Water Reuse Governance Through the Lens of Environmental Justice: A Systematic Review

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Abstract: Water reuse is increasingly promoted as a response to global water scarcity and as a key component of sustainability and climate adaptation strategies. Yet, the extent to which water reuse practices advance environmental justice (EJ) remains insufficiently understood. Existing governance frameworks tend to prioritise technical standards, risk management and economic feasibility, often overlooking justice concerns such as equitable access, procedural fairness, recognition of diverse knowledges, and the protection of vulnerable groups. This systematic review analyses 41 case studies to evaluate how water reuse systems distribute benefits and risks, who is included or excluded in decision-making, and whose knowledge informs governance processes. Following PRISMA 2020 guidelines, the findings reveal recurrent justice deficits: top-down governance structures that constrain participation and transparency; affordability barriers that disproportionately affect smallholder farmers and low-income communities; and epistemic injustices that marginalise local and informal knowledge systems, as illustrated in contexts such as Tanzania, Jordan, Spain and India. These patterns are a symptom of deeper structural and epistemological tensions embedded in water reuse governance. Rather than a neutral technological fix, the reviewed cases underscore that water reuse is a contested sociopolitical process, one that reflects and reshapes existing power relations over water, space and knowledge. These exclusions are not only material but epistemic, as the lived realities of affected communities are routinely absent from formal governance. Notably, many studies do not explicitly use the language of "justice," yet adjacent concepts, equity, vulnerability, participation, social acceptance and governance gaps, consistently point to unequal outcomes. Overall, the review demonstrates that while water reuse contributes to sustainability objectives, it frequently reproduces or exacerbates existing social inequalities. These findings also carry implications for broader governance commitments, including the procedural guarantees of the Aarhus Convention, the equality targets of SDG 6, and emerging efforts to advance the right to a clean, healthy and sustainable environment (R2HE).

I. Introduction

Water stress, characterised by insufficient water supply exacerbated by climate change[2] and growing demands from human,[3] commercial,[4] and agricultural sectors,[5] is one of the greatest challenges facing humanity today. In those instances, a sustainable management of

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[2] Pierre Mukheibir, 'Water Access, Water Scarcity, and Climate Change' (2010) 45 Environmental Management 1027.

[3] Ali Mehran and others, 'Compounding Impacts of Human-Induced Water Stress and Climate Change on Water Availability' (2017) 7 Scientific Reports 6282.

[4] Yoshihide Wada and others, 'Global Monthly Water Stress: 2. Water Demand and Severity of Water Stress' (2011) 47 Water Resources Research <https://onlinelibrary.wiley.com/doi/abs/10.1029/2010WR009792> accessed 30 July 2025.

[5] Gabrijel Ondrasek, 'Water Scarcity and Water Stress in Agriculture' in Parvaiz Ahmad and Mohd Rafiq Wani (eds), *Physiological Mechanisms and Adaptation Strategies in Plants Under Changing Environment: Volume 1* (Springer 2014) <https://doi.org/10.1007/978-1-4614-8591-9_4> accessed 30 July 2025.

water resources has become imperative as water scarcity is becoming a development constraint, impeding the economic growth of many countries around the world.[6] As such, water reuse is gaining traction as a beneficial practice to address the water crisis, especially in the agricultural sector as the largest water consumer worldwide.[7] Reclaiming and reusing water, whether from stormwater, industrial wastewater or municipal sources, can significantly contribute to more sustainable water management practices.[8] The benefits of water reuse are numerous, including conservation of freshwater resources, reduction of wastewater discharges, and the provision of an alternative water source for various applications.[9]

However, the growing adoption of water reuse raises important questions about who benefits, who bears the risks, and whose perspectives shape governance decisions.[10] Existing water reuse policies often prioritise technical standards, risk management, and economic efficiency, while giving far less attention to social dimensions such as equity, participation, local knowledge, and the protection of vulnerable groups.[11] Communities may experience unequal access to reclaimed water, disproportionate exposure to health or environmental risks, and limited opportunities to influence decisions that affect them.[12] For example, smallholder farmers in Spain[13] or India[14] are frequently priced out of purchasing tertiary-treated water, leaving them dependent on lower-quality alternatives with heightened health risks. Similarly, residents of informal settlements in South Africa[15] or peri-urban India often face greater exposure to untreated wastewater due to historical infrastructure exclusion and weak institutional protection.

Against this backdrop, environmental justice (EJ) offers a critical framework for analysing the social and political dimensions of water reuse.[16] EJ scholarship emphasises three interlinked dimensions, distribution, participation, and recognition, that together illuminate how environmental benefits, burdens, and decision-making power are allocated across different social groups. Distributive justice concerns the fair allocation of water resources and associated risks. Procedural justice focuses on who participates in decision-making and whose voices

[6] Dianxi Zhang and others, 'Water Scarcity and Sustainability in an Emerging Economy: A Management Perspective for Future' (2021) 13 Sustainability 144.
[7] Matthijs T Wessels, 'What's in a Name? Politicising Wastewater Reuse in Irrigated Agriculture' (2023) 16 Water Alternatives 563.
[8] Hiroaki Furumai, 'Rainwater and Reclaimed Wastewater for Sustainable Urban Water Use' (2008) 33 Physics and Chemistry of the Earth, Parts A/B/C 340.
[9] Seetharam Chittoor Jhansi and Santosh Kumar Mishra, 'Wastewater Treatment and Reuse: Sustainability Options' [2013] Consilience 1.
[10] Troy W Hartley, 'Public Perception and Participation in Water Reuse' (2006) 187 Desalination 115.
[11] David L Feldman, 'Integrated Water Management and Environmental Justice – Public Acceptability and Fairness in Adopting Water Innovations' (2011) 11 Water Supply 135.
[12] Somaye Imani, Mohammad Hossein Niksokhan and Reza Safari shali, 'Fair Water Re-Allocation: Lessons Learnt from the Perception of Iranian Policy-Makers about Distributive Justice' (2025) 652 Journal of Hydrology 132675.
[13] Kirti Goyal and Arun Kumar, 'A Comprehensive View of Existing Policy Directives and Future Interventions for Water Reuse in India' (2022) 24 Water Policy 1195.
[14] Santosh Ojha, 'Decentralised Wastewater Management for Improving Sanitation in Peri-Urban India' in Basant Maheshwari and others (eds), *The Security of Water, Food, Energy and Liveability of Cities: Challenges and Opportunities for Peri-Urban Futures* (Springer Netherlands 2014) <https://doi.org/10.1007/978-94-017-8878-6_15> accessed 30 July 2025.
[15] Wessels (n 7).
[16] Fabiano de Andrade Correa, 'Environmental Justice: Securing Our Right to a Clean, Healthy and Sustainable Environment' (UNDP 2022) <https://www.undp.org/publications/environmental-justice-securing-our-right-clean-healthy-and-sustainable-environment> accessed 30 July 2025.

shape outcomes. Recognition addresses the value accorded to diverse identities, practices, and forms of knowledge, particularly those of marginalised communities.[17]

Schlosberg argues that environmental justice must go beyond distributive justice to include recognition and participatory justice, ensuring that affected communities have a voice in decision-making.[18] EJ principles are: recognition, participation, and distribution. Recognition involves acknowledging the rights and needs of all communities, particularly marginalized groups, in accessing and benefiting from water resources. Schlosberg emphasizes that recognition is a fundamental aspect of environmental justice, ensuring that all groups are valued, and their unique perspectives are considered in environmental policymaking[19] Participation refers to the inclusion of diverse stakeholders in the policymaking process, ensuring that their voices are heard, and their concerns addressed. Reed demonstrates that participatory approaches to environmental decision-making can lead to more equitable and effective outcomes, as they incorporate a wider range of knowledge and values.[20] Distribution focuses on the fair allocation of water resources and the benefits of water reuse across different social groups, which is supported by the work of Rawls on distributive justice, emphasizing the need for policies that equitably distribute resources to achieve fairness.[21] Incorporating these justice principles into water reuse policies is not only a matter of equity but also a crucial factor in the success and sustainability of these policies. Findings of this systematic review highlighted that policies developed without stakeholder involvement often face significant challenges in implementation and acceptance.

This paper presents findings from a systematic review of 41 case studies assessing whether current water reuse practices advance or undermine environmental justice. The analysis reveals persistent challenges in integrating justice considerations into water governance and underscores the need for reforms that prioritise equitable, participatory, and context-sensitive approaches to water reuse.

II. Methodology

This systematic review examined all the existing literature on water reuse and its EJ implications. The data was synthesized to provide an overview of current practices and potential outcomes. The review identified key themes and gaps (see section 3). By following the PRISMA 2020 protocol, this review ensured a systematic and rigorous step-by-step process to enhance reliability and validity (Fig. 1). The review aimed to answer the central question: What does the literature reveal about potential environmental justice issues associated with water reuse practices? Data extracted from the selected research papers was analysed to assess the impacts of water reuse strategies, particularly their effects on community, access to water, and equitable distribution. The research question was designed to explore how global water

[17] Precious Oluwaseun Okedele and others, 'Human Rights, Climate Justice, and Environmental Law: Bridging International Legal Standards for Social Equity' (2024) 20 Human Rights 232.
[18] David Schlosberg, 'Defining Environmental Justice' in David Schlosberg (ed), *Defining Environmental Justice: Theories, Movements, and Nature* (Oxford University Press 2007) <https://doi.org/10.1093/acprof:oso/9780199286294.003.0001> accessed 30 July 2025.
[19] David Schlosberg, 'Theorising Environmental Justice: The Expanding Sphere of a Discourse' (2013) 22 Environmental Politics 37.
[20] Maureen G Reed and Colleen George, 'Where in the World Is Environmental Justice?' (2011) 35 Progress in Human Geography 835.
[21] Thomas Nagel, 'Rawls on Justice' (1973) 82 The Philosophical Review 220.

reuse policies incorporate justice principles and to evaluate the environmental (in)justice outcomes they produce. This approach provides a nuanced understanding of how such policies affect different populations and highlights best practices for integrating equity into water governance.

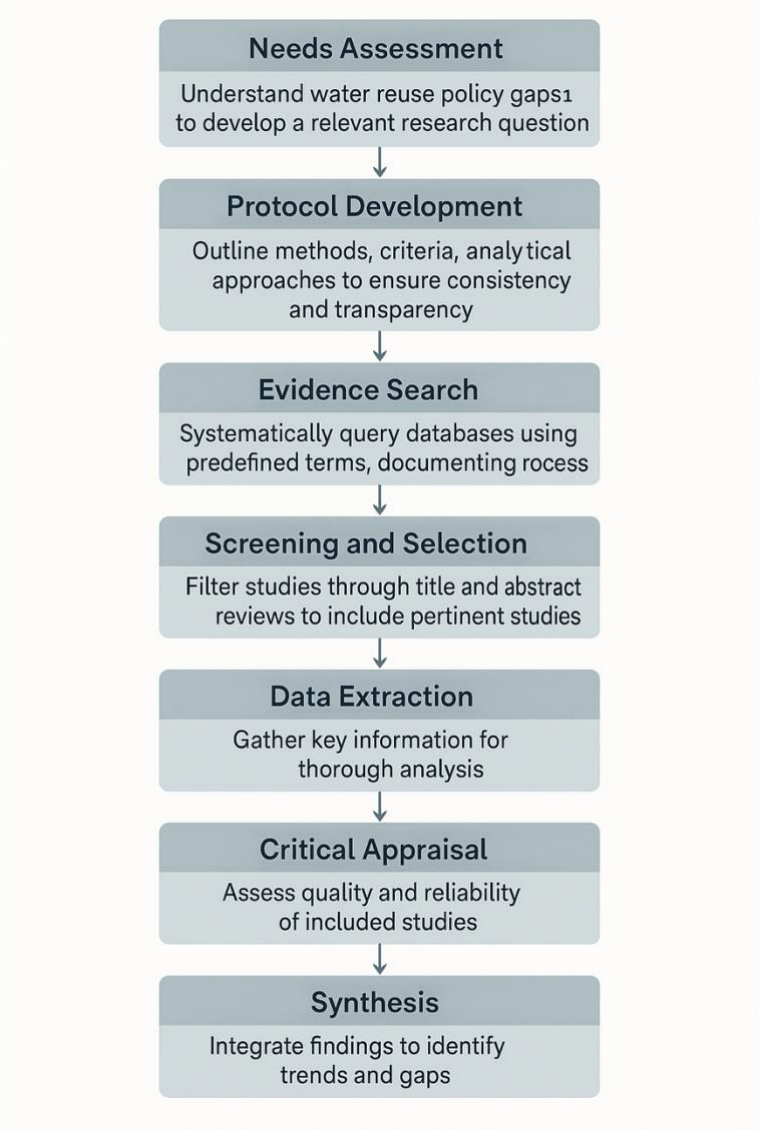

Fig.1 Systematic Review Process PRISMA 2020

To ensure the relevance and quality of the included studies, clear inclusion and exclusion criteria were established (Tab.1). Inclusion criteria consist of studies published in peer-reviewed journals, conference papers, and reports from credible organizations, focusing on water reuse strategies. These studies must be published in English from January 2014 to March 2024. Exclusion criteria include papers that focus solely on technological development or engineering aspects of water reuse, without addressing any social or justice-related dimensions and research papers not available in English.

Tab. 1 Inclusion and exclusion criteria applied in data extraction

Research question What does the literature say about the potential justice and injustice issues around water reuse?		
Inclusion Criteria	**Detail**	**When applied**
Geographical scope (where)	Global	Database search

Language	Published in English	Database search
Date of publication (when)	Evidence since 2014	Database search
Comparator (why)	Water reuse applied in the context of water scarcity	Database search
Population (who)	Evidence related to the reuse of municipal wastewater	Manual 1st screening
Intervention (what)	Case study of the implemented water reuse	Manual 2nd screening
Outcomes (how)	Evidence related to social justice	Manual 3rd screening
Exclusion Criteria	**Detail**	**When applied**
Intervention (what)	Focus on water conservation and saving (not water reuse)	Manual 2nd screening
Outcomes (how)	Focus on technical analysis	Manual 2nd screening
Language	Not published in English	Database search
Date of publication (when)	Published before 2014 and after March 2024	Database search
Comparator (why)	Studies not related to water scarcity as a driver for water reuse	Manual 2nd screening
Population (who)	Studies not related to municipal wastewater (e.g., circular water reuse withing industry)	Manual 2nd screening

The decision to include only studies from January 2014 onwards is informed by a noticeable rise in research activity related to environmental justice and water reuse, as reflected in academic search engines and publication databases. The thematic search terms and levels, outlined in Table 2, were designed to address the overarching research question: What does the literature say about the potential social, climate, and water justice issues around water reuse? The search strategy was structured around six key categories: "What," "How," "Why," "Who," "Where," and "When," each focusing on different aspects of environmental justice.

Tab. 2 Thematic search terms and levels

Overarching research question What does the literature say about the potential justice and injustice issues around water reuse ?							
What	How			Why	Who	Where	When
Event	Recognition	Participation	Distribution	Context	Population		
Water reuse (synonymous words used in search: water re-use, water recycling, water reclamation, water recycling, greywater, grey water, wastewater reuse, waste water reuse, wastewater re-use, waste water re-use, reclaimed water, water recovery, water conservation, water saving)	Diversity and identity Cultu* Knowledge Voic* Inclus* Identit*	Meaningful engagement practices Dialogue Cooperation Interac* Particip* Participat* Engag* Involv* Govern*	Equitable distribution Equit* Inequit* Unequit* Equal* Unequal* Inequal* Just* Injust* Unjust*	Climate change sustainability Adaptation Mitigation Resilience Circular Scarcity	Community Marginalized Indigenous Stakeholders Public People Group Population	No exclusion criteria	1 January 2014 31 March 2024

The study selection process followed a structured and rigorous multi-stage screening aligned with PRISMA standards to ensure only the most relevant and high-quality studies were included in the review (Fig. 2). To initiate the search, we utilized all major academic databases including Scopus, Web of Science, and Compendex. This extensive dataset provided a comprehensive foundation for further screening and analysis. During the identification phase, a total of 12,154 records were retrieved from three major academic databases: Scopus (3,953 records), Compendex (4,856 records), and Web of Science (3,343 records). To avoid duplication, all records underwent an automated deduplication process, which eliminated 3,905 duplicate entries, leaving 8,247 unique records for manual screening.

The first screening phase involved a preliminary manual review of titles to assess basic relevance to the topic. At this stage, 6,363 records were excluded based on title alone for lacking relevance to water reuse and justice, reducing the dataset to 1,884 studies. These remaining records were then subjected to a second screening phase, which involved evaluating both titles and abstracts. In this phase, papers were excluded for one of two main reasons: 1,204 papers focused solely on water conservation or saving measures rather than water reuse, and 326 papers were highly technical in nature, addressing engineering or scientific processes without social or justice dimensions. This brought the number of potentially relevant studies down to 354. The third screening phase applied more stringent eligibility criteria through detailed abstract reviews. The aim here was to isolate studies with direct relevance to the social dimensions of water reuse. A total of 313 papers were excluded at this stage: 59 for lacking a geographical focus and 254 for lacking a focus on social implications such as equity, justice, or public perception. Each paper was independently screened by two reviewers; discrepancies were resolved through discussion or, if needed, by involving a third reviewer to reach a final decision. This ensured transparency, consistency, and methodological rigor throughout the review process. Ultimately, 41 papers were included in the final review. These studies all presented concrete case studies of implemented water reuse strategies and explored associated social justice concerns, such as community-level impacts, public perception (including the “yuck factor”), policy engagement, and the distribution of post-implementation benefits. The screening process ensured a robust, transparent, and focused dataset to support meaningful analysis of justice in water reuse.

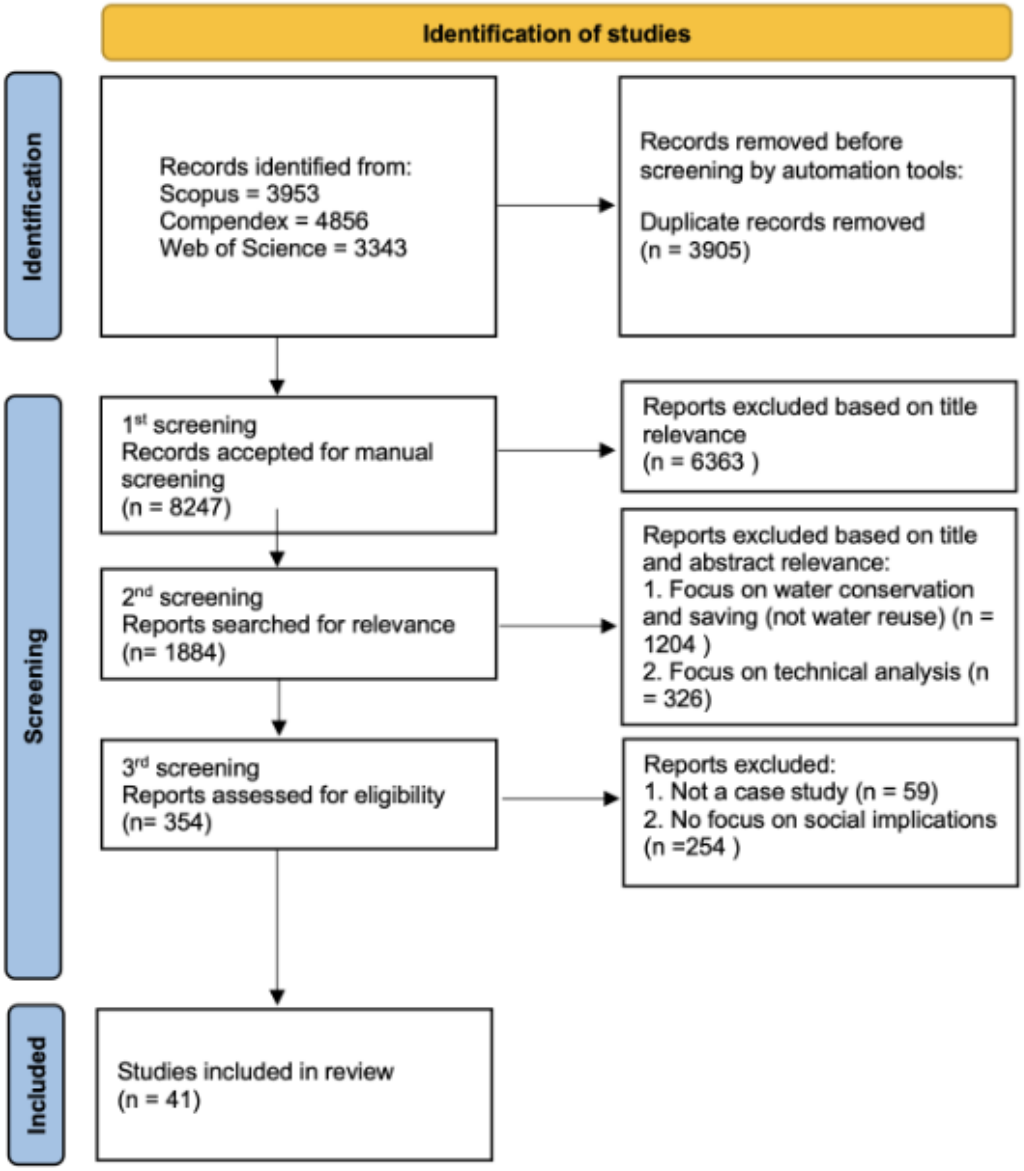

Fig. 2 PRISMA 2020 flow diagram

III. Analysis

The following analysis examines how justice concerns manifest across the 41 research papers included in this systematic review, with particular attention to the three core dimensions of environmental justice, procedural, distributive, and recognition-based. By analysing how decision-making processes, the allocation of benefits and risks, and the treatment of diverse knowledges and identities shape water reuse outcomes, this section identifies the key patterns through which environmental justice is either advanced or undermined in practice.

a. Procedural Justice: Power, Participation, and Public Perception

A key dimension of justice in water reuse is procedural justice, which concerns how decisions are made, who gets to participate, and whether communities have genuine power to influence outcomes. Case studies expose a persistent disconnect between policy frameworks

and local stakeholder engagement. For instance, in the case of Spain, citizens had limited access to relevant information on water reuse and minimal opportunities to influence decision-making, with governance described as "top-down" and overly technical.[22] Similarly, in Chile's Copiapó River Basin weak participation structures were identified together with a lack of funding, and an unclear legal framework, factors that collectively hampered community involvement.[23] In Almendralejo, Spain, no formal mechanisms existed to ensure collective choice despite reuse programs being implemented, reflecting procedural exclusion even where communication about reuse occurred.[24] Eilat (Israel) similarly suffered from overly centralized governance, which bypassed stakeholder co-decision-making despite a high level of reuse. In the Axios River Delta, Greece, weak institutional ties between stakeholders led to ineffective multilevel governance and poor planning outcomes.[25] These findings underscore that procedural justice cannot be achieved through information dissemination alone but requires institutional arrangements that empower affected communities to shape outcomes.

Next, the legal and institutional design of water reuse frameworks often determines the extent of procedural justice. Hopson and Fowler provide a rare example of best practice in the U.S., recommending public listening sessions, stakeholder appointments, and inclusive outreach as necessary components of equitable reuse policy.[26] On the contrary, Goyal and Kumar highlight the absence of these mechanisms in India, noting that existing policies do not contain clear incentives, obligations, or enforcement procedures that include stakeholder voices.[27] Kanchanapiya and Tantisattayakul call for Thailand's local government institutions to not only monitor and disclose reclaimed water quality but also actively involve the public in local policy discussions, an explicit recognition of procedural justice.[28] Similarly, Singapore's centralised but successful expansion of sanitation coverage, though public input was limited due to the efficiency-driven approach to implementation.[29]

Public perception of water reuse is also recognised as a crucial procedural justice issue, particularly when trust in institutions is low. In Albuquerque, targeted and locally adapted education programs fill knowledge gaps and build trust in water reuse efforts.[30] In Huelva, Spain, awareness of the water cycle correlated with greater acceptance, and noting that social factors (e.g., association membership or location within the city) may not always be influential.[31] Farmers resistance in the MENA region was attributed not only to economic

[22] Marketa Šteflová and others, 'Governing Non-Potable Water-Reuse to Alleviate Water Stress: The Case of Sabadell, Spain' (2018) 10 Water 739.
[23] PM Stathatou and others, 'Creating an Enabling Environment for WR&R Implementation' (2017) 76 Water Science and Technology 1555.
[24] Fayaz Riazi and others, 'Institutional Arrangements for Water Reuse: Assessing Challenges for the Transition to Water Circularity' (2023) 25 Water Policy 218.
[25] Leon Kapetas and others, 'Water Allocation and Governance in Multi-Stakeholder Environments: Insight from Axios Delta, Greece' (2019) 695 Science of The Total Environment 133831.
[26] Megan N Hopson and Laurie Fowler, 'An Analysis of and Recommendations for Comprehensive State Water Recycling Policy Strategies in the U.S.' (2022) 183 Resources, Conservation and Recycling 106356.
[27] Goyal and Kumar (n 13).
[28] Premrudee Kanchanapiya and Thanapol Tantisattayakul, 'Wastewater Reclamation Trends in Thailand' (2022) 86 Water Science and Technology 2878.
[29] Cecilia Tortajada and Rachel Yan Ting Koh, 'Integrated Management in Singapore', *Handbook of Catchment Management 2e* (John Wiley & Sons, Ltd 2021) <https://onlinelibrary.wiley.com/doi/abs/10.1002/9781119531241.ch15> accessed 30 July 2025.
[30] Lauren N Distler and others, 'Public Engagement on Water Reuse Beyond Community Surveys' (2021) 113 Journal AWWA 56.
[31] Gustavo Bermejo-Martín, Carlos Rodríguez-Monroy and Yilsy M Núñez-Guerrero, 'Design Thinking for Urban Water Sustainability in Huelva's Households: Needfinding and Synthesis through Statistic Clustering' (2020) 12 Sustainability 9163.

disincentives but also to the lack of trust in reclaimed water safety and governance institutions.[32] In Chile, similarly integrating justice criteria into assessment frameworks requires stakeholder trust and participatory evaluation.[33]

Several studies also draw attention to the procedural exclusion of informal water users and their local knowledge systems. In Dar es Salaam, the dominant framing of wastewater reuse as "unplanned" or "unfit," delegitimizes informal practices and masks the political nature of access.[34] This epistemic injustice is echoed also by Ojha, who advocates for decentralised, community-centred sanitation planning in peri-urban India, where centralised systems often fail due to socio-spatial mismatches.[35] In Macau, inappropriate reuse models were transferred from northern China without consideration of local context or stakeholder perspectives, resulting in procedural failure.[36]

A smaller number of cases offer strong procedural justice examples through co-design and stakeholder empowerment. In South Africa, the URBWAT project's transdisciplinary approach, where informal settlement residents co-designed greywater treatment systems alongside engineers and policymakers.[37] This approach sought to reconcile diverse aspirations and power dynamics, explicitly naming ecological and sanitation justice as intertwined concerns. In Ecuador there is a need for water recycling systems to be developed "hand in hand with end users" to accommodate varying climatic, cultural, and infrastructural conditions.[38] Their participatory design approach across urban and rural communities enabled better social fit and increased acceptance. Similarly, in Ghana and Bangladesh fish farming reuse systems built on local demand and equitable profit-sharing result in not only financial success but also procedural legitimacy.[39] The case of Namibia underscores the value of adaptive governance that empowers marginalized communities and accounts for local meaning-making processes, reinforcing the notion that institutions must evolve to accommodate plural values and knowledge.[40]

Several studies draw attention to information asymmetries that undermine procedural fairness. Schellenberg et al. note that varying wastewater discharge standards and weak

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[32] Mohammad Al-Saidi and Sudeh Dehnavi, 'Toward a Circular Economy in the MENA Region: Insights from the Water-Food Nexus', *Perspectives on Development in the Middle East and North Africa (MENA) Region* (Springer 2021) <http://www.scopus.com/inward/record.url?scp=85131463756&partnerID=8YFLogxK> accessed 30 July 2025.

[33] SM Rodrigues and others, 'Nanotechnology for Sustainable Food Production: Promising Opportunities and Scientific Challenges' (2017) 4 ENVIRONMENTAL SCIENCE-NANO 767.

[34] Wessels (n 7).

[35] Ojha (n 14).

[36] T Zhang and others, 'Optimizing Relative Root-Zone Water Depletion Thresholds to Maximize Yield and Water Productivity of Winter Wheat Using AquaCrop' (2023) 286 AGRICULTURAL WATER MANAGEMENT.

[37] Andrew Thatcher, Geneviève S Metson and Motshwaedi Sepeng, 'Applying the Sustainable System-of-Systems Framework: Wastewater(s) in a Rapidly Urbanising South African Settlement' (2024) 67 Ergonomics 450.

[38] MJM Davis, ML Gutiérrez and J Serrano, 'Know Your People: International Conference on Sustainable Design, Engineering and Construction, ICSDEC 2016' (2016) 145 Procedia Engineering 1258.

[39] Philip Amoah, Solomie A Gebrezgabher and Pay Drechsel, *Safe and Sustainable Business Models for Water Reuse in Aquaculture in Developing Countries* (International Water Management Institute 2021) <https://hdl.handle.net/10568/114589> accessed 30 July 2025.

[40] Fanny Frick-Trzebitzky and others, 'Capacity Development for Water Reuse in In-Formal Partnerships in Northern Namibia' (2022) 4 Frontiers in Water <https://www.frontiersin.org/journals/water/articles/10.3389/frwa.2022.906407/full> accessed 30 July 2025.

enforcement create uncertainty and confusion among stakeholders, especially in India.[41] Maryam and Büyükgüngör argue that a lack of public awareness and poor institutional communication in Turkey hinders water reuse adoption.[42] In urbanised Arab communities, greywater reuse acceptance improves with clear, accessible information about benefits, risks, and treatment technologies.[43] The case study of Spain shows that misconceptions about health risks and pricing schemes affect farmers' willingness to adopt reuse.[44] Research highlights how tailored communication strategies and subsidies can help bridge the information gap[45]. Similarly, in the US, unless equity and justice are embedded into outreach and education, the transition to net-zero water systems risks deepening existing inequalities.[46]

Lastly, even when participation is encouraged, structural barriers often inhibit its effectiveness. Brazil's case showed that there is a need for joint participation between governments, civil society, and the private sector, especially in managing the growing demand for clean water amid pollution and climate threats.[47] López-Ruiz and González-Gómez highlight that while Spain supports water reuse at the national level, the absence of consistent mechanisms to engage stakeholders in cost allocation decisions creates procedural gaps.[48] In Tawfik et al., the internal dynamics of Jordan's WUAs reveal that power imbalances within communities can distort participatory processes.[49] Small farmers lacked access to extra water and had little political clout, while elite farmers dominated decision-making and resisted the use of treated wastewater.

b. Distributive Justice: Access, Affordability, and Risk Allocation

Distributive justice, which focuses on how the benefits, costs, and risks of water reuse are shared across different social groups, emerges as a critical concern in ensuring equity and sustainability. Here, a recurring theme across the dataset is the inaccessibility of reclaimed water due to cost, particularly for smallholder farmers and low-income communities. In Tamil Nadu, India, while wastewater reuse offers socio-economic and environmental benefits, farmers remain vulnerable due to affordability constraints and the high costs of treatment infrastructure.[50] In Spain, identifying the high price of tertiary-treated water as the most

[41] T Schellenberg and others, 'Wastewater Discharge Standards in the Evolving Context of Urban Sustainability-The Case of India' (2020) 8 FRONTIERS IN ENVIRONMENTAL SCIENCE.
[42] Bareera Maryam and Hanife Büyükgüngör, 'Wastewater Reclamation and Reuse Trends in Turkey: Opportunities and Challenges' (2019) 30 Journal of Water Process Engineering 100501.
[43] Md Shafiquzzaman and others, 'Development of Consumer Perception Index for Assessing Greywater Reuse Potential in Arid Environments' (2018) 44 Water SA <https://watersa.net/article/view/6684> accessed 30 July 2025.
[44] María J López-Serrano and others, 'Farmers' Attitudes towards Irrigating Crops with Reclaimed Water in the Framework of a Circular Economy' (2022) 12 Agronomy 435.
[45] ibid.
[46] Courtney Crosson and others, 'Advancing a Net Zero Urban Water Future in the United States Southwest: Governance and Policy Challenges and Future Needs' (2024) 4 ACS ES&T Water 1966.
[47] Giulianna Costa Fico and others, 'Water Reuse in Industries: Analysis of Opportunities in the Paraíba Do Sul River Basin, a Case Study in Presidente Vargas Plant, Brazil' (2022) 29 Environmental Science and Pollution Research 66085.
[48] Samara López-Ruiz and Francisco González-Gómez, 'Regenerate and Reuse Water in Spain: Facts and Politics' in Miltiadis G Zamparas and Grigorios L Kyriakopoulos (eds), *Water Management and Circular Economy* (Elsevier 2023) <https://www.sciencedirect.com/science/article/pii/B9780323952804000059> accessed 30 July 2025.
[49] Mohamed Hassan Tawfik and others, 'Shifting Waters: The Challenges of Transitioning from Freshwater to Treated Wastewater Irrigation in the Northern Jordan Valley' (2023) 15 Water 1315.
[50] B Bharani Baanu and KS Jinesh Babu, 'Climate Change and Farmers' Perception in Sivakasi Taluk, India: A Nexus and a Suggestion for Sustainable Water Reuse' (2024) 15 Journal of Water and Climate Change 883.

widespread barrier, with subsidies suggested to ensure equitable adoption.[51] In the Southwest US, affordability is a critical barrier, where low-income communities may underutilize water to avoid high utility bills.[52] Capital and operational costs of potable reuse projects are out of reach for under-resourced communities, calling for creative funding mechanisms to avoid deepening inequality.[53] In the MENA region, Al-Saidi and Dehnavi explain how subsidies for freshwater and energy make reclaimed water economically unviable, limiting uptake despite sustainability advantages.[54] Similarly, India's national policies lack both financial incentives and enforcement mechanisms, leaving low-income users unable to access or invest in reuse systems.[55] In Cyprus, by contrast, the state subsidizes tertiary treatment, enabling farmers to purchase reused water at a price below cost. Over 75% of Cyprus's reclaimed water is used in agriculture, demonstrating that targeted subsidies can achieve distributive equity in practice.[56]

Distributive justice also relates to who benefits from reuse and who bears its environmental and health risks. In Morocco, permissive wastewater standards have led to adverse impacts on health, soil, and livestock, outcomes that disproportionately affect rural and agricultural communities.[57] Similarly, there is an unequal burden of untreated wastewater exposure in Turkey due to poorly maintained systems, often in lower-income or rural areas.[58] In Senegal, Khouma et al. propose state-sponsored subsidies and preferential tariffs to ensure water access for small-scale urban farmers as farmers are particularly exposed to environmental risks, yet lack institutional support.[59] In China's Yinma River Basin low-income regions suffered from water scarcity, while higher-income areas underutilized their allocation, illustrating a maldistribution of water resources based on economic status.[60] In Arab regions coastal communities bear the environmental costs of wastewater discharge, particularly when untreated or greywater is improperly managed.[61] Similarly, in peri-urban Indian communities suffer from inequities in sanitation and exposure to untreated waste, and calls for decentralised reuse approaches focused on the needs of vulnerable populations.[62]

Moreover, several studies reveal tensions over who should bear the financial burden of water reuse infrastructure and operations. In Spain, López-Ruiz and González-Gómez research asks: "Who should pay for water regeneration and reuse?", noting that public funding, taxation, and polluter-pays principles must be debated transparently to ensure distributive justice.[63] They argue that over-users of aquifers should cover reuse costs, aligning with the principle of

[51] López-Serrano and others (n 44).
[52] Crosson and others (n 46).
[53] Caroline E Scruggs and Catherine M Heyne, 'Extending Traditional Water Supplies in Inland Communities with Nontraditional Solutions to Water Scarcity' (2021) 8 WIREs Water e1543.
[54] Al-Saidi and Dehnavi (n 32).
[55] Goyal and Kumar (n 13).
[56] Giorgio Mannina, Hazal Gulhan and Bing-Jie Ni, 'Water Reuse from Wastewater Treatment: The Transition towards Circular Economy in the Water Sector' (2022) 363 Bioresource Technology 127951.
[57] Jose Luis Ortega-Pozo and others, 'Wastewater Reuse for Irrigation Agriculture in Morocco: Influence of Regulation on Feasible Implementation' (2022) 11 Land 2312.
[58] Maryam and Büyükgüngör (n 42).
[59] Mamadou Khouma and others, 'Knowledge Assessment on Climate Change and Urban and Peri-Urban Agriculture in Dakar, Senegal' in Basant Maheshwari and others (eds), *The Security of Water, Food, Energy and Liveability of Cities: Challenges and Opportunities for Peri-Urban Futures* (Springer Netherlands 2014) <https://doi.org/10.1007/978-94-017-8878-6_26> accessed 30 July 2025.
[60] Pengyu Li and others, 'Optimal Water Resources Allocation in the Yinma River Basin in Jilin Province, China, Using Fuzzy Programming' (2022) 14 Water 2119.
[61] Shafiquzzaman and others (n 43).
[62] Ojha (n 14).
[63] López-Ruiz and González-Gómez (n 48).

environmental responsibility. In Brazil, there is a need for more involvement of government, civil society, and private sectors to manage water reuse equitably across industries and communities.[64] Steflová et al. also address affordability in Sabadell, Spain, calling for co-financing schemes between municipalities, businesses, and citizens to ensure fair infrastructure investment and cost recovery.[65] Conversely, while Singapore achieved universal sanitation access, the government relied on full cost recovery from users as a condition for World Bank funding, potentially excluding vulnerable groups if not paired with redistributive safeguards.[66]

A number of cases highlight that sectoral priorities in water reuse often favour urban, industrial, or high-profit sectors over agriculture or marginal communities. In India 80% of sewage is discharged untreated, with agricultural reuse neglected despite its significant share of water demand.[67] In Dar es Salaam, urban farmers are blamed for using poor-quality water, while lacking access to treated alternatives or formal infrastructure.[68] This reflects a systemic misallocation of water reuse benefits away from the most dependent and exposed groups. In Macau, reuse projects failed due to misapplied strategies from other regions, revealing how spatial and climatic contexts, if ignored, can exacerbate inequities.[69] Riazi et al. note that where institutional capacity is centralized, reuse may succeed technically but neglect local community representation, especially in diverse water-use regions.[70] In Chile, sustainability frameworks for reuse should assess the just distribution of opportunities to use natural resources, especially in sector-diverse or resource-scarce regions.[71]

Lastly, the unequal distribution of reuse benefits intersects with climate vulnerability. In Australia, peri-urban agricultural communities are especially exposed to climate-driven water scarcity and must be integrated into reuse schemes that support both livelihoods and ecosystem resilience.[72] Naserisafavi et al. reinforce this in their Melbourne study, arguing that alternative water systems should explicitly include social sustainability and equity metrics.[73] In Jordan, small farmers, with less access to water and less political influence, were more willing to adopt reused water, but also more vulnerable to elite capture of decision-making in Water User Associations.[74] Without safeguards, water reallocation strategies may reinforce inequalities under climate stress. In South Africa, stakeholders in informal settlements have historically been excluded from infrastructure investments, despite high climate vulnerability. Their study demonstrates the importance of co-designing reuse systems that address historical legacies of marginalization and contemporary adaptive needs.[75]

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[64] Fico and others (n 47).
[65] Šteflová and others (n 22).
[66] Tortajada and Koh (n 29).
[67] Schellenberg and others (n 41).
[68] Wessels (n 7).
[69] Zhang and others (n 36).
[70] Riazi and others (n 24).
[71] Montserrat Rodríguez-Castillo and others, 'Indicators for the Sustainability Assessment of MBR Technologies for Wastewater Reuse in Chile: The Good, the Bad, and the Ugly' (2023) 10 MethodsX 102111.
[72] Roger Attwater, Lyn Anderson and Chris Derry, 'Agricultural Risk Management of a Peri-Urban Water Recycling Scheme to Meet Mixed Land-Use Needs' (2016) 176 Agricultural Water Management 266; Roger Attwater and Chris Derry, 'Achieving Resilience through Water Recycling in Peri-Urban Agriculture' (2017) 9 Water 223.
[73] Niloufar Naserisafavi, Ehsan Yaghoubi and Ashok K Sharma, 'Alternative Water Supply Systems to Achieve the Net Zero Water Use Goal in High-Density Mixed-Use Buildings' (2022) 76 Sustainable Cities and Society 103414.
[74] Tawfik and others (n 49).
[75] Thatcher, Metson and Sepeng (n 37).

c. Recognition and Epistemic Justice: Valuing Diverse Knowledges and Overcoming Marginalisation

Recognition, concerned with whose knowledge counts, whose voices are heard, and how identities and experiences are valued, are essential for inclusive and legitimate water reuse governance. In the context of Dar es Salaam, a stark critique of knowledge inequity and misrecognition, where informal urban farmers using untreated wastewater are labelled as engaging in "unplanned" or "inferior" practices. Farmers reject the term "wastewater" as pejorative, instead calling it *chemchem* or *maji ya Bongo*, indicating pride and intentionality[76]. Their resistance reveals how dominant discourses erase agency and justify exclusionary planning. Farmers had limited control over water quality and were often relocated to marginal lands. These exclusions are not only material but epistemic: their lived realities are absent from formal governance.[77] In Spain, fragmented, overly technical information alienates the public, resulting in procedural and epistemic injustice. Citizens were not involved in framing reuse debates, even though some groups, especially the most vulnerable, depended on equitable services. This misalignment between technical narratives and community realities impairs trust and legitimacy.[78] In South Africa, the historical and present-day marginalisation of informal settlement residents in sanitation planning. Their transdisciplinary project aims to co-produce greywater treatment solutions, explicitly recognising ecological justice and drawing from urban ecology and lived knowledge. This is a rare example where recognition and epistemic justice are not only acknowledged but operationalised.[79]

A dominant theme across several studies is the reduction of water reuse to a technical, managerial issue. This framing, while important for risk and quality control, often neglects social, political, and cultural dimensions. Schellenberg et al., for instance, focus on comparative standards and technologies in India, but also acknowledge how differences in enforcement capacity and social needs make rigid application of standards unjust.[80] Similarly, in Macau, reuse projects failed because technical models were borrowed from Northern China without considering local climate, infrastructure, or social behaviour, resulting in epistemic failure.[81] Ojha criticises top-down infrastructure in India's peri-urban areas, which often ignore the socio-spatial realities of the poorest residents, and argues for context-sensitive, decentralised sanitation models grounded in local knowledge.[82] Even in high-income settings, these tensions persist. In the U.S. recycled water, although technically equal, is perceived as inferior in less wealthy communities, often due to historical distrust in institutions, revealing a disconnect between expert claims and public perceptions.[83]

Several studies highlight how local, or user knowledge is essential for effective water reuse, yet remains undervalued. In Ghana and Bangladesh, successful nutrient reuse systems depended on understanding local dietary patterns, fish preferences, and pond infrastructure.[84] Similarly, in Ecuador, Davis et al. argue for reuse system design "hand in hand with end users," especially in rural and peri-urban areas with varied water habits and cultural needs.[85] Frick-

[76] Wessels (n 7).
[77] ibid.
[78] Šteflová and others (n 22).
[79] Thatcher, Metson and Sepeng (n 37).
[80] Schellenberg and others (n 41).
[81] Zhang and others (n 36).
[82] Ojha (n 14).
[83] Crosson and others (n 46).
[84] Amoah, Gebrezgabher and Drechsel (n 39).
[85] Davis, Gutiérrez and Serrano (n 38).

Trzebitzky et al. in Namibia emphasize how adaptive governance must respect the perspectives of marginalised communities and the meanings they attach to water, noting that power, process, and legitimacy are embedded in these relationships.[86] In Greece, weak social ties and ignorance of other users' needs led to fragmented water governance in the Axios Delta, underscoring the need for social learning and mutual recognition.[87]

Co-production and inclusive framing offer pathways toward epistemic and recognition justice. In Chile, Rodríguez-Castillo et al. propose justice-oriented indicators for assessing MBR systems, including fair access to resources and pollution impact minimisation.[88] Riazi et al. discuss the importance of community-based natural resource management, even though some case cities fell short in ensuring true participatory processes.[89] In Thailand, Kanchanapiya and Tantisattayakul call for transparent monitoring and community engagement in wastewater safety to boost public confidence.[90] Likewise, Hopson and Fowler recommend the inclusion of diverse stakeholder voices in regulatory development across U.S. states, showing that recognition justice can be embedded in formal legislative processes.[91]

IV. Discussion

The findings of this review reveal that while water reuse has been promoted globally as a sustainability innovation, its justice dimensions remain fragmented, under-theorized, and inconsistently integrated into practice. The analysis demonstrates that the current water reuse paradigm continues to be shaped by technocratic logics and infrastructural rationalities that often marginalize the very communities it aims to serve. These patterns are a symptom of deeper structural and epistemological tensions embedded in water reuse governance.

Water reuse is celebrated for its technical ingenuity and potential to close resource loops in the context of climate stress.[92] Yet, the analysis reveals that reuse systems frequently reproduce or exacerbate social inequalities, especially where governance structures are centralized, cost burdens are regressive, or public participation is superficial. These dynamics challenge the assumption that sustainability transitions are inherently equitable or universally beneficial. Instead, the reviewed cases underscore the need to see water reuse not just as a neutral technological fix, but as a contested sociopolitical process, one that reflects and reshapes existing power relations over water, space, and knowledge. The cases from Jordan[93], Spain[94], and India[95] illustrate how elite actors often capture decision-making spaces, while low-

[86] Frick-Trzebitzky and others (n 40).
[87] Kapetas and others (n 25).
[88] Rodríguez-Castillo and others (n 71).
[89] Riazi and others (n 24).
[90] Kanchanapiya and Tantisattayakul (n 28).
[91] Hopson and Fowler (n 26).
[92] Enrico Marinelli and others, 'Water-Energy-Food-Climate Nexus in an Integrated Peri-Urban Wastewater Treatment and Reuse System: From Theory to Practice' (2021) 13 Sustainability 10952; Jordan Hristov and others, 'Reuse of Treated Water in European Agriculture: Potential to Address Water Scarcity under Climate Change' [2021] AGRICULTURAL WATER MANAGEMENT <https://publications.jrc.ec.europa.eu/repository/handle/JRC119630> accessed 31 July 2025.Vasileios A Tzanakakis, Andrea G Capodaglio and Andreas N Angelakis, 'Insights into Global Water Reuse Opportunities' (2023) 15 Sustainability 13007.
[93] Tawfik and others (n 49).
[94] López-Ruiz and González-Gómez (n 48).
[95] Goyal and Kumar (n 13).

income or marginalized groups bear the brunt of cost, risk, or exclusion. This calls for a critical re-examination of governance narratives that celebrate efficiency without interrogating who is empowered, who decides, and who benefits.

Findings further highlight that procedural injustices, limited transparency, weak participation, and inaccessible information, are not isolated implementation flaws but structural features of many reuse governance models.[96] The frequent absence of community voices in design and planning[97] suggests a systematic undervaluing of public agency, particularly in informal settlements, peri-urban zones, or low-income contexts. Even more critically, several studies[98] reveal how informal practices and vernacular knowledge systems are actively delegitimized or erased in policy discourses, replaced by technocratic framings that define reuse in narrowly scientific terms. This results in epistemic injustice: affected communities are not only excluded from decisions but also from the definition of problems and solutions. These findings challenge the prevailing governance orthodoxy and suggest that recognition justice must move beyond tokenistic inclusion toward deep pluralism that honours lived experience as legitimate expertise.

Further, while distributive concerns such as affordability, subsidy access, or health risks, are commonly acknowledged, they are often treated as secondary considerations rather than central criteria for project success.[99] This mirrors a broader tendency in sustainability discourse to treat justice as an "add-on" to technical and economic efficiency, rather than an essential design principle. However, several cases such as the Cypriot subsidy model[100], or Ghana's integrated fish farming systems[101]demonstrate that equitable design is not only possible but functionally advantageous, improving uptake, compliance, and long-term viability. These examples support calls from political ecology and critical infrastructure studies to move from redistribution to transformation restructuring the very foundations of how resources, risks, and responsibilities are allocated in reuse regimes.

Perhaps the most significant insight from this review is that justice in water reuse cannot be engineered retroactively.[102] Many of the most entrenched injustices such as those in South Africa[103], India[104], and Namibia[105] are rooted in historical legacies of infrastructural exclusion, institutional bias, and settler-colonial planning paradigms that continue to shape access to sanitation and water. These legacies cannot be overcome by stakeholder workshops or

[96] Rutgerd Boelens, Jaime Hoogesteger and Jean Carlo Rodriguez de Francisco, 'Commoditizing Water Territories: The Clash between Andean Water Rights Cultures and Payment for Environmental Services Policies' (2014) 25 Capitalism Nature Socialism 84; Margreet Z Zwarteveen and Rutgerd Boelens, 'Defining, Researching and Struggling for Water Justice: Some Conceptual Building Blocks for Research and Action' (2014) 39 Water International 143.
[97] Šteflová and others (n 22); Crosson and others (n 46); Wessels (n 7).
[98] Wessels (n 7); Ojha (n 14).
[99] Erik Swyngedouw, 'Governance Innovation and the Citizen: The Janus Face of Governance-beyond-the-State' (2005) 42 Urban Studies 1991; Karen Bakker, 'Archipelagos and Networks: Urbanization and Water Privatization in the South' (2003) 169 The Geographical Journal 328.
[100] Mannina, Gulhan and Ni (n 56).
[101] Amoah, Gebrezgabher and Drechsel (n 39).
[102] Vanessa Watson, 'Seeing from the South: Refocusing Urban Planning on the Globe's Central Urban Issues' (2009) 46 Urban Studies 2259; Michelle Kooy and Karen Bakker, 'Technologies of Government: Constituting Subjectivities, Spaces, and Infrastructures in Colonial and Contemporary Jakarta' (2008) 32 International Journal of Urban and Regional Research 375.
[103] Thatcher, Metson and Sepeng (n 37).
[104] Ojha (n 14); Goyal and Kumar (n 13); Schellenberg and others (n 41); Baanu and Babu (n 50).
[105] Frick-Trzebitzky and others (n 40).

education campaigns alone. Instead, they demand structural change: decentralised governance, reparative investment, legal reform, and long-term engagement with local histories and identities. The failure to recognize and redress these legacies risks turning water reuse into a sustainability solution that is not only unjust but unsustainable, due to social resistance, institutional failure, or ecological backlash.

While this review explicitly applied a justice lens, it is important to note that majority of the selected studies do not use the word "justice" explicitly in their framing or conclusions. Instead, they refer to justice-related concepts such as equity, inclusivity, participation, social acceptance, affordability, governance gaps, vulnerability, and community engagement. These adjacent terms served as key entry points during the search and coding phases, allowing the identification of case studies that engage with justice-relevant themes even if they do not label them as such. This semantic dispersion reflects the fragmentation and conceptual ambiguity surrounding justice in water reuse literature, where normative concerns are present but not always theorized explicitly.[106] It also highlights the need for a more deliberate and systematic integration of justice frameworks into empirical studies.[107] A critical implication of this finding is that justice is often addressed in practice, but remains under-theorized in discourse, risking invisibility in policy translation and scholarly synthesis. Bridging this gap requires not only more precise language but also cross-disciplinary dialogue to embed justice more fully within the epistemic core of water reuse research. The methodological diversity within the dataset, ranging from community-based participatory methods to advanced modelling, offers an encouraging sign that the field is becoming more interdisciplinary. However, the analysis shows that justice is still often invoked rhetorically rather than analytically, and few studies operationalize justice dimensions in a rigorous, reflexive way. Moving forward, this paper argues for a research agenda that treats justice as a relational, historical, and political process to be unpacked. This entails shifting from evaluation to co-production, from risk to responsibility, and from scaling up technologies to scaling down governance to community and watershed levels.

The patterns identified in this review also reveal a broader misalignment between the ambitions of international governance frameworks and the realities of water reuse on the ground. For example, the persistent procedural injustices observed across cases, characterised by opaque decision-making, technocratic framing, and limited opportunities for meaningful engagement, sit uneasily alongside the Aarhus Convention's[108] legally binding guarantees of access to information, public participation and access to justice. The fact that several Aarhus

[106] Zwarteveen and Boelens (n 96); Julian Agyeman and others, 'Trends and Directions in Environmental Justice: From Inequity to Everyday Life, Community, and Just Sustainabilities' (2016) 41 Annual Review of Environment and Resources 321; Alex Loftus, 'Political Ecology II: Whither the State?' (2020) 44 Progress in Human Geography 139.

[107] Margreet Zwarteveen and others, 'Engaging with the Politics of Water Governance' (2017) 4 WIREs Water e1245; Rutgerd Boelens, Jaime Hoogesteger and Jean Carlo Rodriguez de Francisco, 'Commoditizing Water Territories: The Clash between Andean Water Rights Cultures and Payment for Environmental Services Policies' (2014) 25 Capitalism Nature Socialism 84; M Mills-Novoa, R Boelens and J Hoogesteger, 'Climate Change and Water Justice' in Trevor M Letcher (ed), *Water and Climate Change* (Elsevier 2022) <https://www.sciencedirect.com/science/article/pii/B9780323998758000148> accessed 31 July 2025.

[108] Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (adopted 25 June 1998, entered into force 30 October 2001) 2161 UNTS 447 (Aarhus Convention).

Parties like Spain,[109] Greece[110] and Cyprus[111] continue to exhibit weak participatory structures suggests that compliance is often superficial, reflecting what scholars describe as the "implementation gap"[112] between formal procedural rights and substantive democratisation of environmental governance. The cases reviewed here indicate that the sociotechnical framing of water reuse as an expert-driven engineering domain can narrow participatory spaces, thereby undermining Aarhus's normative commitment to environmental democracy.

A similar tension emerges when these findings are considered in relation to Sustainable Development Goal 6 (SDG 6).[113] While SDG 6.3 explicitly promotes wastewater treatment and reuse as pathways to sustainability, the justice deficits documented here demonstrate that progress on technical indicators can coexist with deepening inequalities. The exclusion of informal water users, the disproportionate exposure of low-income communities to untreated effluent, and the unaffordability of tertiary-treated water for smallholder farmers collectively challenge the assumption that expanded reuse automatically contributes to equitable water access (Targets 6.1 and 6.2). Equally, the weak participatory arrangements described in many case studies directly conflict with SDG 6.5's emphasis on inclusive, integrated water governance. These findings reinforce critical scholarship arguing that SDGs often incentivise infrastructural expansion while neglecting the relational, political and distributive dimensions of sustainability.

Finally, these dynamics have direct implications for emerging international recognition of the right to a clean, healthy and sustainable environment (R2HE).[114] Although not the central conceptual lens of this paper, the recurrent injustices documented, unequal access to safe water, disproportionate environmental risks, procedural exclusion and the erasure of local epistemologies, signal profound challenges for realising both the substantive and procedural dimensions of this right. The reviewed cases illustrate how water reuse practices, when implemented through centralised, expert-led and efficiency-oriented governance regimes, can inadvertently contravene the R2HE's emphasis on equity, participation and non-discrimination. Rather than functioning as purely technical interventions, water reuse systems become sites where environmental rights are negotiated, contested and, at times, denied.

V. Conclusion

This review demonstrated that justice is not peripheral to water reuse governance but fundamental to its legitimacy and effectiveness. Across varied contexts, water reuse initiatives are shaped by governance systems that privilege technical efficiency and risk management while marginalising equity, participation and recognition. The resulting justice deficits, information asymmetries, affordability barriers, exclusion of informal users, and the sidelining of vernacular knowledge, reflect deeper epistemological tensions about whose knowledge counts and how water reuse problems are framed. The analysis reveals that language plays a crucial role in sustaining these dynamics. Technocratic framings that cast reuse as a neutral

[109] Stathatou and others (n 23); Riazi and others (n 24); Bermejo-Martín, Rodríguez-Monroy and Núñez-Guerrero (n 31); López-Ruiz and González-Gómez (n 48); López-Serrano and others (n 44).
[110] Kapetas and others (n 25).
[111] Mannina, Gulhan and Ni (n 56).
[112] Daniel A Farber, 'The Implementation Gap in Environmental Law' (2016) 16 Journal of Korean Law 3.
[113] UNGA Res 70/1 (25 September 2015), Goal 6.
[114] The UN Human Rights Council (2021) and UN General Assembly (2022) recognised "the human right to a clean, healthy and sustainable environment" in resolutions HRC 48/13 and UNGA 76/300.

"technical solution" or "efficiency measure" reinforce a narrow sociotechnical imaginary that elevates expert authority while rendering community perspectives invisible. This discursive closure contributes to epistemic injustice, limiting which experiences and knowledges enter decision-making and shaping whose voices are deemed legitimate. At the same time, the review identifies pathways for more equitable and epistemically inclusive governance. Case studies involving participatory processes, co-produced infrastructure and targeted subsidies show that justice, material, procedural and epistemic, improves both acceptance and performance of reuse systems.

These insights carry important implications for broader governance commitments. The persistent procedural injustices identified, including opaque decision-making and limited stakeholder engagement, sit uneasily alongside the Aarhus Convention's legally binding guarantees of access to information, participation and justice. Similarly, the distributive and procedural inequities documented across cases challenge progress towards SDG6, particularly its commitments to equitable access to water (Targets 6.1 and 6.2), safe wastewater treatment and reuse (6.3), and inclusive, integrated water governance (6.5). Finally, these patterns signal significant obstacles to the right to a clean, healthy and sustainable environment (R2HE), whose substantive and procedural dimensions can only be realised when justice is embedded throughout governance systems, not treated as a downstream outcome.

Taken together, the findings point to the need for a shift toward governance approaches that are relational, participatory and historically informed. Advancing just water reuse requires confronting core questions of knowledge, power and voice: whose expertise shapes decisions, whose experiences are acknowledged, and how the language of policy defines what solutions are imaginable. Embedding justice at every stage, from design to implementation and monitoring, is essential for aligning water reuse with broader commitments to transparency, equity, epistemic inclusion and environmental rights.