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The Restorative Water-Security Nexus

Towards an Integrated Legal Framework for Mitigation, Adaptation, and Hydro-Resilience in Germany and the EU, Iran, and Ukraine

Till Reinholz
Ievgeniia Kopytsia
Atieh Khatibi
Sarah Marenbach

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Abstract[1]

Against the backdrop of accelerating climate change, geopolitical instability, and mounting pressure on freshwater ecosystems, water security can no longer be addressed through adaptation, mitigation, environmental protection, and post-crisis restoration as separate legal agendas. With COP31 providing an important opportunity to strengthen the place of water within international climate governance, this paper develops the concept of a "restorative water-security nexus", conceptualising restoration as a cross-cutting legal function connecting climate mitigation and adaptation with the protection, resilience, and ecological restoration of water systems. The nexus is operationalised through three interrelated dimensions-integrative, temporal, and scalar-and tested against Germany and the European Union, Ukraine, and Iran as deliberately contrasting case studies. These cases demonstrate how different forms of water insecurity-from regulatory fragmentation and structural scarcity to ecosystem degradation and conflict-related destruction-require distinct restorative responses while exposing common gaps across climate, water, and environmental law. The paper argues that hydro-resilience should be understood not merely as the capacity to withstand climatic shocks, but as a legally supported capacity to protect, adapt, recover, and progressively restore the ecological functions on which long-term water security depends. It concludes that common objectives for restorative water security should be combined with functionally differentiated implementation across governance levels, providing the basis for a glocal approach to hydro-resilience that could inform water-related climate governance at COP31 and beyond.

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Authors

Till Reinholz[2]
till.reinholz@ikem.de

Atieh Khatibi[4]
atieh.khatibi@uni-graz.at

Ievgeniia Kopytsia[3]
ievgeniia.kopytsia@ikem.de

Sarah Marenbach[5]
sarah.marenbach@ikem.de

1 This paper provides the broader comparative foundation for a related contribution by the authors in *Klima und Recht (KlimR)* 11/2026. The KlimR article builds on the restorative water-security nexus developed here, with a stronger focus on its theoretical foundations and its application to German and EU law, while the present study offers more extensive analyses of the Ukrainian and Iranian contexts.

2 Till Reinholz is Research Associate in the Research Academy and Mobility Department at IKEM, as well as a doctoral candidate at the University of Greifswald. His research focuses on climate and environmental law, particularly ecosystem restoration and links to Carbon Dioxide Removal, nature-based climate solutions and the legal governance of climate mitigation and resilience.

3 Ievgeniia Kopytsia is a legal scholar specialising in climate, environmental and energy law, with a particular focus on Ukraine, resilience and climate-security governance. She is an MSCA4Ukraine Fellow affiliated with Yaroslav Mudryi National Law University and the University of Genoa and collaborates with IKEM on research concerning Ukraine's green reconstruction and the climate-security nexus.

4 Atieh Khatibi holds both a BSc and MSc in Natural Resources Engineering from renowned universities in Iran, Isfahan University of Technology and the University of Tehran respectively. She also holds Bachelor of Law and Master in Environmental law and serves as a Research Project Assistant at the ClimLaw:Graz Center on the "Climate Law, Environment, and Human Rights" project, while pursuing her PhD at the University of Graz.

5 Sarah Marenbach is Research Associate in the Mobility Department at IKEM. Her work at IKEM addresses legal questions at the intersection of environmental, climate and mobility law.

IKEM
Institute for Climate Protection, Energy and Mobility e.V.

Alte Jakobstraße 85-86
10179 Berlin
Germany

+49 (0) 30 408 18 70-10
info@ikem.de
www.ikem.de

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I. Introduction

Climate change is fundamentally reshaping the relationship between water security, human well-being, and legal governance.[6] While water has long been recognised as a resource management challenge, recent scientific evidence[7] and the United Nations' declaration that the world has entered an era of global water bankruptcy[8] highlight a qualitative shift: freshwater systems are increasingly approaching ecological limits that threaten not only sustainable development but also societal stability and international security. This emerging reality calls for a reconceptualisation of water governance within the broader climate-security nexus.[9]

Water insecurity, however, does not manifest itself uniformly. Its causes and consequences range from structural scarcity, drought and ecosystem degradation to climate-induced extremes and the destruction of water infrastructure and ecosystems in armed conflict. Accordingly, the legal responses required to address water insecurity differ considerably across jurisdictions and hydrological contexts. What these challenges share is that they increasingly transcend conventional regulatory boundaries between climate adaptation, mitigation, water management, environmental protection, restoration, and disaster or post-conflict recovery.

This paper argues that water security should therefore be understood as a core legal dimension of climate security rather than merely as a sectoral adaptation challenge. The paper's contribution is thereby not to introduce restoration into water governance, but to reconceptualise restoration as an integrating legal function through which otherwise fragmented mitigation, adaptation, ecosystem-protection and water-security regimes can contribute to longterm hydro-resilience. Existing legal frameworks - including international and domestic water law, climate law, environmental law, agricultural regulation, and disaster risk governance - remain fragmented and frequently reactive. They are often illequipped to address systemic hydrological risks that transcend administrative boundaries, sectors, and generations. As water insolvency becomes an increasingly foreseeable consequence of climate change, legal systems must evolve from managing individual manifestations of water scarcity and degradation towards safeguarding long-term hydrological resilience.

Existing scholarship recognises the interdependence of water security, climate adaptation, ecosystem resilience and, increasingly, nature-based solutions.[10] Yet these approaches largely remain fragmented across climate, water and environmental governance. In particular, restoration has rarely been conceptualised as a legal connecting principle through which mitigation and adaptation can jointly contribute to long-term water security. The restorative water-security nexus seeks to address this gap by conceptualising restoration not merely as ex post ecological repair, but as a cross-cutting legal function linking ecosystem protection, climate mitigation, adaptation, recovery, and long-term hydro-resilience.

Against this conceptual background, the paper examines Germany and the European Union, Ukraine, and Iran as deliberately contrasting case studies. Rather than assuming the comparability of their respective water challenges and legal systems, the analysis uses their differences to test the capacity of the restorative water-security nexus to respond to distinct manifestations of water insecurity: regulatory integration and ecological restoration in Germany and the EU, conflict-related destruction and reconstruction in Ukraine, and structural scarcity and hydroclimatic vulnerability in Iran. The comparison thus serves not merely to apply the proposed nexus, but to identify, refine, and potentially challenge its underlying legal assumptions.

The paper ultimately explores whether these divergent experiences can inform a common approach to water security within international climate governance. It argues that greater global integration need not-and should not-entail uniform water governance. Rather, a restorative water-security nexus may provide a common normative framework connecting mitigation, adaptation, protection, and restoration while preserving the regulatory space necessary to respond to water insecurity at the appropriate basin, national, regional, and local levels. Against the backdrop of COP31, the paper therefore considers how water may be more systematically integrated into climate governance while remaining responsive to the fundamentally context-dependent nature of water security.

6 See e.g. *UN*, Water and Climate Change, https://www.unwater.org/water-facts/water-and-climate-change (accessed 13.09.2026); on the legal considerations of social-hydrological systems from an earth-system-perspective *Ahlström/Hileman* et al., An Earth system law perspective on governing social-hydrological systems in the Anthropocene, Earth System Governance 10 (2021), 100120, https://doi.org/10.1016/j.esg.2021.100120 (accessed 13.09.2026).

7 *Madani*, Water Bankruptcy: The Formal Definition, Water Resour Manage 40 (78) 2026, https://doi.org/10.1007/s11269-025-04484-0 (accessed 04.09.2026).

8 *United Nations*, World enters era of 'global water bankruptcy', https://news.un.org/en/story/2026/01/1166800 (accessed 03.09.2026).

9 See for a nexus literature overview chapter II of this paper.

10 *Cassin/Matthews/Lopez Gunn*, Nature-Based Solutions and Water Security: An Action Agenda for the 21st Century, Elsevier 2021.

II. Pathways to a Restorative Water-Security Nexus

Building on, but departing from, existing water-security, nexus and resilience approaches,[11] this article conceptualises a "restorative water-security nexus". Existing literature connects the established water-security nexus with planetary boundaries,[12] modular approaches and decentralization,[13] or for instance food and land-use.[14] But rather than treating restoration as a discrete environmental objective, the nexus understands restoration as a cross-cutting legal function capable of generating synergies between climate mitigation, adaptation, ecosystem protection and long-term hydro-resilience.

The restorative water-security nexus is thereby not intended to establish another sectoral nexus, but to provide a legal analytical framework for identifying and governing synergies and trade-offs between water security, mitigation, adaptation, ecosystem protection and restoration. Its distinctive contribution lies in examining restoration across three interrelated dimensions: an integrative, a temporal, and a scalar dimension. Together, these dimensions position restoration not as an isolated environmental objective, but as a legal mechanism for advancing long-term hydro-resilience across regulatory sectors, time horizons, and governance levels.

1. Integrative Dimension

The *integrative dimension* conceptualises restoration as a connecting element between otherwise fragmented legal regimes governing climate mitigation, adaptation, water management, and biodiversity protection. Integration in this sense does not require the merger of these regimes into a single legal framework. Rather, restoration may provide a shared functional objective through which their respective instruments and obligations generate mutually reinforcing outcomes. The relevant question is therefore whether legal frameworks merely pursue restoration alongside other objectives, or whether restoration creates substantive or institutional link-ages between mitigation, adaptation, ecosystem protection, and water security.[15]

2. Temporal Dimension

The *temporal dimension* connects preventive, adaptive, and restorative approaches across different stages of water insecurity. Rather than limiting restoration to an expost response to ecological degradation or crisis, it incorporates the protection and recovery of hydrological and ecological functions into the long-term governance of water security. Restoration may therefore operate both reactively, by supporting recovery from climatic or conflict-related damage, and prospectively, by strengthening the ecological foundations of future hydro-resilience.[16]

11 Providing an overview of existing scientific literature: *Hogeboom/Borsje* et al., Resilience Meets the Water–Energy–Food Nexus: Mapping the Research Landscape, Front. Environ. Sci. 9 (2021), 630395, doi: 10.3389/fenvs.2021.630395 (accessed 04.09.2026).

12 *Gupta/Bosch/van Vliet*, Water security reframed using Water System Justice and Earth system boundaries, foundations, and corridor, Front. Water 7 (2025), 1520853, doi: 10.3389/frwa.2025.1520853 (accessed 03.09.2026).

13 *Wutich/Thomson* et al., MAD water: Integrating modular, adaptive, and decentralized approaches for water security in the climate change era, WIREs Water, 10 (6) 2023, e1680, https://doi.org/10.1002/wat2.1680 (accessed 04.09.2026).

14 *Hogeboom/Borsje* et al., Resilience Meets the Water–Energy–Food Nexus: Mapping the Research Landscape, Front. Environ. Sci. 9 (2021), 630395, doi: 10.3389/fenvs.2021.630395 (accessed 04.09.2026).

15 Examining fragments of this approach: *Brouwer* et al., Mainstreaming Climate Policy: The Case of Climate Adaptation and the Implementation of EU Water Policy, Environment and Planning C: Politics and Space, 31 (1) 2013, https://doi.org/10.1068/c1113 (accessed 02.10.2026); Venuti, Bridging NbS and legal literature: Institutional, proce-dural and substantive barriers to nature-based solutions implementation, Land Use Policy 151 (2025), 107502, https://www.sciencedirect.com/science/article/pii/S0264837725000353 (accessed 02.10.2026); on the transformative potential of the EU-Nature Restoration Regulation see *Reinholz/Kalis,* Transformatives Recht am Beispiel des Moorbodenschutzes in der Nature Restoration Regulation [Transformative Law exemplified by Peat Soil Protection under the Nature Restoration Regulation], KlimR 3/2026, 66 ff.

16 Using the term of „proactive" to address the temporal dimension of adaption laws: *McDonald/McCormack*, Rethink-ing the role of law in adapting to climate change, Wires Climate Change 12 (5) 2021, e726, https://doi.org/10.1002/wcc.726 (accessed 02.10.2026); while the legal concepts of intertemporality and equity across generations (intergenerational justice) are remaining central challenges for legal frameworks: see for further information on the concept of intertemporal law and intergenerational equity Bustami, The Existing Doctrine of Intertemporal Law, in: Bustami (ed), The Legal Relationship between Present and Future Generations, An Intertemporal Perspective on Intergenerational Equity, Springer 2026 https://doi.org/10.1007/978-3-032-03345-1 (ac-cessed 02.10.2026).

3. Scalar Dimension

Third, the *scalar dimension* reconciles the need for common normative objectives with the inherently context-dependent nature of water governance. While overarching objectives for water security, climate resilience, and restoration may be articulated at the global or regional level, their implementation must remain responsive to hydrological conditions at transboundary, basin, national, and local levels. The relevant question is therefore how legal frameworks allocate and coordinate restorative objectives across governance levels without imposing uniform solutions on hydrologically and institutionally diverse contexts.[17]

III. Comparing the Incomparable? Testing the Restorative Water-Security Nexus

The analytical value of the restorative water-security nexus depends on its capacity to operate across fundamentally different manifestations of water insecurity. Germany and the EU, Ukraine, and Iran therefore serve not as directly comparable legal systems, but as deliberately contrasting test cases. They expose the nexus to three distinct challenges – regulatory fragmentation, conflict-related destruction, and structural water scarcity - and thereby allow its integrative, temporal and scalar dimensions to be tested, refined, and, where necessary, qualified.

1. Germany and the EU: Integration and Ecological Restoration

Germany and the EU represent a setting in which the central challenge is less the absence of water and restoration law than the integration of an increasingly dense regulatory landscape - both horizontally and vertically in a multi-level-governance system. Their relevance to the restorative water-security nexus therefore lies in whether existing obligations on water protection, climate adaptation, mitigation, and ecosystem restoration can be connected into a more coherent legal approach to hydro-resilience.

1.1. European Union

EU law provides a particularly instructive starting point because restoration is already embedded in a broader architecture of water, climate, biodiversity, and landuse regulation. The focus is therefore not whether restoration has entered EU law, but whether these dispersed legal elements can interact in a way that transforms restoration from a sectoral objective into an integrating function of water-security governance.

1.1.1. Systemic Hydro-Resilience under Climate Change

Europe increasingly faces interconnected pressures on its water systems, including drought and water scarcity, flooding, declining groundwater availability, the degradation of aquatic ecosystems, and competing demands from agriculture, energy, industry, households, and ecosystems.[18] Water insecurity in the EU can therefore not be reduced to a problem of scarcity alone, but raises the broader question of systemic hydro-resilience under climate change. This makes the EU a particularly instructive case for testing the restorative water-security nexus: while restoration already constitutes an element of European environmental law, the central legal question is whether it remains one obligation among many or can perform a broader integrative function, connecting the ecological objectives of the Water Framework Directive with EU climate adaptation and mitigation and ultimately contributing to long-term hydro-resilience.

17 Highlighting the transboundary and level dependent framing: *Rieu-Clarke* et al., Transboundary water governance and climate change adaptation: International law, policy guidelines and best practice application, Paris, UNESCO 2015; later in this paper in chapter IV, the term of "Glocalisation" is introduced, thereby linking the global and the local governance theatre conceptually and linguistically. For a general introduction to this concept see *Mihr*, Glocal Governance, How to Govern in the Anthropocene?, Springer 2022, https://doi.org/10.1007/978-3-031-02108-4 (accessed 02.10.2026) and Roudometof, Theorizing glocalization: Three interpretations, European Journal of Social Theory, 19 (3) 2016, 391-408, https://doi.org/10.1177/1368431015605443 (accessed 02.10.2026).

18 *European Commission*, Water scarcity and droughts, https://environment.ec.europa.eu/topics/water/water-scarcity-and-droughts_en (accessed 02.10.2026).

1.1.2. Water and its Sectoral Legal Recognition

At EU level, water security is addressed through a fragmented but increasingly interconnected set of legal and policy frameworks, including the European Climate Law,[19] the Water Framework Directive (WFD),[20] the Floods Directive,[21] the Nature Restoration Regulation (NRR),[22] as well as, to varying degrees, the LULUCF Regulation,[23] the Common Agricultural Policy (CAP),[24] the EU Adaptation Strategy,[25] and the EU Water Resilience Strategy as part of the evolving water-resilience policy framework.[26]

Within this regulatory landscape, the WFD combines the prevention of further deterioration with the protection, enhancement and restoration of European waters and the objective of achieving good water status.[27] The NRR strengthens this restorative dimension by introducing more explicit and quantified restoration obligations for degraded ecosystems with a more explicitly affirmative restoration logic, requiring active measures to restore degraded ecosystems and thereby moving beyond the prevention of further ecological deterioration.[28] Read together, the two instruments may therefore indicate a broader development in EU environmental governance from predominantly defensive environmental protection towards a more affirmative and active restoration logic. From the perspective of the restorative water-security nexus, the crucial question is whether this interaction can develop into a legally integrated approach in which restoration contributes not only to biodiversity objectives, but also to climate adaptation, mitigation, and long-term hydro-resilience.[29]

1.1.3. Restoration as a Paradigm Shift in European Environmental and Climate Law?

Yet the emergence of stronger restoration obligations does not in itself overcome the fragmentation of EU water governance. Climate law, water law, biodiversity and restoration law, agricultural policy, land use and carbon regulation pursue partly distinct objectives and operate through different planning cycles, competent authorities,

19 Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law').

20 Consolidated text: Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy.

21 Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks.

22 Regulation (EU) 2024/1991 of the European Parliament and of the Council of 24 June 2024 on nature restoration and amending Regulation (EU) 2022/869.

23 Regulation (EU) 2018/841 of the European Parliament and of the Council of 30 May 2018 on the inclusion of green-house gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU.

24 The CAP 2023-2027 is legally organised through three regulations, see for an overview European Commission, The common agricultural policy at a glance, https://agriculture.ec.europa.eu/common-agricultural-policy/cap-overview/cap-glance_en#legal-foundations (accessed 13.09.2026); Regulation (EU) 2021/2116 of the European Parliament and of the Council of 2 December 2021 on the financing, management and monitoring of the common agricultural policy and repealing Regulation (EU) No 1306/2013; Regulation (EU) 2021/2115 of the European Parliament and of the Council of 2 December 2021 establishing rules on support for strategic plans to be drawn up by Member States under the common agricultural policy (CAP Strategic Plans) and financed by the European Agricultur-al Guarantee Fund (EAGF) and by the European Agricultural Fund for Rural Development (EAFRD) and repealing Regulations (EU) No 1305/2013 and (EU) No 1307/2013; Regulation (EU) 2021/2117 of the European Parliament and of the Council of 2 December 2021 amending Regulations (EU) No 1308/2013 establishing a common organisation of the markets in agricultural products, (EU) No 1151/2012 on quality schemes for agricultural products and foodstuffs, (EU) No 251/2014 on the definition, description, presentation, labelling and the protection of geographical indications of aromatised wine products and (EU) No 228/2013 laying down specific measures for agriculture in the outer-most regions of the Union.

25 European Commission, COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUN-CIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Forging a climate-resilient Europe - the new EU Strategy on Adaptation to Climate Change COM/2021/82 final.

26 European Commission, Water resilience strategy, https://commission.europa.eu/topics/environment/water-resilience-strategy_en (accessed 03.09.2026).

27 *Carvalho/Mackay* et al., Protecting and restoring Europe's waters: An analysis of the future development needs of the Water Framework Directive, Science of The Total Environment, 658 (2019), 1228-1238, https://doi.org/10.1016/j.scitotenv.2018.12.255 (accessed 13.09.2026).

28 As stated in the recitals 1 et seq. to the regulation and highlighted with regards to freshwater ecosystems in Art. 4 and natural connectivity of rivers and natural functions of the related floodplains in Art. 9. Member stated are obligated to implement the targets via national restoration plans.

29 Since nature-based solutions are best-practice examples in linking co-benefits, peatlands could serve as a model ecosystem especially addressing the climate mitigation dimension. See for further contextualisation: *Reinholz/Kalis*, Transformatives Recht am Beispiel des Moorbodenschutzes in der Nature Restoration Regulation [Transformative Law exempliefied by Peat Soil Protection under the Nature Restoration Regulation], KlimR 3/2026, 66 ff.; *Reinholz/Kopytsia/Tanneberger,* Global Peatland Protection in the Context of the Climate-Security Nexus: Legal Perspec-tives on Multi- and Unilateral Developments in the EU, Ukraine, Russia and the US, https://usercontent.one/wp/www.ikem.de/wp-content/uploads/2025/11/Reinholz-Kopytsia-Tanneberger_Global-Peatlands-Protection.pdf (accessed 02.10.2026).

metrics, and enforcement structures. From the integrative dimension of the restorative water-security nexus, the EU may therefore already contain many of its legal components without possessing a coherent framework capable of connecting them. At the same time, integration cannot mean uniformity.

Water security is inherently dependent on local and basin-specific hydrological conditions, while river basins and other hydrological systems frequently transcend administrative and national boundaries. This reflects the scalar dimension of the nexus: common ecological objectives, restoration obligations, and climate-resilience requirements can be established at Union level while their implementation remains differentiated across Member States, river basins, and local contexts, as exemplified by the river-basin approach of the WFD. The temporal dimension is likewise emerging as EU water governance increasingly connects preventive protection and climate adaptation with the active restoration of degraded ecosystems, thereby linking ex ante resilience-building with the recovery of impaired ecological and hydrological functions. The EU Water Resilience Strategy may provide a further step towards connecting these dimensions by bringing climate adaptation, ecosystem restoration, water efficiency, infrastructure, and pre-paredness under a broader resilience agenda. Whether this emerging framework can translate these connections into more coherent governance, rather than adding another policy layer to an already fragmented regulatory landscape,[30] is therefore a central question for assessing the EU through the restorative water-security nexus.

1.1.4. The European Legal Watershed: Between Potential and Limitation

The EU illustrates both the potential and the limitations of a restorative water-security nexus. Its legal framework contains elements of all three dimensions: an integrative dimension linking water, climate and restoration objectives, a temporal dimension extending governance from prevention towards adaptation and active restoration, and a scalar dimension combining common EU objectives with differentiated implementation at Member State and river-basin levels. Yet these elements remain fragmented across distinct regulatory regimes. The central challenge is therefore not the absence of restoration obligations, but their integration into a coherent framework for long-term hydro-resilience.

1.2. Germany

Germany translates these broader European dynamics into a domestic legal setting in which growing hydrological pressures increasingly test the capacity of established water law to support long-term hydro-resilience.

1.2.1. Changing Circumstances and "New" Risks

Germany is accustomed to having a sufficient high-quality water supply, but resources are facing increasing threats, mainly caused by climate change and anthropogenic degradation of the natural environment.

The climate crisis is having a widespread impact on the water regime, although the effects vary across regions.[31] As in many other European countries, there is a growing likelihood of extremely heavy rainfall and catastrophic flooding and at the same time, however, extended dry periods and reduced water levels in summer,[32] that lead to a decline in the average annual groundwater formation in Germany.[33]

Furthermore the functioning of aquatic ecosystems of water bodies is affected by far reaching human intervention, such as substantial inputs of nutrients, pollutants and particulate matter into aquatic ecosystems, intensified water abstraction and extensive regulation of river courses that has eliminated natural flow regimes and floodplain areas.[34] This has led into a loss of biodiversity and, consequently, to a decline in the ecosystem services of aquatic systems.[35] In many cases, the human induced transformation of water bodies and their associated ecosystems has progressed so far that the integrity of these systems is at risk of being irrevocably lost.[36] Currently fewer than 10 percent of Germa-

30 As observed already before the European Green Deal in 2019: Rieu-Clarke/Allan/Hendry (eds), Routledge Handbook of Water Law and Policy, 1st edition 2017, Routledge.

31 *Federal Ministry for the Environment, Climate Action, Nature Conservation and Nuclear Safety*, National Water Strategy, March 2023, p. 5.

32 *Federal Institute of Hydrology*, BfG 2030 Strategy – Vision, Mission and Strategic Goals, June 2023, p. 11.

33 *Frings*, Nachhaltigkeit im Umgang mit Grundwasser in Deutschland als komplexes Governanceproblem, ZfU 2025, 315, 322.

34 *Federal Institute of Hydrology*, BfG 2030 Strategy – Vision, Mission and Strategic Goals, June 2023, p. 8.

35 *Federal Institute of Hydrology*, BfG 2030 Strategy - Vision, Mission and Strategic Goals, June 2023, p. 16.

36 *Federal Institute of Hydrology*, BfG 2030 Strategy - Vision, Mission and Strategic Goals, June 2023, p. 8.

nys water bodies meet the target of 'good ecological status' or 'good ecological potential', as stipulated by the WFD and the Federal Water Resources Act (Wasserhaushaltsgesetz, WHG) respectively.[37]

1.2.2. Multitude of Statutes in German Water Law

The fundamental act for water protection in Germany is the WHG.[38] It is the most important instrument for the implementation of EU water legislation and is content wise determined by the WFD.[39] Besides, each federal state also has its own State Water Act (Landeswassergesetz, LWG) but their legislative powers are limited to the gaps that the federal legislature has left for them to fill.[40] In addition, German water law comprises numerous specific acts at federal and state level, for example concerning the costs of water use, the quality of drinking water, the protection of water bodies from water hazardous substances and waterway traffic law.[41] The operational responsibility lies in general with the districts (Kreise) and urban districts (kreisfreie Städte).[42]

The WHG outlines the central principles[43] and objectives[44] of water management: besides the objective of a good water status and the principles of sustainability, environmental and climate protection, the restoration of water bodies to a near-natural condition is cited as an objective under the WHG. Unlike the other principles and objectives, the principle of restoration is not compulsory and is limited by conflicting public interests on the one hand and the constitutional principle prohibiting disproportionate measures on the other.[45]

Also important for water management is the National Water Strategy, that should ensure a more responsible use of water resources.[46] The strategy is based on a Cabinet decision and, as such, constitutes a political declaration of intent but does not represent a legally binding provision with external effects; it rather constitutes the internal legislation of the cabinet.[47] The National Water Strategy comprises ten strategic themes, among others the protection and restoration of the water regime for long term. One of the specific measures set out in the strategy is a nature-based restoration, conservation, ecological improvement and reconnection of floodplains (measure 23): restoration, nature conservation, climate change mitigation and adaptation to climate change as well as existing uses of water bodies is meant to be considered as a whole.[48]

In future, the National Restoration Plan, which Germany must adopt under the NRR by September 2027 at the latest, will also play an important role in the restoration of ecosystems.[49] This plan has to line out how Germany is going to reach the restoration obligations for degraded ecosystems set out by the NRR.

1.2.3. Is Germany (Mis)recognising the Nexus?

Considering these regulations against the background of the three outlined dimensions of the restorative water-security nexus, it becomes apparent that the integrative dimension has not yet been consistently reflected in German water law. To date, restoration has been pursued rather as an isolated objective alongside others, even though the National Water Strategy already states that restoration must be considered in conjunction with nature conservation, climate change mitigation and adaptation. But the strategy lacks a clear action plan setting out how the identified measures are to be implemented more rapidly, as well as the provision of additional financial resources to ensure swift implementation.

However, the future National Restoration Plan could mark a shift in this legislation by treating restoration as an ac-

37 *German Environment Agency*, Gewässerzustand verbessern - ein gesetzlicher Auftrag, 16.1.2025, https://www.umweltbundesamt.de/en/node/75086#europische-wasserrahmenrichtlinie-gibt-das-entwicklungsziel-vor (accessed 14.09.2026).

38 *Kloepfer*, Umweltrecht, § 14 para. 29.

39 *Kloepfer*, Umweltrecht, § 14 para. 33.

40 *Kloepfer*, Umweltrecht, § 14 para. 34.

41 *Kloepfer*, Umweltrecht, § 14 paras. 38 et seq.

42 Cf. §§ 124 et seq. BbgWG, §§ 114 et seq. LWG NRW in conjunction with ZustVU NRW.

43 Section 6 WHG.

44 Section 27 WHG.

45 *Pape/Snjka*, in: Landmann/Rohmer (eds), Umweltrecht, WHG § 6 Rn. 99.

46 *Federal Ministry for the Environment*, Climate Action, Nature Conservation and Nuclear Safety, National Water Strategy, March 2023.

47 Administrative Court of Berlin, judgment of 31 October 2019 – 10 K 412.18., EnWZ 2020, 88, 90.

48 *Federal Ministry for the Environment*, Climate Action, Nature Conservation and Nuclear Safety, National Water Strategy, March 2023, p. 86.

49 *BMUKN*, Nationaler Wiederherstellungsplan für die Natur in Deutschland, https://www.bundesumweltministerium.de/themen/naturschutz/wiederherstellung-von-oekosystemen/die-eu-verordnung-zur-wiederherstellung-der-natur/nationaler-wiederherstellungsplan-fuer-die-natur-in-deutschland (ac-cessed 02.10.2026).

tive measure and can thereby move beyond the mere prevention of further ecological deterioration. This also shifts the temporal dimension of restoration away from reactive measures towards a preventative system that aims to achieve hydro resilience. Finally, a scalar dimension is apparent in German water law: whilst the law is predominantly governed by federal legislation, regional authorities are responsible for implementing the regulations, which enables them to adapt the implementation to regional differences. As the analysis of the EU's legal framework has already shown, there is no shortage of restoration obligations in Germany either (at least once the National Restoration Plan is adopted). The challenge lies rather in integrating these into a coherent framework for long-term water resilience.

1.3. Synthesis: The Restorative Water-Security Nexus in the European Multi-Level System

Taken together, the EU and German cases demonstrate that the restorative water-security nexus does not depend on the creation of a single comprehensive legal regime. Its potential lies rather in connecting existing legal objectives and instruments across sectors and governance levels. The **integrative dimension** can be identified in the interaction between water protection, climate adaptation, mitigation, biodiversity protection, and ecosystem restoration, even though these objectives remain institutionally and legally fragmented.

The **temporal dimension** emerges in the gradual shift from preventing further deterioration towards actively restoring ecological and hydrological functions as a basis for future resilience.

The European multi-level system particularly illustrates the **scalar dimension** of the nexus. EU law can establish common objectives for water status, climate resilience, and ecosystem restoration, while their implementation is further specified through national law and strategies and ultimately operationalised at regional, local, and river-basin levels. Germany therefore demonstrates how common European objectives can be translated into context-specific restorative pathways without requiring uniform implementation. At the same time, the case reveals the central challenge of such a multi-level approach: the existence of restorative objectives at several governance levels does not by itself ensure their functional integration.

The EU and Germany thus illustrate restorative integration as a distinct pathway towards hydro-resilience. The principal legal challenge is not to create additional restoration objectives, but to coordinate existing obligations across regulatory sectors, time horizons, and governance levels so that restoration can operate as a connecting legal function rather than as an isolated environmental objective. In this respect, the European case anticipates the broader glocal governance logic developed below: common normative objectives require differentiated implementation at the governance level most capable of responding to the relevant hydrological conditions.

2. Ukraine: War, Destruction and Restorative Reconstruction

Ukraine illustrates a distinct and particularly acute form of water insecurity in which pre-existing hydro-climatic vulnerability, uneven territorial distribution of water resources, and conflict-related destruction converge. Water security is therefore not only an environmental or climate-adaptation concern, but also a matter of civilian protection, public health, territorial resilience, post-war recovery and European integration. Russia's full-scale invasion of Ukraine has intensified risks already apparent in water-stressed southern and eastern regions.

2.1. Water Insecurity under War and Climate Change

Ukraine has comparatively limited renewable freshwater resources per capita, and water resources are unevenly distributed across the country. Southern and eastern regions have historically experienced particularly significant pressure owing to climatic conditions, industrial demand, irrigated agriculture, urban consumption and the uneven location of available water sources.[50] This exposure is compounded by a substantial dependence on transboundary inflows: the Dnipro and its tributary, the Desna, rise in the Russian Federation; the Dnipro also crossing Belarus; the Siverskyi Donets rises in the Russian Federation and the Danube reaches Ukraine

50 *OECD*, Developing a Water Policy Outlook for Georgia, the Republic of Moldova and Ukraine, OECD Studies on Water, OECD Publishing, Paris 2021, https://www.oecd.org/content/dam/oecd/en/publications/reports/2021/07/developing-a-water-policy-outlook-for-georgia-the-republic-of-moldova-and-ukraine_a1b2f035/512a52aa-en.pdf (accessed 14.09.2026).

only at its delta. Climate change is likely to deepen these pressures through higher temperatures, droughts, more variable precipitation patterns, declining water availability and additional stress on surface-water and groundwater ecosystems.[51]

Russia's full-scale invasion 2022 has transformed this structural vulnerability into a multidimensional water-security crisis. Attacks on water-supply systems, wastewater-treatment facilities, pumping stations, energy infrastructure and hydraulic installations can interrupt access to safe water, hinder sanitation services and generate long-term pollution risks.[52] Damage to energy infrastructure is particularly significant because water and wastewater systems depend upon electricity for abstraction, pumping, treatment and distribution.

The destruction of the Kakhovka dam and Hydroelectric Power Plant in June 2023 illustrates the cascading character of this risk. The dam had been under the control of Russian forces since the first days of the full-scale invasion, and its destruction is being investigated by Ukraine's Office of the Prosecutor General, inter alia, as ecocide under Article 441 of the Criminal Code of Ukraine.[53] It affected drinking-water supply, agricultural irrigation, electricity generation, river and reservoir ecosystems, floodplain functions and the wider ecological integrity of the Dnipro basin.[54] The draining of the Kakhovka reservoir also deprived large irrigation systems in southern Ukraine of their principal water source and removed the reservoir from which the Zaporizhzhia Nuclear Power Plant had drawn its cooling water, showing how a single attack can propagate across the water-energy-food and nuclear-safety nexus.[55] It further demonstrated that a water-related installation can perform several interconnected functions at once and that its destruction can therefore produce climate, environmental, food-security, public-health and humanitarian consequences simultaneously.

The Ukrainian Parliament Commissioner for Human Rights (Ombudsperson) has documented repeated disruptions to access to safe water and sanitation under martial law, including as a consequence of damage to critical infrastructure, electricity shortages and hostilities. The report also records the extensive environmental implications of war-related water pollution.[56] In this context, water security cannot be reduced to maintaining infrastructure or managing scarcity. It requires the protection, recovery and restoration of water-related ecological functions alongside the repair and transformation of essential services.

2.2. Legal and Institutional Framework

The central domestic legal framework is the Water Code of Ukraine, which regulates the protection, use, reproduction and restoration of water resources, prevention of water pollution and harmful water impacts, and the protection of water users' rights.[57] The Water Code operates within a constitutional framework under which water and other natural resources are the property of the Ukrainian people (Article 13) and everyone is guaranteed the right to an environment that is safe for life and health (Article 50).[58] Its provisions establish the legal basis for integrated water-resources management, water monitoring, water-use permits, protection zones and river-basin governance. Legislative reforms have moved Ukraine from a predominantly administrative-territorial approach towards management based on river-basin districts, broadly reflecting the logic of the EU Water Framework Directive.[59]

Ukraine's approximation to the EU environmental acquis is supported by the Association Agreement between

51 *Cabinet of Ministers of Ukraine*, Water Strategy of Ukraine until 2050, approved by Order No. 1134-r of 9 December 2022; OECD, Developing a Water Policy Outlook for Georgia, the Republic of Moldova and Ukraine, OECD Publishing, Paris 2021.

52 *Commissioner of the Verkhovna Rada of Ukraine for Human Rights*, Special Report on the State of Compliance with Citizens' Rights to Clean and Accessible Water under the Conditions of the Legal Regime of Martial Law, Kyiv 2025, https://www.ombudsman.gov.ua/storage/app/media/uploaded-files/2-09072025-hhombudsmanspecialreport2025ukr-to-englishv4-2.pdf (accessed 14.09.2026).

53 *Criminal Code of Ukraine,* No. 2341-III of 5 April 2001, as amended, Art. 441; Office of the Prosecutor General of Ukraine, public statements on the criminal proceedings concerning the destruction of the Kakhovka dam, June 2023.

54 *Commissioner of the Verkhovna Rada of Ukraine for Human Rights*, Special Report on the State of Compliance with Citizens' Rights to Clean and Accessible Water under the Conditions of the Legal Regime of Martial Law, Kyiv 2025; United Nations Environment Programme, Environmental Impact of the Kakhovka Dam Destruction, Nairobi 2023.

55 *Government of Ukraine/World Bank/European Union/United Nations*, Ukraine Rapid Damage and Needs Assessment (RDNA), successive editions since 2023; International Atomic Energy Agency, Updates on Nuclear Safety, Security and Safeguards in Ukraine, June 2023.

56 *Commissioner of the Verkhovna Rada of Ukraine for Human Rights*, Special Report on the State of Compliance with Citizens' Rights to Clean and Accessible Water under the Conditions of the Legal Regime of Martial Law, Kyiv 2025.

57 Water Code of Ukraine, No. 213/95-VR of 6 June 1995, as amended, especially Arts. 1, 13, 13-1–13-3, 49, 70 and 95–111.

58 *Constitution of Ukraine* of 28 June 1996, as amended, Arts. 13 and 50.

59 *UNECE*, Baseline Analysis of the Legislative, Institutional and Content Aspects Related to 20 Target Areas of the Protocol on Water and Health for Revision of the National Targets of Ukraine, Geneva 2021, available at: https://unece.org/sites/default/files/2021-04/BLA_English.pdf (accessed 14.09.2026).

the European Union and Ukraine as well as by its status as an EU candidate country, granted on 23 June 2022. Following the European Council's decision of December 2023, accession negotiations were formally opened on 25 June 2024.[60] Environmental and climate law falls under negotiating Chapter 27 (Environment and Climate Change), which forms part of Cluster 4 (Green Agenda and Sustainable Connectivity). Alignment with EU environmental law must therefore be understood not merely as a bilateral association commitment, but also as part of Ukraine's ongoing accession process and preparation for eventual EU membership. This includes the gradual approximation and effective implementation of the EU environmental acquis, including water-quality and water-management legislation.[61] The Water Framework Directive provides a particularly important point of reference through its emphasis on river-basin planning, environmental objectives, prevention of deterioration, monitoring, public participation and programmes of measures.[62] Although the Directive does not apply to Ukraine directly, as Ukraine is not an EU Member State, Ukraine has undertaken to approximate its legislation to it under Annex XXX to the Association Agreement, and WFD-oriented reforms have become a central component of its European-integration and accession pathway. The European Commission has observed that Ukraine's water-quality legislation remains only partially aligned with the EU acquis, while also recognising that implementation of the Water Framework Directive has advanced.[63]

The Water Framework Directive is, however, only one part of the restoration-relevant acquis. Ukraine's accession pathway also entails approximation to the Floods Directive, the recast Drinking Water Directive, the recast Urban Wastewater Treatment Directive and, prospectively, the Nature Restoration Regulation, which sets binding restoration targets including for river connectivity and riverine and floodplain habitats.[64] Accession thus links Ukraine's reconstruction directly to the restoration paradigm discussed above for the EU (section III.1.1.3), so that the acquis serves not only as a benchmark for water-quality alignment but also as a potential legal vehicle for restorative reconstruction.

The adoption of River Basin Management Plans for all nine river-basin districts for the period 2025–2030 constitutes an important governance milestone. The plans cover the Danube, Dniester, Dnipro, Don, Southern Bug, Vistula, river-basin districts and the districts of the Black Sea rivers, the Azov Sea rivers and the Crimean rivers and establish a framework for addressing pollution, wastewater, water abstraction, ecosystem degradation and river restoration at the hydro-logically appropriate scale.[65] Their preparation reflects Ukraine's move towards WFD-compatible planning, although implementation will depend on institutional capacity, sustained financing, robust monitoring and the feasibility of action in territories affected by occupation or active hostilities.[66]

This limitation is not merely practical. The plans for the Crimean rivers district, and for substantial parts of the Azov Sea rivers and Don districts, cover territory that is currently occupied, where Ukrainian authorities can neither monitor water status nor implement programmes of measures. The basin approach thus formally extends to the whole territory, while its operational reach is determined by the course of the war.

The Water Code operates alongside the Law of Ukraine *On Environmental Protection, the Law On Environmental Impact Assessment, the Law On Drinking Water and Drinking Water Supply*, sanitary and public-health rules,

60 *European Council*, European Council Conclusions, 23 June 2022, EUCO 24/22, 24 June 2022; European Council, European Council Conclusions, 14–15 December 2023, EUCO 20/23, 15 December 2023; Council of the European Union, First Intergovernmental Conference at Ministerial Level on the Accession of Ukraine to the European Union, Luxembourg, 25 June 2024.

61 *European Commission*, Ukraine's Path towards EU Accession, https://commission.europa.eu/topics/eu-solidarity-ukraine/ukraines-path-towards-eu-accession_en (accessed 14.09.2026); Association Agreement between the European Union and its Member States, of the one part, and Ukraine, of the other part, OJ L 161, 29.5.2014, 3–2137, especially Annex XXX.

62 Consolidated text Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy.

63 *European Commission*, Ukraine 2025 Report, SWD(2025) 759 final, 4 November 2025, https://enlargement.ec.europa.eu/document/download/17115494-8122-4d10-8a06-2cf275eecde7_en?filename=ukraine-report-2025.pdf (accessed 14.09.2026); The Commission reports partial legislative alignment on water quality, while recognising progress in WFD implementation, see European Commission, COMMISSION STAFF WORKING DOCUMENT Ukraine 2025 Report, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52025SC0759 (accessed 02.10.2026).

64 Directive 2007/60/EC of 23 October 2007 on the assessment and management of flood risks; Directive (EU) 2020/2184 of 16 December 2020 on the quality of water intended for human consumption (recast); Directive (EU) 2024/3019 of 27 November 2024 concerning urban wastewater treatment (recast); Regulation (EU) 2024/1991 of 24 June 2024 on nature restoration, especially Arts. 4 and 9.

65 *International Commission for the Protection of the Danube River*, Ukraine Adopts Nine River Basin Management Plans: A Major Milestone Towards Sustainable Water Management, 30 March 2025, https://www.icpdr.org/danube-basin/countries/ukraine/ukraine-adopts-nine-river-basin-management-plans-major-milestone (accessed 14.09.2026).

66 *EU4Environment Water Resources and Environmental Data*, Conclusion Note: River Basin Management Plans in Ukraine, 2024, available at: https://davr.gov.ua/fls18/EN_Conclud-note_RBMPs_UA_20241129.pdf (accessed 14.09.2026); International Commission for the Protection of the Danube River, Ukraine Adopts Nine River Basin Management Plans, 30 March 2025.

environmental-monitoring legislation, emergency-law instruments and Ukraine's Water Strategy until 2050.[67] These instruments contain elements relevant to prevention, climate adaptation, environmental remediation and reconstruction. Yet governance remains dispersed across environmental, water-management, health, infrastructure, energy, emergency and local-government bodies. Municipalities and water utilities bear much of the immediate responsibility for water supply and sanitation, whereas basin-level management, national regulation, transboundary cooperation and international reconstruction support operate at different institutional and territorial levels.

2.3. From Adaptation to Restorative Reconstruction

Ukraine's water-security challenges are often framed principally through adaptation. Measures such as drought preparedness, water conservation, leakage reduction, efficient irrigation, climate-resilient drinking-water systems, wastewater treatment and groundwater protection can reduce sensitivity to water scarcity and extreme events.[68] These objectives are reflected in Ukraine's climate-policy framework, notably the Environmental Security and Climate Change Adaptation Strategy until 2030 and the updated Nationally Determined Contribution, and correspond to the global goal on adaptation under Article 7 of the Paris Agreement.[69] In the context of war and reconstruction, however, these measures also have mitigation relevance. Energy-efficient pumping and treatment systems, renewable backup power for water utilities, reduced network losses and decentralised or modular water-service solutions can reduce the energy intensity and emissions profile of the water sector while strengthening continuity of essential services.

Conversely, the destruction of the Kakhovka Hydroelectric Power Plant and the severe damage to the Dnipro Hydroelectric Power Plant in March 2024 have removed low-carbon generating capacity. Decisions on whether and how to rebuild such installations therefore involve a genuine trade-off between mitigation through renewable hydropower and restoration through the recovery of free-flowing river sections and of the floodplain vegetation that has begun to re-establish itself in the former Kakhovka reservoir bed. Nature-based solutions are particularly relevant to the interaction between adaptation, mitigation and restoration. The protection and restoration of wetlands, floodplains, riparian ecosystems, peatlands and natural water-retention landscapes can retain water during dry periods, moderate floods, support water purification, enhance biodiversity and, depending on the ecosystem, contribute to carbon sequestration or the avoidance of emissions associated with degradation.[70] Such measures cannot replace secure treatment plants, pipelines, storage and pumping infrastructure. They should instead be integrated into a hybrid model of hydro-resilience in which ecological systems and resilient infrastructure mutually reinforce one another.

The River Basin Management Plans offer an institutional opportunity for this integration because they shift attention from individual assets towards the ecological status, cumulative pressures and restorative needs of entire catchments.[71] However, recovery and reconstruction finance must avoid prioritising rapid replacement of damaged infrastructure at the expense of longer-term ecological recovery, pollution prevention, climate adaptation and energy efficiency. The relevant objective is not merely to restore pre-war service levels, but to establish water systems that are safer, more resource-efficient and more resilient than those that existed before the invasion. This principle is already reflected in the international reconstruction framework. The Lugano Declaration adopted at the 2022 Ukraine Recovery Conference endorses a sustainable recovery that "builds back better", while the Ukraine Facility requires the reforms and investments it supports to

67 Law of Ukraine on Environmental Protection, No. 1264-XII of 25 June 1991, as amended; Law of Ukraine on Environmental Impact Assessment, No. 2059-VIII of 23 May 2017, as amended; Law of Ukraine on Drinking Water and Drinking Water Supply, No. 2918-III of 10 January 2002, as amended; *Cabinet of Ministers of Ukraine*, Water Strategy of Ukraine until 2050, approved by Order No. 1134-r of 9 December 2022.

68 *World Bank*, Ukraine Water Supply and Sanitation Policy Note: Toward Improved, Inclusive and Sustainable Water Supply and Sanitation Services, Washington, DC, 2021, https://documents1.worldbank.org/curated/en/844681624034932176/pdf/Ukraine-Water-Supply-and-Sanitation-Policy-Note-Toward-Improved-Inclusive-and-Sustainable-Water-Supply-and-Sanitation-Services.pdf (accessed 14.09.2026); *Cabinet of Ministers of Ukraine*, Water Strategy of Ukraine until 2050, approved by Order No. 1134-r of 9 December 2022.

69 *Cabinet of Ministers of Ukraine*, Strategy of Environmental Security and Adaptation to Climate Change until 2030, approved by Order No. 1363-r of 20 October 2021; Ukraine, Updated Nationally Determined Contribution to the Paris Agreement, 2021; Paris Agreement, 12 December 2015, Art. 7.

70 *Cassin/Matthews/Lopez Gunn*, Nature-Based Solutions and Water Security: An Action Agenda for the 21st Century, Elsevier 2021; *UN Environment Programme*, Nature-Based Solutions for Climate Change Mitigation, Nairobi 2022.

71 *Cabinet of Ministers of Ukraine*, Resolution No. 336 of 18 May 2017 On Approval of the Procedure for the Development of River Basin Management Plans, as amended; *International Commission for the Protection of the Danube River*, Ukraine Adopts Nine River Basin Management Plans, 30 March 2025.

respect the "do no significant harm" principle and to contribute to the green transition.[72] Their restorative potential, however, depends on whether ecological recovery is treated as an eligibility and appraisal criterion for water projects rather than as a general policy aspiration, and on whether simplified procedures for urgent restoration works adopted under martial law are accompanied by adequate safeguards for environmental assessment and public participation. In Ukraine, restoration has at least three interrelated meanings.

First, it involves the urgent restoration of basic water and sanitation services. This requires repair and protection of water-treatment plants, pipelines, pumping stations, wastewater facilities and electricity supply, alongside contingency measures that safeguard drinking-water access for communities affected by hostilities, displacement or infrastructure failure. This dimension is indispensable to the effective protection of rights to life, health, dignity and an adequate standard of living. It is further anchored in the human right to safe drinking water and sanitation and, under international humanitarian law, in the prohibition of attacking, destroying or rendering useless drinking-water installations and supplies as objects indispensable to the survival of the civilian population.[73]

Second, restoration concerns environmental remediation and the recovery of damaged water ecosystems. Relevant measures include pollution monitoring, environmental-damage assessment, containment and clean-up, rehabilitation of contaminated riverine and wetland systems, restoration of riparian zones and floodplains, and the reconstruction of environmental-monitoring capacity. Under the Law of Ukraine *On Environmental Protection*, damage resulting from violations of environmental legislation must in principle be compensated, which provides a legal basis for environmental liability and remediation.[74] However, compensation in itself does not guarantee ecological recovery. Moreover, domestic liability rules presuppose a liable person within Ukrainian jurisdiction; for damage caused by the aggressor state, they encounter problems of state immunity and enforcement. Damage is therefore assessed domestically under a dedicated procedure for determining damage and losses caused by the armed aggression, including environmental damage, while compensation depends primarily on international mechanisms: the UN General Assembly's recognition of the Russian Federation's obligation to make reparation, the Council of Europe Register of Damage and the Convention establishing an International Claims Commission for Ukraine.[75] Effective restoration requires coordination between damage assessment, remediation obligations, reconstruction planning and basin-management measures so that degraded ecological functions are actually recovered.

Third, restorative reconstruction requires a forward-looking transformation of water infrastructure and governance. Reconstructing highly centralised, energy-dependent or ecologically disruptive systems without reconsidering their exposure to future climate and security risks may reproduce, rather than reduce, vulnerability. A restorative approach should prioritise resilient and, where appropriate, decentralised water systems; renewable backup power; reduced water losses; wastewater treatment and reuse; source-water protection; climate-sensitive spatial planning; and the restoration of natural retention landscapes. Ecological restoration is therefore not a supplementary environmental objective after reconstruction, but a condition for long-term water security.

72 *Ukraine Recovery Conference*, Lugano Declaration, 4–5 July 2022; Regulation (EU) 2024/792 of the European Parliament and of the Council of 29 February 2024 establishing the Ukraine Facility.

73 UNGA Res. 64/292 of 28 July 2010, The Human Right to Water and Sanitation; *CESCR*, General Comment No. 15: The Right to Water, E/C.12/2002/11, 20 January 2003; Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol I), 8 June 1977, Art. 54(2).

74 Law of Ukraine on Environmental Protection, No. 1264-XII of 25 June 1991, as amended, especially Arts. 68–69; *Yaremak/Danyliuk/Kobetska*, Legal Protection of Environment in Conditions of War, 2025, https://ukrainenaturenetwork.org/wp-content/uploads/2025/04/nr.07-03ukr-01.yaremak-danyliuk-kobetska.pdf (accessed 14.09.2026).

75 *Cabinet of Ministers of Ukraine*, Resolution No. 326 of 20 March 2022 On Approval of the Procedure for Determining Damage and Losses Caused to Ukraine as a Result of the Armed Aggression of the Russian Federation; UNGA Res. ES-11/5 of 14 November 2022, Furtherance of Remedy and Reparation for Aggression against Ukraine; *Committee of Ministers of the Council of Europe*, Resolution CM/Res(2023)3 establishing the Enlarged Partial Agreement on the Register of Damage Caused by the Aggression of the Russian Federation against Ukraine, May 2023; Convention on the International Claims Commission for Ukraine, The Hague, December 2025.

2.4. Hydro-Resilience and the Restorative Water-Security Nexus in the Ukrainian Context

Ukraine's legal and policy framework already contains significant elements of a restorative water-security approach. Basin-based governance, WFD-oriented River Basin Management Plans, environmental-impact assessment, water-quality monitoring, environmental-liability rules and the Water Strategy until 2050 offer institutional and normative entry points for integrating water protection, climate adaptation, ecological restoration and recovery.[76] The 2025–2030 River Basin Management Plans are particularly important because they can connect reconstruction measures with pollution reduction, river restoration and ecological-status objectives at the basin scale.[77]

Nonetheless, several legal and governance gaps remain. First, water, environmental, climate, energy, infrastructure, health and emergency-law regimes remain institutionally fragmented. Second, implementation is constrained by destruction, occupation, continuing security risks, loss of monitoring access, financial shortages and the urgent need to repair essential services. Third, reconstruction processes may favour rapid physical replacement over systemic ecological recovery unless restorative objectives are clearly embedded in project appraisal, funding eligibility and territorial recovery planning. Fourth, further institutional and legal clarity is needed concerning responsibility for conflict-related environmental damage, long-term remediation, environmental information and the restoration of water-dependent ecosystems. These questions are governed not only by domestic law but also by international humanitarian law, which prohibits methods of warfare intended or expected to cause widespread, long-term and severe damage to the natural environment and accords special protection to dams and dykes as works and installations containing dangerous forces, and by the International Law Commission's Principles on the Protection of the Environment in relation to Armed Conflicts, which extend to post-conflict remediation.[78] Fifth, landmines and unexploded ordnance in floodplains, on riverbanks and in the former Kakhovka reservoir bed physically obstruct monitoring and restoration, making demining a precondition of restorative reconstruction.

Ukraine's case thus demonstrates that hydro-resilience cannot be assessed solely according to whether water continues to flow through repaired infrastructure. It depends on the ability to secure equitable access to safe water, prevent and remediate pollution, restore ecological functions, protect source areas and adapt infrastructure and institutions to climatic and geopolitical uncertainty.

Ukraine provides a particularly strong illustration of the **integrative dimension** of the restorative water-security nexus. Conflict-related water insecurity connects public health, civilian protection, environmental law, energy security, infrastructure resilience, climate adaptation, pollution prevention, agricultural recovery and territorial reconstruction. No individual legal regime can adequately address these interdependencies. Restoration may therefore operate as a shared objective through which otherwise fragmented legal and governance systems contribute to the recovery and long-term protection of water systems.

The Ukrainian case also demonstrates the **temporal dimension** of the nexus. It requires governance that connects immediate humanitarian action and emergency infrastructure repair with medium-term environmental remediation and reconstruction, as well as long-term climate adaptation and ecosystem recovery. Restoration is both reactive and prospective: reactive because conflict damage demands repair, clean-up and recovery; prospective because the restoration of wetlands, floodplains, groundwater recharge areas and resilient water infrastructure can reduce vulnerability to future climate and security shocks.

Finally, Ukraine demonstrates the **scalar dimension** and the practical relevance of glocalisation.[79] International climate, environmental and human-rights frameworks, EU accession commitments and reconstruction partnerships can provide common standards, finance and strategic direction. Their implementation, however, must remain responsive to the circumstances of individual municipalities, territorial communities, river basins and transboundary water systems. At the transboundary level, Ukraine is a party to the UNECE Water Convention and its Protocol on Water and Health, participates in the International Commission for the Protection of the Danube River and cooperates with the Republic of

76 Water Code of Ukraine, No. 213/95-VR of 6 June 1995, as amended; Law of Ukraine on Environmental Impact Assessment, No. 2059-VIII of 23 May 2017, as amended; *Cabinet of Ministers of Ukraine*, Water Strategy of Ukraine until 2050, approved by Order No. 1134-r of 9 December 2022.

77 *International Commission for the Protection of the Danube River,* Ukraine Adopts Nine River Basin Management Plans, 30 March 2025; *EU4Environment Water Resources and Environmental Data*, Conclusion Note: River Basin Management Plans in Ukraine, 2024.

78 Protocol I, Arts. 35(3), 55 and 56; *International Law Commission*, Principles on the Protection of the Environment in relation to Armed Conflicts, 2022, taken note of in UNGA Res. 77/104 of 7 December 2022.

79 As stated in footnote 16, see for further information on the concept and the application on the Restorative Water-Security Nexus chapter IV of this paper.

Moldova under the 2012 Dniester Treaty.[80] By contrast, cooperation with the Russian Federation on shared basins such as the Don and the Siverskyi Donets has collapsed, showing that the scalar dimension ultimately depends on functioning interstate relations. The nine River Basin Management Plans provide an institutional expression of this logic, translating nationally adopted WFD-oriented objectives into basin-specific assessments and programmes of measures.[81]

Ukraine therefore supports the broader proposition that global or regional normative integration should not mean uniform water governance. Rather, it should enable functionally differentiated governance in which shared objectives, such as safe water, ecological integrity, climate resilience, restoration and equitable access are operationalised at the governance level most capable of responding to the relevant hydrological and security risk. In conflict-affected areas and post-conflict settings, restorative reconstruction can consequently become a practical bridge between climate adaptation, mitigation, environmental recovery, EU accession and long-term peace-oriented resilience.

At the same time, the Ukrainian case qualifies the nexus in important respects. First, restoration must begin before peace and without control over the entire territory, so that the sequence pre-supposed by post-crisis restoration does not hold. Second, the humanitarian urgency of restoring services creates a structural tension with longer-term ecological ambition, which the law must manage through sequencing rather than resolve through prioritisation alone. Third, the financing of ecological restoration remains partly dependent on reparations whose realisation is uncertain. Ukraine thus shows that the restorative water-security nexus can guide reconstruction under conditions of ongoing conflict, but only if its objectives are embedded in binding appraisal criteria, financing conditions and basin plans rather than left to post-war discretion.

3. Iran: Scarcity, Adaptation and Hydro-Resilience

Iran provides a contrasting case in which water insecurity is driven not only by hydroclimatic pressures, but by long-term structural overuse and governance challenges that increasingly undermine hydro-resilience.

3.1. Structural Water Insecurity and its Legal Governance

Iran represents an extreme case of structural water insecurity due to hydroclimatic vulnerability, governance failure and unsustainable demand. The country is experiencing water bankruptcy;[82] the water crisis is driven not only by climate change, drought, and rising temperatures but also by extensive groundwater abstraction, dam construction, inter-basin transfers, and supply-oriented water policies that have increased demand beyond renewable availability. For instance, Iran lost an estimated 211 cubic kilometres of groundwater, twice its annual water consumption, with excessive pumping from 2003 to 2019 driven by irrigated agricultural expansion, energy subsidies, and weak regulation, leading to land subsidence at rates up to 30 centimetres per year, affecting areas where around 14 million people live.[83] In addition, reduced environmental flows have degraded lakes, rivers, and wetlands, including Lake Urmia and the Hamoun, Shadegan, and Gavkhouni wetlands. As a result, water insecurity has become a systemic issue rather than a periodic, temporary problem.[84]

Meanwhile, critically low water levels have constrained hydropower generation, with declining storage reducing generation capacity and, in some cases, forcing hydropower plants to suspend electricity production.[85] This water-energy nexus failure further undermines

80 Convention on the Protection and Use of Transboundary Watercourses and International Lakes, Helsinki, 17 March 1992; Protocol on Water and Health, London, 17 June 1999; Convention on Cooperation for the Protection and Sustainable Use of the Danube River, Sofia, 29 June 1994; Treaty between the Government of the Republic of Moldova and the Cabinet of Ministers of Ukraine on Cooperation in the Field of Protection and Sustainable Development of the Dniester River Basin, Rome, 29 November 2012.

81 *International Commission for the Protection of the Danube River*, Ukraine Adopts Nine River Basin Management Plans, 30 March 2025; *UNECE*, Baseline Analysis of the Legislative, Institutional and Content Aspects Related to 20 Target Areas of the Protocol on Water and Health for Revision of the National Targets of Ukraine, Geneva 2021.

82 Permanent structural deficit in which demand systematically exceeds renewable supply, according to Madani, Water Bankruptcy: The Formal Definition, Water Resour Manage 40 (78) 2026, https://doi.org/10.1007/s11269-025-04484-0 (accessed 02.10.2026).

83 Iran's biggest centres of protest are also experiencing extreme pollution and water shortages, see for further infor-mation Shokri, 26 January 2026, https://theconversation.com/irans-biggest-centres-of-protest-are-also-experiencing-extreme-pollution-and-water-shortages-274217 (accessed 02.10.2026).

84 *Noori/Maghrebi* et al., Anthropogenic depletion of Iran's aquifers. Proceedings of the National Academy of Sciences, 118 (25) 2021, e2024221118, https://doi.org/10.1073/pnas.2024221118 (accessed 02.10.2026).

85 *Torabi Haghighi/ Mazaheri* et al., Water or mirage? Nightmare over dams and hydropower across Iran, International Journal of Water

water supply systems that depend on electricity for pumping, treatment, and distribution.[86] This dynamic reflects vulnerabilities identified in the Ukrainian case study, with different sources in Iran which are not related to armed conflict and are linked to structural mismanagement. This makes Iran a particularly important case for exploring the restorative water-security nexus, where the central challenge is no longer simply adapting to prior droughts but restoring ecological and hydrological functions after decades of overexploiting water resources.

Iran's water governance, a predominantly government-centric legal framework, combines constitutional environmental protection, centralised water-allocation law, five-year development plans, and more recent ecosystem-oriented legislation. Article 50 of the Constitution establishes environmental protection as a public duty and prohibits economic activities causing pollution or irreparable environmental damage.[87] The foundational national instruments for water allocation are "Iran Water Law and Methods of Nationalisation of Water (1968)"[88] and "the Law on Equitable Distribution of Water Resources (1982)"[89] (hereinafter 1982 Water Law).[90] The 1982 Water Law established public ownership over water resources and introduced instruments such as exploitation permits, water-meter installation, designation of forbidden zones, and local commissions.[91]

Under this Law, the Ministry of Energy (MoE) exercises extensive authority over surface and groundwater management, abstraction, and allocation.[92] However, the MoE and the Department of Environment (DoE) mainly share environmental protection responsibilities, while the Ministry of Agriculture Jihad mainly controls agricultural water demand. The 1982 Water Law provided a relatively comprehensive framework with a shared legal language for integrated management of both surface and groundwater resources.[93] However, four decades later, this law faces significant structural and implementation challenges. The Law transformed water from a shared social asset into "a state commodity", leading to sidelining local communities and undermining indigenous knowledge. In addition, institutional disconnection between allocation and distribution agencies, with regulatory capture by influential interest groups, has severely hindered Integrated Water Resources Management.[94]

Later on, more explicit references to a restorative approach have emerged in legal instruments in Iran, including "The Law of Conservation, Restoration and Management of the Country's Wetlands (2017)" and its implementing regulation, which requires institutional coordination for wetlands protection and restoration, providing a clearer legal basis for environmental water requirements.[95] Furthermore, "The Seventh Five-Year Development Plan" further requires integrated management of water resources at national and river-basin levels and calls for ecosystem-based wetland management, allocation and provision of environmental water requirements, prevention of unauthorised abstraction of environmental flows and participation of local communities.[96]

These arrangements reveal the scalar dimension of the restorative water-security nexus. Water governance in Iran remains strongly centralised at national and municipal levels. While institutions at the river basin level do exist, they are weak, and local stakeholders are mostly excluded. Lake Urmia, Shadegana, and Hamoun wetlands illustrate that the national-level objective must be implemented through basin, provincial, and local institutions.

Resources Development, 40 (2) 2024, 234–251, https://doi.org/10.1080/07900627.2023.2238844 (accessed 02.10.2026).

86 *Hogeboom/Borsje* et al., Resilience Meets the Water–Energy–Food Nexus: Mapping the Research Landscape, Frontiers in Environmental Science, 9 (2021) 630395, https://doi.org/10.3389/fenvs.2021.630395 (accessed 02.10.2026).

87 Constitution of the Islamic Republic of Iran 1979 (as amended 1989), art 50. https://www.legal-tools.org/doc/4205c7/pdf

88 Water Law and Methods of Nationalization of Water (Iran, 18 July 1968), available under https://leap.unep.org/en/countries/ir/national-legislation/iran-water-law-and-methods-nationalization-water (accessed 02.10.2026).

89 Law on Equitable Distribution of Water Resources 1982, available under https://www.informea.org/en/legislation/law-fair-distribution-water (accessed 02.10.2026).

90 Law on Equitable Distribution of Water Resources (Iran) art 1.

91 Ganjalipour/Kianpour, Reassessing the Fair Water Distribution Law through the Lens of Water Governance, Journal of Natural Resources Governance, 3 (1) 2026, 112–134.

92 Law on Equitable Distribution of Water Resources (Iran) arts 2–3, 21–22, 29.

93 *Hosseini/Rostami*, Evaluating Four Decades of the Fair Water Distribution Law in Iran: Performance, Challenges, and Prospects for Reform, Watershed Engineering and Management 2026, https://doi.org/10.22092/ijwmse.2026.371721.2142 (accessed 02.10.2026).

94 *Ganjalipour/Kianpour*, Reassessing the Fair Water Distribution Law through the Lens of Water Governance, Journal of Natural Resources Governance, 3 (1) 2026, 112–134.

95 Law of Conservation, Restoration and Management of the Country's Wetlands 2017.

96 Law on the Seventh Five-Year Development Plan of the Islamic Republic of Iran (2024–2028) (Iran, 2024) arts 37–38, particularly art 38(b).

3.2. Adaptation, Mitigation and Ecological Restoration

Water policymaking in Iran is predominantly adaptation oriented. Some measures, including water-use efficiency, groundwater management, developing climate-informed drought early warning systems, wastewater reuse, sustainable agriculture, adjusting cropping calendars, and protecting vulnerable ecosystems, primarily aim to reduce exposure to and sensitivity to scarcity. Iran's Third National Communication to the UNFCCC similarly identifies water as a major adaptation sector and provides water-specific adaptation strategies, including measures related to agriculture, biodiversity, and natural resources.[97]

Although the mitigation dimension is less institutionally integrated into water governance, important synergies exist in two ways. First, energy-efficient pumping and treatment systems, renewable backup power for water utilities, and reduced network losses can reduce the water sector's energy intensity and emissions.[98] Second, protecting and restoring wetland ecosystems can retain water during dry periods, moderate floods, support water purification, enhance biodiversity, and contribute to carbon sequestration.[99] Therefore, Nature-based Solutions are particularly relevant to the interplay between adaptation and mitigation. The main question is whether the laws and policies in Iran identify and manage the co-benefits between mitigation and adaptation, as this interplay is currently weak. This represents a gap in the integrative pathway of the restorative water-security nexus, as adaptation and mitigation measures remain largely governed by separate institutional and policy frameworks, rather than considering restoration as a common functional objective across these two fields.

Restoration is particularly significant in Iran, where it connects with different levels of governance and legal instruments. First, restoration involves protecting wetland ecosystems, and Iran already provides a practical example: the Conservation of Iranian Wetlands Project (CIWP), launched in 2005 with UNDP and the Department of Environment, has been instrumental in wetlands protection through an ecosystem-based management approach.[100] This project's outcomes illustrate the temporal dimension of the nexus. Restoration is not only about ex post measures to restore already degraded wetlands; it also includes measures such as reducing abstraction, securing environmental water rights, and restoring ecosystem functions with preventive characteristics, such as restoring the ecological resilience needed to cope with droughts and future climate-related tensions.

Second, restoration also involves rehabilitating groundwater systems and reversing land subsidence. Integrated modelling of the Anzali coastal wetland shows that sustainable groundwater management is the dominant factor for controlling wetland–aquifer hydraulic connectivity, highlighting the need for integrated groundwater abstraction control and aquifer-recharge strategies.[101] Third, restoration requires a fundamental development in water governance to include more integrated, participatory and climate-adaptive basin management approaches. In this regard, a review of the 1982 Water Law is needed, using an integrated, participatory, environmentally oriented, data-driven, and climate-adaptive approach.[102] At the jurisprudential level, the principle of "No Harm" in Imamiyyah jurisprudence limits ownership and control over one's property, preventing such ownership and control from serving as a justification for harming shared resources or the environment.[103]

97 *Islamic Republic of Iran*, Third National Communication to UNFCCC (Department of Environment 2017), 128–130, https://unfccc.int/sites/default/files/resource/Third%20National%20communication%20IRAN.pdf (accessed 05.10.2026).

98 *Karimi/Qureshi*, Reducing carbon emissions through improved irrigation and groundwater management: A case study from Iran, Agricultural Water Management, 108 (2012), 52-60, https://doi.org/10.1016/j.agwat.2011.09.001 (accessed 02.10.2026).

99 *United Nations Environment Programme (UNEP)* and *International Union for Conservation of Nature (IUCN)*, 2021, Nature-based Solutions for Climate Change Mitigation, https://www.unep.org/resources/report/nature-based-solutions-climate-change-mitigation (accessed 02.10.2026).

100 For more information on the CIWP project, see: UNDP, CONSERVATION OF IRANIAN WETLANDS PROJECT, https://www.undp.org/sites/g/files/zskgke326/files/2024-03/ciwp_factsheet.pdf (accessed 05.10.2026).

101 *Sodori/Janatrostami/Mohammadi,* Integrated modeling of groundwater–surface water interactions to evaluate management strategies for the protection of the Anzali coastal wetland, Scientific Reports, 16 (1) 2026, 29011, https://doi.org/10.1038/s41598-026-59235-x (accessed 02.10.2026).

102 *Ganjalipour/Kianpour,* Reassessing the Fair Water Distribution Law through the Lens of Water Governance, Journal of Natural Resources Governance, 3 (1) 2026, 112–134.

103 *Baziyar/Salimi/Pilevar,* A Critical Analysis of Imamiyyah Jurisprudence and Iranian Law Regarding the Exploitation of Groundwater with Emphasis on Environmental Obligations and the Principle of La-Zarar, Legal Studies in Digital Age, 5 (2) 2026, 1–18.

3.3. From Hydro-Resilience to Restorative Transformation

Iran's framework contains important components of restorative hydro-resilience including constitutional environmental protection, legal mechanisms for regulating abstraction, environmental water requirements, wetland-restoration legislation, integrated basin-management objectives, and practical experience with ecosystem-based and participatory restoration. However, the principal gaps exist concerning implementation and institutional integration.

First, legal and institutional systems related to water, environment, agriculture, energy and land use are yet fragmented, with no coherent framework for integrated water resource management. Second, enforcement mechanisms are fundamentally inadequate, as the laws are more normative than practical and implementable, with vague conditions and unspecified penalties.[104] Third, there is no comprehensive legal recognition of the right to water as a justiciable human right. Fourth, the water policy paradigm, remains heavily supply-oriented, with inter-basin water transfers and dam construction prioritised over demand management and ecological restoration. Finally, climate change adaptation approaches are reactive and crisis-oriented rather than preventive and resilience-oriented.

Iran offers an instructive case for exploring the restorative water-security nexus, as it shows both the necessities and limitations of the proposed framework because of limited water resources, weak governance, and hydroclimatic vulnerability. Iran's case clearly shows the **integrative dimension** of this nexus. Water insecurity connects with agricultural collapse, energy grid failure, urban decay, food insecurity, and potential state failure. Water-energy nexus failure shows that no single legal regime can adequately address these interdependencies. If restoration is recognised as a cross-cutting priority for the legal function, it will provide a common objective through which current fragmented governance systems work towards longerm water resilience. The CIWP, for instance, presents a practical example of such integration, connecting wetlands restoration, climate-smart agriculture, and local communities' livelihoods in 269 villages.[105]

The **temporal dimension** is also evident. Iran's water crisis is the result of decades of mismanagement, but still the legal and policy response remains reactive and crisis oriented. A restorative approach shifts from short-term crisis responses to resilience-focused adaptation, linking preventive measures with active ecosystem restoration and the restoration of damaged hydro-logical systems.
The **scalar dimension** is particularly relevant to Iran's context. For instance, each wetland and water basin requires specific approaches based on its condition. Over-centralisation in Iran's legal and governance system is a major obstacle to effective water management. This dimension shows that responsibility, in line with functional subsidiarity, should lie with the level best able to address the relevant hydrological risk.[106]

The Iranian case supports glocalisation[107] (climate-related international commitments under the UNFCCC and multilateral environmental agreements (MEAs)), but it is politically constrained by centralisation, sanctions, and the economic-security situation. The restorative water-security nexus remains valuable for addressing gaps and framing reforms, but in Iran it must be coupled with political-economy analysis. Therefore, Iran presents both capacities and challenges of restorative water-security nexus as this case confirms the need for integrative, temporal, and scalar functions. At the same time, it shows that restorative water-security nexus realisation depends on political will, institutional capacity, and a shift from supply-side as well as centralised water governance.

IV. Framing the Nexus Globally, Governing Water Security Glocally

The restorative water-security nexus reveals an apparent paradox: while water insecurity constitutes a global challenge requiring a coherent international response, its causes, impacts, and appropriate legal responses remain inherently local and context-dependent. A global framework should therefore not seek to harmonise water governance or prescribe uniform solutions. Rather, its function should be to articulate common principles connecting mitigation, adaptation, ecosystem protection, and restoration, while enabling their

104 *Hosseini/Rostami*, Evaluating Four Decades of the Fair Water Distribution Law in Iran: Performance, Challenges, and Prospects for Reform, Watershed Engineering and Management 2026, https://doi.org/10.22092/ijwmse.2026.371721.2142 (accessed 02.10.2026).

105 *United Nations Development Programme (UNDP)*, 'Story of a Joint Effort: Conservation of Iranian Wetlands Project' (3 February 2025), https://www.undp.org/iran/news/story-joint-effort-conservation-iranian-wetlands-project (accessed 20.09.2026)

106 *Ganjalipour/Kianpour*, Reassessing the Fair Water Distribution Law through the Lens of Water Governance, Journal of Natural Resources Governance, 3 (1) 2026, 112–134.

107 See chapter IV for theoretical conceptualization.

differentiated implementation at the basin, national, and local levels.

The divergent experiences of Germany and the EU, Ukraine, and Iran illustrate precisely this need. Water scarcity, ecological degradation, climate-induced extremes, and conflict-related destruction demand fundamentally different regulatory responses. Yet they can be connected through a common commitment to restorative hydro-resilience. The missing link in international climate and water governance is thus not a universal model of water management, but a framework capable of translating globally shared climate and restoration objectives into locally appropriate legal pathways.

1. Global Normative Framing

Water security is increasingly reflected across international climate,[108] environmental,[109] and sustainable-development frameworks,[110] yet remains dispersed across distinct normative agendas. The Paris Agreement provides relevant entry points through its parallel objectives of mitigation and adaptation, while nationally determined contributions and adaptation planning can incorporate water-related measures according to national circumstances. Similarly, the Sustainable Development Goals connect water security with climate action, ecosystem protection, and sustainable development. These frameworks provide important normative foundations, but do not yet constitute an integrated legal approach to restorative hydro-resilience.

From the perspective of the restorative water-security nexus, international governance need not prescribe a uniform model of water management. Its principal function should instead be to articulate common objectives capable of connecting mitigation, adaptation, ecosystem protection, and restoration. Such a framework could strengthen the recognition of healthy hydrological and water-dependent ecosystems not merely as objects of environmental protection, but as foundations of long-term climate resilience and water security. NDCs, adaptation planning, and future COP outcomes could provide pathways for progressively integrating these objectives into national climate governance while preserving the flexibility required by differing hydrological and institutional conditions.

2. Local & Regional Operationalisation

Common normative objectives can only contribute to water security if they are translated into legal and governance arrangements responsive to specific hydrological conditions. Water insecurity does not necessarily correspond to political or administrative boundaries: groundwater pressures may require local or national responses, while river basins may extend across regions or national borders and therefore require basin-wide or transboundary coordination. Effective operationalisation must consequently reflect both the ecological scale of the relevant water system and the institutional capacity of the respective governance level.

The scalar dimension of the restorative water-security nexus therefore hints towards a principle of functional differentiation. Rather than allocating water governance uniformly to either the international, national, or local level, responsibility should lie at the level most capable of effectively addressing the relevant hydrological risk, thereby suggesting a form of functional subsidiarity.[111] Local and national restoration strategies may accordingly operationalise broader climate and water objectives, while transboundary water systems require corresponding forms of international cooperation. Global integration and local differentiation are thus not competing approaches: common normative objectives can provide direction, while their implementation remains responsive to ecological, institutional, and socio-economic circumstances.

This interaction between globally articulated objectives and their context-specific operationalisation reflects a broader logic of glocalisation.[112] Glocalisation in the understanding of this paper describes the interaction

108 See for further details UNFCCC, NDC Registry, https://unfccc.int/NDCREG (accessed 03.10.2026).

109 See, in particular, the Kunming–Montreal Global Biodiversity Framework (especially target 2 on ecosystem restoration) and the Ramsar Convention on Wetlands. Notably, the latter was adopted in Ramsar, Iran, in 1971, giving this major international wetland treaty a direct historical connection to Iran.

110 In particular goal 6, UN, THE 17 GOALS, https://sdgs.un.org/goals (accessed 03.10.2026).

111 *Garrick*, Decentralisation and drought adaptation: Applying the subsidiarity principle in transboundary river basins, International Journal of the Commons, 12 (1) 2018, 301-331, DOI: 10.18352/ijc.816 (accessed 13.09.2026).

112 *Mihr*, Glocal Governance, How to Govern in the Anthropocene?, Springer 2022, https://doi.org/10.1007/978-3-031-02108-4 (accessed 02.10.2026) and Roudometof, Theorizing glocalization: Three interpretations, European Journal of Social Theory, 19 (3) 2016, 391-408, https://doi.org/10.1177/1368431015605443 (accessed 02.10.2026).

between global objectives and their context-specific implementation at regional, national, basin, and local levels. Rather than translating global norms into uniform solutions, it allows common objectives to be operationalised according to differing ecological, institutional, and socio-economic conditions, while local experiences may in turn inform the development of broader governance frameworks.

3. Glocal Synthesis

Taken together, the comparative analysis points towards a Glocal approach to restorative water security: global integration of common normative objectives combined with their functionally differentiated operationalisation across transboundary, basin, national, and local levels.[113] This governance logic reflects the scalar dimension of the restorative water-security nexus while interacting with its integrative and temporal dimensions. It does not seek to harmonise water governance across fundamentally different hydrological contexts, but to provide a common normative framework within which context-specific pathways towards restorative hydro-resilience can develop. Conversely, experiences generated through context-specific implementation may feed back into and progressively inform the development of regional and global water and climate governance.

V. Conclusion

The comparison of Germany and the EU, Ukraine, and Iran demonstrates that fundamentally different manifestations of water insecurity ultimately expose a common legal challenge: the fragmentation of water, climate, environmental, and restoration governance. The restorative water-security nexus offers a framework for addressing this fragmentation by understanding restoration not merely as a response to environmental damage, but as a cross-cutting legal function connecting mitigation, adaptation, ecosystem protection, and long-term water security. From this perspective, hydro-resilience is more than the capacity to withstand climatic or geopolitical shocks; it encompasses the capacity of legal systems to protect, adapt, recover, and restore the ecological functions upon which water security depends.

The comparison ultimately reveals three distinct pathways through which restoration can contribute to hydro-resilience: restorative integration in Germany and the EU, where the central challenge lies in connecting existing legal regimes and governance levels; restorative reconstruction in Ukraine, where restoration links immediate recovery with ecological remediation and long-term resilience; and restorative transformation in Iran, where hydro-resilience requires structural changes to water use and governance alongside ecological restoration. These different pathways demonstrate that the restorative water-security nexus does not prescribe a uniform model of restoration, but provides a common legal framework through which restoration can perform different functions in response to different forms of water insecurity.

The very differences between the case studies reinforce, rather than weaken, this proposition. Whether confronted with ecosystem degradation and regulatory complexity in Germany and the EU, conflict-related destruction and reconstruction in Ukraine, or structural scarcity and hydro-climatic vulnerability in Iran, sustainable water security requires legal approaches capable of connecting mitigation, adaptation, protection, and restoration across regulatory sectors, time horizons, and governance levels. These findings thereby confirm the relevance of the nexus's integrative, temporal, and scalar dimensions while demonstrating that their concrete expression necessarily differs across legal and hydrological contexts. The comparative analysis further suggests that restorative water security requires a glocal governance logic: common normative objectives should be articulated internationally, while their legal operationalisation must remain functionally differentiated across transboundary, basin, national, and local levels according to the hydrological risks concerned.

The challenge for global climate governance is therefore not to harmonise these divergent contexts, but to provide an integrative framework within which context-specific pathways towards restorative hydro-resilience can emerge. In the context of COP31, the restorative water-security nexus may thus offer a conceptual bridge between currently fragmented climate and water agendas: shifting the focus from merely adapting to water insecurity towards protecting and restoring the ecological foundations of water security itself.

113 With a focus on protection rather than restoration: Gupta/Pahl-Wostl/Zondervan, Glocal' water governance: a multi-level challenge in the anthropocene, Current Opinion in Environmental Sustainability 5 (6) 2013, 573-580, 10.1016/j.cosust.2013.09.003 (accessed 03.10.2026).