategically. Governments need to provide an enabling environment to build investor confidence. Investments could be prioritized to include those that strengthen energy efficiency by converting diesel to solar pumps and connecting households to existing transmission lines as short-term goals. Long-term objectives would include large water or wastewater treatment plants.

55. Projects, investments and financing flows that are harmful to the water agenda should be actively discouraged. Further work with corporate entities, including disclosing impact on the water sector, should be made mandatory. Collaborating with financial institutions to inform them of how water risks can affect them individually or collectively would be an important area to pursue. Additional collaboration is required with standard setters on due diligence and corporate accounting standards and on the regulation of financial markets.[26]

56. A range of innovative data-led practices can be used to support interventions that pertain to water access, management and conservation for sustainable development of all sectors and domains. Water accounting and auditing (including water tenure) provide significant opportunities for the global community of water stakeholders to make substantial improvements in the availability, quality and application of information about water through data collection.[27]

57. Opportunities for progress in the generation and collection of water data at the country level include the use of open-access tools and data portals, such as earth observation satellites at the local level; satellite remote sensing; advanced geospatial modelling and “big data” analytics through the hand-in-hand initiative of the Food and Agriculture Organization of the United Nations;[28] artificial intelligence to augment near-real-time information in support of decision-making; and stakeholder involvement through citizen science (enabling participative data collection, allocation regimes and water tenure dialogue). The Principles on Water Governance[29] and the Indicator Framework[30] of the Organisation for Economic Co-operation and Development, for instance, enable coherence across sectors/actors on water use,

[26] The Water as Leverage programme acknowledges that water is leverage for the best climate impact, but notes that it takes millions to invest billions wisely: the programme invests those catalytic first millions with the goal of leveraging the investment necessary to implement catalytic projects that in turn leverage water for real urban climate resilience. The programme is aimed at involving the international financial world, development banks and governments in the advancement of this new approach to create an inclusive and innovative pre-project preparation facility.

[27] When States Members of the United Nations adopted the 2030 Agenda for Sustainable Development, countries took responsibility for collecting and sharing indicator data and metadata on water for the purpose of global reporting. UN-Water established the Integrated Monitoring Initiative for SDG 6 in 2015, during the initial phases of the 2030 Agenda. The overarching goal of the Initiative is to accelerate the achievement of Goal 6 by increasing the availability of high-quality data for evidence-based policymaking, regulations, planning and investments at all levels. More specifically, the Initiative is aimed at supporting: (a) countries in collecting, analysing and reporting Goal 6 data; and (b) policymakers and decision makers at all levels to use the data in a holistic manner. At the national level, the Initiative promotes intersectoral collaboration and consolidation of existing capacities and data across organizations.

[28] See www.fao.org/hand-in-hand/en.

[29] See www.oecd.org/governance/oecd-principles-on-water-governance.htm.

[30] See www.oecd.org/cfe/regionaldevelopment/oecd-water-governance-indicator-framework.htm.

equitable allocation and management, and early warning systems, which are increasingly vital to the management of systemic, cascading and compounding risk.

Capacity development

58. The complexity of water issues as part of sustainable economic and urban development requires capacity development that is systemic, long-term and forward-looking. This in turn requires local ownership if it is to be sustainable beyond any one initiative: it is an iterative process for lifelong learning that enables societal change. Capacity development is not "just training". With the rise in Internet communication and coordination, the potential for making significant strides in capacity-building are noteworthy and primed to advance. This will include capacity development in local languages in areas such as water quality monitoring, water quantity assessment, ecosystem roles, and climate change impacts and adaptation measures. It will include developments in adoption of standards in measuring and monitoring that will allow for nationwide, regional and global reporting in coherent and comparable ways. Capacity development is much needed by national and local authorities, not least to increase the creditworthiness of local authorities seeking to attract more financing.

59. Additional courses on water for sustainable economic and urban development are needed, as water is often taken for granted by those mandated with realizing sustainable economic and urban development. Open-source courses on integrated water resources management and intersectoral water management must be built and shared on a wide range of topics, including, inter alia, water resources economics, river system ecology, water diplomacy, water and gender, multi-stakeholder engagement in water resources, water demand management practices, the Water-Energy-Food-Ecosystem Nexus and more.[31] See box 2.

Box 2

Integrated water resources management capacity development: the Integrated Water Resources Management Academy

A United Nations Development Programme-Global Environment Facility initiative under the Kura River Basin project developed the training modules for capacity-building at the Integrated Water Resources Management Academy.[a] It includes courses in Azerbaijani, English and Georgian, taught by international experts in the fields of environmental economics, environmental flow methodology, climate change adaptation for water, gender mainstreaming in water, river basin management planning and the European Union directive, hydroeconomic modelling, hydrological modelling, monitoring for regional and transboundary groundwater management with the United Nations Educational, Scientific and Cultural Organization Intergovernmental Hydrological Programme, International Organization for Standardization 17025 laboratory monitoring standards, pollution abatement plans, river ecology, wastewater emissions inventories and environmental inspection and enforcement. An overview course on the water nexus is also included.

[a] See https://iwrm.designlab.ge/.

[31] A prototype for this is the International Capacity Development Network for Sustainable Water Management of the United Nations Development Programme, which has served as the global network for capacity development in sustainable water management over the past two decades. It is strategically positioned to bridge global expertise with local needs and foster local authority partnerships towards universal access to basic services. Through its 23 networks with a footprint across 120 countries, close integration with the Goals and cross-scale approaches, the Network's inclusive capacity development initiatives are able to support vulnerable groups to be active decision makers.

Innovation

60. To achieve Goal 6 in the face of the growing water crisis, innovation and technology have a vital role to play in scarcity and safety, water efficiency, utility operations, monitoring and treatment, and data analytics.

61. Innovation in the clean water sector is already taking place.[32] There are many promising innovative technologies to help to address the water crisis and contribute to achieving Goal 6, including new technologies for improved water management and protecting a resilient water supply; improved utility management; improved customer service and relationships; and reaching unserved and underserved populations. A key target of this area of innovation is to improve the economic return per unit of water.

62. Water infrastructure development projects are notorious for a cycle of "build, neglect, rebuild". There is a need to break this wasteful and disempowering cycle. It is therefore essential to harness technology and resources and enhance capacity to help to build resilience and sustainability into water infrastructure. Innovation can take place by finding synergies between urbanization, water sources and systems through evidence-based spatial planning, enhancing urban metabolism. Innovative financing models for certifying water and sanitation projects for carbon credits could be explored, offering small and medium-sized enterprises carbon credits opportunities to leverage finance for increasing access to safe water.

63. Moving past the barriers to disruptive technologies in the water sector will require engagement by policymakers across stakeholders, utilities, regulators, investors, industry and utility associations, technology providers, academia and government at all levels. Water tariffs must be adjusted to reflect the realistic price of piped water delivery service and to encourage innovation,[33] and funding should be invested in research, testing and deploying new technologies. Several water utilities are innovating disruptive technologies, helping technology providers to pilot potential solutions and exploring opportunities to invest in innovations to make service more efficient, inclusive and participatory.

Conclusion

64. Water valuation, the Water-Energy-Food-Ecosystem Nexus, and sustainable economic and urban development are key components of a larger goal: equitable access for all to clean and sustainably managed water.

65. To succeed in the pursuit of equitable and sustainable water governance, it is important to explore fully the links between water, climate change and biodiversity loss. Water services providers need to be more technically and financially efficient in order to attract more public and private investment. Water services provision must be valued to halt the disastrous patterns of water wastage while ensuring equitable access to water for all. There needs to be support to countries to generate and use the insights that data and information yield in pursuit of clean water and sanitation because what is not measured cannot be managed. Capacity development and innovation will be key to finding new solutions and achieving impact at the scale needed, setting aside

[32] National Association of Clean Water Agencies, Water Environment Research Foundation, and Water Environment Federation, "The water resources utility of the future: a blueprint for action" (Alexandria, Virginia, 2018).

[33] In the United Kingdom of Great Britain and Northern Ireland, the price review framework of the Water Services Regulation Authority promotes innovation by providing early tariff determinations and financial and reputational benefits for companies that develop and implement new ways of working, including the use of new markets, cooperating more effectively with third parties and moving from successful pilots to swiftly embed best practices from the water sector and other sectors into their day-to-day business. See www.ofwat.gov.uk/wp-content/uploads/2017/12/Driving-innovation-in-water-FINAL.pdf.

the conservatism that has historically characterized the water sector. The final piece of the water and sustainable development puzzle is governance. Acknowledging the multiple values of water in water governance enables stakeholder processes to recognize and reconcile a comprehensive mix of values, including benefit-sharing in water governance, as well as integrating ecological and environmental values into climate-resilient water management. Drawing on this comprehensive understanding of the value of water, integrated water resources management is critical to successful governance for water services valuation, the Water-Energy-Food-Ecosystem Nexus and sustainable economic and urban development, a shared tool for managing land and water resources to maximize economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. These are the tools available to confront the challenge of securing access to safe and well-managed water for all, a goal without which it is not possible to achieve sustainable development.

V. Recommendations

66. The following recommendations are made:

General

(a) With additional financial commitments must come a rapidly scaled-up global pipeline of water investment opportunities;

Valuing water

(b) The economic valuation of water services is key to correcting the water access imbalance. Innovative approaches are needed to inform the international community of the need for valuation and to better articulate, measure and appreciate the value of ecosystem services and water;

(c) Governments must determine the cost of inaction on water valuation to society;

(d) Development banks, both domestic and international, have a critical role to play in financing water for sustainable development: concessional financing for water projects is essential;

(e) Look to industry for thought leadership on circular ecosystems that will reduce water pollution;

(f) Incentives to improve performance and attract private finance require economic regulation of water services, including incentives to agglomerate service providers to reach economies of scope and scale;

(g) Water services providers need to become more technically and financial efficient;

(h) Governance arrangements need to become clearer and more transparent;

(i) Training for professional water resource managers across all sectors will benefit from curricula designed specifically for their needs and in their own languages;

(j) There is a need to address and resolve the regulatory barriers that currently exist and inhibit investment in secure access to water, such as a lack of a clear regulatory framework for wastewater reuse;

Water-energy-food nexus

(k) Responsible agricultural water management, including climate resilience and pollution control, is a major and necessary priority to secure equitable future access to water, food and energy while ensuring ecosystem protection;

(l) Governments must invest in less water-intensive renewable energy;

(m) Efficiency measures along the entire agrifood chain must be boosted to help to save water and energy. Protection of ecosystems, along with agriculture and energy production, can ensure environmental integrity;

(n) Stronger water management, sector reform and greater efficiency and coherence across the Water-Energy-Food-Ecosystem Nexus are overdue;

(o) Overall agricultural water efficiency and productivity can be increased through adapted crops and cropping practices, such as agroecological approaches or improved monitoring of water use;

(p) Transformative applications of water management systems must incorporate all elements of the water-energy-food nexus, including adaptation to meet the expanding needs of agriculture;

Sustainable economic and urban development

(q) Urban planners need to integrate system-wide water management to limit the footprint that cities have with regard to water quality and quantity, as well as to energy and agrifood systems, to reduce food loss and waste;

(r) Multilevel governance and integrated regional and urban planning, including compact city models, can conserve and rehabilitate water resources, storage and retention and promote investment in climate-resilient infrastructure;

(s) Renew focus on the role of women, Indigenous communities, the young and vulnerable populations in ecosystems stewardship and water governance. These voices must be incorporated into water governance models that are future-oriented and equitable in outlook;

(t) Work with, not against, natural ecosystems – focus on development of blue-green infrastructure and sustainable drainage systems;

(u) End water wastage: $200 billion is lost each year to water leaks from municipal water networks. For the same cost, governments could rehabilitate these systems, improve the efficiency of water distribution and save water for other uses;

(v) Consistent strategies and data-informed tools for the prioritization of irrigation investments are required to maximize financial efforts and deliver the highest impacts. Taking full advantage of increased land value around water canals, rivers and coasts is key for sustainable urban development;

(w) Better mobilize the private sector: make water impact disclosure mandatory, and work with standard setters on due diligence, corporate accounting standards and the regulation of financial markets;

(x) Circular solutions: embed innovative data-led practices in support of interventions relating to water access, management and conservation for sustainable economic development across all sectors;

(y) Promote water accounting and auditing, including water tenure, to provide significant opportunities for global water stakeholders to make data-informed improvements to equitable and sustainable water access and quality;

(z) Open-source courses for integrated water resources management and intersectoral water management must be built and shared;

(aa) Water tariffs must be adjusted to reflect the realistic price of piped water delivery service and to encourage innovation, and funding should be invested in researching, testing and deploying new technologies. Embrace disruptive technologies in water delivery services;

(bb) Place water access and management at the heart of planning processes.

VI. Guiding questions

67. The following guiding questions may be used to inform the dialogue:

(a) How does one develop mechanisms for engagement of stakeholders across water services valuation, the water nexus, and sustainable economic and urban development?

(b) Water and sustainable development: a planetary problem with local solutions?

(c) Is it time for an aqua innovation challenge?

Valuing water

(d) Will a focus on equitable outcomes for secure water access resolve the existing impasse between a rights-based and a valuation-based approach to water management?

(e) How can the role of the private sector be enlarged in supporting water innovation, both as an investor and an implementer?

(f) How do people build up the global water projects pipeline quickly?

Water-energy-food nexus

(g) What are the opportunities, incentives and trade-offs to drive systemic change in water management across food, energy and the built environment? What are some best practices that can be replicated and scaled up?

(h) How do people achieve greater efficiencies in the agrifood chain in support of sustainable water use?

(i) What is the role of hydrological economic modelling in support of blue and green economy integration and growth?

(j) What are the best alternatives to water-intensive renewable energy generation?

Sustainable economic and urban development

(k) How do people create incentives for innovation in water governance and finance for water?

(l) What are the principles and best practices of effective and transparent water monitoring systems?

(m) How can innovation and digital data help in better managing water resources?

(n) How can countries better organize their water data systems to ensure that all sectors are included and that no one is left behind?

(o) How does one quantify the specific finance needs arising from the national adaptation plans of Governments, especially as they relate to water infrastructure and drought and flood mitigation?

(p) How do people acknowledge and build on the role played by women as custodians of water in emerging markets? How does one quantify the productive time saved by girls and women who no longer spend hours each day sourcing water?

(q) How can the water management knowledge of Indigenous Peoples be scaled to address the new challenges of decentralized populations and their need for secure access to safe water?