Scientific Research Publishing

Journal of Environmental Protection, 2025, 16(6), 553-573
https://www.scirp.org/journal/jep
ISSN Online: 2152-2219
ISSN Print: 2152-2197

Public Participation and Water Governance: Trends, Challenges, and Prospects

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How to cite this paper: Song, C.D. and Wang, X.J. (2025) Public Participation and Water Governance: Trends, Challenges, and Prospects. *Journal of Environmental Protection*, **16**, 553-573.
https://doi.org/10.4236/jep.2025.166029

Received: April 18, 2025
Accepted: June 15, 2025
Published: June 18, 2025

Abstract

Public participation serves as a vital driving force in translating the institutional advantages of the River Chief System into governance effectiveness. To provide a scientific basis for public participation in water governance, this paper reviews, synthesizes, and expands upon existing research through a systematic literature review of six key themes: conceptual definitions, practical approaches, participation models, existing challenges, influencing factors, and improvement strategies, thereby mapping the research landscape in this field. The findings reveal that scholars have conducted extensive and systematic explorations on public participation in water governance, laying a robust research foundation. Future efforts should focus on further deepening and innovating this domain through a stronger integration of theory and practice.

Keywords

Public Participation in Water Governance, River Chief System, Systematic Literature Review

1. Introduction

Public participation has long been a focal issue in political science and public administration circles at home and abroad. At the normative level, it not only helps mitigate institutional biases and power imbalances, addressing the "dual failure" of both government and market mechanisms [1], but also fosters civic values and agency consciousness, enhances public trust in governance, and thereby sustains its legitimacy [2]. However, at the practical level, academic scholarship remains skeptical about the current state of public participation in governance. Previous studies have argued that public participation in China predominantly remains at the stage of "symbolic participation" or "limited participation" [3].

In China's water governance arena, the high-level political impetus from the central government to implement the River Chief System has unleashed substantial political momentum. Through vertical integration of bureaucratic functions, strategic reprioritization of governmental agendas, and accountability mechanisms that compel interagency collaboration, preliminary governance outcomes have been achieved. However, the River Chief System is essentially a responsibility contracting system. While it can effectively address the "tragedy of the commons" caused by "laissez-faire" during its implementation, this emergency institutional innovation not only confronts challenges such as "responsibility dilemmas" "capacity constraints" and "organizational logic dilemmas" in practice [4], but also embodies paradoxes between centralization and democracy, rule by man and rule of law, as well as uniformity and diversity [5]. Therefore, relying solely on the "single-core governance" of grassroots river chiefs is difficult to achieve long-term river management. The water governance predicament of "Government failure, market failure and social failure" still exists. The strong externality, public goods attribute, and regional nature of water environment collectively render its governance a wide-ranging social system engineering. To resolve grassroots water governance dilemmas, address the capacity gaps of the "single-core governance" model, and enhance the policy effect of the River Chief System, it is imperative to introduce third-party governance and elevate public participation [6].

Many countries around the world have accumulated practices and successful experience in environmental public governance. The U.S. Congress passed the Tennessee Valley Authority Act in 1933 and established the Tennessee Valley Authority to support public participation in river basin management. The Integrated Water Resources Management (IWRM) in Australia and the EU Water Framework Directive both involve public participation at the decision-making stage. Specifically, to increase the effectiveness and legitimacy of the decision-making process, the EU Water Framework Directive requires the public to participate in three forms: active involvement, consultation, and provision of information [7]. A comparative analysis of the cases of Germany, the United Kingdom, and Spain by Euler et al. shows that with an increase of public awareness it is desirable to increase the public's participation in river basin management [8]. Ananga et al. concluded based on a study of the water supply system in Kenya that the authorities in Africa and other impoverished areas should facilitate citizen or community participation as a feasible cost-saving strategy to promote and protect the sanitary quality of drinking water [9]. There have been a growing number of cases of civil society advocacy and participation that have significantly impacted the decision processes of environmental policies and projects.

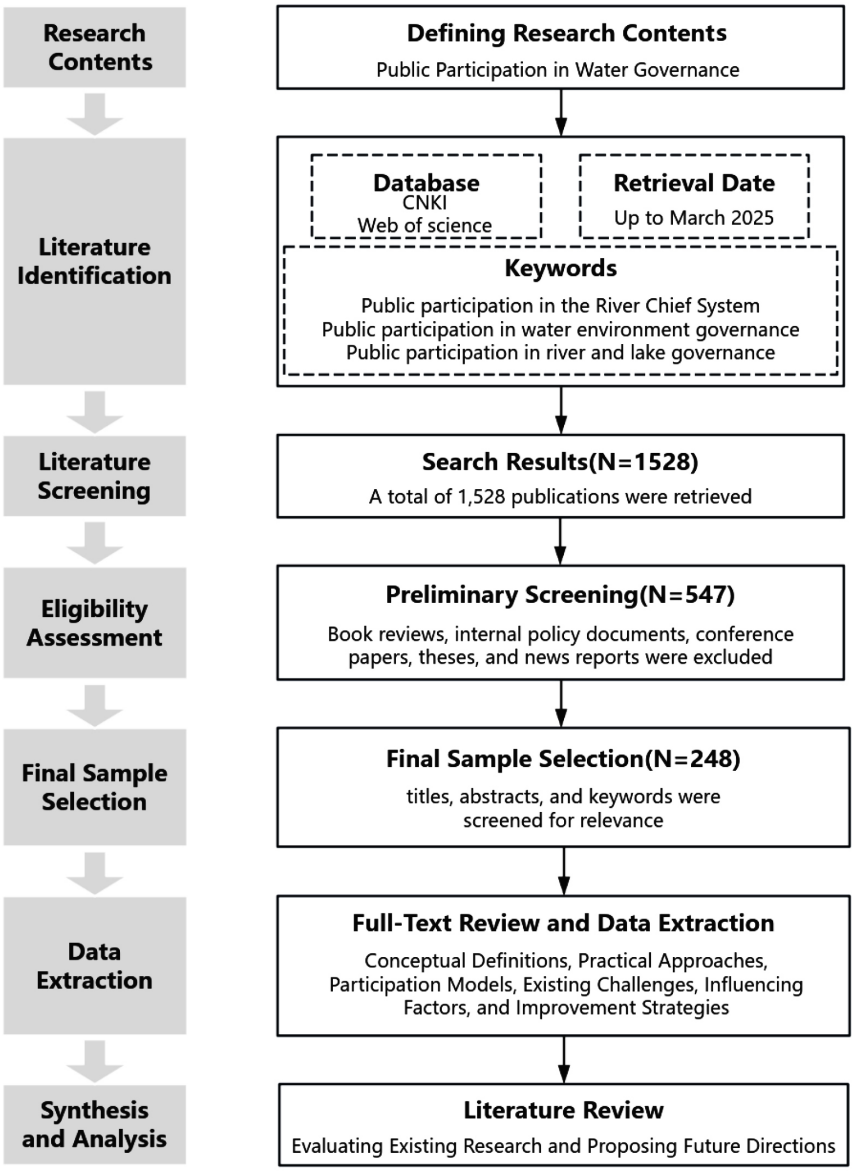
Information asymmetry, institutional deficiencies in participatory mechanisms, and the persistent influence of the public's "government dependency" mindset have collectively undermined the effectiveness of public participation in the River Chief System's implementation. To enhance public participation and achieve genuinely collaborative water governance, a systematic analysis of existing research in this

domain is imperative. In recent years, there has been a growing academic discussion on public participation in water governance within the Chinese context. However, existing studies remain isolated and fragmented, which hinders their practical application for practitioners and impedes academic research continuity. Against this background, this paper employs a systematic literature review method to synthesize existing research, aiming to identify key elements and integrate fragmented knowledge to establish a comprehensive and scientific understanding of the subject.

2. Research Design

2.1. Application of Systematic Literature Review

Scholars have conducted extensive research on public participation in water governance, revealing a relatively clear research trajectory. Therefore, this paper adopts a systematic literature review method to conduct an integrated analysis of the existing research results (as shown in **Figure 1**). The systematic literature review methodology, originally developed in the medical field, has increasingly been embraced by international social science research in recent years. This approach employs standardized procedures for literature screening and content synthesis through targeted techniques, engaging with existing studies via specific research questions. It not only provides an objective overview of current research but also addresses concrete issues and facilitates theoretical framework development [10]. Guided by the principles of systematic literature review, this study organizes the process into two stages: literature retrieval and literature screening. For the literature retrieval phase, the China National Knowledge Infrastructure (CNKI) and Web of Science databases were selected as primary data sources. Search terms such as "public participation in the River Chief System" "public participation in water governance" "public participation in water environment management" "public participation in watershed ecological governance" and "public participation in river-lake governance" were combined using the "OR" Boolean operator. The literature search, conducted up to March 2025, retrieved 1,528 publications. This meets the requirements of systematic literature review methodology regarding both the quantity of screened literature and the optimal timeframe for review. During the literature screening phase, three criteria were applied: first, only peer-reviewed journal articles were retained, excluding book reviews, internal policy documents, conference papers, theses, and news reports; second, theoretical or empirical studies were prioritized, with review articles excluded; third, each selected study needed to address at least one research question. Initial exclusions were conducted based on titles, abstracts, and keywords, followed by full-text evaluations for further refinement. Citation tracking was also employed to supplement potentially overlooked studies. Ultimately, 248 articles were identified as the core corpus for analysis.

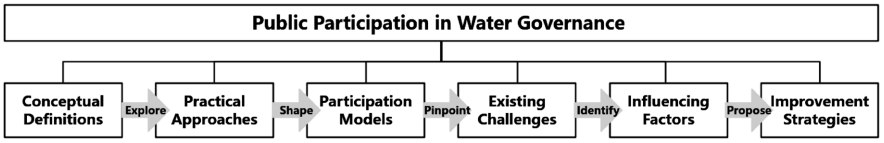


Source: The author made her own according to the methodology of systematic literature review and tailored to the specific research objectives.

Figure 1. Systematic literature analysis: Key operational steps.

2.2. Analytical Framework

As public participation in water governance has deepened, the scope of the topic continues to expand. On the temporal dimension, the proportion of research types varies across different stages of the issue's development. In terms of empirical methodologies, integrated qualitative and quantitative approaches have generated a series of studies from diverse perspectives. Based on a comprehensive review and analysis of existing research, this paper systematically synthesizes six key themes: conceptual definitions, practical approaches, participation models, existing challenges, influencing factors, and improvement strategies (as shown in Figure 2).



Source: The author made her own tailored to the specific research objectives.

Figure 2. Framework diagram for the systematic review of public participation in water governance.

3. Analysis of Research Themes in Public participation in Water Governance

3.1. Conceptual Definitions

Academic research on "public participation in water governance" has primarily focused on themes such as "public participation in watershed ecological governance" "public participation in the River Chief System" and "public participation in grassroots water governance". However, the field has not yet converged on a unified conceptual definition of "public participation in water governance" which can be understood through three dimensions: the participants, the scope of participation, and the behaviors of participation.

3.1.1. The Participants

Wang Ping (2019) and Meng Junliang (2019) argue that the term "public" in the context of the River Chief System generally refers to citizens, legal entities, and organizations outside the government and enterprises, including individuals, volunteer organizations, community groups, and news media, all of whom engage in River Chief System initiatives through diverse channels and methods [11]. Cui Caixian (2024) categorizes public participants in watershed ecological restoration into two groups based on their motivations: subjective participants with intrinsic willingness to express demands, and objective participants driven by instrumental interests. Through synthesizing these subjective and objective dimensions, they classify participants into five types: riparian residents, enterprises, NGOs, ordinary citizens, and media entities, each with distinct roles and demand [12]. Yang Ningxia (2021) and Huang Taozhen (2021) propose that the selection of participants in watershed water management should be guided by analyzing stakeholders' relationships to specific water governance issues. Key criteria include the scope of their influence, the groups they represent, and their capabilities, political, social, and environmental contexts [13]. Chen Liuyan (2021) selected farmers as representatives of the public. Farmers exhibit an inherent emotional connection to rivers, as their livelihoods and daily lives are closely tied to river conditions. The quality of river ecosystems directly impacts farmers' economic gains and living environments. As direct participants and beneficiaries of river environmental governance, farmers demonstrate research relevance due to their proximity to and dependence on these ecosystems [14].

3.1.2. The Scope of Participation

Ma Pengcheng (2020) emphasizes that the successful implementation of the River Chief System requires scientifically effective public participation and well-defined boundary frameworks. Only by clarifying subject boundaries, defining authority boundaries, and balancing pathway boundaries can sustained and effective public engagement be ensured [6]. Wu Chenhui (2020) states that the essence of public participation is that to prevent the abuse of power and rent-seeking behaviors of government agencies in the implementation of policies, relevant interest groups will negotiate with government departments in terms of resource utilization and distribution, as well as social welfare establishment and operation, and supervise and evaluate the implementation of the policy [15]. Chen Liuyan (2021) proposes that, under the full implementation of the River Chief System, the purpose of introducing public participation is to overcome the limitations of the original governance structure by integrating the public into the entire river governance process [14]. Wang Bo (2024) argues that recognizing the public's rights to environmental information, expression, participation, and supervision, along with establishing clear principles and institutional frameworks for public engagement, is essential to mobilizing their enthusiasm for participating in river-lake water environment governance [16]. Xu Mingqing (2024) and Zhu Yuchun (2024) highlight that the public serves as a critical stakeholder in water governance efforts, including protecting water resources, safeguarding river-lake shorelines, preventing and controlling basin water pollution, improving water environments, restoring aquatic ecosystems, and overseeing law enforcement activities related to rivers [17].

3.1.3. The Behaviors of Participation

Chen Liuyan (2021) categorized public participation behaviors into three types based on their governance roles: decision-making, conservation management, and supervision. Decision-making participation refers to the process in which farmers express opinions and suggestions regarding the institutional development and practical implementation of the River Chief System. Conservation management participation involves farmers in managing and maintaining the outcomes of the River Chief System. Supervisory participation is a concrete, oversight-oriented form of environmental engagement, where farmers monitor, report, and provide feedback on river conditions. These three forms may occur independently or coexist, reflecting both the granularity and unity of farmers' participatory behaviors [14]. Xu Mingqing (2024) and Zhu Yuchun (2024) classified water environment governance participation into four categories: self-initiated participation, decision-making participation, supervision participation, and formal complaints. Self-initiated participation involves farmers voluntarily participating in river pollution prevention and conservation efforts. Decision-making participation positions farmers as active contributors to river governance—acting as participants, experiencers, or even "Civil river chiefs"—to inform policy making under the River Chief System. This process integrates public proposals, evaluations,

and feedback to ensure effective decision-making and advance regulatory frameworks. Supervision participation entails monitoring pollution from industrial and agricultural activities, as well as overseeing government and non-profit organizations' river conservation efforts. Formal complaints occur when farmers follow institutional procedures to report pollution incidents or mismanagement to relevant authorities through official channels [17].

3.2. Practical Approaches

The traditional water governance model of "government emergency responses and passive societal observation" has become obsolete. A paradigmatic transition from "government-led governance" to "whole-of-society co-governance" has emerged as the dominant approach. In practice, continuous efforts are being made to explore effective approaches for integrating public participation. Academic research in this field has closely aligned with national institutional frameworks, expanding its analytical perspectives while demonstrating a dynamic interplay between theoretical exploration and practical implementation. Meanwhile, theoretical studies provide actionable insights and empirical evidence for advancing public participation and deciphering the "dynamic drivers" of governance innovation.

Feng Chao (2021) argues that the intrinsic logic driving active public participation lies in the political momentum inherently embedded within the River Chief System. The three dimensions of political momentum—"the presence of Party leadership" "constructing authority" and "leveraging momentum to accomplish tasks"—generate gravitational, propelling, and pulling forces through consensus-building, organizational resource integration, and multi-pronged government measures, thereby enhancing the breadth, depth, and effectiveness of public participation. Furthermore, he emphasizes that institutionalized supporting mechanisms, propelled by strong political potential energy, are critical to ensuring the sustainability of participatory governance practices [18].

To encourage collaborative participation from all sectors of society in river and lake conservation, some regions have innovatively introduced the Civil river chief system. Lei Minggui (2018) notes that the "Civil river chief system" as an important supplement to the River Chief System, serves as an effective mechanism for incorporating public participation into watershed governance. It channels extensive public participation demands into governance practices while fostering public enthusiasm [19]. Zeng Lu (2019) and Mao Chunmei (2019) highlight that Civil river chiefs, rooted in local communities, maintain close ties with the public. Leveraging their social connections and access to information, they are better positioned to precisely identify micro-level issues in watershed governance and public demands, while also holding inherent advantages in mobilizing public engagement in water governance efforts [20].

In the context of deepening digital government development, digital technologies provide local governments with innovative pathways to advance public participation in water governance. Ma Pengchao (2022) and Zhu Yuchun (2022) pro-

pose that digital technologies serve dual functions of public empowerment and governmental enabling. They offer the public open, interconnected, and real-time information access platforms; establish equitable, convenient, and efficient participatory channels; and diversify means for public expression and communication. This digital infrastructure opens a "window of opportunity" for enhancing the synergistic interplay between governmental governance and public participation, enabling citizens to more effectively engage in decision-making, conservation management, supervision, and complaint resolution within water environmental governance [21]. Yan Haina (2023) and Wu Yongzhao (2023) further articulate a "digital nudging" framework to systematically advance public involvement in water governance: During the government-led participation phase, implementing "digital science popularization" cultivates public awareness of participation; In the public-government collaboration phase, building "digital communities" addresses public's needs for structured engagement; In the proactive public participation phase, developing "intelligent crowdsourcing mechanisms" incentivizes behavioral shifts toward sustained environmental stewardship [22].

To prevent public participation from devolving into performative formalism and ensure sustained effective engagement, the establishment of robust incentive mechanisms is imperative. Xu Jiajun (2021) and Li Ping (2021) highlight the pioneering "Eco-Green Coin" incentive model in Deqing County, Zhejiang Province, as a groundbreaking approach that redefines public participation. This model integrates institutional incentives with technological innovations, forging a replicable pathway for community-driven river and lake conservation [23]. Hu Lin (2022) further analyzes Zhejiang Province's "Green Water Coin" initiative, arguing that such mechanisms disrupt the government's traditional monopolistic approach to water governance. By decentralizing stewardship responsibilities through gamified participation, the system sharpens the "governance nerve endings" [24].

3.3. Participation Models

Enhancing public engagement to achieve truly inclusive water governance, where citizens authentically experience a sense of involvement, fulfillment, and well-being, remains a critical challenge. The resolution hinges on establishing context-sensitive incentive-constraint mechanisms and cultivating locally adapted participation models that align with socio-ecological conditions. This necessitates systematic analysis of public participation models in water environmental governance. Academic inquiries into participation models primarily advance along two dimensions: Transplanting and adapting international practices, examining the localization of institutional innovations from global contexts; Indigenous theoretical development, constructing context-specific conceptual frameworks rooted in China's unique governance ecology.

3.3.1. International Experience

The mature paradigms of public participation in water environmental governance

from developed countries offer valuable theoretical references for China. Japan's Lake Biwa exemplifies a state-led governance model, which involves constructing a three-tier institutional framework of laws, regulations, and ordinances; establishing a governance committee to ensure transparency of information and restructuring of powers and responsibilities; and fostering cultural identity within the watershed. This approach achieves synergy among institutional rigor, technological integration, and community lifeworld practices [25]. The Mississippi River Basin in the United States employs a river basin alliance model, emphasizing unified watershed governance and multi-stakeholder collaboration. Legislative mandates institutionalize public participation principles, establishing a modern participatory environmental management paradigm [26]. France prioritizes ecological governance, basin autonomy, and public participation. The public participates in water environment governance through the basin autonomy model. Legislation lays the foundation for public participation, the basin governance organizational system reserves space for multi-stakeholder participation, and "public consultation" expands the scope of public participation [27]. The Murray-Darling River Basin in Australia has developed a collaborative governance model that coordinates stakeholders through the Ministerial Council and Community Advisory Committees. Utilizing a two-way communication mechanism and policy action documents as carriers, it maximizes the representation of the interests and demands of the government, communities, and the public [28].

3.3.2. Domestic Practice

Chinese scholars have advanced theoretical frameworks and governance pathways based on practical explorations. Ma Pengchao (2020) systematically analyzed and compared four participation models—village consultation panels, civil river chiefs, river-sustaining-river initiatives, and the Internet + River Chief System—revealing their variations in efficacy and applicability boundaries. He emphasized the necessity of adaptive governance approaches tailored to local conditions while avoiding rigid replication of models [6]. Wang Shuyi (2019) and Zhao Xiaojiao (2019) proposed a collaborative co-governance model through three analytical dimensions: multiplicity of stakeholders, clarity of governance targets, and multi-directional power dynamics. They identified bottlenecks hindering basin governance effectiveness, including boundary ambiguity and information asymmetry in governance targets, insufficient stakeholder diversity, and unidirectional power flows in decision-making [29]. Wang Yebing (2015) advocated the government-community-farmer tripartite interactive governance model as a proactive and feasible approach for public participation in water governance. Its operational efficacy depends critically on the effective functioning of rural communities [30]. Yan Haina (2019) conceptualized a technology-embedded collaborative governance model, demonstrating how digital platforms not only facilitate internal coordination in water management but also create opportunities for government-society interaction and public engagement [31].

3.4. Existing Challenges

The effectiveness of public participation in water governance remains limited, with a significant gap between normative ideals ("ought to be") and empirical realities ("what is"). Current practices fall short of theoretical aspirations and policy objectives for societal water governance, necessitating in-depth analysis of existing bottlenecks to inform future improvements. The challenges can be categorized into three dimensions: the indifference to subject consciousness, the wide range of interests, and the lack of long-term mechanisms.

3.4.1. Indifference to Subject Consciousness

Zheng Jiali (2020) highlights that public participation in environmental governance is often passive, constrained by a deeply ingrained "government-dependent mindset" with weak environmental responsibility awareness and a pervasive "free-rider mentality" undermining collective action [32]. Wu Chenhui (2020) further notes that grassroots engagement in water environment governance remains limited, aligning with the "degrees of tokenism" in Arnstein's ladder of participation, where most individuals remain in a passive state of receiving unidirectional information through leaflets, television, radio, and other propaganda channels. Additionally, the public's limited knowledge of river and lake governance hinders their intrinsic motivation to engage in watershed management [15]. Deng Hongbing (2021) pointed out that the general public holds low expectations for watershed ecological civilization governance. The reasons lie in four main aspects: first, they believe that restoring watershed ecosystems and environments requires prohibitively high costs that ordinary citizens cannot afford; second, they lack sufficient understanding of the technologies involved in ecological restoration and environmental protection, leading to skepticism about achieving desired outcomes; third, they perceive that the destruction of watershed ecosystems and environments is primarily caused by large, economically powerful, and well-organized enterprises, which are often protected and supported by local governments, making restoration efforts extremely challenging and costly; fourth, they consider that ecological restoration and environmental governance of watersheds may demand prolonged time and substantial effort, resulting in a lack of motivation among ordinary citizens to engage in related work [33]. Geng Yanhu (2022) argues that community residents do not lack public spirit, as local reputation and village public opinion can motivate their participation in community affairs. However, the issue lies in the widespread perception among residents that environmental governance is not a "community-owned responsibility". Under the government-led approach to environmental governance, residents naturally view such tasks as the sole responsibility of the government [34].

3.4.2. Wide Range of Interest

Geng Yanhu (2022) posits that interest alignment serves as a critical determinant of residents' engagement in environmental governance. Participation necessitates investments of time, effort, and financial resources, and when perceived costs out-

weigh potential benefits, residents often deem such involvement "uneconomical" [34]. Sun Meng (2022) theorizes a cost-benefit calculus in public participation: when the additional benefits gained from public participation are less than the costs, the public lacks the incentive to participate actively. It thus tends to choose the behavior strategy of non-participation. When the additional benefits of public participation are more significant than the costs, the public chooses the behavior strategy of active participation [35]. Chen Meiqi (2021) observes that public awareness of water environmental issues is diluted by the pressures of daily life and work routines, leading to a gradual desensitization where ecological crises become "invisible" through habitual neglect [36]. Liu Shaoting (2024) critiques the coercive enforcement mechanisms under China's River Chief System, where local governments impose stringent pollution control measures—such as bans, production limits, and facility closures—to meet environmental targets. These top-down interventions disrupt livelihoods in agriculture, aquaculture, and fisheries, exacerbating economic vulnerabilities for displaced farmers and fishermen, thereby fueling social discontent [37]. Liu Yazhou (2024) warns that centralization itself will easily deviate from the will of the public due to the interests of all parties. Once there is a lack of an absorption mechanism for public opinions, it is easy to cause the consequences of actions to be out of the way of the people [38]. Wu Chenhui (2020) analyzes structural flaws in China's policy dissemination framework: This top-down communication path has two obstacles to fully conveying information. First, governments at all levels will act as "information filters". After balancing their interests, governments will filter out information that is not good for them. Governments often re-form operational policies for work convenience on the one hand and for the pursuit of benefits on the other hand, which can not only deceive higher-level governments but also omit information. Second, when information lags, the public cannot receive it on time, which restricts the paths of participation [15].

3.4.3. Lack of Long-term Mechanisms

Wu Chenhui (2020) points out that the ways and levels of public participation in water environment governance vary widely across the country. Most regions can only satisfy the public's right to know and are limited to creating a superficial participatory atmosphere. Challenges persist in enabling meaningful engagement in decision-making and democratic supervision, compounded by the absence of transparent communication and feedback mechanisms for public reporting [15]. Hu Yu (2021) emphasizes that the closed nature of bureaucratic governance systematically excludes the public from environmental decision-making processes. Insufficient information disclosure raises participation costs, while institutional designs lack procedural safeguards for public engagement at both the source identification and process oversight stages [39]. Chen Tao (2021) pointed out the emergence of nominal "civil river chiefs" whose water governance actions lack sustainability and operational stability, serving more as symbolic gestures than functional mechanisms. He further highlights the enduring contradiction wherein

public participation remains theoretically emphasized, yet is insufficiently supported by institutional policies and demonstrates limited effectiveness in practice [40]. Liu Liu (2021) highlights that ambiguous accountability results in blank participation, incomplete legal frameworks foster disordered participation, and the lack of procedural safeguards confines the public to end-stage participation [41]. Wang Yifei (2023) stresses that water environment governance requires long-term mechanisms to sustain outcomes. However, most local governments have yet to institutionalize public participation, treating it as an ad hoc measure to achieve short-term policy goals rather than a sustained collaborative framework [42].

3.5. Influencing Factors

Why does the general public lack proactive engagement? What entrenched obstacles hinder the effectiveness of participation? Clarifying these scientific questions is crucial for enhancing the governance capacity of grassroots organizations and improving the performance of water environment governance. Public participation in environmental governance is shaped by the dual interplay of the "rational economic actor" logic and the "community-based social actor" logic, with decision-making influenced by both individual intrinsic factors and external contextual factors. Existing literature has conducted comprehensive and systematic studies from these two perspectives, offering robust explanatory frameworks that reveal the complexity of the system and the interconnectedness of multiple contributing elements. This elucidation addresses the critical question of why the public, as "vested stakeholders" exhibit limited proactive engagement.

3.5.1. Individual Intrinsic Factors

Internal drivers influencing public participation include value cognition, trust, psychological perception, social networks, place attachment, and cadre-community relations. Shen Jinyu (2021) examined the relationship between public cognition of aquatic ecosystems' ecological value and their willingness to engage in governance. Their study revealed that stronger recognition of ecological value enhances understanding of environmental governance imperatives, thereby increasing public participation willingness [43]. Zhao Jingjing (2023) delineated the mechanisms linking fairness perception, social trust, and public engagement in watershed ecological compensation. They advocated achieving multidimensional fairness to amplify perceived equity, while leveraging institutional and interpersonal trust as drivers of participatory behavior [44]. Wang Bo (2024) identified environmental rights consciousness and political trust as two key factors exerting significant positive effects on public engagement in water governance [16]. Shi Hengtong (2018) demonstrated that social networks positively influence participation in watershed ecological governance. Specifically, strong-tie networks facilitate environmental information diffusion and knowledge transfer through stable social resource channels, thereby incentivizing farmers' engagement. Weak-tie networks enhance participation probabilities by leveraging extensive social resources to strengthen communication and mobilization capacities [45]. Wang

Xueting (2020) found that reinforcing farmers' place attachment mitigates the negative impacts of collective action dilemmas and absence of governance actors on environmental participation, ultimately boosting willingness to participate [46]. Pan Zichun (2023) emphasized that cadre-farmer relations—an endogenous social capital for rural governance—enhance villagers' willingness to participate in local river-lake governance through three pathways: mobilization via demonstration, rule identification, and policy advocacy [47].

3.5.2. External Contextual Factors

Scholars have explored external determinants including institutional capacity, informal institutions, technological embeddedness, and exogenous incentives. Ma Pengchao (2021) conceptualizes institutional capacity as an enabling environment for rural commons governance, empirically verifying its significant impact on villagers' water governance decision-making through three dimensions: knowledge resources, relational resources, and mobilization capacity [48]. Yan Haina (2021) demonstrated that government responsiveness and environmental transparency significantly enhance public participation in water governance, highlighting institutional operational processes as primary drivers of civic engagement [49]. Zhu Yuchun (2021) posits that informal institutions—unconsciously formed and socially legitimized norms rooted in daily agrarian life—provide subconscious frameworks for behavioral choices. Specifically, value orientation, disciplinary norms, and socialization mechanisms within informal institutions significantly strengthen collective action in water governance [50]. Chen Lu (2022) proposed that policy outreach, as an external persuasion tool, fundamentally constitutes a process of spatial diffusion of environmental knowledge from specific regions or groups to others. Through this dissemination, the enhancement of residents' environmental cognition levels leads to more proactive environmental attitudes and behaviors, with heterogeneity in outreach effectiveness serving as the primary driver of variations in residents' willingness-to-pay and payment amounts for water environment governance [51]. Ma Pengchao (2022) argued that technological embeddedness provides the public with diversified participation channels, opening windows of opportunity for collaborative water governance engagement [21]. Zhu Xiaolin (2023) emphasized the inducement effects of exogenous incentives, which function as mobilization resources for village cadres to enhance collective cooperation levels, thereby critically shaping farmers' engagement in water governance [52].

3.6. Improvement Strategies

Public participation has long posed a significant challenge, yet remains crucial for the sustainable development of the River Chief System and the efficacy of water environment governance. Existing research integrates practical and problem-oriented approaches, proposing countermeasures from diverse perspectives that offer new pathways to address real-world dilemmas in public engagement.

3.6.1. Improve Public Participation Capability

To enhance public participation in water environment governance, the primary focus should be on improving the public's capacity for engagement. The effectiveness of public involvement in water environment governance is currently influenced by participants' abilities. This underscores the necessity of enhancing public capabilities to enable comprehensive, process-wide participation in water governance.

Chen Lu (2022) proposes developing differentiated public education programs tailored to distinct social groups. For high-income groups, efforts should focus on clarifying their roles in decision-making related to water governance, strengthening their policy awareness and sense of responsibility through multiple channels and perspectives, and leveraging their active participation in environmental initiatives. For groups with limited perception of water environment importance, strategies should include environmental education workshops and enhanced community-government interactions to raise ecological awareness [51]. Xu Ying (2023) emphasizes building a professional team capable of adopting innovative concepts and methods. Such professionals, equipped with diverse expertise, can provide specialized guidance to motivate public participation in rural water governance [53]. Wang Yifei (2023) highlights the need to elevate environmental literacy and stimulate engagement through multifaceted campaigns. These should disseminate foundational knowledge of water conservation, governance principles, and legal frameworks via community outreach, corporate partnerships, and school curricula. Integrating water governance content into educational programs and organizing competitions can cultivate water-saving and pollution-prevention awareness from childhood. Regular public lectures, media updates through TV, newspapers, and social platforms, and sharing local success stories are recommended to maintain public interest and transparency [42]. Gao Jintao (2020) advocates for stratified, targeted education aligned with demographic characteristics. For elderly and less-educated populations, family-based environmental education and culturally adapted communication methods should be prioritized. For younger generations, interactive online learning platforms, knowledge contests, and dynamic feedback mechanisms can optimize engagement. This approach ensures environmental policies and concepts achieve universal coverage and resonate across all societal segments [54].

3.6.2. Implement Public Participation in the Process

The implementation of the River Chief System relies too much on administrative power and is vulnerable to rent-seeking and corruption. River and lake governance cannot rely solely on the power system, and social forces cannot be ignored or underestimated. Beyond investigating and monitoring river governance outcomes, the public should actively engage in the formulation and execution of water environment governance decisions. At present, it is necessary to change the situation that the public participation process of water environment governance mainly focuses on terminal participation and passive participation, while avoiding

the formality.

(1) Decision-making: Wu Chenghui (2020) proposes that in the process of formulating the "One River, One Policy" work plan and various river and lake protection and governance plans, relevant departments should invite public representatives and stakeholders to participate in hearings, forums, and seminars to ensure collaborative public involvement in decision-making and implementation [15]. Liu Liu (2021) emphasizes that decision-making bodies such as the River Chief System Committee should incorporate social organizations, enterprise representatives, and citizens to enhance the diversity of decision-makers and the rationality of outcomes, thereby facilitating better public participation in watershed governance. Beyond selecting specific public representatives to join government RCS offices, more diversified public voices should be heard. Therefore, a public feedback mechanism should be established to ensure tangible responses to public input rather than leaving it unaddressed [41]. (2) Management and protection: Hu Yu (2021) highlights challenges of spontaneity and irrationality in public participation during the custodial phase. He advocated for Party leadership as a prerequisite, strengthened interdepartmental collaboration, implementation of the mass line, and guided orderly public involvement in custodial work. Legislation should clarify the public's right to express opinions and suggestions on environmental law enforcement, mobilizing and relying on public support to concentrate collective wisdom in environmental governance. Beyond volunteer river patrol and cleanup activities, specialized public training programs should be conducted, with regular updates on governance outcomes and recognition of "Top Ten River Guardians" to boost engagement [39]. (3) Supervision: Chen Zihan (2021) proposes a dual supervision model. For administrative oversight, public monitoring should influence RCS performance evaluations. This requires establishing universal river environmental standards to improve public awareness, incorporating public satisfaction surveys into RCS assessment criteria, and introducing incentive-based supervision mechanisms such as anonymous reporting funds to overcome public apathy. For judicial oversight, the linkage between environmental administrative public interest litigation and public participation should be enhanced, integrating RCS into supervisory frameworks [55]. Wu Chenghui (2020) further suggests strengthening supervision channels like RCS bulletin boards and WeChat official accounts, while expanding media exposure through regional webpages, forums, radio, television, and newspapers to amplify the role of mass media in shaping public opinion for RCS development [15].

3.6.3. Build a Long-term Public Participation Mechanism

The higher the public's satisfaction with the disclosure of water environment information, the stronger the public's willingness to participate. However, it is far from enough to provide supervision channels. What is more important is to establish a feedback mechanism to ensure that every complaint can receive an effective response from the competent authority. In addition, strengthening the incentives and feedback for public participation can ensure long-term public participa-

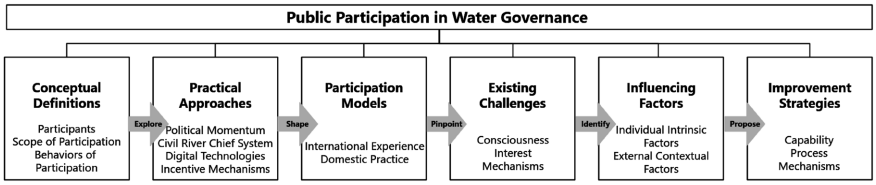
tion enthusiasm. To fully express the real interests of the public, promote the improvement of the overall governance level of the society, and ensure the effectiveness of the River Chief System, there is an urgent need to build a long-term public participation mechanism.

(1) Improve the water environment information disclosure mechanism. Environment information disclosure is a prerequisite for effective public participation. Wang Yifei (2023) proposes three core measures to enhance environmental transparency: First, clarify institutional responsibilities by legally defining the scope of information disclosure for relevant departments and ensuring strict enforcement. Second, expand the depth of disclosure beyond superficial metrics like water quality to include pollution sources, governance objectives, budgets, implementation timelines, and detailed records of corporate violations and corrective actions. Third, modernize communication by integrating traditional channels such as government gazettes and press conferences with digital tools like WeChat and Weibo, supplemented by expert explanations for technical content, to ensure accessible and timely public access to environmental information [42]. (2) Improve the public interest litigation mechanism and feedback mechanism. It is necessary to promptly investigate and deal with violations of the water environment reported by the public and provide timely feedback on the public's relevant opinions on river and lake governance. Wu Lihua (2020) proposes that in many environmental mass incidents, the lack of participation channels and the government's ignorance or even suppression of public appeals have led to poor results, including long-term and irreversible damage to the credibility of the government. The government should actively respond to the public's environmental demands; establish effective communication channels; handle petition letters, visits and telephone calls from the public in an efficient manner; and respect the public's principal position. Whether through the development of an environmental information disclosure system, environmental hearing system or environmental emergency system, there is still much room for improvement [56]. (3) Improve the public participation incentive mechanism. The essence of the incentive mechanism operation mode is profit-driven so that participants can not only obtain certain economic benefits but also enjoy the ecological benefits brought by the treatment of river and lake environments. Wang Yifei (2023) emphasizes that effective incentive mechanisms can promote public engagement by stimulating enthusiasm and sharing participation costs. A well-designed system should integrate both spiritual and material incentives while establishing scientific standards tailored to local water quality characteristics through consultation with experts, practitioners, and citizen representatives. Diverse approaches are necessary for different stakeholders: material rewards and honorary titles for community residents, tax reductions and policy support for enterprises, and financial subsidies for social organizations [42]. Xu Jiajun (2021) highlights the need for targeted incentive strategies based on varying public motivations and capabilities. For those lacking both willingness and capacity, material rewards and role model guidance can cultivate participa-

tion habits. Willing but incapable individuals benefit from training programs with performance-based rewards, while capable yet unwilling participants require inducements through material, emotional, or social incentives. Highly motivated and competent individuals should be empowered through institutional channels to leverage their leadership potential [23].

4. Conclusion

Building on the preceding analysis, the review framework has been refined (as shown in Figure 3). The conceptualization of public participation in water governance encompasses three fundamental dimensions: the participants, the scope of participation, and the behaviors of participation. Practical explorations have developed approaches for public participation, such as political momentum, civil river chief system, digital technologies, and incentive mechanisms, while leveraging international experiences to construct context-specific participatory models in China. However, the actual effectiveness still falls short of the theoretical imagination and policy expectations of societal water governance, which manifests in three key challenges: the indifference to subject consciousness, the wide range of interest, and the lack of long-term mechanisms. Further analysis of influencing factors highlights the dual interplay of individual intrinsic drivers and external contextual conditions. Scholars have proposed improvement strategies integrating practical feasibility and problem-solving orientations across multiple analytical lenses. Collectively, systematic investigations into these six dimensions—conceptual definitions, practical approaches, participation models, existing challenges, influencing factors, and improvement strategies—have established a robust scholarly foundation for advancing participatory water governance research.



Source: The author made her own tailored to the specific research objectives.

Figure 3. Research landscape of public participation in water governance.

5. Prospects

Water environment governance constitutes a long-term and complex systemic endeavor. Regardless of how governance practices and innovations evolve, public participation remains an indispensable imperative. Within the participatory governance framework, two critical questions demand resolution: defining the developmental trajectory of watershed governance and identifying adaptive pathways for the River Chief System. Numerous issues regarding the innovation and advancement of public participation in water governance warrant further exploration. The foremost priority lies in institutionalizing and operationalizing public

participation to achieve sustainable governance outcomes. Simultaneously, the tension between the dynamic complexity of water governance and the lagging theoretical frameworks necessitates innovative, forward-thinking theories and approaches to bridge this gap.

Funding

Shandong Provincial Youth Innovation Team Development Program for Higher Education Institutions (20211212); Shandong Province Postgraduate Education and Teaching Reform Project (SDYJSJGC2024045); 2024 Shandong Agricultural University Postgraduate Teaching Reform Project (2024JG006).

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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