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FROM SCARCITY TO EQUITY: THE STRATEGIC ROLE OF SOCIAL WORKERS IN WATER POLICY ANALYSIS

DA ESCASSEZ À EQUIDADE: O PAPEL ESTRATÉGICO DOS ASSISTENTES SOCIAIS NA ANÁLISE DE POLÍTICAS HÍDRICAS

DE LA ESCASEZ A LA EQUIDAD: EL PAPEL ESTRATÉGICO DE LOS TRABAJADORES SOCIALES EN EL ANÁLISIS DE POLÍTICAS DEL AGUA

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Abstract

Access to water is a fundamental human right. However, it faces persistent challenges related to scarcity and inequality. In this context, social workers play a strategic role at the intersection of technical management and social justice. This study analyzes the contribution of these professionals to the evaluation of public water policies, investigating how sociodemographic indicators can be integrated with physicochemical and biological markers. Adopting a qualitative approach, a systematic literature review was conducted in national and international databases (2019–2024), following the PRISMA guidelines and the PICO strategy. Twenty articles were selected, revealing methodological heterogeneity ranging from analyses of "infrastructure violence" to machine learning models. The results demonstrate that technical indicators (such as fecal coliform levels and heavy metals) act as sentinels of public health, scientifically validating the demands of vulnerable communities. The analysis reveals that the social worker acts as a "data translator," converting complex environmental metrics into accessible language to empower participatory governance. We conclude that mastery of these "hard" technologies is indispensable to the profession's political

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competence, enabling the transition from reactive management to proactive policies grounded in evidence and equity.

Keywords: Social worker; water resources; public policies; markers; indicators.

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Resumo

O acesso à água é um direito humano fundamental, mas enfrenta desafios persistentes de escassez e desigualdade. Nesse contexto, os assistentes sociais desempenham um papel estratégico na interseção entre a gestão técnica e a justiça social. Este estudo analisa a contribuição desses profissionais na avaliação de políticas públicas hídricas, investigando como indicadores sociodemográficos podem ser integrados a marcadores biológicos e físico-químicos. Adotando uma abordagem qualitativa, realizou-se uma revisão sistemática da literatura em bases de dados nacionais e internacionais (2019–2024), seguindo as diretrizes PRISMA e a estratégia PICO. Foram selecionados 20 artigos que evidenciam uma heterogeneidade metodológica, que varia de análises de "violência infraestrutural" a modelos de Machine Learning. Os resultados demonstram que indicadores técnicos (como níveis de coliformes fecais e metais pesados) atuam como sentinelas de saúde pública, validando cientificamente as demandas das comunidades vulneráveis. A análise revela que o assistente social atua como um "tradutor de dados", convertendo métricas ambientais complexas em linguagem acessível para empoderar a governança participativa. Conclui-se que o domínio dessas tecnologias "duras" é indispensável à competência política da profissão, permitindo a transição de uma gestão reativa para políticas proativas baseadas em evidências e equidade.

Palavras-chave: Assistente social; recursos hídricos; políticas públicas; marcadores; indicadores.

Resumen

El acceso al agua es un derecho humano fundamental, pero enfrenta desafíos persistentes de escasez y desigualdad. En este contexto, los trabajadores sociales desempeñan un papel estratégico en la intersección entre la gestión técnica y la justicia social. Este estudio analiza la contribución de estos profesionales a la evaluación de las políticas públicas del agua e investiga cómo los indicadores sociodemográficos pueden integrarse con marcadores biológicos y fisicoquímicos. Adoptando un enfoque cualitativo, se realizó una revisión sistemática de la literatura utilizando bases de datos nacionales e internacionales (2019-2024), siguiendo las directrices PRISMA y la estrategia PICO. Se seleccionaron veinte artículos que evidenciaron heterogeneidad metodológica, que abarcaban desde análisis de "violencia en la infraestructura" hasta modelos de aprendizaje automático. Los resultados muestran que los indicadores técnicos (como los niveles de coliformes fecales y de metales pesados) actúan como centinelas de la salud pública, validando científicamente las demandas de las comunidades vulnerables. El análisis revela que los trabajadores sociales actúan como "traductores de datos", convirtiendo métricas ambientales complejas en un lenguaje accesible para fortalecer la gobernanza participativa. Se concluye que el dominio de estas tecnologías “duras” es indispensable para la competencia política de la profesión, lo que permite la transición de una gestión reactiva a políticas proactivas basadas en la evidencia y la equidad.

Palabras clave: Trabajador social; recursos hídricos; políticas públicas; marcadores; indicadores.

1. Introduction

Water is more than just a resource. It is a fundamental human right that transcends economic value and is essential for community well-being (Gleick &

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Iceland, 2018). The quality and quantity of available water significantly influence public health and the socio-environmental sustainability of populations (Hutton et al., 2004). However, the trajectory of human development, characterized by uncontrolled urbanization, industrialization, and intensive agriculture, has introduced serious threats to water availability and quality (Gerten et al., 2008; Vörösmarty et al., 2010). The consequences are drastic, such as the degradation of water bodies, the depletion of groundwater, and damage to aquatic ecosystems.

Therefore, it is essential to look beyond the physical changes and analyze the social, economic, and environmental impacts of shifting water quality and volume within communities. These shifts trigger long-range social consequences, from public health crises linked to contaminated water to economic stagnation caused by scarcity in agriculture and industry (Prüss-Ustün et al., 2019). Furthermore, inequalities in access and competition for water resources can escalate into social conflicts (Warner et al., 2019). Addressing these challenges requires a multidisciplinary approach that weaves the technical-environmental dimensions of water management together with social and human perspectives (Biswas et al., 2012).

Acting as a critical link between communities and public policies, social workers are strategically positioned to understand and analyze the social effects of changes in water availability. They are the advocates for actions that promote equity and social justice (Mariosa, De Benedicto, Sugahara, 2019).

Public policies, the actions, programs, and measures adopted by the State to promote social welfare, are decisive for ensuring equitable and sustainable access to water (Secchi, Coelho & Pires, 2019). The development of laws, management plans, and environmental education initiatives aims to protect water bodies and improve water quality (Grangeiro, Ribeiro & Miranda, 2020). However, the effective implementation of these policies depends on integrating social, economic, and environmental considerations while addressing the specific needs of local communities, particularly those in vulnerable socioeconomic situations. By promoting social participation, inclusion, and sustainability, these policies can

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ensure adequate and democratic water resource management.

The multidimensional perspective of sustainability drives the increasing involvement of social workers in environmental issues. Although their engagement in the water sector is essential, climate change has significantly impacted the efficacy of new improvements. Within the context of global sustainability goals and national policies, the core problem this research addresses can be summarized as follows: What is the role of the social worker in analyzing social and economic changes in communities due to water scarcity and pollution?

Given this context, this study aims to analyze the contribution of social workers in the formulation and evaluation of public policies for the sustainable management of water resources, using sociodemographic indicators and biological and physicochemical markers.

This research justifies itself through its originality and importance for implementing water resource management policies. It provides scientifically validated tools for decision-making that promote more sustainable actions and a precise evaluation of socio-environmental sustainability and water security. The project aligns with the expectations of the Agency and Committees of the Piracicaba, Capivari, and Jundiaí River Basins (PCJ Basins) for Sustainable Water Resource Management (Comitês PCJ, 2021). Integrating these results into the discussions and policies of the PCJ committees could contribute to the water security of populations living in these hydrographic basins.

2. Theoretical Framework

The role of social workers in environmental issues in Brazil is growing as the multidimensional perspective of sustainability consolidates, also incorporating ethical, social, and political dimensions (Rabelo, Lopes & Proeza, 2014). From this perspective, their work is essential to address the challenges posed by climate change, including global warming, water scarcity, and difficulties in providing basic sanitation and equitable water distribution.

Furthermore, in recent decades, climate change has taken center stage in

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socio-environmental debates. This opens up a range of possibilities for social workers to contribute to the sustainable management of water resources, integrating socio-demographic indicators with biological and physico-chemical markers to assess the impact of climate change on vulnerable populations.

The global action plan established by the United Nations (UN, 2015), titled "Transforming Our World: The 2030 Agenda for Sustainable Development," aims to build a world free of poverty, hunger, and inequality. This agenda comprises 17 Sustainable Development Goals (SDGs) and 169 targets. Among the various themes, the impact of climate change on water resources stands out. SDG 6, which aims to "ensure availability and sustainable management of water and sanitation for all," is particularly relevant to this study. Understanding the impact of climate change on water resources in Brazil, as emphasized in the 2030 Agenda, is fundamental for developing adaptation measures.

Moreover, a report on water resources, focusing on the Piracicaba, Capivari, and Jundiaí (PCJ) river region, notes a continuous reduction in per capita water availability, increased demand for water for various uses, and water deficits in some areas. The report also addresses the need to improve basic sanitation services, including sewage collection and treatment, as well as solid waste management.

Water quality, another critical aspect of the 2030 Agenda, is assessed in Brazil using the Water Quality Index (WQI), which considers variables such as temperature, pH, dissolved oxygen, biochemical oxygen demand, thermotolerant coliforms, total nitrogen, total phosphorus, total solids, and turbidity. The 2030 Agenda also mentions the Toxic and Organoleptic Substances Index (TOS), which evaluates toxic substances and variables that affect the organoleptic quality of water.

Sustainable water resource management remains a global concern due to increasing scarcity and pollution, which is why public policies must consider both technical and environmental aspects as well as social and human ones. Social workers play a central role in developing and implementing policies that promote equity, social justice, and well-being in communities affected by water resource

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management challenges. This occurs through their ethical-political competencies, which address issues of social justice and equity, and their technical-operational competencies, which facilitate community participation through education and critical reflection (Mariosa et al., 2024).

In this context, several issues deserve the attention of social workers, especially mapping and understanding the impact of water access on the population. This mapping is fundamental to identifying social, economic, and territorial inequalities, highlighting that people in vulnerable situations often lack adequate access to this essential resource or basic sanitation services. By understanding and mapping these conditions, it is possible to support public policies and intervention actions that promote social justice, equity, and the sustainable use of water. The social worker's specialized perspective on the "social question" provides a comprehensive view of the difficulties communities face, enabling the identification of specific needs and vulnerabilities in each territory.

3. Methodology

This research adopted a qualitative approach through a systematic literature review, focusing on articles that presented thematic relevance. Aligning with Minayo (1993), qualitative research investigates a reality that transcends quantification, exploring the universe of meanings, motives, aspirations, beliefs, values, and attitudes corresponding to a deeper space of relationships, processes, and phenomena.

3.1. Research Design

The study adopted an interdisciplinary approach, integrating knowledge from Social Work, Environmental Management, and Public Policies, to investigate the social worker's contribution to the analysis and evaluation of public policies related to sustainable water resource management (Creswell; Clark, 2015).

3.2. Data Collection Techniques

To achieve the proposed objectives, a systematic literature review was

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conducted with an emphasis on the social worker's contribution to sustainable water resource management and the use of sociodemographic indicators, biological markers, and physicochemical markers in assessing water quality. The review covered scientific articles published in English, Spanish, and Portuguese over the last five years, indexed in databases such as Scielo, Doaj, Science Direct, Scopus, and Web of Science, accessed through the CAPES Periodicals Portal.

3.3. Inclusion and Exclusion Criteria

The selection followed strict criteria to ensure interdisciplinary relevance.

Inclusion criteria: (1) Peer-reviewed articles published between 2019 and 2024; (2) Studies addressing water quality, management, or scarcity; (3) Research containing specific technical indicators (biological, physicochemical) OR sociodemographic analysis.

Exclusion criteria: (1) Duplicate records; (2) Studies strictly focused on chemical engineering processes without environmental or social application contexts; (3) Editorials and gray literature.

3.4. Data Analysis Strategy and AI Disclosure

A total of 20 articles were selected for the final systematic review. The analysis employed a mixed-method approach. Quantitatively, we mapped the geographical distribution and methodological trends using VOSviewer. Qualitatively, we applied the PICO framework to categorize how technical interventions (e.g., bio-indicators, machine learning) intersect with social outcomes (e.g., public health, inequality reduction). The articles were clustered into three thematic axes: (I) Socio-political Management of Water; (II) Technical Monitoring and Public Health; and (III) Advanced Technologies for Resilience.

We disclose that Rayyan and VosViewer's internal AI capabilities were used to assist in the preliminary screening of abstracts, accelerating the identification of exclusion criteria (e.g., incorrect publication type) and keyword extraction, but all final inclusion/exclusion decisions were manually verified by the authors. Furthermore, generative AI (Gemini 2.5) was used exclusively for linguistic review, manuscript translation assistance, and table organization, but no synthetic data or

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scientific interpretation was generated by the AI without critical evaluation by the authors.

4. Results

Initially, relevant content was collected from scientific databases, including the CAPES Periodicals Portal, Scopus, and Google Scholar, using Boolean expressions that combined keywords and their semantic variations, as shown in Table 1. To broaden the scope of content, the descriptors were organized into four categories: Social Service, Sociodemographic Indicators, Biological Markers, and Physicochemical Indicators.

Table 01 - Boolean search equations used

Equation 1 - Search criteria in the CAPES Periodicals Database (Social Work)
social worker AND public policy analysis AND water resources AND water quality AND ("sociodemographic indicators" OR "sociodemographic data" OR "social indicators") AND ("biological markers" OR "biological indicators") / ("social worker" OR social assistance") AND ("sustainable management" OR "sustainability" OR "sustainable development") AND ("water resources" OR "water" OR "water management") AND ("water quality" OR "water monitoring") AND ("social inclusion" OR "social participation").
Equation 2 - Search criteria in the CAPES Periodicals Database (Sociodemographic Indicators)
("sociodemographic indicators" OR "sociodemographic data" OR "social indicators") AND ("water resources" OR "water" OR "water management") AND ("water quality" OR "water monitoring")

Source: Elaborated by authors (2025)

The identification process in databases yielded an initial set of 854 records. After removing duplicates and screening titles and abstracts based on the exclusion criteria, 64 articles remained for full-text eligibility assessment. Of these, 44 were excluded for reasons such as lack of specific indicators or purely chemical focus. Finally, 20 articles were selected to compose the analytical

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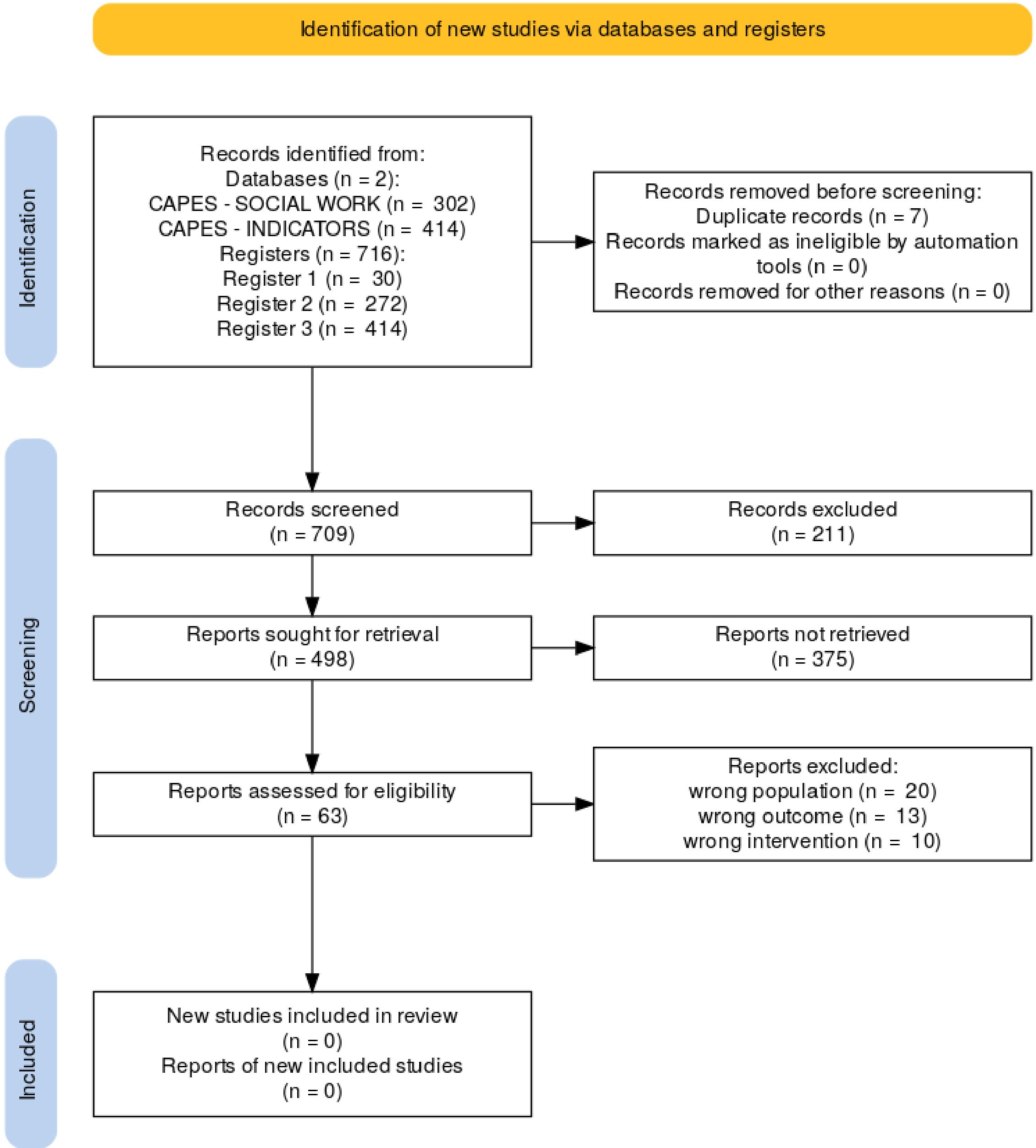
framework. These procedures follow the PRISMA guidelines (Figure 1)

Figure 1 - Methodological flow of the search and selection of relevant articles (PRISMA)



Source: Elaborated by authors (2025)

The selected studies present significant heterogeneity in terms of geography (covering Europe, South America, North America, Africa, and Asia) and

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methodology (ranging from advanced machine learning to qualitative social perception analysis). To systematize the contribution of these studies to the formulation of public policies, we applied the PICO framework (Population, Intervention, Comparison, Outcome). Table 2 presents the analytical matrix of the 20 selected articles.

Table 2 - Analytical Matrix (PICO Strategy) of Selected Studies

Ref / Study Focus	Population Target System (P)	Intervention / Indicator / Method (I)	Comparison / Context (C)	Outcome for Policy & Social Analysis (O)
1. (Zlati *et al.*, 2024) EU Water Security	EU-27 Member States	Water Security Index (WSI)	Comparative analysis among member states	Demonstrates direct correlation between water security and socio-economic development levels.
2. (Hale *et al.*, 2023) Nature-Based Solutions	Peri-urban areas (5 countries)	Nature-Based Solutions (NBS)	Cross-context evaluation (ecological vs. social)	Validates NBS as a flexible tool to address water scarcity while promoting social well-being.
3. (Silva, Marcelo Carlos de Oliveira *et al.*, 2022) Water Footprint (Brazil)	Semi-arid population (Pernambuco)	Water Footprint Measurement	Regional consumption vs. National averages	Reveals income-based inequality in water use; guides policies on dietary habits over restriction.
4. (Delpla; Proulx; Rodríguez, 2020) Vulnerability (Canada)	Urban water consumers (Quebec)	Spatio-temporal Monitoring + Social Data	Vulnerable zones vs. General population	Optimizes monitoring to prioritize areas with elderly/low-mobility populations (equity).
5. (Wakhungu *et al.*, 2021) Infrastructure (USA)	Marginalized urban communities	Geospatial Vulnerability Framework	Low-income/Minority areas vs. Wealthy areas	Exposes "infrastructure violence" and systemic neglect in water distribution systems.
6. (Agaton; Guila, 2024) Wetlands	Local community (Bayawan City)	Constructed Wetlands (NBS)	Success factors vs. Implementation	Identifies community engagement as a critical success factor for wastewater treatment projects.

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(Philippines)			challenges	
7. (Mariosa *et al.*, 2024) Rights (Brazil)	Vulnerable territories (PCJ Basins)	Rights-based Management Analysis	Managers' discourse vs. Social reality	Highlights the gap between technical water management and the effective realization of human rights.
8. (Doro; Ehosioke; Aizebeokhai, 2020) Policy (Nigeria)	Communities with degraded soil/water	Data-driven Policy Model	Traditional policymaking vs. Scientific data	Proposes a framework to integrate scientific evidence into governance for food/water security.
9. (Biswas *et al.*, 2022) Sustainability (India)	Population under water stress	Water Sustainability Index (WSI)	Current practices vs. SDG 6 Targets	Establishes a performance gauge to monitor progress toward UN Sustainable Development Goal 6.
10. (Siqueira Neto; Menezes, 2019) Waste Pickers (Brazil)	Low-income waste cooperatives	Bidding Exemption (Policy Tool)	Direct hiring vs. Traditional bidding	Promotes social inclusion and sustainability by formalizing the role of waste pickers in sanitation.
11. (Alvizuri-Tintaya *et al.*, 2022) Mining (Bolivia)	Mining-affected communities	Remote Sensing + Heavy Metal Analysis	Traditional monitoring vs. Integrated Technology	Provides concrete evidence of contamination (Arsenic/Lead) to support community health claims.
12. (Petrea *et al.*, 2021) Resilience (Romania)	Blue Economy sectors	Machine Learning Forecasting	Standard control vs. Predictive Models	Increases economic resilience and adaptive capacity against climate change impacts.
13. (Reymond; Sudalaimuthu, 2022)	Downstream river communities	GIS Mapping + Physicochemical Analysis	Measured parameters vs. WHO/BIS limits	Identifies critical pollution zones to direct immediate management interventions.

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GIS Analysis (India)				
14. (Wang *et al.*, 2024) Phytoplankton (China)	Aquatic ecosystem (Lake Taihu)	Quantile Regression Analysis	Seasonal variability and concentratio n effects	Offers precise biological data to forecast ecological shifts affecting water availability.
15. (Zhang *et al.*, 2020) Wastewater (China)	Urban wastewater systems	Advanced Treatment Processes	Comparison of 3 treatment technologies	Evaluates reduction in bio-toxicity/genotoxicity to protect public health downstream.
16. (Silva, Thaís Tagliati Da *et al.*, 2022) Bio-indicators (Brazil)	River Phytoplankt on	Taxonomic/ Morphofuncti onal Approach	Responses across different hydrographic basins	Uses biological responses as early warning indicators of environmental quality changes.
17. (Rodríguez-López *et al.*, 2023) Machine Learning (Chile)	Lake Ecosystem (Llanquihue)	Machine Learning Algorithms	Prediction of Chlorophyll-a vs. Traditional Lab	Enables rapid, low-cost prediction of water quality parameters for better decision-making.
18. (Good *et al.*, 2024) Biomarkers (UK)	Coastal water users	Endotoxin Biomarkers	Rapid method (Bacterisk) vs. Culture methods	Provides rapid risk assessment for fecal contamination, protecting public health in real-time.
19. (Akita *et al.*, 2021) Bacteria (Ghana)	Tropical beach users	Bacterial Spatial Variability	Urban beaches vs. Environment al factors	Links sanitation deficits (sewage) to public health risks, demanding infrastructure investment.
20. (Kalaitzidou *et*	Mussel cultivation areas	Bacteria/Cya nobacteria Indicators	Harmful Algal Blooms (HAB) vs. Food	Uses biological indicators to prevent economic loss and health risks in food

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al., 2022) Aquaculture (Greece)			Security	production.

Source: Elaborated by authors (2025)

Analysis of Table 2 reveals a compelling narrative. While studies such as those by Wang et al. (2024) (phytoplankton analysis in China), Zhang et al. (2020) (biotoxicity in wastewater), and Rodríguez-López et al. (2023) (machine learning for water quality in Chile) are technically focused, their scientific results provide fundamental data for diagnosis and social intervention. For example, the identification of biotoxicity in wastewater (Zhang et al., 2020) or heavy metal contamination in mining areas (Alvizuri-Tintaya et al., 2022) serves as indisputable evidence for social workers advocating for community relocation, health reparations, or environmental justice.

On the other hand, studies that directly address governance and policy gaps (Doro; Ehosioke; Aizebeokhai, 2020; Mariosa et al., 2024; Siqueira Neto; Menezes, 2019) highlight that the technical solutions, however advanced they may be, often prove insufficient when they ignore local social dynamics and fundamental human rights.

To provide a deeper understanding, the findings were grouped into three thematic categories:

4.1. Territorial Vulnerability and Environmental Justice

A significant body of research highlights that water scarcity and pollution are not democratic phenomena, as they disproportionately affect marginalized populations. Wakhungu et al. introduce the critical concept of "infrastructure violence," demonstrating how obsolete and inadequate water infrastructure in the US is concentrated in low-income areas and among minorities, leading to systemic inequality. Similarly, Mariosa et al. identify a profound gap in the Piracicaba, Capivari, and Jundiaí river basins in Brazil, where water resource managers frequently fail to integrate the rights and needs of territorially vulnerable

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populations into planning. Silva et al. further reinforces this idea, showing that the water footprint in a semi-arid region is strongly associated with income, indicating that consumption patterns are socioeconomically stratified.

This suggests that restrictive water policies should target the habits of the wealthy, rather than penalizing the domestic use of the poor. The European Union context, as noted in Zlati et al. (2024), also highlights that disparities in the Water Security Index correlate directly with socioeconomic development, reinforcing the notion that access to water is a determinant of social equity. Finally, Siqueira Neto and Menezes (2019), in their study on recyclable material collectors in Brazil, demonstrate how public policy instruments, such as exemption from bidding processes, can explicitly promote social inclusion and sustainable development in sanitation management.

4.2. Biological and Physicochemical Markers as Social Sentinels for Public Health

The review unequivocally confirms that "concrete" scientific indicators serve as powerful tools for advocating social justice. Studies in diverse geographical contexts, such as Ghana, where Akita et al. (2021) assess bacterial variability on beaches; Bolivia, where Alvizuri-Tintaya et al. (2022) study the impact of heavy metals from mining; India, for the physicochemical analysis of river contamination investigated by Reymond; Sudalaimuthu (2022); and the United Kingdom and the endotoxin biomarkers studied by Good et al. (2024) utilize specific biological and physicochemical data not only as environmental metrics but as critical maps of public health risk.

For social workers, a report indicating high levels of E. coli (Akita et al., 2021) or arsenic contamination (Alvizuri-Tintaya et al., 2022) immediately signals the need for urgent social intervention, such as health screenings, community alerts, and advocacy for improved sanitation infrastructure. These markers transform the community's subjective suffering into objective scientific evidence, providing the leverage needed to meet political demands and hold the state accountable.

Furthermore, the articles by Kalaitzidou et al. (2022) on aquaculture in

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Greece and by Silva, Thaís Tagliati et al. (2022) on phytoplankton in Brazil exemplify how biological indicators of water quality are directly linked to food security and the economic well-being of local communities, making their monitoring a socioeconomic imperative. Advanced phytoplankton analysis (Wang et al., 2024) provides accurate biological data to predict ecological changes that can affect water availability and quality, thereby directly impacting human populations.

4.3. Advanced Technologies for Predictive Governance and Nature-Based Solutions

An emerging and highly promising trend observed is the integration of advanced technologies, such as Machine Learning (Petrea et al., 2021; Rodríguez-López et al., 2023) and Remote Sensing (Alvizuri-Tintaya et al., 2022), in water resource management. These tools enable predictive modeling and real-time monitoring. For public policy, this capability shifts the paradigm from reactive "disaster response" to proactive "prevention." By accurately predicting algal blooms (Rodríguez-López et al., 2023) or contamination events, managers can implement preventive measures to protect vulnerable economies, such as aquaculture in Greece (Kalaitzidou et al., 2022), and secure alternative water sources for communities before a crisis worsens.

The methodology developed in Quebec (Delpla, Proulx, and Rodríguez, 2020) uses spatiotemporal monitoring combined with social data to prioritize interventions in vulnerable areas, demonstrating how technology can promote equity in water distribution. Furthermore, the robust evaluation of Nature-Based Solutions (NBS) in Hale et al. (2023) and the successful implementation of constructed wetlands in the Philippines (Agaton; Guila, 2024) highlight economically viable and environmentally sustainable alternatives that integrate community engagement, proving that ecological solutions can simultaneously promote social well-being and sustainability. Doro, Ehosioke, and Aizebeokhai (2020), in a study conducted in Nigeria, further emphasize the need for a data-driven policy approach to integrate scientific evidence into governance, aiming to improve food and water security.

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5. Discussion

The synthesis of these 20 articles strongly challenges traditional disciplinary boundaries and advocates for an integrated approach between technical and social skills in water resource management. The main conclusion of this review is that sociodemographic indicators acquire unparalleled power when synergistically combined with biological and physicochemical markers, forming a comprehensive framework for effective social interventions and the advocacy of public policies.

5.1. The Social Worker as a "Data Translator" and Intermediary

The role of Social Worker in this interdisciplinary context is multifaceted, going beyond mere rights defense to include serving as a "data translator," interpreter, and intermediary. Technical data, whether a sophisticated Water Security Index (Biswas et al., 2022; Zlati et al., 2024), a water quality prediction through Machine Learning (Rodríguez-López et al., 2023), or complex bacterial counts (Akita et al., 2021), is often inaccessible or unintelligible to the public and, at times, even to policymakers without scientific knowledge.

The social worker interprets this raw, complex data, converting it into understandable, actionable information. This translation is vital for empowering communities, transforming them from passive recipients of aid into active agents of environmental governance, as eloquently suggested by Doro et al. (2020) and Hale et al. (2023), who emphasize community engagement as a success factor in Nature-Based Solutions (NbS). For example, when Alvizuri-Tintaya et al. (2022) reveal heavy metal contamination from mining, the social worker translates this scientific finding into tangible health risks for the local population, facilitating mobilization for medical assistance, legal redress, and the demand for political reforms. This role is essential to reduce the knowledge gap between scientific institutions and vulnerable communities.

5.2. From Reactive Diagnosis to Proactive, Evidence-Based Policy

The integration of diverse indicators and advanced methodologies transforms social work practice, shifting from a reactive stance to a proactive,

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evidence-based model of public policy advocacy. The geospatial vulnerability structure identified by Wakhungu et al., when combined with water quality data from Delpla et al., allows for targeted interventions in areas affected by "infrastructure violence," requiring specific investments in water and sanitation infrastructure.

Similarly, understanding the population's water footprint (Silva, Marcelo Carlos de Oliveira et al., 2022) can guide changes in food policies that address inequality rather than penalize basic consumption. The rapid assessment enabled by endotoxin biomarkers (Good et al., 2024) enables immediate public health interventions in coastal areas, directly impacting user well-being. This holistic view, supported by concrete data from the 20 studies, allows social workers to advocate for policies that are not only equitable but also preventive, cost-effective, and sustainable. The social worker, therefore, acts as a central link, ensuring that the results of technical studies directly inform and shape public policies, addressing the root causes of water insecurity rather than just its symptoms.

5.3. Limitations of the Study

This review acknowledges certain inherent limitations. While expanding the scope to 20 articles from various disciplines significantly enhanced the depth of analysis, the heterogeneity of methodologies—ranging from molecular biology to social perception and policy analysis—precluded a quantitative meta-analysis of results. Consequently, the synthesis remains qualitative, focusing on thematic integration rather than statistical aggregation.

Furthermore, many highly technical studies (e.g., (Rodríguez-López et al., 2023; Silva, Thaís Tagliati Da et al., 2022; Wang et al., 2024; Zhang et al., 2020)) do not explicitly mention "Social Work" in their abstracts or keywords, necessitating an interpretative effort to bridge the gap between engineering findings and their social implications. This gap itself highlights the nascent stage of explicit interdisciplinary collaboration in the published literature. Finally, the selection criteria focusing on recent publications (last five years) and specific languages, though necessary for feasibility, might have inadvertently excluded older foundational works or relevant studies published in other languages.

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6. Conclusions

This study, supported by a systematic review of 20 articles using the PRISMA and PICO methodologies, successfully identified the strategic and indispensable role of Social Workers in analyzing and influencing public policies for the sustainable management of water resources through an integrated lens of sociodemographic, biological, and physicochemical markers.

The results decisively refute the outdated notion that Social Work in the water sector is limited to abstract environmental education or community organizing. On the contrary, the analysis forcefully demonstrates that the profession is essential for interpreting complex technical data and translating scientific evidence into concrete actions to defend human rights. The application of biological markers (such as indicators of fecal contamination) and physicochemical parameters (such as heavy metals and water quality indices) provide the necessary scientific basis to support claims and defend the rights of the most vulnerable populations.

We conclude that the effective integration of "hard" scientific technologies (e.g., Machine Learning, Remote Sensing, GIS mapping) with "social" technologies (e.g., Vulnerability Mapping, Participatory Governance, Rights-Based Approaches) is the most promising and robust path to achieving true water security and environmental justice. For the Social Worker, mastering the understanding and application of these diverse indicators is no longer an optional skill, but a fundamental requirement for ethical-political and technical-operational competence in contemporary water governance.

Future research should prioritize the development of standardized, interdisciplinary protocols that facilitate direct access to and use of environmental monitoring data by Social Workers in their daily practice, ensuring that no technical advance in water management leaves a community behind and that equity remains at the forefront of policy implementation.

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