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# A SYSTEMATIC LITERATURE REVIEW OF COMMUNITY RESILIENCE AND ADAPTATION TOWARDS SUSTAINABLE WATER SECURITY

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## ABSTRACT

This systematic review examines the key factors driving community resilience and adaptation within the framework of sustainable water security, with a specific focus on both urban and rural environments. Utilizing the PRISMA guidelines, a thorough search of multiple databases identified 15 relevant studies published between 2011 and 2021, a period selected to capture recent trends while maintaining analytical depth. The analysis revealed six critical themes: awareness, water conservation, education, pricing mechanisms, social movements, and the value of water. The study uniquely contributes by emphasizing the necessity of integrating indigenous knowledge and advancing tailored solutions to enhance water security. The findings suggest significant implications for future research, particularly in developing long-term strategies and assessing the efficacy of current approaches.

***Keywords:*** *PRISMA, Systematic Review, Community Resilience, Water Security, Sustainable Adaptation, Water Conservation, Social Movements, Indigenous Perspectives, Pricing Mechanisms*

## INTRODUCTION

Water security, crucial for human well-being and sustainable development, faces formidable global challenges amidst escalating water scarcity and rapid population growth. This concern remains urgent, as recent assessments emphasize how climate variability, urbanization, and socio-political inequality continue to exacerbate community-level vulnerabilities (Heidari et al., 2021; Dopico et al., 2022). According to the United Nations, an alarming 2.2 billion people worldwide lack access to safe drinking water (United Nations, 2019), highlighting the urgency of addressing this pressing issue. Sustainable water security necessitates the long-term resilience of water systems to meet current needs while safeguarding resources for future generations. This entails the efficient utilization, conservation, and equitable distribution of water resources.

The impact of population growth on water-related concerns cannot be overstated (Cosgrove & Loucks, 2015). Both rural and urban areas grapple with distinct yet interconnected challenges. In rural communities, limited water access impedes household water provisioning, particularly in low-resource regions of developing nations (Dave & Sundarraj, 2018; Everard *et al.*, 2019). The scarcity of resources for constructing water sources exacerbates challenges, impacting agricultural-dependent areas reliant on ample water supply.

Conversely, urban areas face their own set of water security challenges, including drought, flooding, and water quality degradation (Hoekstra, Buurman & van Ginkel, 2018). High population density and valuable assets make urban centres particularly vulnerable, with inadequate water infrastructure exacerbating shortages and pollution issues (Cook & Bakker, 2012). Even in developed urban areas, persistent challenges persist, hindering environmental development and sustainability efforts (Elmqvist *et al.*, 2019).

Community resilience emerges as a critical factor in managing water-related disasters in both urban and rural settings. Beyond emergency response, resilient communities are characterized by effective collaboration and operation under stress, crucial for ensuring well-being and sustainability (Koontanakulvong, Doungmanee & Hoisungwan, 2014).

Sustainable water security and community resilience are deeply intertwined concepts essential for the prosperity of communities (Varady *et al.*, 2020). While water security addresses the availability, accessibility, and quality of water resources, resilient communities collaborate and operate critical systems under stress (Mishra, Kumar, Sarawat, Chakraborty & Gautam, 2021). Municipalities and urban planners embrace disaster resilience strategies, aiming to mitigate the impact of natural disasters through flood-resistant initiatives and infrastructure protection (Arbon, Gebbie, Cusack, Perera & Verdonie, 2012).

Understanding and assessing community resilience necessitates recognizing the interconnectedness and relationships between governance levels and diverse systems impacting communities (Cavaye & Ross, 2022). Despite water security concerns transcending boundaries, local communities often receive limited attention in resilience planning, leading to challenges stemming from conflicting objectives, social power disparities, and longstanding disputes within neighbouring communities (Grimm, 2014).

This review aims to synthesize current research on community resilience and adaptation strategies for sustainable water security, with a focus on both traditional knowledge systems and modern approaches. By highlighting successful examples of resilience in action, this paper seeks to guide future research and policymaking.

## MATERIALS AND METHODS

This section will elucidate the methodology employed for retrieving literature on community resilience and adaptation towards sustainable water security. The systematic literature review was conducted using the PRISMA (Preferred Reporting Items for

Systematic Reviews and Meta-Analysis) framework, encompassing resources, eligibility and exclusion criteria, a systematic review process, and data abstraction and analysis.

**PRISMA**

The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) comprises a set of evidence-based guidelines designed to assist authors in precisely and reliably reporting on a broad spectrum of systematic reviews and meta-analyses. PRISMA serves as an indispensable tool for summarizing evidence (Page *et al.*, 2021). A diverse array of journals currently utilizes it as a pre-submission checklist and is equally applicable for reviews in the fields of conservation and environmental management (Haddaway, Macura, Whaley & Pullin, 2018).

**Information Sources and Search**

Literature for this study was primarily sourced from electronic journal databases, including ScienceDirect and Web of Science. Web of Science by Clarivate Analytics comprehensively indexes 5,900 significant journals spanning 150 scientific disciplines. The Science Citation Index Expanded within Web of Science offers access both current and historical data from 1900 on a global scale. Simultaneously, ScienceDirect, provided by Elsevier, covers encompassing a wide range of subjects, including health sciences, physical sciences, social sciences, and life sciences. All these databases offer an Advanced Search tool, enabling users to refine their search results. As the search query, Boolean strings were used with the keywords TITLE-ABS-KEY (community resilience) AND TITLE-ABS-KEY (Adapt*) AND TITLE-ABS-KEY (sustainable water security). The utilization of Boolean operators streamlines the search process, directing researchers toward more pertinent results while eliminating irrelevant materials, thus saving time and enhancing search precision.

**Eligibility and exclusion criteria**

When conducting the database search, it is essential to adhere to specific eligibility and exclusion criteria. For this study, various criteria, as outlined in Table 1, must be considered. On the one hand, the study encompasses specific criteria, including the type of literature, countries, language, timeline, and study type. Only research journal articles that utilize empirical data are considered because research journal articles with empirical data are more likely to present current and original findings derived from direct observation or experimentation. This focus supports staying abreast of the latest developments in a field. While literature types such as books, book chapters, book series, review articles, and conference proceedings are excluded. Language-wise, only articles in English and Malay are referenced. The ten-year timeframe (2011–2021) was selected to ensure the inclusion of substantial and influential empirical studies on water security, reflecting developments over a critical period marked by growing global water concerns and strategic adaptation responses. This temporal boundary aligns with PRISMA protocol and maintains manageability within the review scope. Geographically, there are no exclusions, as the study encompasses a literature review spanning worldwide regions. Given the focus on community resilience and adaptation towards sustainable water security, all types of studies related to this topic are included in the search.

**Table 1:** The inclusion and exclusion criteria

| Criterion | Eligibility | Exclusion |
|---|---|---|
| Literature type | Research article journal (Empirical data) | Review article journals, books, book chapters, book series, and conference proceedings. |
| Language | English and Malay | Other than the English and Malay language |
| Timeline | Between 2011-2021 | < 2011 |
| Countries and region | All | None |

**Systematic review procedure**

The systematic procedure comprises four phases, as depicted in Figure 1. In the initial phase, several keywords pertinent to the study were identified. To acquire synonyms and precise keywords related to the study, such as community resilience, adaptation, sustainability, and water security (as detailed in Table 2), an exploration of previously relevant articles from electronic databases such as Web of Science, and Science Direct was conducted. This phase yielded a total of 28,243 publications, comprising 22,530, and 5,677 articles from Web of Science and Science Direct, respectively.

The subsequent phase involves screening the publications, during which duplicates, non-English articles and irrelevant articles were removed. Out of the total articles reviewed, 28,194 were eliminated, leaving 49 articles for further evaluation in the eligibility phase. In this phase, articles that did not primarily focus on 'community resilience and adaptation towards sustainable water security' were excluded. It resulted in the exclusion of 34 articles, leaving 15 articles for the final stage, which involves qualitative analysis.

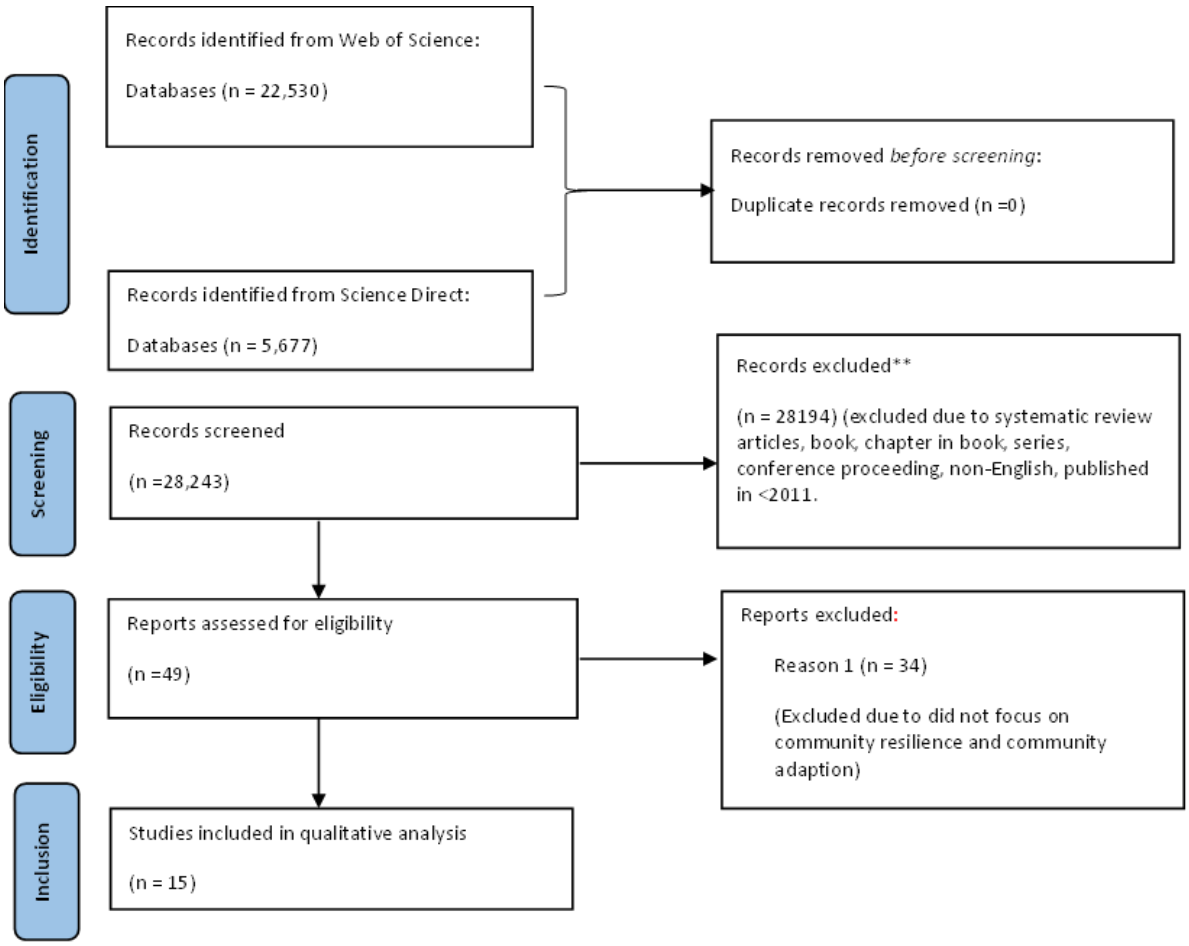


**Figure 1:** Articles Selection using PRISMA

**Table 2:** Keywords Used for Database Searches

| Databases | Keywords |
|---|---|
| Web of Science | TS = (Community AND Resilience OR Adaptation AND Sustainable AND "Water Security") |
| Science Direct | (Community AND Resilience AND Adaptation AND Sustainable AND "Water Security") |

**Data abstraction and analysis**

A total of 15 articles underwent evaluation and qualitative analysis. The focus was on selected studies that addressed the formulated questions. To extract data regarding relevant themes, a thorough review of the abstract and full text of these selected articles was conducted. Content analysis was employed to identify themes related to community resilience and adaptation towards sustainable water security. Coding categories were devised, structured around the theme established by the typology.

**RESULTS**

The systematic review identified six major themes awareness, water conservation, education, pricing mechanisms, community social movements, and the value of water that are central to understanding community resilience and adaptation in the context of

sustainable water security. Each theme directly addresses the research questions, offering deep insights into how communities navigate and manage water security challenges across different environments. Among these, three studies centred on awareness (Roth *et al.*, 2019; Allan *et al.*, 2021; Lai *et al.*, 2017), while nine delved into water conservation (Sen & Kansal, 2019; Leong, 2016; Varady *et al.*, 2020; Gerlak *et al.*, 2018; Shrestha *et al.*, 2018; Assayed *et al.*, 2013; Tauhid Ur Rahman *et al.*, 2017; Meissner *et al.*, 2018; Herawati *et al*, 2021). Seven studies addressed education (Allan *et al.*, 2021; Lai *et al.*, 2017; Ching Leong, 2016; Varady *et al.*, 2020; Gerlak *et al.*, 2018; Meissner *et al.*, 2018; Herawati *et al.*, 2021), four explored pricing mechanisms (Pinto *et al.*, 2018; Ching Leong, 2016; Gerlak *et al.*, 2018; Hinojosa *et al.*, 2017), two investigated community social movements (Varady *et al.*, 2020; Shrestha *et al.*, 2018), and an additional two examined the value of water (Sen & Kansal, 2019; Awume *et al.*, 2020) (Table 3).

**Table 3:** Themes identified from the systematic review

| ID | Author | Themes | | | | | |
|---|---|---|---|---|---|---|---|
| | | Awareness | Water conservation | Education | Pricing mechanism | Community social movement | Value on water |
| 1. | Roth *et al.* (2019) | ✓ | | | | | |
| 2. | Sen & Kansal (2019) | | ✓ | | | | ✓ |
| 3. | Allan, Kenway & Head (2021) | ✓ | | ✓ | | | |
| 4. | Lai, Chan & Roy (2017) | ✓ | | ✓ | | | |
| 5. | Pinto, Tchadie, Neto & Khan (2018) | | | | ✓ | | |
| 6. | Leong (2016) | | ✓ | ✓ | ✓ | | |
| 7. | Varady *et al.* (2020) | | ✓ | ✓ | | ✓ | |
| 8. | Gerlak *et al.* (2018) | | | ✓ | ✓ | | |
| 9. | Shrestha *et al.* (2018) | | ✓ | | | ✓ | |
| 10. | Assayed *et al.* (2013) | | ✓ | | | | |
| 11. | Tauhid Ur Rahman *et al.* (2017) | | ✓ | | | | |
| 12. | Hinojosa, Villegas & Muñoz (2017) | | ✓ | | ✓ | | |
| 13. | Meissner *et al.* (2018) | | ✓ | ✓ | | | |
| 14. | Awume, Patrick & Baijius (2020) | | | | | | ✓ |
| 15. | Herawati, Kartini, Akbar & Abdurrahman (2021) | | ✓ | ✓ | | | |

Figure 2 illustrates the thematic network map, which visualizes the relationship between reviewed articles and the six identified themes: awareness, water conservation, education, pricing mechanism, social movement, and value on water. Themes are represented as central nodes, while articles are linked as peripheral nodes. The map shows that water conservation and education are the most interconnected themes, with multiple articles addressing them. In contrast, themes such as social movement and value on water are addressed by fewer studies, indicating potential research gaps. This visual helps to identify thematic concentrations and gaps across the selected literature.

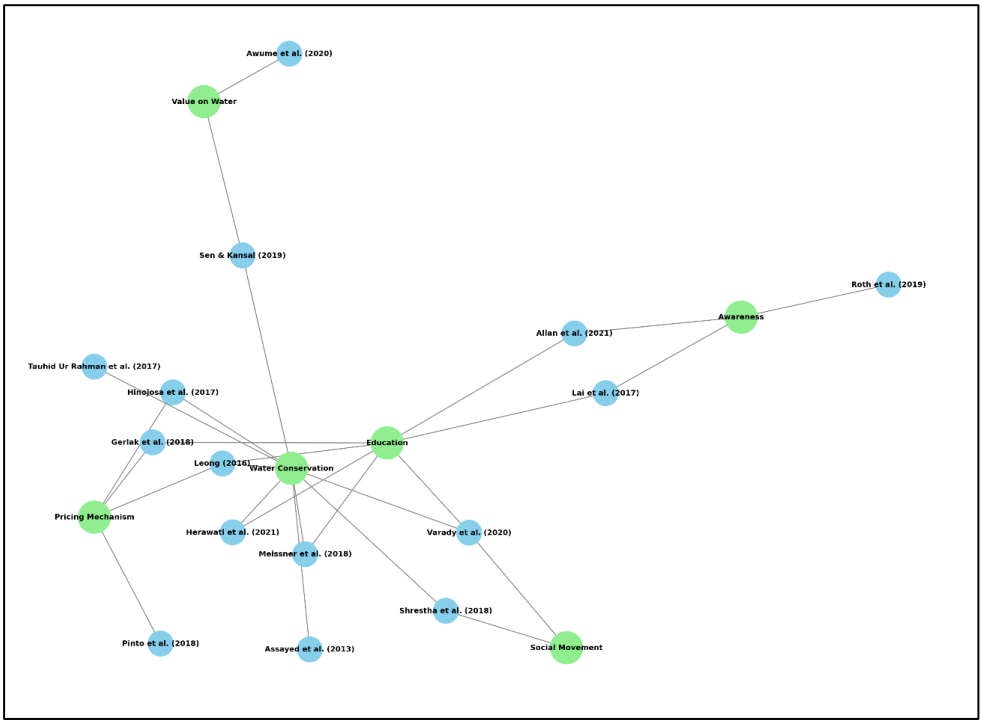


**Figure 2:** Thematic Network Map

## Awareness

Awareness plays a fundamental role in discussions of sustainability water security, particularly concerning communities, as their awareness is crucial for ensuring water safety. According to Roth *et al.* (2019), sustainable water security policies should encompass awareness as an integral component. Communities lacking awareness can inadvertently or directly contribute to water safety issues that jeopardize sustainable water security. Community awareness also plays a critical role in water conservation efforts, as it can alleviate public reluctance to pay reasonable water bills. However, Lai *et al.* (2017) noted that despite the frequent occurrences of river pollution and drinking water contamination in Malaysia, the awareness among the populace remains insufficient to address these issues. Enhancing community awareness is an expectation within demand management programs to foster a shared understanding of water supply risks (Allan *et al.*, 2021).

## Water Conservation

Water conservation involves the efficient use of water to minimize unnecessary waste. It is of paramount importance due to the limited nature of water resources, and communities should actively participate in using water efficiently and supporting institutions in

awareness campaigns. For instance, in Cotacachi, the community collaborates with a local institution to develop a village-level water security plan. This plan serves as a source of information to educate communities on adopting water security practices rooted in their customs and traditions. Additionally, discussions on water security and conservation practices take place, aligning with local norms for protecting water sources (Sen & Kansal, 2019; Hinojosa, Villegas & Muñoz, 2017). The exploration of potential engineering strategies for water conservation has garnered attention from water managers, including the Public Utilities Board (PUB) in Singapore. While concerns about water scarcity due to population growth exist, emphasis should also be placed on public consumption and perceptions of water (Leong, 2016).

Water conservation encompasses community engagement, social mobilization, and learning facilitated through educational programs, community garden projects, and citizen science-based monitoring initiatives (Varady *et al.*, 2020). Several studies have suggested that communities can adopt various conservation techniques in their daily lives, such as using dual flushing button toilets, adhering to the 3R (reduce, reuse, recycle) principles, and implementing rainwater harvesting (Shrestha *et al.*, 2018; Assayed *et al.*, 2013). Initiatives related to water conservation have been undertaken by some communities, including the use of natural ponds and rainwater harvesting at their homes, as reported by Tauhid Ur Rahman *et al.* (2017) and Herawati *et al.* (2021). In Sekhukhune, South Africa, specific communities support water conservation by storing water in tanks and demonstrating a preference for avoiding water wastage (Meissner *et al.*, 2018).

**Education**

Educating communities about water conservation and security stands as an essential and pressing task. Its impact becomes more significant as communities embrace education and develop an awareness of future water security prospects. Education emerges as the linchpin for instigating behavioural and regulatory shifts towards water security amongst humans. This approach offers a softer path to engage with communities (Leong, 2016; Gerlak *et al.*, 2018). NGOs and community-led educational programs have yielded commendable outcomes in conserving river ecosystems (Varady *et al.*, 2020). In nations like Malaysia, governmental bodies and NGOs persistently educate the populace about water conservation through awareness campaigns, community outreach, and educational initiatives (Lai *et al.*, 2017). Uneducated individuals face barriers to achieving sustainable water security (Meissner *et al.*, 2018). Education presents a potential solution to address clean water resources and sanitation challenges within communities (Herawati *et al.*, 2021).

**Pricing Mechanism**

Implementing a pricing mechanism within communities seeks to mitigate high water consumption by reflecting high water bills, thereby conserving water. The pricing structure, inclusive of tariffs, varies across countries and population incomes, garnering acceptance in some communities to bolster sustainable water security (Pinto *et al.*, 2018). Leong (2016) cited a viewpoint from communities, asserting that water is a strategic good; its value transcends monetary worth. Water represents an economic good: if we possess money, we acquire water." Pricing also represents a softer approach to meeting water security objectives (Gerlak *et al.*, 2018). Reasonable water pricing can encourage prudent water consumption among users (Hinojosa *et al.*, 2017).

**Community Social Movement**

Community resilience encompasses individual-level recognition and preparedness, complemented by a networked social support structure within a community, enabling resilience and recovery from public issues. Collaborative community efforts enhance the ability to withstand challenges pertaining to sustainable water security. Such social networks also foster enhanced relationships among diverse stakeholders, potentially influencing water security (Varady *et al.*, 2020). Social movements involved in managing resources for decentralized water supply, alongside community group engagement, yield positive impacts. Insufficient social capital or movement hampers collective action in addressing community-based water challenges (Shrestha *et al.*, 2018).

**Water Value**

Value holds significant importance as it influences decision-making and underpins the importance or worth of something. The perception of water's value varies among communities, shaped by their beliefs, culture, society, and economy. At times, these factors act as barriers to effective water management (Sen & Kansal, 2019). Indigenous perspectives have introduced human values that elucidate the relationship between humans and water, offering ethical considerations concerning water (Awume *et al.*, 2020).

## DISCUSSION

This study provides a comprehensive analysis of existing literature on community resilience and adaptation in the context of sustainable water security. The findings highlight the crucial role of community attitudes and behaviours in shaping water security outcomes. By systematically examining six key themes, the study not only reinforces existing knowledge but also introduces new perspectives on the integration of indigenous practices and the role of social movements in enhancing resilience. These insights are particularly valuable for policymakers and practitioners seeking to develop more effective and inclusive water management strategies. People's attitude has led to sustainable water security issues that require control. A thorough review of sources from Web of Science, and Science Direct has identified 15 articles related to community resilience and adaptation towards sustainable water security. Within this review's scope, six themes emerged. It becomes evident that community resilience and adaptation globally, between 2011 and 2021, predominantly focused on people's resilience and adaptation towards sustainable water security. The communities' resilience and adaptation strategies encompassed awareness, water conservation, education, pricing mechanisms, community social movement, and valuing water.

Rivers serve as lifelines for human habitation, necessitating heightened awareness of their value to encourage water protection. Furthermore, ecological awareness influences water policies, emphasizing the need to explore alternative water usage with reduced impacts on river ecosystems (Dopico *et al.*, 2022). Awareness campaigns were anticipated to influence community behaviour, potentially reducing water demand by 4% (Puchol-Salort *et al.*, 2022). The systematic review indicates that practising awareness may generate water safety issues that directly or indirectly affect water security. Moreover, discussions involve sustainable water security and conservation practices rooted in local

approaches aimed at safeguarding water sources (Sen & Kansal, 2019; Hinojosa *et al.*, 2017).

Water consumption patterns mirror those of other rapidly developing nations, driven by population growth, resulting in increased water demand. It underscores the importance of employing water conservation measures to curtail agricultural, industrial, and domestic water usage (Naidoo et al., 2016). Water conservation initiatives advocate against wasteful personal water use habits and recognise methods to mitigate water-related challenges (Benedict & Hussein, 2019). Additionally, water conservation intersects with religion; educating formally trained religious leaders about the imperative need for water conservation enables them to disseminate this knowledge within their respective communities (Benedict & Hussein, 2019). They are collaborating with local institutions in water security planning and adopting community customs and traditions to aid in adapting to water security challenges by utilising locally-based practices to safeguard water sources (Sen & Kansal, 2019; Hinojosa et al., 2017).

Implementing rainwater harvesting in residential structures emerges as an adaptive measure for communities, contributing to water conservation efforts (Rahman et al., 2017; Herawati et al., 2021).

Building on these findings, it is imperative to establish priorities that integrate water ecosystem services for human and environmental purposes. Engaging with local stakeholders, academics, and decision-makers across various levels is essential to identify mutual interests through education. Challenges primarily arise in setting and implementing these priorities. Successful sustainable water security among communities hinges on considering mutual interests and education throughout the planning, execution, and maintenance phases (Scott et al., 2021). Communities advocate for user-friendly knowledge transfer (from research to application) and public education on sustainable water security (Naidoo et al., 2016). Education stands pivotal in altering human behaviour concerning sustainable water security (Leong, 2016; Gerlak et al., 2018). Numerous NGOs conduct educational programs aimed at conserving river ecosystems (Varady et al., 2020). Without community education, achieving water security becomes arduous (Meissner et al., 2018), given its pivotal role in addressing water-related issues (Herawati et al., 2021).

Sustainable water security necessitates a dedicated framework that views water as a commodity, linking its economic value to its price and social good. Economic value varies based on the willingness of buyers and sellers to pay. Social good, when applied to pricing mechanisms, demands that water remains affordable for people experiencing poverty, benefitting a significant population (Soto Rios, Deen, Nagabhatla & Ayala, 2018). Price increments prompt consumers to reduce demand through various physical and behavioural measures; later discussions delve into the price elasticity of demand (Sahin, Stewart & Porter, 2015). Pricing emerges as an optimal solution to achieve water security goals (Gerlak *et al.*, 2018), promoting judicious water consumption among users (Hinojosa *et al.*, 2017). Some communities have endorsed this pricing mechanism as a strategic approach, recognising that water's value transcends monetary worth (Leong, 2016).

Equally important in the discussion is the role of social movements. A social movement holds paramount importance in ensuring water security. Building networks and alliances to share community values and foster trust is crucial. Specific social movements have effectively addressed water-related issues by uniting diverse groups towards a common objective, engaging in collective campaigning and legal battles, and bridging local and global struggles (Van den Berge, Vos, Boelens, Kishimoto & Jonker, 2021). Social movements are instrumental not only in campaigning but also in addressing various forms of water-related injustice across diverse locales (Van den Berge, Vos & Boelens, 2022). The absence of a robust social movement delays community action on water issues.

There exists a significant discrepancy between the environment's value and people's concern for the economic values associated with agricultural, domestic, and industrial water use (Opperman *et al.*, 2018). Balancing the diverse values and the imperative for contrast presents a critical challenge for water security (Jenkins *et al.*, 2021). Water values span a broad spectrum as diverse as cultural imaginations (Sen & Kansal, 2019; Jenkins *et al.*, 2021). Indigenous values concerning water may not be succinctly measured on a scale ranging from human rights to economic usage rights; however, they encapsulate values crucial for ethical considerations regarding water (Awume *et al.*, 2020). Recent studies have further emphasized the need to integrate ecological values and justice-based water policies in community resilience planning (Dopico et al., 2022; Van den Berge et al., 2022).

## CONCLUSIONS

This systematic review, covering the decade from 2011 to 2021, provides critical insights into community resilience and adaptation strategies for sustainable water security. By analysing 15 relevant studies, the review identifies six key themes such as awareness, water conservation, education, pricing mechanisms, social movements, and the value of water that are integral to enhancing community resilience.

The findings underscore the importance of targeted awareness campaigns, which have the potential to significantly reduce water usage through behaviour change. Similarly, adaptive pricing mechanisms are shown to be effective in curbing water consumption, but their broader applicability requires further testing in diverse settings. The success of community-driven social movements in improving water security highlights the need for targeted policy support and sufficient resource allocation to ensure these initiatives are both sustainable and impactful. Moreover, the integration of indigenous knowledge into mainstream water management practices emerges as a crucial strategy, warranting the development and testing of frameworks that effectively incorporate these perspectives.

In conclusion, this review not only elucidates the interconnected roles of these themes in fostering sustainable water security but also provides a roadmap for future research. It is imperative that upcoming studies focus on evaluating the effectiveness of these strategies across various contexts and developing tailored interventions that address the unique needs of different communities. By doing so, we can advance efforts to build resilient communities and secure sustainable water resources for future generations.

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