Gradus Vol 13, No 2 (2026)
ISSN 2064-8014
Article No. 2026.2.ECO.015

From WSSD/Johannesburg to the Water–Energy–Food Nexus: Conceptual Perspectives, Paradigm Evolution, and Goal Attainment (2002–2025)

Andrianasolomahefa Rovatiana Salema [1*]

[1] Faculty of Public Governance and International Studies, Doctoral School of Public Administration, National University of Public Service, Budapest, Hungary,
https://orcid.org/0009-0004-7726-8811
https://doi.org/10.47833/2026.2.ECO.015

Keywords:
World Summit on Sustainable Development (WSSD 2002)
Integrated Water Resources Management (IWRM)
Water–Energy–Food Nexus
Bonn Nexus Conference
Sustainable Development Goals (SDGs)

Article history:
Received 13 May 2026
Revised 25 May 2026
Accepted 29 May 2026

Abstract
Water governance has traced a remarkable arc since Johannesburg. The dominant analytical framework that emerged from the 2002 World Summit on Sustainable Development (WSSD) placed Integrated Water Resources Management (IWRM) at the center of a hub-and-spoke model linking water to energy, health, biodiversity, and food influential, but structurally incomplete. A critical political economy perspective demonstrates that the underlying IWRM paradigm, rooted in the Dublin Principles (1992), failed developing countries by privileging environmental governance over the water infrastructure investment they most urgently needed. By 2011, the Water–Energy–Food (WEF) Nexus formalized at the World Economic Forum in Davos and at the Bonn 2011 Conference had reframed the challenge from single-sector management to cross-sectoral systems governance. This paper traces the conceptual distance between these paradigms through a qualitative conceptual-historical and political economy analysis, evaluating goal attainment and current nexus operationalization status. Findings reveal that while conceptual tools have matured substantially, implementation remains constrained by governance, finance, gender equity, and digital capacity deficits. The paper recommends five actionable correctives: cross-sectoral governance bodies, nexus-specific financing mechanisms, adaptive monitoring systems, gender mainstreaming, and digital infrastructure investment.

1 Introduction

Water is both a primary resource and a system connector. Its links to food production, energy generation, ecosystem health, and human welfare make it simultaneously a governance challenge in its own right and a diagnostic lens through which broader development failures become visible. Few other resources expose the gap between political ambition and institutional delivery as consistently.

The 2002 WSSD in Johannesburg elevated IWRM as the central governance instrument and produced the first global sanitation target. The post-WSSD analytical literature framed water as the 'link and key' in sustainable development: a radial hub-and-spoke architecture with water at the center and energy, health, agriculture, and biodiversity as spoke domains. A critical political economy

* Corresponding author.
E-mail address: andrianasolomahefa.rovatiana.salema@stud.uni-nke.hu; rovatiana.salena@gmail.com

strand demonstrates that the dominant IWRM variant of this period promoted through the World Water Council (WWC) and Global Water Partnership (GWP) from 1996 diverged from the development-oriented paradigm endorsed at Mar del Plata (1977) and in Agenda 21, effectively marginalizing infrastructure investment priorities of donor-dependent developing countries [1].

Two 2011 events catalyzed a paradigm shift. The World Economic Forum's Water Security: The Water–Food–Energy–Climate Nexus [2] and the Bonn2011 Nexus Conference's Understanding the Nexus background paper [3] together formalized a model in which water, energy, and food are co-equal interdependent systems.

This paper contributes to the growing literature on nexus governance by providing a critical political economy genealogy that: (i) traces the conceptual distance between WSSD 2002 and Bonn 2011 frameworks; (ii) identifies the structural and political-economy limitations of Dublin IWRM; (iii) integrates gender, equity, climate justice, and digital dimensions frequently absent from paradigm-comparison studies; and (iv) proposes actionable correctives grounded in the 2025 implementation record.

This paper *asks: what structural and political-economy limitations did the WSSD framework carry? Why did the paradigm shift*? Were the goals of Johannesburg and Bonn achieved? And what does the current state of nexus implementation reveal about the persistence of underlying governance deficits?

2. Methodology

This paper employs a qualitative conceptual-historical analysis combined with a critical political economy lens. The conceptual-historical dimension traces how water governance frameworks evolved in response to shifting institutional, empirical, and political contexts between 2002 and 2025. The critical political economy lens examines how power relations, development finance structures, and the interests of particular actor coalitions shaped the emergence and adoption of governance frameworks, following the approach established by Muller [1] and developed by Leck et al. [4] and Pahl-Wostl et al. [5].

Source base and selection criteria. Literature was selected from three overlapping categories: (i) primary institutional documents (WSSD Plan of Implementation, Bonn2011 Conference outputs, UN SDG Progress Reports, IPCC Assessment Reports, and WHO/UNICEF JMP monitoring data); (ii) peer-reviewed conceptual and review literature from Q1 journals, prioritizing studies published between 2015 and 2024 to ensure recency; and (iii) critical political economy analyses of water governance paradigms. Searches were conducted in Web of Science and Scopus using the terms 'water-energy-food nexus,' 'IWRM political economy,' 'nexus governance,' and 'SDG water implementation.' All sources cited appear in the reference list.

Limitations. As a conceptual review, this paper does not generate new primary empirical data. Causal claims about policy impact rest on the existing literature rather than original field research. The paper does not claim generalizability to all national contexts; governance outcomes reflect local institutional, financial, and political conditions that vary substantially across regions.

3. The WSSD 2002 Framework: Architecture and Political Economy

3.1 Johannesburg and WEHAB

The WSSD convened in Johannesburg from 26 August to 4 September 2002 to translate Agenda 21 adopted at UNCED Rio de Janeiro (1992) into funded, time-bound programmes. Secretary-General Kofi Annan's WEHAB Initiative (Water, Energy, Health, Agriculture, Biodiversity) structured the summit's thematic programme [6]. The Johannesburg Plan of Implementation

produced the first global sanitation target: halving the proportion of people without sanitation by 2015. The failure to secure any binding target on renewable energy was the summit's most visible deficiency, exposing the difficulty of cross-sectoral integration even within a nominally integrative framework.

3.2 Post-WSSD Analytical Architecture

The theoretical synthesis of the period framed water supply and IWRM as the hub of sustainable development, with energy, health, biodiversity, and agriculture as spoke domains (see Figure 1). This radial architecture captures feedforward effects (water enables food and energy production) but not feedback loops (energy and food demand reshape water scarcity; agricultural intensification restructures hydrological cycles). Governance built on this model systematically underestimates cross-sectoral resource risks.

3.3 Political Economy of Dublin IWRM

The IWRM that shaped this period was a specific political artefact. The 1992 Dublin Principles, not endorsed in Agenda 21's final text, were subsequently institutionalized through the WWC and GWP, shaped primarily by OECD governments and environmental NGOs. Muller [1] demonstrates how strategic funding channels locked donor-dependent developing countries into Dublin IWRM while middle-income economies (China, Brazil, South Africa) continued infrastructure-led water development essentially undisturbed. Dublin IWRM's deliberative democracy requirements imposed prohibitive transaction costs on under-resourced institutions, and its cost-recovery logic conflicted with the public goods character of water provision.

3.4 Private Sector Political Economy

The private sector's role in the WSSD framework was peripheral largely a recipient of environmental regulations rather than a governance actor. This exclusion had material consequences: private capital flows to water and sanitation remained marginal precisely because no framework articulated water's economic relationships in investment-legible terms [7]. The nexus concept's origins in the WEF Davos process (2008–2011) were partly a business-community response: by framing water security as systemic economic risk, the nexus recast the private sector from compliance subject to active governance partner. This reframing attracted new capital, but also introduced the risk of subordinating water's public goods dimensions to commercial return logic [4]. Effective nexus governance must manage this tension explicitly mobilizing private finance while maintaining public accountability for universal access.

4. Structural and Conceptual Perspectives: A Comparative Analysis

Four structural gaps in the WSSD framework are analytically decisive. The first is architectural: the hub-and-spoke model (Figure 1) cannot represent mutual constraints. Energy production is the second largest water user globally [8]; irrigation accounts for approximately 70% of freshwater withdrawals [9]; biofuel expansion simultaneously depletes water and raises food prices [10]. The second gap is in governance design: IWRM addresses coordination within the water sector, not the political economy of decisions made by energy, agriculture, and finance ministries. The third gap is risk framing: the WSSD treated the challenge as a water crisis; the WEF Nexus reframed it as systemic economic risk. The fourth gap is temporal: all nexus interdependencies were empirically documented at Mar del Plata (1977) what changed by 2011 was the institutional vocabulary and political platform to model them as an integrated governance challenge, not the reality of the nexus itself.

Two additional gaps, absent from most paradigm-comparison studies, demand inclusion. The gender and social equity gap: the WSSD 2002 framework largely excluded women's differential exposure to water insecurity from its analytical architecture, despite strong evidence that women and girls bear disproportionate burdens of water collection, sanitation access, and food production across sub-Saharan Africa and South Asia [11, 12]. The digital and technological gap: neither framework adequately anticipated how digital infrastructure remote sensing, smart metering, AI-driven demand forecasting, and digital water twins could transform both the data availability and the management efficiency of nexus governance [13, 14]. Table 1 synthesizes these gaps

Table 1. Comparative framework analysis: WSSD 2002 vs. WEF Nexus 2011 vs. current SDG architecture. Source: author synthesis based on [2, 3, 11, 13, 15, 16].

Dimension	WSSD 2002	WEF Nexus 2011	SDG Status 2025
Framework	Water-centric hub-and-spoke (IWRM at center; Fig. 1)	Triangular co-equal model: water, energy, food (Hoff [3]; Fig. 2)	SDG 6 plus cross-linkages; largely siloed in practice
Energy–Water	Energy as downstream water recipient; reverse flows absent	Energy production modelled as major driver of water depletion	Partly operationalized; monitoring fragmented
Food–Energy	Not modelled; absent from analytical framework	Explicitly modelled: irrigation energy costs, biofuels	SDGs 2 & 7 institutionally siloed
Climate	Background challenge; not structurally integrated	Cross-cutting nexus driver throughout framework	SDG 13 linked in principle; operationalization weak
Trade-offs	Not systematically addressed	Central analytical instrument of nexus approach	Under-developed in practice [15]
Governance unit	Water-sector institutions	Cross-sectoral policy coherence	Fragmented ministerial mandates persist
Finance logic	ODA + domestic mobilization (MDG framework)	Green economy investment (private + blended)	USD 114bn/yr gap for SDG 6 alone [16]
Gender & Equity	Largely absent from analytical model	Acknowledged; not operationalized	SDG 5 linked; implementation gaps [11]
Digital/Tech	Not addressed	Not addressed	Smart water / digital twins emerging [13]

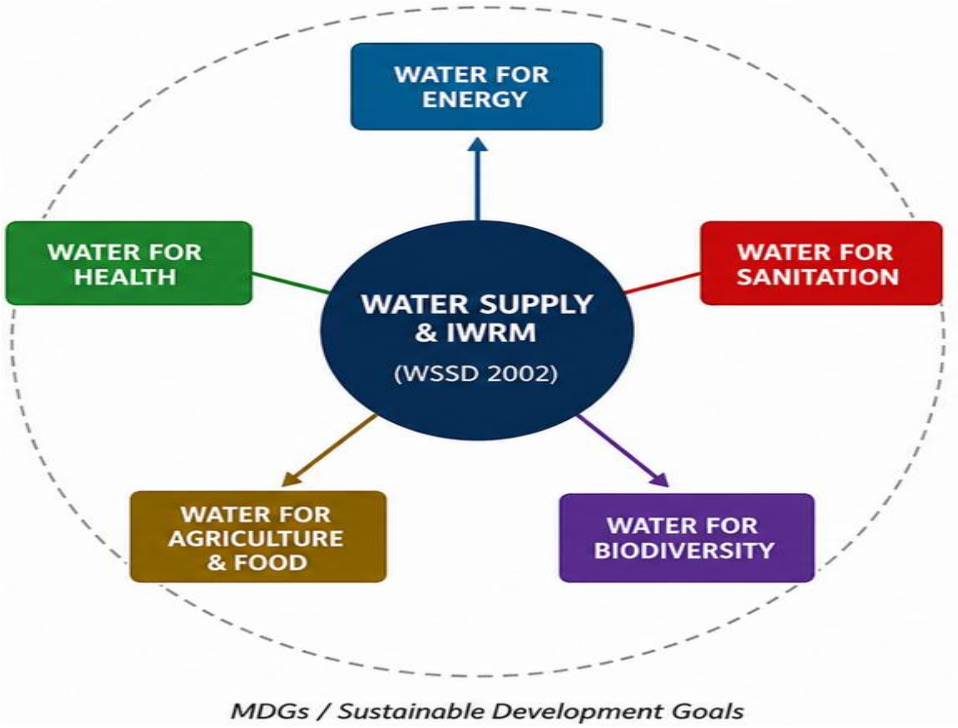

Figure. 1. WSSD 2002 Hub-and-Spoke Architecture. (Water centric radial model)

Source: author schematic based on [6].

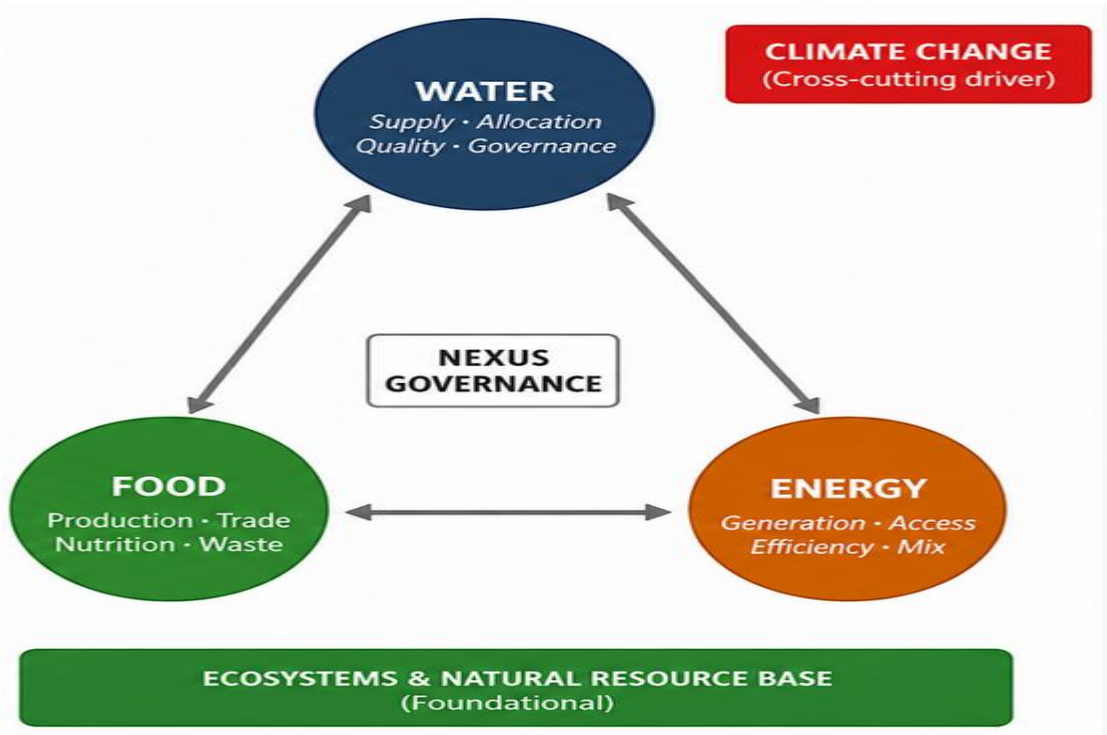

Figure. 2. WEF Nexus Triangular Architecture (Bonn 2011/ Hoff [3]; Co-Equal System Model Waughray [2]).

Source: author schematic.

5. Drivers of the Paradigm Shift: Davos, Bonn, and the IWRM-Nexus Relationship

By the late 2000s, converging pressures had made single-sector frameworks untenable. The World Economic Forum [7] projected a 30–50% rise in demand for water, food, and energy within two decades; the National Intelligence Council [17] estimated demand growth at approximately 35%, 40%, and 50% respectively. These projections were simultaneous: each demand curve created real-time constraints for the others, and no governance framework treating them separately could produce coherent responses.

IWRM-nexus relationship. The nexus does not replace IWRM but operates at a different governance level. IWRM addresses the internal coordination of water uses within the sector allocation between users, environmental flows, basin-scale management. The nexus addresses the external political economy of decisions made by actors outside the water sector whose choices are the primary determinants of water demand: energy ministers choosing fuel mix, agriculture ministers setting irrigation policy, finance ministries deciding infrastructure investment priorities [4, 5]. Treating the two frameworks as competitors misreads their functional relationship: IWRM remains necessary within the water sector; the nexus is necessary at the cross-sectoral governance level. Countries that have achieved most in water governance Singapore, the Netherlands, Israel operate sophisticated IWRM systems that are embedded within broader resource governance architectures.

The institutional origin of the WEF Nexus is significant: it achieved global traction through the World Economic Forum rather than through traditional water-sector institutions (WWC, GWP, UNESCO-IHP). This gave the nexus immediate business and finance salience, but also exposed it to Muller's [1] critique that it remains an essentially tactical response legitimizing the search for IWRM alternatives rather than providing a fully coherent successor governance paradigm. The Bonn2011 Conference, convened by the German Federal Government (16–18 November 2011) as a contribution to Rio+20, provided the conceptual rigor that the Davos process had lacked: Hoff's [3] triangular model (Figure 2) positioned water, energy, and food as co-equal nodes, with climate change as a cross-cutting driver and ecosystems as the foundational resource base.

6. Did the Goals Get Achieved? A Critical Assessment

6.1 Johannesburg (2002–2015)

The WSSD's water commitment extended MDG 7C to encompass sanitation: halve the proportion without access by 2015. The drinking-water target was technically met in 2010, 91% using improved sources [18] but 'improved source' is not 'safely managed water,' and the SDG 6 baseline subsequently appeared dramatically worse [19]. The sanitation target was simply missed: 2.4 billion people lacked improved sanitation and 946 million still practiced open defecation by 2015 [20]. Sub-Saharan Africa's absolute number without sanitation access increased over the MDG period even as proportional coverage improved.

6.2 Country and Regional Evidence

Sub-Saharan Africa. Despite widespread IWRM adoption in name, countries such as Ethiopia, Tanzania, and Mozambique failed to translate river basin management structures into infrastructure investment at scale. The institutional architecture required by Dublin IWRM River basin organizations, multi-stakeholder platforms, and cost-recovery tariffs-imposed governance transaction costs that outstripped institutional capacity, delaying the construction of water supply systems that populations urgently needed [1, 14].

South and Southeast Asia. India's experience illustrates the food–water–energy nexus in practice: Green Revolution-era subsidies for energy-intensive groundwater irrigation drove the depletion of aquifers in Punjab and Gujarat, ultimately threatening the food security the subsidies were designed to protect [21, 22]. The nexus trade-off short-term food security purchased at the cost of long-term water depletion was invisible to governance frameworks that treated agriculture and water as separate sectoral mandates.

Latin America. Brazil's 2021 water crisis provides a contemporaneous example: sustained drought combined with hydropower's dominant share of the electricity mix (approximately 63%) produced simultaneous water scarcity, electricity rationing, and irrigation shortfalls across multiple sectors [23]. The crisis was a textbook nexus event; Brazil's federal governance structure, in which the National Water Agency (ANA) and the National Electricity Regulatory Agency (ANEEL) operate under separate legislative mandates, was structurally incapable of producing an integrated response

6.3 Climate Justice and Global South Perspectives

The SDG and nexus literature has increasingly recognized that resource interdependencies are not climate-neutral or equity-neutral. Countries of the Global South which have contributed least to cumulative greenhouse gas emissions face the most severe nexus stress: more intense droughts, more erratic monsoons, greater groundwater depletion, and weaker institutional capacity to manage cross-sectoral crises [24, 12]. This is a climate justice problem: the governance frameworks evaluated in this paper were designed largely by and for the institutional contexts of OECD countries, yet their primary implementation challenge lies in the Global South.

Sultana's [12] feminist political ecology framework underscores that nexus impacts are also gender-differentiated: water insecurity imposes asymmetric burdens on women and girls (time poverty from water collection, safety risks from inadequate sanitation, reduced educational and economic participation), yet women remain systematically underrepresented in water governance structures at all levels [11]. A governance framework that does not incorporate gender as a structural variable will systematically misallocate interventions and replicate the inequities it aims to address.

6.4 WEF Nexus and SDG Progress (2015–2025)

Conceptually, the Hoff [3] triangular framework is now the organizing model for integrated resource governance globally. Operationally, five binding constraints persist: poor cross-sectoral data; weak empirical evidence on nexus interventions at scale; inadequate multi-sector modelling tools; absence of cross-ministerial governance bodies with nexus mandates; and institutional silo resistance [5, 25]. As of 2025, half the 169 SDG targets show minimal progress; one-third have stagnated or regressed [26]. Two billion people lack safely managed drinking water; 3.6 billion lack sanitation; water stress affects over 3.6 billion for at least one month per year.

7. Persistent Deficits

7.1 Finance

The annual SDG 6 financing gap is approximately USD 114 billion [16]. Recent estimates by the World Bank [27] indicate that achieving universal safely managed water and sanitation by 2030 would require an increase in annual investment from USD 28.4 billion to USD 114 billion in low- and middle-income countries alone. When food and energy infrastructure are included, the aggregate nexus financing gap runs to several hundred billion dollars annually. The structural barrier that water infrastructure cannot generate cost-recovery revenues sufficient to attract private capital demands structural solutions: blended finance platforms that de-risk private investment through public guarantees; nexus bonds that bundle water, energy, and food infrastructure assets for institutional investors; and payment-for-ecosystem-services mechanisms that create revenue streams from

watershed protection. None of these mechanisms has yet been demonstrated at scale, but all are being actively piloted [14, 27].

7.2 Digital Transformation

Neither the WSSD 2002 framework nor the original Bonn 2011 nexus model addressed the governance opportunities of digital infrastructure. By 2025, this represents a significant analytical gap. Smart water meters, IoT sensor networks, satellite remote sensing for agricultural water use, AI-driven demand forecasting, and digital water twins are transforming both the data availability and management efficiency of nexus governance in a growing number of settings [13, 14]. Digital technologies can resolve one of the most persistent operational constraints identified by Pahl-Wostl et al. [5]: the absence of cross-sectoral data sufficient to support integrated governance decisions. However, digital infrastructure investment is itself unequally distributed: the same countries that face the most acute nexus stress typically have the weakest digital infrastructure, creating a compounding governance deficit. Bridging this gap requires targeted digital capacity investment as an explicit component of nexus financing frameworks.

7.3 IWRM-Nexus Institutional Relationship

As established in Section 5, IWRM and the WEF Nexus operate at different governance levels and are functionally complementary rather than alternatives. A persistent source of confusion in the nexus literature is the tendency to conflate the two: to treat the nexus as a replacement for IWRM when it is more accurately understood as an extension of the governance architecture into the cross-sectoral domain. Countries that have invested in strong IWRM systems effective river basin organizations, robust water allocation frameworks, and functional water data systems are better positioned to implement nexus governance than those which have not, because IWRM provides the within-sector institutional foundation upon which cross-sectoral governance must build. Future frameworks should explicitly specify the division of labour between IWRM and nexus governance rather than allowing ambiguity to generate institutional competition.

8. Recommendations

Drawing on the analysis above, five structural recommendations are advanced for international water and nexus governance actors:

- **1. Establish cross-sectoral resource governance bodies with formal mandates.** Nexus governance requires institutional actors that do not yet exist in most national systems: cross-ministerial planning bodies with authority over integrated Water–Energy–Food decisions, separate from and higher than single-sector ministries. The EU Water Framework Directive Energy Union linkage and Brazil's post-2021 water-energy task force offers early models that should be assessed for transferability.
- **2. Design nexus-specific financing mechanisms.** Move beyond ODA mobilization to blended finance platforms, nexus bonds, and payment-for-ecosystem-services mechanisms that generate investment-grade revenues from nexus infrastructure. The World Bank's PROBLUE programme and GEF's integrated resource efficiency grants are entry points. National development banks in Brazil, India, and South Africa are better placed than OECD donors to anchor nexus investment platforms in the countries where the financing gap is widest.
- **3. Build adaptive monitoring systems with explicit nexus indicators.** SDG monitoring should be supplemented with cross-sectoral nexus indicators that track Water–Energy–Food

trade-offs explicitly (not merely sectoral coverage rates). UN-Water and FAO jointly developing a Nexus Indicator Framework, linked to the HLPF monitoring process, would provide the evidence base that nexus governance currently lacks.

- **4. Mainstream gender and social equity as structural variables.** Gender-differentiated impacts of nexus stress must be incorporated into data collection, project design, and governance representation frameworks. The UN-Water Gender Mainstreaming Guidance [11] provides a practical starting point; it should be operationalized as a mandatory criterion for all nexus investment and governance reform programmes rather than remaining a voluntary commitment.
- **5. Invest in digital infrastructure as a nexus enabler in the Global South.** Targeted funding for smart water metering, agricultural remote sensing, and cross-sectoral data platforms in low- and lower-middle-income countries should be treated as a prerequisite for nexus governance, not an optional add-on. Development finance institutions should incorporate digital infrastructure as an eligible expenditure category within water and food security financing windows.

9. Conclusion

The intellectual journey from the WSSD (2002) to the WEF Nexus (2011) represents genuine conceptual progress. Replacing the water-centric radial model with a triangular co-equal systems architecture corrected the WSSD framework's most significant structural gap: its inability to represent the feedbacks through which resource demands in one sector constrain availability in another. The Bonn2011 Conference embedded this advance within the green economy and Rio+20 discourse, and the nexus vocabulary now shapes integrated resource governance globally.

Yet the political economy lens offered by Muller [1] is a necessary counterweight. The nexus is not simply conceptual progress but a pragmatic response to Dublin IWRM's accumulated failures and it risks, if left uncorrected, reproducing Dublin IWRM's most consequential error: prioritizing analytical elegance over the infrastructure and development needs of the Global South countries where water, food, and energy insecurity is most acute. The integration of climate justice, gender equity, and digital transformation dimensions into nexus governance frameworks is no longer analytically optional: it is operationally necessary.

Twenty-three years after Johannesburg, two billion people still lack safely managed water [26]. The governance deficits identified at the summit have been diagnosed with increasing precision and modelled with increasing sophistication. Closing the gap between conceptual achievement and operational reality will not require new frameworks. It will require the political will, institutional innovation, cross-sectoral finance, and equity-grounded implementation that both Johannesburg and Bonn called for and which, as yet, remain insufficiently forthcoming.

References

[1] Muller, M. (2015). The nexus as a step back towards a more coherent water resource management paradigm. Water Alternatives, 8(1), 675–694. https://www.water-alternatives.org/index.php/all-abs/271-a8-1-4/file

[2] Waughray, D. (Ed.) (2011). Water Security: The Water–Food–Energy–Climate Nexus. Island Press, Washington, DC. https://www3.weforum.org/docs/WEF_WI_WaterSecurity_WaterFoodEnergyClimateNexus_2011.pdf

[3] Hoff, H. (2011). Understanding the Nexus. Background Paper for the Bonn2011 Conference: The Water, Energy and Food Security Nexus. Stockholm Environment Institute (SEI), Stockholm. https://www.sei.org/publications/understanding-the-nexus/

[4] Leck, H., Conway, D., Bradshaw, M. & Rees, J. (2015). Tracing the Water–Energy–Food Nexus: Description, Theory and Practice. Geography Compass, 9(8), 445–460. https://doi.org/10.1111/gec3.12222

[5] Pahl-Wostl, C. et al. (2021). Operationalising the water-energy-food nexus through the theory of change. Renewable and Sustainable Energy Reviews, 149, 111398. https://doi.org/10.1016/j.rser.2021.111398

[6] United Nations (2002a). WEHAB Framework Papers (5 vols). UN Secretariat. https://www.un.org/esa/sustdev/publications/

[7] World Economic Forum (2011). Global Risks 2011 (6th ed.). WEF, Geneva. https://www3.weforum.org/docs/WEF_GlobalRisks_Report_2011.pdf

[8] IEA (2012). Water for Energy: Is Energy Becoming a Thirstier Resource? International Energy Agency, Paris. https://www.iea.org/reports/water-energy-nexus

[9] Gleick, P.H. (2000). The World's Water 2000–2001. Island Press, Washington, DC.

[10] Rosegrant, M.W., Ringler, C. & Zhu, T. (2008). Water for agriculture: maintaining food security under growing scarcity. Annual Review of Environment and Resources, 34, 205–222.

[11] UN-Water (2023). Summary Progress Update 2023: SDG 6 — water and sanitation for all. Geneva: UN-Water. https://www.unwater.org/publications/summary-progress-update-2023-sdg-6-water-and-sanitation-all

[12] Sultana, F. (2018). Water justice: why it matters and how to achieve it. Water International, 43(4), 483–493. https://doi.org/10.1080/02508060.2018.1458272

[13] IWA — International Water Association (2023). Digital Water — Industry Leaders Manual. IWA Publishing, London. https://iwa-network.org/publications/digital-water/

[14] OECD (2023). Water Finance and Investment. OECD Environment Policy Paper No. 37. OECD Publishing, Paris. https://doi.org/10.1787/b3b8bb68-en

[15] Mohtar, R.H. (2022). The WEF Nexus Journey. Frontiers in Sustainable Food Systems, 6, 820305. https://doi.org/10.3389/fsufs.2022.820305

[16] UN High-Level Panel on Water (2018). Making Every Drop Count: An Agenda for Water Action. United Nations, New York. https://sustainabledevelopment.un.org/content/documents/17825HLPW_Outcome.pdf

[17] National Intelligence Council (2012). Global Trends 2030: Alternative Worlds. NIC, Washington, DC. https://www.dni.gov/index.php/gt2030

[18] WHO/UNICEF JMP (2015). Progress on Sanitation and Drinking Water: 2015 Update. WHO, Geneva. https://www.who.int/publications/i/item/9789241509145

[19] WHO/UNICEF JMP (2017). Progress on Drinking Water, Sanitation and Hygiene: 2017 Update and SDG Baselines. WHO, Geneva. https://www.who.int/publications/i/item/9789241512893

[20] United Nations (2015). Transforming our world: the 2030 Agenda for Sustainable Development. UN General Assembly Resolution A/RES/70/1.

[21] Shah, T. (2009). Taming the Anarchy: Groundwater Governance in South Asia. Resources for the Future, Washington, DC.

[22] Srinivasan, V. et al. (2017). The nature and causes of the global water crisis: Syndromes from a meta-analysis of coupled human-water studies. Water Resources Research, 48(10). https://doi.org/10.1029/2011WR011087

[23] ANA Agência Nacional de Águas (2022). Conjuntura dos Recursos Hídricos no Brasil 2022. Brasília: ANA. Available at: https://www.ana.gov.br/conjuntura-dos-recursos-hidricos

[24] IPCC (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability. Sixth Assessment Report, Working Group II. Cambridge University Press. https://www.ipcc.ch/report/ar6/wg2/

[25] Albrecht, T.R., Crootof, A. & Scott, C.A. (2018). The water-energy-food nexus: a systematic review of methods for nexus assessment. Environmental Research Letters, 13(4), 043002. https://doi.org/10.1088/1748-9326/aaa9c6

[26] United Nations (2023). The Sustainable Development Goals Report 2023. United Nations, New York. https://unstats.un.org/sdgs/report/2023/

[27] World Bank (2023). The Global Water Security & Sanitation Partnership (GWSP) Annual Report 2023. Washington, DC: World Bank. https://www.worldbank.org/en/topic/water/publication/gwsp-annual-report-2023

[28] BMU Germany (2012). Water, Energy and Food Security Nexus Solutions for the Green Economy. Bonn2011 Nexus Conference Outcome Document. Federal Ministry for the Environment (BMU), Berlin. https://www.water-energy-food.org

[29] Earth Negotiations Bulletin (2002). Summary report of the WSSD, 26 August – 4 September 2002. IISD. https://enb.iisd.org/events/wssd

[30] European Commission (2023). Water–Energy–Food–Ecosystem Nexus. International Partnerships. https://international-partnerships.ec.europa.eu/policies/climate-environment-and-energy/water-energy-food-ecosystem-nexus_en

[31] Gleick, P.H. & Palaniappan, M. (2010). Peak water limits to freshwater withdrawal and use. Proceedings of the National Academy of Sciences, 107(25), 11155–11162. https://doi.org/10.1073/pnas.1004812107

[32] ICWE (1992). Dublin Statement on Water and Sustainable Development. International Conference on Water and the Environment, Dublin, 26–31 January 1992. WMO, Geneva.

[33] IISD (2013). The Water–Energy–Food Security Nexus: Towards a practical planning and decision-support framework. International Institute for Sustainable Development. https://www.iisd.org/system/files/publications/wef_nexus_2013.pdf

[34] Simpson, G.B. & Jewitt, G.P.W. (2019). The Development of the Water-Energy-Food Nexus as a Framework for Achieving Resource Security. Frontiers in Environmental Science, 7, 8. https://doi.org/10.3389/fenvs.2019.00008

[35] UNFCCC (2022). Glasgow–Sharm el-Sheikh Work Programme on Loss and Damage. COP27 Decision 2/CP.27. https://unfccc.int/loss-and-damage-fund-joint-interim-secretariat

[36] United Nations (2002b). Johannesburg Plan of Implementation. WSSD, New York. https://www.un.org/esa/sustdev/documents/WSSD_POI_PD/English/WSSD_PlanImpl.pdf

[37] WRI (2002). The Outcomes of Johannesburg: Successes and Failures of the WSSD. World Resources Institute, Washington, DC. https://pdf.wri.org/wssd_joburg_english.pdf