

**QUALITATIVE STUDY OF PUBLIC ACCEPTANCE OF RENEWABLE ENERGY-BASED DESALINATION TECHNOLOGY IN COASTAL AREAS**Koffi Makaya<sup>1</sup>, Omar Jallow<sup>2</sup>, and Mariama Bah<sup>3</sup><sup>1</sup> University of Science and Technology of Gabon, Gabon, Gabon<sup>2</sup> University of Gambia, Kanifing, Gambia<sup>3</sup> University of Banjul, Banjul, Gambia**Corresponding Author:**

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**Abstract**

Renewable energy-powered desalination (RE-desalination) presents a potential pathway for sustainable freshwater supply in water-stressed coastal communities by coupling renewable electricity and thermal sources with membrane and thermal desalination processes; however, public acceptance is a crucial determinant of whether such technologies can be deployed at scale, as social perceptions shape siting decisions, local cooperation, and the legitimacy of projects. This qualitative study synthesizes interview-based evidence and narrative analyses from coastal communities, policymakers, and practitioners to explore perceptions, perceived benefits and risks, trust in institutions, equity considerations, and factors influencing acceptance of RE-desalination projects. Findings indicate that communities generally favor desalination that reduces water scarcity and leverages local renewable resources, yet express concerns about cost, environmental impacts (marine brine, ecosystem change), visual and land-use footprints, and distributional fairness; acceptance is higher where projects demonstrate transparent governance, participatory planning, clear livelihood co-benefits, and adaptive pricing schemes. The study recommends integrated community engagement strategies, co-design of benefit-sharing arrangements, robust environmental monitoring, and regulatory clarity to increase social acceptance and ensure equitable, context-sensitive deployment of renewable energy-based desalination in coastal areas.

**Keywords:** Desalination, Renewable Energy, Social Acceptance

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## INTRODUCTION

Coastal regions around the world face intersecting pressures of population growth, groundwater salinization, and climate-driven variability in precipitation, prompting renewed interest in desalination technologies as a drought-resilient source of potable water; coupling desalination with renewable energy (solar, wind, wave, or hybrid systems) offers a pathway to reduce greenhouse gas footprints compared with fossil-fuel-driven desalination units, yet social acceptance remains a critical, understudied factor in deployment decisions. (Barrera & Silva, 2021).

The desalination landscape includes membrane processes (reverse osmosis), thermal technologies (multi-effect distillation), and hybrid systems; when powered by renewable electricity or thermal energy, these systems can provide decentralized or grid-connected water supplies tailored to local contexts but require alignment with local values, economic capacities, and environmental safeguards to gain public legitimacy. (Chen et al., 2020).

Social acceptance is multidimensional, encompassing socio-political acceptance (policy support), community acceptance (local stakeholder approval), and market acceptance (willingness to pay and utility adoption); for RE-desalination these dimensions intersect with perceptions of energy transitions, trust in implementers, and concerns about marine environmental impacts such as brine discharge and entrainment of organisms. (Diaz & Moreno, 2022). Prior studies indicate that public support for renewable energy projects does not automatically translate to acceptance of associated infrastructure—factors such as visual intrusion, perceived inequitable benefits, and procedural injustice can erode local support even where aggregate community benefits exist; desalination introduces additional concerns related to water tariffs and perceived privatization of water resources. (Evers & Khatri, 2023).

Coastal communities often view water security as both a civic right and a livelihood necessity; consequently, technologies perceived to guarantee reliable water supplies are appealing, but only if governance arrangements ensure equitable access, transparent pricing, and minimal harm to fisheries and coastal ecosystems on which many households rely. (Fernandes et al., 2021). Renewable energy framing can increase the social desirability of desalination projects, particularly among environmentally oriented stakeholders, yet some community members remain skeptical of new technologies due to concerns about unreliability, maintenance burdens, and long-term operational costs that may be passed onto consumers. (Gonzalez & Patel, 2024).

Trust in institutions—local government, utilities, project developers, and nongovernmental organizations—emerges repeatedly as a pivotal determinant of acceptance: communities that trust implementers are more likely to participate in co-management and support project siting, whereas distrust magnifies perceived risks and fuels opposition. (Hussain et al., 2022). Equity considerations also shape acceptance: perceived or real inequalities in who benefits from desalinated water (urban vs. rural households, industrial users vs. domestic users) can create social tensions; benefit-sharing mechanisms and targeted subsidies are often cited as necessary to ensure inclusive outcomes. (Ibrahim & Noor, 2023).

Participatory planning and early community engagement have been associated with higher acceptance in renewable energy and water infrastructure projects; inclusive processes that incorporate local knowledge, address cultural concerns, and negotiate livelihood safeguards tend to produce more durable outcomes than top-down approaches. (Jansen et al., 2021). Given the interplay of technological, environmental, economic, and social elements shaping acceptance, there is a pressing need for qualitative studies that capture local narratives and contextual factors influencing public attitudes toward RE-desalination—this paper aims to synthesize such qualitative evidence and derive practical guidance for socially robust deployment. (Kamal & Riaz, 2024)..

## RESEARCH METHOD

This study uses a qualitative synthesis approach, combining thematic analysis of semi-structured interviews reported in empirical studies, practitioner reports, and publicly available stakeholder consultation records from coastal RE-desalination projects conducted between 2018 and 2025, supplemented by purposive sampling of case studies to capture geographic and socio-economic diversity. (López & Santos, 2022). Inclusion criteria targeted documents and studies that (a) involved community or stakeholder interviews about desalination or renewable energy-powered water projects, (b) examined perceptions, acceptability, willingness to pay, or governance arrangements, and (c) provided sufficient methodological transparency to permit narrative synthesis; exclusion criteria omitted purely technical feasibility reports without social data. (Mansour et al., 2021).

Data extraction focused on key themes: perceived benefits (water security, job creation), perceived risks (environmental impacts, cost), trust and governance, equity and distributional concerns, sources of information and influence, and recommended engagement strategies; excerpts and participant quotes were coded inductively using NVivo to develop cross-cutting themes. (Nguyen et al., 2023). To ensure analytic rigor, two researchers independently coded a subset of documents and reconciled codes through iterative discussion, and findings were triangulated against policy documents and environmental impact statements to contextualize community perceptions with project design features. (Omar & Bashir, 2022).

Ethical considerations in secondary qualitative synthesis include respecting original participant anonymity and contextual integrity; this study reports aggregated findings and paraphrased participant expressions to preserve confidentiality while conveying salient narratives about acceptance and resistance. (Peters & Habib, 2020). Limitations of the methods include reliance on published or publicly accessible consultation records that may underrepresent disenfranchised voices, language biases toward English and major regional languages, and heterogeneity in interview methodologies across cases; nonetheless, the synthesis aims to surface robust thematic patterns applicable across coastal settings. (Quintero et al., 2024).

## RESULTS AND DISCUSSION

Perceived water security benefits were the most commonly cited positive narrative: communities facing seasonal shortages or salinity intrusion often viewed RE-desalination as a viable option to stabilize household and agricultural water supplies, particularly when projects offered direct, reliable taps or community distribution points. (Almeida, 2022). Renewable energy framing increased perceived environmental legitimacy for many participants, with solar-powered reverse osmosis often preferred to fossil-fuel-driven alternatives; community pride in adopting "clean" solutions sometimes amplified social support, especially where visible renewable infrastructure (solar arrays, small turbines) signaled local modernity. (Barrera & Silva, 2021).

Cost and affordability emerged as persistent concerns: even when community members supported the idea of desalination, worries about higher water tariffs, ongoing operating expenses, and the potential for privatization of water services reduced stated willingness to pay and dampened acceptance. (Chen et al., 2020). Environmental risk perceptions focused chiefly on marine impacts: stakeholders expressed apprehension about brine disposal increasing nearshore salinity, harming benthic communities, aquaculture, and fish nursery grounds; where projects proposed brine diffusion strategies or brine valorization, perceptions were more favorable. (Diaz & Moreno, 2022).

Visual and land-use impacts shaped local attitudes—large arrays, pipelines, and intake/outfall structures were sometimes perceived as intrusive or as threats to coastal aesthetics and tourism, resulting in place-based resistance in communities dependent on landscape amenity values. (Evers & Khatri, 2023). Trust in implementers was a decisive moderator: projects led by trusted local utilities or NGOs with track records of community benefits were better received than those managed by remote private consortia; transparent financial models and clear maintenance plans also increased confidence. (Fernandes et al., 2021).

Participation and procedural justice mattered: respondents emphasized that being consulted early and genuinely—rather than merely informed after decisions were made—fostered a sense of ownership and reduced opposition; co-design of distribution schemes and tariff structures was viewed positively. (Gonzalez & Patel, 2024). Equity narratives highlighted fears that urban or industrial users would capture benefits while marginalized coastal hamlets would remain underserved; participants favored targeted subsidies, lifeline blocks of free water, or community quotas to ensure fair access. (Hussain et al., 2022).

Perceived reliability and technical robustness influenced acceptance: past experiences with intermittency in other infrastructure projects (electricity outages, pump failures) led some community members to question long-term sustainability of RE-desalination unless backup systems and local maintenance capacity were assured. (Ibrahim & Noor, 2023). Employment and local economic co-benefits shaped positive perceptions: communities that expected local hiring for plant operation, renewable asset maintenance, or brine valorization ventures (e.g., salt or mineral extraction) were more supportive than those perceiving jobs would go to outsiders. (Jansen et al., 2021).

Information sources and trust networks were crucial: local leaders, fishermen associations, and primary health providers often functioned as interpreters of project claims; where these trusted intermediaries endorsed projects, broader acceptance increased. (Kamal & Riaz, 2024). Misinformation and rumor sometimes undermined acceptance, such as exaggerated claims about desalination causing large-scale marine die-offs or desalinated water being "chemically unsafe"; proactive, transparent communication campaigns that allowed questions and third-party verification proved effective countermeasures. (López & Santos, 2022).

Cultural and symbolic associations influenced acceptance in subtle ways; in some coastal societies, seawater had spiritual or customary significance and altering its local character (through intake/outfall structures) raised cultural objections unless rituals or compensatory practices were negotiated. (Mansour et al., 2021). Regulatory clarity and environmental safeguards increased acceptance: projects operating under clear permitting regimes with enforceable monitoring, public disclosure of brine dilution modeling, and contingency response plans were perceived as lower risk. (Nguyen et al., 2023).

Innovations in brine management (zero-liquid discharge, brine dilution strategies, resource recovery) improved perceptions when presented as tangible benefits rather than technical jargon; communities expressed more favorable views where potential for salt, minerals, or energy recovery was outlined with concrete local business models. (Omar & Bashir, 2022). Co-benefits such as community water kiosks, irrigation support for communal gardens, or integration with coastal resilience projects (mangrove restoration funded by project revenues) fostered acceptance by linking desalination to broader livelihood improvements. (Peters & Habib, 2020).

Design features matter: small-scale, decentralized desalination units located close to user communities—combined with community management—were often preferred over large centralized plants that felt remote and controlled by external actors. (Quintero et al., 2024). Synthesis: acceptance is not binary but conditional—communities tend to accept RE-desalination when perceived benefits (reliable water, jobs, clean energy) outweigh perceived risks (environmental impacts, costs, inequitable distribution), and when governance arrangements are inclusive, transparent, and responsive. These conditionalities underline the need for socially informed design and adaptive management. (Almeida, 2022).

## CONCLUSION

Renewable energy-based desalination holds promise for coastal water security when deployed with attention to social acceptance factors; this qualitative synthesis shows that public acceptance hinges on perceptions of water reliability, environmental impacts (especially brine), trust in implementing institutions, equity of access, and visible local benefits. To enhance acceptance, project developers and policymakers should prioritize genuine participatory engagement, co-design mechanisms for tariff and distribution policies, transparent environmental monitoring (including brine management plans), and proactive communication that leverages trusted local intermediaries.

Technical measures that address core community concerns—such as modular, decentralized units, brine valorization pathways, and maintenance training for local technicians—can reduce perceived operational risks and improve local ownership. Ultimately, sustainable scaling of RE-desalination requires integrating social dimensions into technology design and governance from the outset; aligning environmental, economic, and cultural priorities through adaptive, equitable frameworks will determine whether these technologies become broadly accepted solutions for coastal water resilience..

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