United Nations University
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COMMENTARY

Water Bankruptcy, Justice, and the Danger of False Dichotomies

A Response to Rusca et al., "The Limits of the Water Bankruptcy Framing Call for a Water Justice Response"

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Abstract

In a Comment published in *Nature Water*, Rusca et al. question the water bankruptcy framing and argue that its limitations call for a water justice response. This response by the United Nations University Institute for Water, Environment and Health (UNU-INWEH) examines their principal criticisms in light of the formal definition of water bankruptcy and its foundational publications. It clarifies that water bankruptcy is a scientifically defined condition of human–water systems, characterized by persistent hydrological overshoot and irreversible degradation of water-related natural capital, rather than merely a metaphor for water scarcity. The response demonstrates that several concerns presented as overlooked, including human agency, political economy, unequal responsibilities, technological fixes, accountability, equity, and justice, are explicitly addressed in the foundational publications. It also questions whether the empirical evidence presented in the Comment substantiates its criticisms. While welcoming further scholarly development of the framework, UNU-INWEH emphasizes that opportunities to extend a scientific concept should not be confused with evidence of its shortcomings, and that scholarly criticism must accurately represent existing research. **Water bankruptcy diagnoses a condition; just water transitions guide how societies respond to it fairly and sustainably. The two are complementary, not competing, approaches.**

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In their Comment published in *Nature Water*, *The limits of the water bankruptcy framing call for a water justice response*, Maria Rusca (Uppsala University), Amitangshu Acharya (Monash University), Filippo Menga (University of Bergamo and University of Reading), and Giuliano Di Baldassarre (Uppsala University) raise concerns about UNU-INWEH's *Global Water Bankruptcy* report, discuss its potential implications, and offer recommendations for advancing water justice [1].

UNU-INWEH welcomes further research on improving the water bankruptcy framework, especially through deeper engagement with colonial histories, epistemic justice, political ecology, and the experiences of marginalized communities. Such contributions can enrich both science and policy. However, opportunities to extend a framework should not be confused with evidence of its shortcomings, particularly when the concerns being raised are already addressed in its foundational publications.

Rusca et al.'s concerns about a just future are genuine and deserve serious scholarly attention. The fundamental problem with their publication, however, is that many of the criticisms are directed at a characterization of water bankruptcy that does not correspond to its formal definition, scientific foundations, or proposed governance approach.

Several mischaracterizations of water bankruptcy lead Rusca et al. to interpretations and conclusions that are not substantiated by the foundational publications. More surprisingly, some of the issues they present as overlooked or requiring a new approach are already explicitly and extensively addressed in the UNU-INWEH report [2]. **Justice is a striking example**: the word *justice* appears 16 times in the report, alongside extensive discussions of equity, human rights,

unequal responsibilities, political economy, and just transitions. Yet the Comment presents justice as a major shortcoming of the framework.

The resulting criticism resembles **judging a book by its cover rather than engaging with its contents**. By focusing on the financial connotations of *bankruptcy* rather than the scientific framework developed in the foundational publications, the authors criticize their own interpretation of the concept instead of its actual arguments.

The title of their publication makes a significant scientific claim. By asserting that the limits of the water bankruptcy framing call for a water justice response, the authors present those limitations as sufficiently established to warrant a particular alternative. **But how are these limitations identified, demonstrated, and verified?** Are they derived from a critical examination of the concept's formal scientific definition, supported by evidence of its consequences for policy and practice, or based primarily on the authors' perception of the concept? Distinguishing demonstrable conceptual shortcomings from hypothetical risks of misinterpretation is essential to a rigorous scientific critique. The possibility that a framing might produce undesirable consequences does not, by itself, establish that those consequences follow from the framework or that its scientific foundations are deficient.

Scholarly criticism is essential to the development and refinement of scientific concepts, particularly those still in their infancy. Water bankruptcy is no exception. Since the publication of its foundational scientific paper and the UNU-INWEH report, the concept has attracted scholarly attention and debate concerning its strengths, limitations, and implications for water governance. Such engagement is welcome and necessary, but **meaningful criticism must be grounded in what the original publications actually establish, rather than in assumptions** about what a concept might imply.

Rusca et al.'s Comment is not the only scholarly assessment of the water bankruptcy framework. In his review of the Global Water Bankruptcy report, Touzard [3] recognizes that although bankruptcy acknowledges failure, it can also represent a new beginning and an opportunity to avoid total collapse. More importantly, he explicitly identifies eight principles for action proposed in the Global Water Bankruptcy report, including principle iv: "**protect the most vulnerable populations and more explicitly integrate issues of justice and equity**."

The contrast with Rusca et al.'s characterization is difficult to overlook. What one scholarly publication explicitly identifies as a central recommendation of the report, another portrays as a neglected or inadequately addressed dimension of the framework. **This is not merely a disagreement over the desirability of a concept or the adequacy of its proposed solutions**. It raises a more basic question about the accuracy of how the original research is represented. Whether justice, equity, protection of vulnerable populations, and transformative governance are included in the report is directly verifiable by reading it. Scholarly debate can legitimately question whether these provisions are sufficient, but it should not overlook their existence.

This problem extends to the use of empirical evidence in the Comment. The authors present examples and figures documenting unequal water consumption in Cape Town and the unintended consequences of infrastructure-driven water development in the United States, but do not establish how these cases demonstrate limitations of the water bankruptcy framework as none of them has resulted from the application of the water bankruptcy concept. Yet the Comment moves from documenting these problems to questioning the framework's ability to address them, without establishing the necessary logical or causal connection. **These examples illustrate precisely the types of structural failures and unequal outcomes that the foundational water bankruptcy publications recognize and seek to address**. Evidence of a problem should not be mistaken for evidence of the shortcomings of a framework developed to diagnose and confront it.

According to *Nature Water*'s editorial policies, Comments are intended to provide perspectives on matters of scientific and public importance, with external peer review conducted at the editors' discretion. However, the flexibility of this format does not diminish **the responsibility of authors and editors to ensure factual accuracy, scholarly rigor, and fair representation of existing research**, particularly in a journal of such standing in the field of water resources. A critique claiming to identify the limits of a scientific framework should demonstrate those limitations through reasoned analysis and relevant evidence, clearly distinguishing documented shortcomings from hypothetical risks of misinterpretation. It is therefore concerning that a critique built on questionable assumptions and mischaracterizations of foundational publications, and drawing conclusions about a scientific framework without establishing the relevance of its empirical examples, has appeared in a leading journal of the Nature Portfolio. This raises legitimate questions about the evidentiary standards and editorial scrutiny applied to scholarly criticism, regardless of whether external peer review was conducted.

Nevertheless, in the spirit of constructive scholarly dialogue and respect for scientific debate, UNU-INWEH considers it important to respond in good faith and clarify the scientific record. **Scientific disagreement is**

Table 1. Water Bankruptcy: Mischaracterizations in Rusca et al.'s Comment Compared with the Foundational Scientific and Policy Publications

Issue	Rusca et al.'s Comment	What the foundational water bankruptcy publications establish	Discrepancy and its significance
1. Metaphor versus scientific concept	Repeatedly characterizes water bankruptcy as a "metaphor," using the term eight times across the Comment.	Explicitly distinguish the historical metaphor from the formal scientific concept. The foundational paper traces its evolution from metaphor to allocation tool to system diagnosis and establishes its formal definition [4, Sections 3–4].	**Mischaracterization:** Reduces a formally defined scientific concept to its communicative analogy, directing criticism toward the authors' own interpretation of the concept rather than what the formal definition of water bankruptcy actually establishes.
2. Human–water systems versus hydrological state	Characterizes water bankruptcy as "a new hydrological state" and questions whether the concept obscures the human and political drivers of depletion.	Explicitly define water bankruptcy as a condition of human–water systems, not purely natural (or hydrological) systems. Human decisions, institutions, and development choices are integral to the diagnosis [4, p. 10; 3, pp. 40–44].	**Mischaracterization:** Treats human agency as an overlooked dimension even though it is fundamental to the definition and explanation of water bankruptcy.
3. Irreversibility	Characterizes water bankruptcy through temporary shocks and water depletion becoming chronic, without addressing irreversible degradation of water-related natural capital.	Define water bankruptcy through two necessary conditions: persistent water insolvency and irreversible or effectively irreversible degradation of water-related natural capital [4, pp. 9–10].	**Fundamental omission:** Overlooks irreversibility as the defining condition distinguishing bankruptcy from prolonged water stress or recurring crises. This distinction has major policy implications: while conventional crisis management emphasizes mitigation and restoration, bankruptcy management requires combining mitigation with adaptation to changed environmental conditions, alongside fundamental transformation of institutions, development models, and resource allocation.
4. Inevitability versus transformation	Warns that water bankruptcy may foster "a sense of inevitability, even hopelessness," potentially discouraging transformative visions for alternative water futures.	Explicitly present water bankruptcy as an opportunity for a transformative fresh start, requiring the abandonment of business as usual, restructuring of unsustainable commitments, and adaptation to changed environmental conditions [4, Abstract, Sections 3.3 and 8; 3, pp. 13–14, 48–50].	**Overlooked argument:** Confuses the irreversibility of certain environmental damages with the inevitability of future failure. The framework recognizes that historical conditions cannot always be recovered while explicitly emphasizing the urgent need for transformation, prevention of further damage, and just transitions.
5. Global versus local scale	Characterizes water bankruptcy as a planetary condition and questions whether its global framing obscures local differences in water availability, access, and vulnerability.	Explicitly recognizes that not every basin or country is water-bankrupt. Bankruptcy is diagnosed in particular human–water systems, while its growing prevalence and interconnected consequences create global risks [4, Section 5; 3, p. 15].	**Scale conflation:** Confuses a local condition with a planetary one, failing to distinguish between the "era of global water bankruptcy" and the "state of water bankruptcy" in a particular human–water system. Conflating the geographical scale of diagnosis with the scale of consequences leads to overlooking how localized water bankruptcy can have global implications without being a universal condition.
6. Political economy and unequal responsibilities	Argues that the bankruptcy concept risks obscuring unequal power, historical responsibilities, and the political-economic structures that sustain overconsumption.	Explicitly identify water bankruptcy as a justice, security, and political-economy challenge. The report examines vested interests, unequal entitlements, and the need for powerful beneficiaries of overextraction to bear appropriate adjustment costs [2, pp. 14, 53–54].	**Overlooked argument:** Presents political economy and differentiated responsibilities as neglected concerns despite their explicit treatment in the report.
7. Technological fixes and supply expansion	Warns that the water bankruptcy may justify further infrastructure expansion and technological interventions that fail to address underlying structural problems.	Explicitly criticize supply-oriented management and calls for shifting toward demand reduction and water reallocation. The report also examines infrastructure-driven overshoot, rebound effects, and the limitations of technological solutions [4, pp. 4, 13; 3, pp. 44, 51, 55].	**Contradiction:** Attributes to the framework an approach it explicitly criticizes, overlooking the central argument that continued supply expansion can perpetuate water bankruptcy.
8. Accounting versus accountability	Argues that just water transitions should prioritize accountability and recognition, rather than focusing only on accounting.	Explicitly recognize that allocation decisions are not value-neutral and advocate participation, social protection, and safeguards against dispossession. The report also emphasizes accountability for unequal consumption, entitlements, and environmental impacts [4, p. 13; 3, pp. 54, 56].	**False opposition:** Presents accounting and justice as competing approaches despite the framework's treatment of accounting as evidence for informed, accountable, and equitable governance.
9. Just water transitions	Proposes a shift toward just water transitions, presenting justice-oriented transformation as a necessary alternative to the water bankruptcy framing.	Explicitly advocate just transitions as part of bankruptcy management, including equitable sharing of losses, protection of vulnerable communities, compensation, livelihood diversification, and institutional reform [4, Section 7; 3, pp. 49–54].	**False dichotomy:** Presents just transitions as an alternative to a framework that already incorporates them as an essential part of the response to water bankruptcy.
10. Participation and local knowledge	Calls for greater recognition of marginalized communities, alternative knowledge systems, and the co-production of just water transitions.	Explicitly advocate participatory platforms, citizen assemblies, co-management, local knowledge, human rights protections, and grievance mechanisms [2, pp. 56–57].	**Partial overlap:** The report already emphasizes participation and local knowledge, while the Comment identifies opportunities to deepen the framework's treatment of epistemic justice and knowledge co-production.

essential to advancing knowledge, but a meaningful critique must engage with what the original publications actually establish, rather than what the critics perceive a concept to mean.

This response examines the principal mischaracterizations in Rusca et al.'s Comment (Table 1) in light of the formal definition of water bankruptcy [4] and the original UNU-INWEH report [2]. It clarifies the concept's scientific foundations, the role of human agency and geographical scale, and its treatment of political economy, technological interventions, accountability, and justice. In doing so, it distinguishes legitimate opportunities for further scholarly development from criticisms based on an incomplete characterization of the framework.

1. Water bankruptcy is a scientific concept, not merely a metaphor

Throughout their Comment, **Rusca et al. repeatedly characterize water bankruptcy as a "metaphor,"** using the term eight times, without adequately engaging with its evolution into a formally defined scientific concept.

This distinction is explicitly addressed in the foundational paper, *Water Bankruptcy: The Formal Definition*, published in *Water Resources Management* [4]. Section 3, entitled *From Metaphor to Allocation Tool to System Diagnosis*, traces the **concept's evolution from a rhetorical expression of scarcity in the 19th century to a method for reallocating insufficient water among competing claims, and ultimately to a diagnosis of systemic failure in human-water systems**. The paper distinguishes these different uses and explains why the modern diagnostic framework cannot be reduced to the financial analogy from which it draws inspiration.

In particular, the formal definition establishes two necessary conditions: persistent hydrological insolvency and irreversible or effectively irreversible degradation of water-related natural capital [4, Section 4]. The distinction matters. The financial analogy is one of the strengths of water bankruptcy as a communication tool. Financial bankruptcy is widely understood, and the comparisons of surface water and groundwater to checking and savings accounts have helped communicate complex hydrological realities to policymakers, journalists, and the public. This accessibility has contributed to the concept's visibility in mainstream media, social media, and policy discussions. But the analogy is a means of communicating the concept, not a substitute for its scientific foundations.

A critique of the financial language may raise legitimate questions about public perception and interpretation. However, identifying possible risks associated with a framing is not equivalent to demonstrating limitations of the scientific concept it communicates. The distinction is particularly important when the critique moves from questioning a terminology to proposing that the recently developed water bankruptcy should give way to an alternative for its "limits" without substantiating such limits. **Assessing the scientific framework requires engaging with its formal definition, underlying assumptions, and established policy implications, rather than relying primarily on hypothetical and personal interpretations of its terminology**.

By repeatedly reducing water bankruptcy to a metaphor, Rusca et al. direct much of their criticism toward their narrower interpretation of the term rather than the framework established in the foundational publications and subsequently communicated through media and policy discussions. This distinction matters because misconceptions about a formal scientific framework can lead to fundamental misunderstandings and misleading conclusions [5], as seen in Rusca et al.'s Comment.

2. Water bankruptcy is a condition of human–water systems, not merely a hydrological state

Rusca et al.'s misunderstanding of the concept is evident from the opening of their Comment, where water bankruptcy is characterized as "a new hydrological state," followed by questioning whether it obscures the human and political processes responsible for water depletion. This characterization overlooks a fundamental aspect of the formal definition: **water bankruptcy is explicitly defined as a condition of human–water systems, not purely natural or hydrological systems** [4, p. 10]. The distinction matters because **human agency** is integral to the condition being diagnosed.

Water bankruptcy is not simply the consequence of inadequate rainfall, natural scarcity, hydrological variability, or even climate change. It emerges through interactions between natural processes and human decisions concerning water extraction, economic development, infrastructure, land use, institutions, political economy, and resource allocation. The foundational paper explicitly links bankruptcy to development decisions that pursue short-term economic and political gains at the expense of long-term resilience [4, Section 3.3]. The UNU-INWEH report likewise identifies over-allocation, institutional inertia, economic incentives, and infrastructure-driven overshoot as pathways into bankruptcy [2, pp. 40–44]. **Addressing water bankruptcy therefore requires confronting the human, political, and economic systems that enable, incentivize, and constrain decisions contributing to it.**

This does not imply that all actors have equal power

or responsibility. Quite the opposite: **understanding a human–water system requires examining whose decisions shape its trajectory, who benefits, and who bears the consequences**. Human agency also matters for the future. Although some environmental losses may be irreversible, societies retain the capacity to prevent further damage, restructure institutions, redistribute resources, and transform unsustainable development models. The concept therefore neither removes humans from the diagnosis nor treats water bankruptcy as an unavoidable natural phenomenon.

3. Irreversibility is a defining condition, not a secondary environmental concern

The Comment's characterization of water bankruptcy as chronic depletion completely overlooks **irreversibility**, one of the two essential conditions in its formal definition. This omission is consequential because irreversibility is precisely what distinguishes bankruptcy from prolonged water stress or repeated crises that motivate business-as-usual technocratic responses that disregard underlying institutional settings, the eroding natural capital as the machinery of water production, and the changing conditions of the system that affect the stability of existing governance settings.

Water bankruptcy occurs when persistent overshoot damages water-related natural capital so severely that historical conditions cannot realistically be restored within relevant societal time scales. The distinction between water stress, water crisis, and water bankruptcy is not merely terminological. Water stress describes a condition of pressure on available resources in which the underlying system may still be recoverable through improved management. Water crisis refers to an acute disruption for which emergency interventions and restoration may offer a path back to previous conditions. **Water bankruptcy, by contrast, describes a persistent state of systemic failure in which prolonged overshoot and irreversible degradation have made a return to historical conditions infeasible**. This distinction has fundamental implications for policy: while conventional crisis management emphasizes *mitigation* only, bankruptcy management requires *mitigation* to prevent further damage and restore what remains recoverable, combined with *adaptation* to new hydrological and environmental realities [4, Sections 4–5; 3, pp. 42–43, 48–49].

When the baseline itself has changed, previously established economic plans, infrastructure investments, legal entitlements, and development expectations may no longer be viable. Water-sharing arrangements can become especially problematic. Historical allocation agreements may promise water quantities or patterns of availability that no longer exist under changed climatic and hydrological conditions.

The UNU-INWEH report explicitly recognizes these challenges in its discussion of bankruptcy governance [2, p. 57]. It explains that agreements and legal arrangements developed under assumptions of hydrological stationarity face new tests as depletion, water quality deterioration, and climate change alter established baselines.

This does not mean that existing agreements automatically become invalid. It means that their implementation and, where necessary, renegotiation must account for changing water availability and ecological conditions. The distinction is particularly important for cooperation among beneficiaries, where outdated assumptions can intensify tensions between countries, communities, and sectors.

Irreversibility also raises questions of intergenerational justice. Present generations may benefit from the depletion of resources and degradation of ecosystems whose functions cannot be restored for future generations. Recognizing these losses is not an admission that further action is pointless. It is the basis for distinguishing what can still be protected or restored from what requires adaptation to a new reality. **Water bankruptcy is not simply about having insufficient water today. It is about having changed the system in ways that constrain what will be possible tomorrow.** That is why recognizing irreversibility fundamentally changes the questions governments and societies must ask.

4. Water bankruptcy does not imply inevitability or hopelessness

Rusca et al. argue that water bankruptcy may foster a sense of inevitability and hopelessness, discouraging the search for alternative water futures. This concern overlooks one of the central messages of the foundational publications: **recognizing bankruptcy is not an invitation to surrender, but an urgent call to abandon business as usual and pursue a transformative fresh start.**

The foundational scientific paper explicitly presents water bankruptcy as a means of communicating both the severity of environmental failure and the **urgency of a transformative fresh start** [4, Abstract]. Indeed, the financial bankruptcy analogy is valuable precisely because bankruptcy is not necessarily the end of an enterprise. It creates an opportunity to acknowledge failure, restructure unsustainable obligations, abandon an unsuccessful business model, and pursue a more viable future. Accordingly, the *Global Water Bankruptcy* report calls for fundamental changes in

water allocation, development priorities, economic activities, and governance arrangements [2, pp. 13–14, 42, 48–50].

There is, however, a crucial distinction between financial and water bankruptcy that the foundational paper explicitly discusses [4, Section 3.3]. While a financially bankrupt enterprise may recover and even surpass its previous condition, a water-bankrupt system cannot necessarily return to its historical baseline. Some environmental losses are irreversible, even when human institutions and development models are successfully transformed. **The irreversibility of past damage must not be confused with the inevitability of future failure.**

Water bankruptcy does not imply that environmental degradation was unavoidable, that other systems are destined to follow the same trajectory, or that further action is futile. Human decisions have contributed to bankruptcy, and different decisions can prevent other systems from reaching the same condition while limiting further damage in those already affected. However, **the longer societies delay necessary reforms, the more natural capital they risk losing, the greater the costs of adjustment, and the fewer options remain for building a sustainable future.** Bankruptcy management calls for immediate action to prevent further irreversible losses, restore what remains recoverable, and transform the development models and governance arrangements that contributed to failure.

Far from promoting resignation, the framework recognizes that acknowledging failure is a prerequisite for meaningful change. The foundational paper makes this position unmistakably clear in its concluding section, *Naming Failure to Enable Change*, explicitly stating that recognizing water bankruptcy does not mean giving up [4, Section 8]. **Irreversibility does not mean inevitability, and recognizing failure does not mean accepting defeat. Water bankruptcy recognizes that the past cannot always be recovered, but insists that the future can still be changed.**

5. Entering the era of global water bankruptcy does not mean every basin or country is bankrupt

Rusca et al. characterize water bankruptcy as a planetary condition, suggesting that a global framing obscures local differences in water availability, access, and vulnerability. This interpretation fails to distinguish between the **scale of diagnosis** and the **scale of consequences**.

The UNU-INWEH report explicitly acknowledges that not every basin or country is water-bankrupt [2, p. 15]. Water bankruptcy is diagnosed within particular human–water systems, especially river basins and aquifers, using indicators appropriate to their hydrological and ecological circumstances [4, Section 5]. Some systems may be bankrupt, others may be approaching bankruptcy, and many may remain sustainable or recoverable.

The declaration of an era of global water bankruptcy recognizes that enough critical systems around the world have crossed these thresholds to create risks extending beyond their geographical boundaries. These risks propagate through food production, trade, supply chains, migration, economic stability, and geopolitical relations. **A local or regional condition can therefore have global consequences without becoming a uniform planetary condition**.

This distinction matters because water governance must respond to the specific conditions of each human–water system while recognizing the international implications of failures in interconnected systems. **The global framing does not eliminate local differences. It explains why locally experienced water bankruptcy can also demand coordinated international responses**.

6. Political economy and unequal responsibilities are not missing from the framework

Rusca et al. argue that water bankruptcy risks depoliticizing water depletion by obscuring unequal power, historical responsibilities, and the economic structures that sustain overconsumption. **Yet the UNU-INWEH report explicitly identifies water bankruptcy as a justice, security, and political economy challenge** [2, p. 14].

Chapter 4 examines powerful vested interests, institutional dependencies, water-intensive development, and the unequal distribution of benefits and costs. Section 4.5 (p. 54) calls for identifying who consumes water, under what authority, and with what consequences for others. It advocates restructuring entrenched entitlements and ensuring that powerful users who benefited from excessive extraction contribute appropriately to the costs of reform.

This is not merely recognition that water consumption is unequal. **It is a call to confront the political and institutional arrangements that sustain those inequalities**. The Cape Town example discussed by Rusca et al., showing disproportionate consumption among affluent groups, reinforces rather than contradicts this argument. This is also evident in Figure 1 of their Comment, which illustrates how disproportionate consumption by privileged groups can exacerbate water scarcity. The figure provides evidence of unequal water use and the importance of

examining differentiated responsibilities, but it does not demonstrate that the water bankruptcy framework obscures these inequalities. Indeed, the foundational publications explicitly recognize the political and institutional drivers of excessive consumption and call for confronting the interests and allocation arrangements that perpetuate them. The figure therefore reinforces a central argument of the bankruptcy framework rather than establishing a limitation of it [4, Section 7; 3, pp. 53–54]. **It is therefore difficult to understand how the authors consider this figure evidence of a limitation of the water bankruptcy framework, or how its relevance to such a claim was established through the journal's editorial process.**

A shared condition of water bankruptcy does not imply shared responsibility for creating it or equal vulnerability to its consequences. Similarly, the inequalities discussed in relation to Palestine illustrate why water insecurity must be examined through political power, historical injustice, and institutional control. However, **water injustice and water bankruptcy are not interchangeable**, as Rusca et al's proposal to move from bankruptcy to just water transitions risks implying. Severe injustice can exist without a system meeting the formal criteria for bankruptcy, just as bankruptcy can emerge through processes involving profoundly unequal responsibilities.

One cannot overlook the role of subsidies, economic dependencies, institutional incentives, and political power in perpetuating unsustainable water use in diagnosing and addressing water bankruptcy [6]. This is why the original report emphasizes that **water bankruptcy cannot be managed without confronting the underlying political economy**.

7. The framework explicitly challenges supply-oriented management and technological fixes

Rusca et al. warn that water bankruptcy may reinforce technocratic solutions and supply expansion that fail to address the structural causes of depletion. This criticism is particularly difficult to reconcile with the foundational water bankruptcy publications.

The distinction between crisis management and bankruptcy management is particularly important in evaluating technological and supply-side interventions. Conventional crisis responses often seek to overcome temporary shortages and restore previous levels of water availability and consumption. Such interventions may be appropriate for short-term disruptions, but they cannot, on their own, resolve a structural condition in which water-related natural capital has been irreversibly degraded and previous levels of consumption are no longer sustainable. Indeed, expanding dams, wells, water transfers, or desalination without addressing underlying demand can reinforce the very development patterns that contributed to bankruptcy.

The foundational paper explicitly warns against the borrowing-more-from-nature approach and calls for a shift from supply expansion toward demand reduction and water reallocation [4, pp. 4, 13]. The UNU-INWEH report develops this argument through its discussion of infrastructure-driven overshoot, rebound effects, and the limitations of supply-enhancing technologies [2, pp. 44, 48, 51, 55]. It recognizes that technological improvements can be useful, but cannot independently resolve structural overcommitment when additional supplies enable continued or expanded consumption.

These arguments build on earlier water resources systems research examining the unintended consequences of infrastructure expansion and water transfers, including interventions that can worsen the problems they are intended to solve [7–10]. The infrastructure-induced demand discussed by Rusca et al. is therefore consistent with the original framework's critique of supply-oriented management and its warnings against technocratic solutions. It is surprising to see these concerns presented as shortcomings of the framework.

Figure 2 in Rusca et al. illustrates the historical relationship between expanding agricultural water supply and increasing irrigation demand in the United States. However, this evidence does not establish that the water bankruptcy framing encourages infrastructure expansion or technological dependence. On the contrary, **the foundational water bankruptcy publications explicitly warn that supply-enhancing interventions can reinforce unsustainable demand and accelerate environmental degradation when underlying consumption patterns and institutional arrangements remain unchanged**. The figure therefore illustrates a problem the framework explicitly recognizes and seeks to address, rather than demonstrating a shortcoming of the framework itself [4, pp. 4, 13; 3, pp. 44, 51].

The problem is not that water bankruptcy advocates technological fixes, but that conventional reliance on such fixes is one of the failures the concept seeks to expose. Bankruptcy management requires moving beyond interventions aimed at maintaining unsustainable consumption patterns toward a combination of mitigation, adaptation, and structural transformation.

8. Water accounting does not replace accountability, participation, or justice

Rusca et al. suggest that the accounting language of bankruptcy risks reducing water to an economic

commodity and replacing political and ethical considerations with technical calculations. This interpretation conflates water accounting with water commodification.

Water accounting helps establish how much water is available, who consumes it, how natural capital is being degraded, and where existing claims exceed sustainable limits. It does not determine who should receive water, how benefits and costs should be distributed, or which rights deserve priority. Those remain political, legal, and ethical decisions.

The foundational publications explicitly recognize this distinction. They also argue that **governance must protect not only water as a measurable resource but the natural processes that produce and sustain it** [4, Section 4; 3, p. 46]. More importantly, the foundational paper warns that **water reallocation cannot be treated as value-neutral**. Section 7 recognizes that **allocation decisions embody judgments about fairness and power and calls for participatory processes and social protection to prevent bankruptcy management from becoming a technocratic justification for dispossession** [4, p. 13].

The Global Water Bankruptcy report likewise advocates citizen assemblies, co-management arrangements, local knowledge, human rights protections, and mechanisms for addressing grievances [2, pp. 56–57]. These recommendations directly address the exclusion of marginalized communities from decision-making.

Accounting cannot determine justice, but it can support accountability by making unequal consumption, benefits, and environmental harms visible. The Cape Town example cited by Rusca et al. itself depends on such quantitative evidence. The relevant question is therefore how accounting can be made transparent, inclusive, and responsive to different forms of knowledge—not whether it should be rejected as inherently incompatible with justice.

9. Just water transitions are already part of bankruptcy management

The central false dichotomy in the Comment is its proposed shift from water bankruptcy to just water transitions. This framing suggests that justice-oriented transformation requires moving beyond, or replacing, the bankruptcy framework. Yet **the Global Water Bankruptcy report explicitly advocates just transitions as an essential part of bankruptcy management**.

Sections 4.2–4.5 [2, pp. 49–54] address equitable sharing of unavoidable losses, protection of vulnerable communities, restructuring of water rights, compensation, alternative livelihoods, and economic diversification. The foundational paper similarly calls for inclusive reallocation, ecological protection, economic transformation, and social safety nets [4, Section 7].

Addressing water bankruptcy requires examining responsibility, inequality, representation, intergenerational justice, ecological justice, institutional reform, just transitions, and the need for credible information to support accountability. These dimensions are not peripheral to the framework [11]. Recognizing bankruptcy raises difficult questions about who created the problem, who benefited, who must reduce consumption, who bears the costs, and how future generations and ecosystems should be protected. The framework also recognizes that **environmentally necessary reforms can themselves become unjust if their costs are transferred disproportionately to vulnerable communities**.

Likewise, restructuring water-intensive economies requires more than improving efficiency. Decoupling the economy from water, reducing total water consumption and transforming economic incentives are essential to avoiding continued depletion or simply transferring its consequences to other regions [12].

Water bankruptcy diagnoses a condition of human–water systems. Just transitions concern how societies respond to that condition fairly and sustainably. The two are not competing objectives. A diagnosis cannot substitute for justice, but a just transition must recognize the physical limits and irreversible changes within which difficult decisions must be made.

10. Opportunities to extend a framework should not be confused with evidence of its shortcomings

Rusca et al's emphasis on colonial histories, race, caste, epistemic justice, and the experiences of marginalized communities raises valuable questions. These subjects deserve further research, and the water bankruptcy framework can benefit from deeper engagement with them. However, neither the foundational paper nor the Global Water Bankruptcy report claims to provide an exhaustive theory of water justice or a comprehensive analysis of every historical and political dimension of water insecurity. Their purposes are clearly defined: establishing a scientific diagnosis of water bankruptcy and proposing a corresponding transformation in governance. A publication cannot comprehensively address every aspect of a complex human–environment challenge.

It is therefore important to distinguish between

concerns that a framework excludes, questions it addresses inadequately, and opportunities for further development. **Not discussing every relevant subject in detail is not evidence of rejecting its importance.**

Constructive criticism should identify genuine conceptual weaknesses, unsupported assumptions, or ways in which additional scholarship can improve the framework. It should not attribute omissions to the foundational publications without examining what they actually establish.

Conclusion: Beyond the false dichotomy

Water bankruptcy was developed to challenge the assumption that persistent water problems can always be resolved through conventional crisis management, technological improvements, or further supply expansion. It recognizes that some human–water systems have experienced prolonged overshoot and irreversible degradation, requiring fundamental changes in development priorities, economic activity, resource allocation, and governance. These changes **inevitably raise questions of power, responsibility, human rights, equity, and justice**.

The foundational publications explicitly recognize these challenges. They call for confronting entrenched interests, protecting vulnerable communities, rebalancing water rights, preserving remaining natural capital, and supporting just transitions. Rusca et al. raise legitimate concerns about the future of water governance. However, several of their principal criticisms overlook these arguments or attribute to water bankruptcy positions that the foundational publications explicitly reject.

UNU-INWEH welcomes serious scientific debate and further development of the framework. But meaningful scholarly progress requires distinguishing genuine conceptual limitations from overlooking and misunderstandings of existing research [10]. **Scientific journals, including *Nature Water*, have an equally important responsibility to uphold this distinction, ensuring that scholarly criticism is grounded in evidence, accurately represents existing research, and meets appropriate standards of scientific rigor.**

The relevant question is not whether water bankruptcy should be replaced by just water transitions. It is how recognizing how the water bankruptcy concept can help societies undertake just transitions that confront unequal responsibilities, protect human rights, and support sustainable development within changing hydrological realities.

Water bankruptcy diagnoses a condition of human–water systems. Human decisions helped create that condition, and human decisions will determine how its consequences are managed. **Justice must guide those decisions**.

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