ENJUST
Energy Justice
ENJUST 2(1): 1–29
ISSN 3047-9851

Institute for Advanced Science, Social and Sustainable Future
MORALITY BEFORE KNOWLEDGE

Community-driven strategies for sustainable resource management, pollution control, and renewable energy transition in the Asia-Pacific

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Received Date: January 12, 2025 Revised Date: February 28, 2025 Accepted Date: February 28, 2025

ABSTRACT

Background: Environmental degradation in the Asia-Pacific region, driven by rapid urbanization, deforestation, overfishing, and unsustainable resource use, threatens biodiversity and local livelihoods. Community-based Conservation (CBC) initiatives play a crucial role in addressing these challenges while advancing Sustainable Development Goals (SDGs), particularly SDG 6 (clean water and sanitation), SDG 7 (affordable and clean energy), SDG 11 (sustainable cities and communities), and SDG 14 (life below water). **Methods:** This study uses a Systematic Literature Review (SLR) to analyze the contribution of local communities to sustainable development in Asia-Pacific, focusing on air conservation, renewable energy, urban aspirations, and marine conservation. Data were obtained from verified journals and reports (2011–2023), analyzed thematically to identify challenges, successful strategies, and opportunities in community-based initiatives. **Findings:** CBC initiatives have demonstrated success in improving environmental conditions and socio-economic well-being. Local communities effectively leverage their ecological knowledge to implement conservation strategies, leading to better resource management and ecosystem restoration. However, financial and technical constraints remain key challenges to the scalability and long-term sustainability of these projects. **Conclusion:** Addressing financial and technical barriers is essential for expanding CBC initiatives. Strengthening policy integration and multi-level governance—through collaboration between local communities, national governments, and international organizations—can enhance institutionalization and long-term sustainability. These efforts are critical for promoting resilience against climate change and other environmental threats in the Asia-Pacific region. **Novelty/Originality of this article:** This study highlights the intersection of traditional ecological knowledge and modern conservation strategies in CBC initiatives. It underscores the importance of policy integration and multi-level governance in ensuring the success and scalability of community-driven conservation efforts, contributing to sustainable development and climate resilience in the Asia-Pacific region.

KEYWORDS: community-driven solutions; sustainable resource management; pollution control.

1. Introduction

Environmental degradation is a critical issue in developing countries, particularly in the Asia-Pacific, where rapid urbanization, deforestation, and unsustainable agricultural practices place significant pressure on biodiversity and ecosystems (Balsalobre-Lorente et al., 2023; Padhiary & Kumar, 2024). This degradation disproportionately affects rural and coastal communities that rely heavily on natural resources, worsening poverty and inequality within these vulnerable populations. The convergence of environmental and socio-economic challenges highlights the need for community-based conservation

Cite This Article:
Ash-Shiddiqie, L. (2025). Community-driven strategies for sustainable resource management, pollution control, and renewable energy transition in the Asia-Pacific. *Energy Justice, 2*(1), 1-29. https://doi.org/10.61511/enjust.v2i1.2025.1706

approaches that leverage local knowledge and skills to address these issues effectively (Slayi et al., 2024).

The Sustainable Development Goals (SDGs), introduced by the United Nations, provide a holistic framework to address these global challenges, particularly SDG 6 (clean water and sanitation), SDG 7 (affordable and clean energy), SDG 11 (sustainable cities and communities), and SDG 14 (life below water) (Fatimah et al., 2024; Mujtaba et al., 2024; Pandit & Paul, 2023). These goals emphasize sustainable resource management, adoption of renewable energy, urban resilience, and marine conservation (Kalfas et al., 2023). Achieving sustainability goals in the Asia-Pacific requires both global and local efforts, with a strong emphasis on empowering local communities most impacted by environmental degradation (Pan et al., 2024; Yanou et al., 2023). These communities play a critical, empowering role, acting as the primary solution to environmental challenges through community-led initiatives that integrate traditional knowledge with modern conservation practices (Hanifa et al., 2024). Such initiatives not only address complex ecological issues but also foster a sense of importance and empowerment among local populations (Ferdinand et al., 2023; Kim, 2023; Martin et al., 2023).

Water resource management is a critical focus in the Asia-Pacific, where issues like pollution, over-extraction, and inadequate sanitation have caused severe water scarcity and degraded freshwater ecosystems In Indonesia, community-led efforts have proven effective in addressing these challenges by restoring natural water flows, reducing contamination, and promoting equitable access to clean water (Dharmawan et al., 2023; Francis et al., 2023). These initiatives blend indigenous practices with modern water management techniques, improving water quality and availability while building resilience to climate-related impacts, such as floods and droughts (Kamyab et al., 2023). The success of these localized efforts demonstrates the potential for expanding community-based water management across the region (Selje et al., 2024; Telwala, 2023).

Community-driven renewable energy solutions (SDG 7) have become essential to sustainable development in rural and remote areas, especially in the Asia-Pacific (Mousazadeh, 2024; Rai & Maheshwari, 2024). Solar energy projects led by local communities have revolutionized energy access, delivering affordable, reliable electricity to thousands and supporting carbon reduction, job creation, and rural economic growth (Dolezal & Novelli, 2020; Mahmood et al., 2024; Raihan et al., 2024). These initiatives' success hinges on local ownership and management, fostering sustainability and strong community support (Kepper et al., 2024). Renewable systems like solar and biogas have reduced reliance on fossil fuels, enhancing quality of life and highlighting community involvement's crucial role in the global shift to renewable energy (Bojarajan et al., 2024; Hassan et al., 2024; Kepper et al., 2024; Mukhtar et al., 2024; Standal et al., 2023).

The Coral Triangle, covering Indonesia, Malaysia, and the Philippines, is one of the planet's most biodiverse marine regions but faces significant threats from overfishing, pollution, and climate change (Goulding & Dayrat, 2023; Pollom et al., 2024). Local communities, heavily reliant on marine resources, lead marine conservation (SDG 14) efforts in this area, working with NGOs and government bodies to establish Marine Protected Areas (MPAs) that protect biodiversity and encourage sustainable fishing (Xue et al., 2023). Community-managed MPAs have shown high effectiveness by integrating traditional ecological knowledge, fostering community commitment, and creating new economic opportunities through eco-tourism, which provides alternative incomes and eases pressure on marine ecosystems (Boateng et al., 2024; Murua et al., 2023; Schiller et al., 2023; Yang et al., 2024).

Despite the success of many community-based conservation initiatives, several challenges persist, particularly the need for increased financial and technical support to help communities expand and sustain their efforts (Esmail et al., 2023; Zhang et al., 2023). A key issue is the pressing need for more financial and technical support available to local communities, which limits their capacity to expand and sustain their conservation efforts (Khurram et al., 2024; Sharma, 2023). Many projects remain underfunded and rely heavily on volunteer labor, which limits their scalability and capacity to tackle larger environmental

issues (Kelly, 2023; Sharp, 2024). A disconnect often exists between local conservation goals and broader national or international policies, hindering communities' access to needed resources and support, (Carmenta et al., 2023; Fernandes et al., 2024; Valckenaere et al., 2023). Strong partnerships among local communities, governments, and NGOs are crucial to overcoming these barriers (Quader et al., 2023; Rahman & Tasnim, 2023), as they can provide essential funding, expertise, and policy alignment to ensure the long-term sustainability of these initiatives. (Islam et al., 2024; Tien et al., 2024; Wilson et al., 2023).

Education and capacity-building play a vital role in empowering local communities to lead conservation efforts, equipping them with essential knowledge and tools for sustainable natural resource management (Aziz et al., 2023). Government and NGO support in training strengthens community-led initiatives, as seen in the Philippines, where education programs on mangrove restoration have improved environmental outcomes and local livelihoods (Jayousi & Nishide, 2024; Marquez & Olavides, 2024). These programs teach residents the importance of protecting mangrove forests, which are crucial for shielding coastlines from storm surges and erosion (Hernández-Delgado, 2024; Meivian et al., 2023). Community involvement in these efforts has fostered a sense of ownership, supporting the long-term success of conservation (Ullah, 2024; Wang et al., 2024).

Local communities are essential partners in sustainable development and environmental conservation across the Asia-Pacific, bringing valuable ecological knowledge and a strong sense of responsibility to regional challenges (Becken & Loehr, 2023; Goutte & Sanin, 2024; Hong & Xiao, 2024). to maximize the impact of community-based conservation, increased support in funding, education, and technical resources is necessary (Moisès et al., 2023; Radjab et al., 2023). Strengthening partnerships between communities, governments, and NGOs can create a sustainable future for the Asia-Pacific and beyond, contributing to the achievement of SDGs and ensuring a healthy environment for future generations (Danladi et al., 2023; Hariram et al., 2023; Ikhlas & Ramadan, 2024; Mohan et al., 2024).

A research gap exists in the Asia-Pacific region due to insufficient integration of local community insights into broader environmental policies, particularly in community-driven solutions for sustainable resource and pollution management. While community-led efforts have succeeded in areas like water, renewable energy, and marine conservation, studies on scaling these approaches across diverse cultural and ecological contexts are limited (Slayi et al., 2024; Pan et al., 2024). Despite alignment with SDGs 6, 7, and 14, the role of supportive governance and policy in strengthening these local actions is underexplored (Fatimah et al., 2024; Kalfas et al., 2023; Pandit & Paul, 2023). Financial and technical constraints further impede long-term impact, and current research often lacks broader analysis on adapting community-based conservation (CBC) models beyond isolated case studies (Ferdinand et al., 2023; Kamyab et al., 2023). Bridging this gap through research on funding, policy, and partnerships could enhance the scalability of sustainable, community-driven environmental solutions across the Asia-Pacific (Yanou et al., 2023; Boateng et al., 2024; Tien et al., 2024).

This paper examines the crucial role of Community-based Conservation (CBC) initiatives in tackling environmental challenges in the Asia-Pacific region, specifically focusing on their contributions to key Sustainable Development Goals (SDGs). It explores how CBC efforts align with SDG 6 (clean water and sanitation), SDG 7 (affordable and clean energy), SDG 11 (sustainable cities and communities), and SDG 14 (life below water), which are vital for achieving environmental and social sustainability. By analysing case studies from across the region, the paper demonstrates how local communities effectively integrate their traditional ecological knowledge with modern conservation techniques. This combination allows them to improve water quality, implement renewable energy systems, reduce urban waste, and restore marine ecosystems, showcasing CBC as an effective model for addressing both environmental issues and community needs. Through these initiatives, communities are not only protecting their natural resources but are also contributing to global sustainability efforts.

2. Methods

This study employs a systematic literature review as the core research approach to investigate the contribution of local communities to sustainable development in the Asia-Pacific region. The review targets community-led efforts related to water conservation, renewable energy adoption, urban sustainability, and marine conservation, aligning with Sustainable Development Goals (SDGs) 6, 7, 11, and 14. The systematic review process includes identifying, selecting, and critically evaluating a diverse set of peer-reviewed journal articles, reports, and case studies published from 2011 to 2023. This method was chosen to synthesize the existing research, offering a comprehensive overview of current knowledge and highlighting gaps in understanding community-based environmental initiatives.

To conduct the review, we accessed reputable databases, including Google Scholar, Web of Science, Scopus, and JSTOR, using keywords such as "community-based conservation," "sustainable water management," "renewable energy in local communities," "urban sustainability practices," "marine conservation in the Asia-Pacific," and "SDGs." Articles were selected based on peer-reviewed status, focus on the Asia-Pacific region, and relevance to community-led initiatives within the last decade. Studies unrelated to local communities or based on outdated contexts were excluded to ensure the review reflects the most relevant, high-quality research. In the analysis phase, we categorized the selected studies, focusing on recurring themes like financial and technical challenges, and successful strategies, such as blending traditional ecological knowledge with modern conservation practices. This thematic synthesis offers insights into the potential of community-based approaches to contribute meaningfully to SDG objectives in the Asia-Pacific, identifying both critical opportunities and barriers.

3. Results and Discussions

Recent findings regarding community-based conservation and sustainable development initiatives are presented in Table 1.

Table 1. Recent findings on community-based conservation and sustainable development initiatives (2022-2023)

No	Title	Authors	Journal	Key findings	SDGs
1	A review of renewable energy powered seawater desalination treatment process for zero waste	(Olufisayo & Olanrewaju, 2024)	MDPI – Water	This study examines renewable energy-powered desalination systems as a zero-waste solution for water-scarce regions. Using solar and wind energy, these systems can meet freshwater needs sustainably with low environmental impact. However, high initial costs present a major barrier, necessitating significant investment to scale for community use.	SDG 6 Clean Water and Sanitation
2	Illuminating progress: The contribution of bioluminescence to sustainable development goal 6 — Clean water	(Gregucci et al., 2023)	Sensors	Provides an overview of recent developments and their significance BL's contribution to SDG 6, focusing attention on the potential use of BL-based sensing platforms	SDG 6 Clean Water and Sanitation

	and sanitation — of the United Nations 2030 agenda			to further ensure water management, protect ecosystems and prosperity community.	
3	Community-based water demand management: socio-technical strategies for improving water security in Australian Indigenous communities	(Beal et al., 2023)	Environmental Research	From a systems view, community-based management promotes water conservation education, aiming for sustainable outcomes and social capital growth through smart tools and collaborative policies with local communities.	SDG 6 Clean Water and Sanitation
4	Clean water issues, community behavior and communication models in sustainable development goals 6 in Banten West Java Indonesia	(Fitriyah et al., 2024)	International Journal of Sustainable Development and Planning	The study identifies discrepancies in achieving SDG 6, primarily due to infrastructure inequality limiting access to clean water and sanitation. It points to poverty, economic disparity, and inadequate public education as key issues. In Banten Province, low stakeholder participation can be addressed through a participatory development communication approach. The research emphasizes the need for cross-sector collaboration and new laws to improve public awareness of healthy living and social standards.	SDG 6 Clean Water and Sanitation
5	Policy pathways for mapping clean energy access for cooking in the Global South—A case for rural communities	(Vassiliades et al., 2022)	Sustainability	The study proposes a business model for rural clean cooking initiatives that starts with a government-driven approach, shifts to incentivized operations in the mid-life phase, and transitions to private sector involvement as technology adoption increases. It highlights the necessity for further exploration of the techno-economic parameters of clean cooking technologies and their alignment with sociocultural factors to support sustainable development goals.	SDG 7 Affordable and Clean Energy
6	Clean and future-oriented: Local perceptions of	(Carpanese et al., 2024)	The Extractive Industries	The study reveals that lithium became significant during Evo Morales'	SDG 7

	lithium extraction in Bolivia during the presidency of Evo Morales		and Society	presidency in Bolivia (2006–2019) with the launch of a national extraction industry in the Uyuni salt flat. While promoted as a "clean" and "future-oriented" activity, public perceptions were shaped by memories of colonial exploitation, linking lithium to a potential decolonial future.	Affordable and Clean Energy
7	Review of renewable energy potentials in Indonesia and their contribution to a 100% renewable electricity system	(Langer et al., 2021)	Energies	Indonesia possesses significant renewable energy resources, with academic estimates suggesting greater potential than current figures from the Energy Ministry, which guide existing policies. These resources could support a 100% renewable electricity system while minimizing land use impact. However, the study identifies three key knowledge gaps: economic assessments of renewable energy technologies, integrated spatial potential mapping for various technologies, and a lack of empirical data on natural resources.	SDG 7 Affordable and Clean Energy
8	Building a just transition in asia-pacific: Four strategies for reducing fossil fuel dependence and investing in clean energy	(McCauley & Pettigrew, 2023)	Energy Policy	Asia Pacific region's vulnerability to climate change and reliance on coal, despite a recent increase in renewable energy use. It advocates for a 'just energy transition' framework that emphasizes social justice in the shift to a low carbon future. Key components include boosting investments in clean energy, prioritizing equity in decision-making, developing financing strategies, and ensuring restorative justice for affected communities.	SDG 7 Affordable and Clean Energy
9	Two decades of community-Based marine conservation provide the	(Villaseñor-Derbez et al., 2022)	Frontiers in Marine Science	Community-based conservation in Mexico's Gulf of California has effectively restored marine biodiversity, establishing over 514 km^2 of marine	SDG 14 Marine Conservation

	foundations for future action			reserves. These efforts have led to notable fish population recovery and habitat protection, demonstrating the value of local knowledge and community involvement in sustainable marine management.	
10	Implications of community-Based management of marine reserves in the Philippines for reef fish communities and biodiversity	(Marriott et al., 2021)	Frontiers in Marine Science	Community-managed marine reserves in the Philippines have positively impacted coral reef fish populations, enhancing species richness and biomass. The study reveals that local knowledge and community enforcement have been key to improving reef biodiversity. Challenges remain in scaling these initiatives due to limited financial and technical resources.	SDG 14 Marine Conservation
11	National-level evaluation of a community-based marine management initiative	(O'Garra et al., 2023)	Nature Sustainability	A national evaluation of community-based marine management in Fiji indicates that increased community participation and governance enhance conservation outcomes, notably in fish stock management. The study reveals limited direct ecological improvements, suggesting a need for stronger mechanisms to convert community involvement into sustained ecological benefits.	SDG 14 Marine Conservation
12	Challenges and opportunities of area-based conservation in reaching sustainability goals	(Hoffmann, 2022)	Biodiversity and Conservation	The challenges in protected areas, including human encroachment and habitat fragmentation, revealing that community-managed areas face less biodiversity loss than government-managed ones, thanks to local enforcement and traditional knowledge. It advocates for greater integration of local communities in conservation planning to help achieve global biodiversity goals.	SDG 14 Marine Conservation

The literature review emphasizes how important community-based conservation and sustainable development programs are in a variety of fields, especially when it comes to solving global environmental issues. SDGs 6 (Clean Water and Sanitation), 7 (Affordable and Clean Energy), 11 (Sustainable Cities and Communities), and 14 (Life Below Water) are among the Sustainable Development Goals (SDGs) that the manuscript focuses on, and the results are essential to demonstrating how these efforts help achieve these goals. The studies offer verifiable proof that community empowerment, involvement, and local knowledge are essential to the effective implementation and maintenance of these programs. Nonetheless, there are still several policy gaps, technical restrictions, and financial limitations.

3.1 Clean water and sanitation (SDG 6)

The reviewed studies contribute diverse approaches to achieving SDG 6: Clean Water and Sanitation by integrating renewable energy, advanced technology, and community-led strategies. Olufisayo & Olanrewaju (2024) analyzes renewable energy-powered desalination systems, focusing on their potential as sustainable, zero-waste solutions for addressing water scarcity (SDG 6: Clean Water and Sanitation). By integrating solar and wind energy, these systems aim to provide freshwater while minimizing environmental impact. The review highlights that such desalination processes can recover up to 90% of freshwater and reusable salts, reducing waste significantly. However, initial high costs and technological complexities are identified as barriers to broader community adoption, which points to the need for significant investments and subsidies to scale up and make this technology accessible, especially in water-scarce regions. The study emphasizes the importance of developing efficient desalination processes that incorporate renewable energy to ensure sustainable water management. By addressing water scarcity with eco-friendly technologies, this approach aligns closely with SDG 6 objectives, particularly by reducing dependency on fossil fuels and promoting sustainable water cycles. Additionally, the document underscores that monitoring systems and adequate regulatory support are essential to enhance operational efficiency and foster resilience in desalination projects within community-based conservation frameworks.

Gregucci et al. (2023) discuss bioluminescence (BL) sensors for real-time water monitoring, positioning BL as a transformative tool for water management. By offering continuous insights into water quality, BL-based systems can enhance ecosystem protection and support community health, further advancing SDG 6.

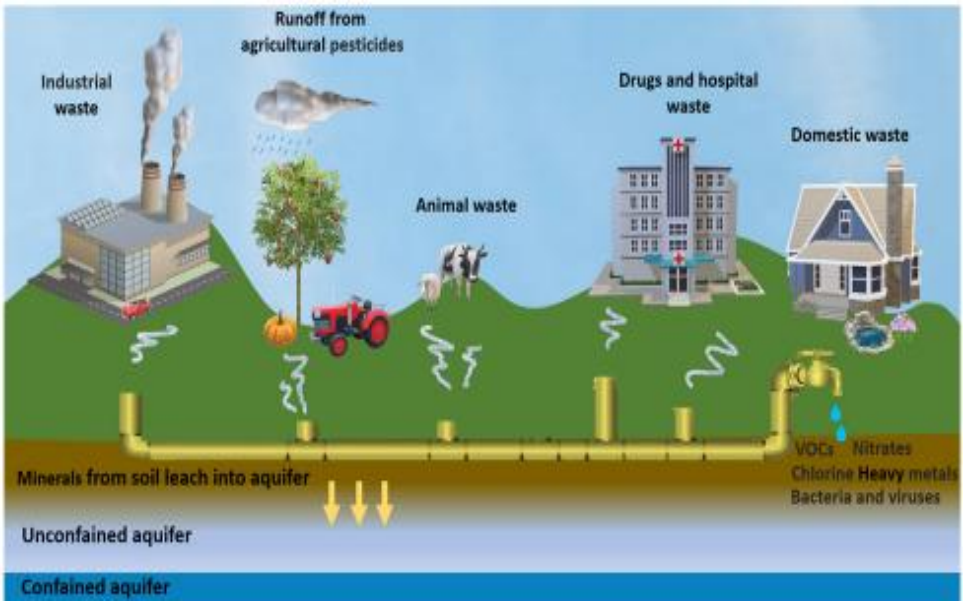

Fig. 1. Schematic illustration of possible groundwater contamination sources (Gregucci et al., 2023)

Water quality is compromised by microbiological contaminants in drinking and tap water, such as bacteria, viruses, and protozoa, which pose significant risks to water ecosystems. Addressing these challenges involves monitoring waste streams, optimizing production processes, detecting contaminants, and recovering valuable materials, all of which align with the circular economy's 4Rs (reduce, reuse, recycle, recover). Given the anticipated 80% increase in urban water demand by 2050, innovative strategies for water reuse and resource recovery are essential. Effective aquatic monitoring and protection require advanced, cost-effective, environmentally friendly analytical methods capable of precise, on-site detection of trace contaminants at critical points in the water cycle.

Beal et al. (2023) take a community-focused approach, examining water demand management among Australian Indigenous communities. This systems-based perspective integrates water conservation education with socio-technical strategies, including smart water technologies and community-driven policies, to build sustainable, socially cohesive water management frameworks. Together, these studies underscore the importance of addressing water security through a blend of technological innovation, financial support, and community empowerment to realize long-term impacts in global water sustainability efforts.

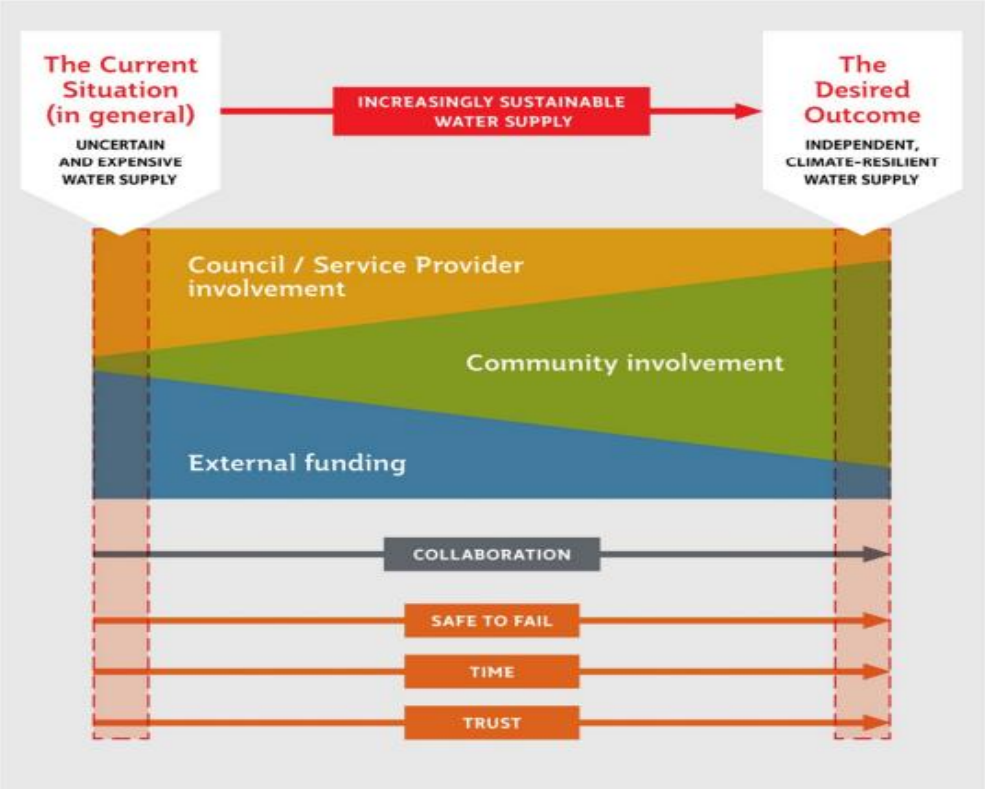

Fig. 2. A proposed community-based strategy for water management (Beal et al., 2023)

Figure 2 illustrates the pathway from the current challenges in water supply—characterized by uncertainty and high costs—to a desired outcome of a sustainable, climate-resilient water supply. It emphasizes the importance of collaboration among various stakeholders, including council/service providers, community involvement, and external funding, to achieve increasingly sustainable water management. The foundation for this transformation includes three critical elements: collaboration, a "safe to fail" mindset that encourages experimentation, and the necessity of time and trust in building relationships among stakeholders. This visual representation aligns with Beal et al. (2023), highlighting the need for community engagement and innovative approaches to water demand management, ultimately reinforcing the significance of collective efforts in enhancing water security and sustainability.

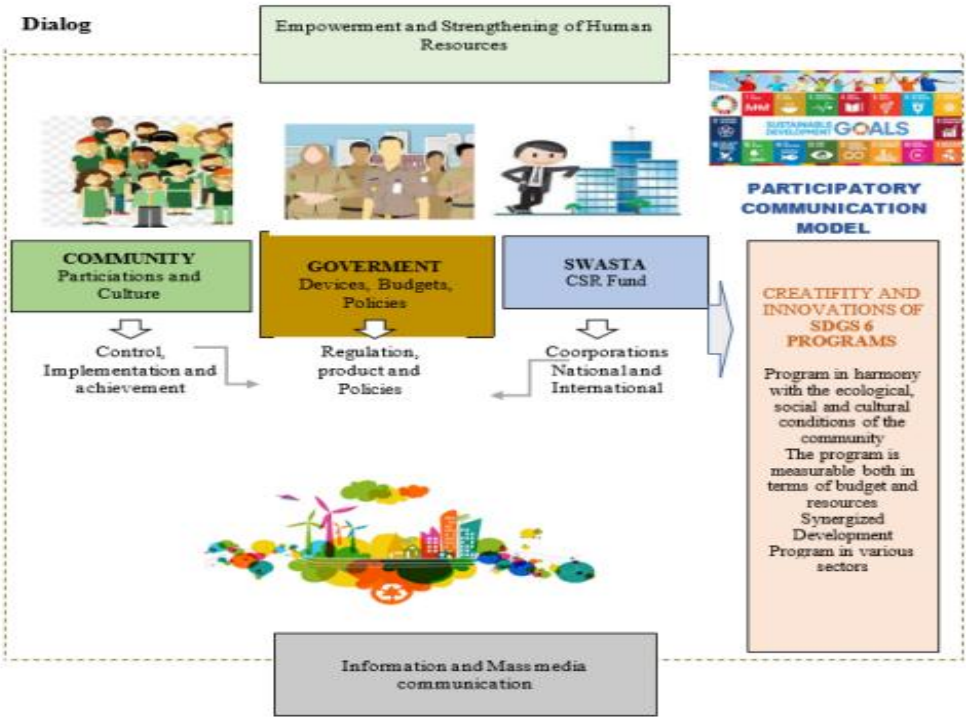

Fig. 3. Communication participatory models
(Fitriyah et al., 2024)

Figure 3 presents a participatory communication model designed to enhance community-based conservation efforts and achieve Sustainable Development Goal 6 (SDG 6: Clean Water and Sanitation). It emphasizes the empowerment of human resources through collaboration among communities, government, and the private sector, highlighting the importance of community participation in decision-making and implementation. The government provides necessary regulations and funding, while corporate engagement through CSR supports these initiatives. Additionally, the model underscores the role of information and mass media communication in raising awareness about conservation efforts. Ultimately, the framework aims to create programs that are contextually relevant, measurable, and synergistic, fostering effective dialogue and collaboration to tackle water-related challenges and promote sustainable water management (Fitriyah et al., 2024).

The reviewed studies emphasize innovative strategies for achieving SDG 6: Clean Water and Sanitation through renewable energy, advanced technology, and community engagement. Olufisayo and Olanrewaju (2024) highlight renewable energy-powered desalination systems as effective solutions to water scarcity, capable of recovering up to 90% of freshwater, despite facing high initial costs. Gregucci et al. (2023) introduce bioluminescence sensors for real-time water quality monitoring, enhancing ecosystem protection. Beal et al. (2023) advocate for a community-focused water demand management approach among Australian Indigenous communities, integrating education with smart technologies. Collectively, these findings underscore the need for technological innovation, financial investment, and community empowerment to promote long-term water security and sustainability, while the importance of collaboration and participatory models in addressing water-related challenges.

3.2 Renewable energy (SDG 7)

The global shift to clean energy must be advanced via community-led renewable energy projects, particularly in off-grid and rural areas. The crucial problem of more than 1.5 billion people in the Global South not having access to contemporary energy for cooking in their homes (Vassiliades et al., 2022). It maps alternative energy sources, technology, and

supportive policies to improve clean cooking services for better socioeconomic development, with a focus on rural populations. The report suggests strategies that take into account technology, cost, accessibility, climate action, business models, and local capability after reviewing the literature on clean cooking technologies and energy availability.

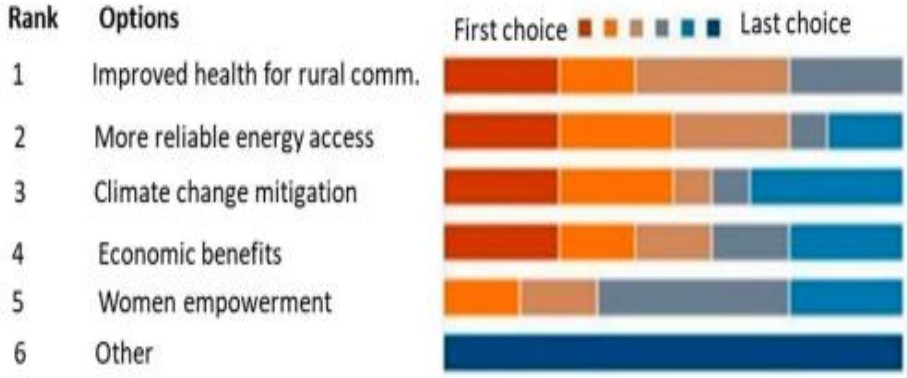

Fig. 4. Main benefits of implementing this shift towards cleaner energy access (Vassiliades et al., 2022)

Figure 4 shows the top priority is improved health for rural communities, followed by more reliable energy access and climate change mitigation. economic benefits and women empowerment also rank high, indicating the multifaceted advantages of clean cooking solutions. The low ranking of Other options suggests a focused concern on these key areas. Overall, the findings emphasize the importance of health, reliability, and sustainability in driving the adoption of clean cooking practices, while also recognizing economic and social factors in enhancing community acceptance and implementation. A business model for rural clean cooking initiatives, advocating for a government-driven approach in the early stages, transitioning to incentivized mid-life operations, and ultimately moving towards private sector involvement as technology penetration increases. The research underscores the need for further investigation into the techno-economic parameters of clean cooking technologies and their alignment with sociocultural factors, contributing to sustainable development goals.

The study by Carpanese et al. (2024) critically examines local perceptions of lithium extraction in Bolivia during Evo Morales' presidency (2006–2019), highlighting its emergence as a significant industry in the Uyuni salt flat. While the Bolivian government marketed lithium extraction as a "clean" and "future-oriented" initiative, aiming to differentiate it from exploitative traditional mining practices, public sentiment was deeply influenced by historical memories of colonial exploitation. This context framed lithium as a pathway to a decolonial future, instilling hope for economic development. However, as Morales' presidency progressed, there was a notable decline in public confidence regarding the government's capacity to translate lithium production into tangible local and national benefits. This shift in perception underscores the complexities of implementing sustainable resource management practices and aligns with the objectives of SDG 7, which emphasizes the need for affordable and clean energy solutions while considering socio-political dynamics and community expectations.

Indonesia faces rising electricity demand, predominantly met by fossil fuels, despite plans to enhance Renewable Energy Technologies (RET) (Langer et al., 2021). Implementation of these technologies has been sluggish, which is concerning given the country's vast potential for renewable resources, particularly considering its archipelagic geography. The absence of a comprehensive literature review on the potential of various RETs limits understanding of their capability to satisfy current and future electricity demands. Indonesia could achieve a 100% renewable electricity system with minimal land use impact.

Table 2. 100% RET scenario until 2050 based on the reviewed potentials in Indonesia

RET	Potential (Type) [GWe]	Potential electricity production [GWh/Year]	Share of practical potential [%]	Deployed capacity [GWe]	Annual electricity production [GWh/Year]	Share of electricity generation [%]
Geothermal	42 (pract)	279,619	100%	42	279,619	14%
Large hydro	38 (RUEN)	143,138	100%	38	143,138	7%
Small hydro	7 (RUEN)	26,368	100%	7	26,368	1%
Biomass	18 (pract)	115,324	100%	18	115,324	6%
Solar PV	3397 (pract)	4,677,669	14%	491	676,306	33%
Wind energy	2976 (pract)	8,318,237	7%	214	676,306	33%
OTEC	102 (pract)	339,045	16%	16	128,94	6%
Total	6580	13,899,400	-	826	2,046,000	100%

(Langer et al., 2021)

The scenario in Table 7 aligns with SDG 7: Affordable and Clean Energy, proposing that Indonesia can achieve a 100% renewable energy system by 2050 through a diverse mix of sources like hydropower, geothermal, biomass, solar PV, and wind. With minimal spatial requirements, the plan allows for expansion without significant land use conflicts. However, substantial investments in transmission infrastructure are needed to connect renewable energy production in the economically underdeveloped east to demand centers in the west, emphasizing equitable energy distribution. The approach also highlights the importance of diversifying the energy mix for economic viability and promotes local community empowerment through decentralized systems, supporting broader economic growth, environmental sustainability, and social equity in line with SDG 7.

The study by McCauley & Pettigrew (2023) presents a compelling analysis of the Asia Pacific region's challenges and opportunities in achieving a just energy transition. It highlights the region's vulnerability to climate change and ongoing dependence on coal, which poses significant risks to both the environment and communities. Despite recent advancements in renewable energy adoption, the transition to a low-carbon future remains uneven and fraught with social justice concerns. The authors advocate for a 'just energy transition' framework, emphasizing that efforts to reduce fossil fuel reliance must prioritize social equity and community involvement. Key strategies identified include increasing investments in clean energy, ensuring equitable decision-making processes, developing comprehensive financing strategies, and implementing restorative justice measures for communities impacted by the transition. These strategies align closely with SDG 7, which focuses on ensuring access to affordable and clean energy for all.

3.3 Urban sustainability (SDG 11)

3.3.1 Long-term success of community-based conservation

In particular, marine ecosystems have benefited greatly from the ecological and socioeconomic conditions that Community-based Conservation (CBC) has successfully improved. Fish populations have recovered and marine biodiversity has been restored in Mexico's Gulf of California as a result of two decades of consistent community-driven conservation initiatives (Villaseñor-Derbez et al., 2022). The environment and nearby populations have benefited from the protection of more than 514 km^2 of marine reserves. These conservation initiatives have boosted sustainable fishing and eco-tourism, among other economic endeavours, underscoring the connection between ecological well-being

and financial success. Strong compliance has been encouraged by the inclusion of local people in the creation and implementation of conservation laws, guaranteeing the long-term viability of these initiatives. This opinion is supported by Pomeroy & Berkes (1997), who highlight that community involvement improves management, enforcement, and biodiversity recovery in Marine Protected Areas (MPAs) around the world.

Table 3. Key factors for long-term success in community-based conservation

Factor	Description	Examples
Local involvement	Engagement of local communities in designing and enforcing conservation regulations ensures compliance and advocacy.	MPAs in Mexico and the Philippines (Villaseñor-Derbez et al., 2022; Marriott et al., 2021)
Financial support	Consistent, long-term funding is necessary for sustaining conservation efforts.	Conservation Trusts, Payment for Ecosystem Services (Sangha et al., 2024)
Policy integration	Aligning local efforts with national biodiversity goals improves scalability and sustainability.	Mexico's MPAs (Précoma-de la Mora et al., 2021)
External enforcement	Protection against external threats like illegal fishing requires robust enforcement beyond local communities.	Pacific Island MPAs (Chen et al., 2023)
Socio-economic benefits	Eco-tourism and sustainable fisheries provide alternative income sources for local communities.	Gulf of California (Villaseñor-Derbez et al., 2022)
Capacity building	Providing technical expertise and infrastructure enhances community capacity for effective conservation management.	Solar electrification projects (Bhandari & Stadler, 2011)

Table 3 outlines key factors for the long-term success of community-based conservation (CBC). Local involvement is crucial, with community engagement in planning and enforcement enhancing compliance and advocacy in marine protected areas (MPAs) in Mexico and the Philippines (Villaseñor-Derbez et al., 2022; Marriott et al., 2021). Financial support is essential for sustaining initiatives, exemplified by Conservation Trusts and Payments for Ecosystem Services (Sangha et al., 2024). Policy integration aligns local efforts with national biodiversity goals, improving scalability and sustainability, particularly in Mexico (Précoma-de la Mora et al., 2021). External enforcement is necessary to combat threats like illegal fishing, as seen in Pacific Island MPAs (Chen et al., 2023). Socio-economic benefits from eco-tourism and sustainable fisheries provide alternative income, supporting conservation indirectly (Villaseñor-Derbez et al., 2022). Lastly, capacity building through technical expertise enhances local conservation capabilities, illustrated by solar electrification projects (Bhandari & Stadler, 2011).

CBC programs have achieved notable local success, but scaling these initiatives to national or regional levels presents significant challenges. Zhang et al. (2020) emphasize that community involvement is essential for expanding conservation efforts, requiring support from governments and international organizations through policies and substantial financial investments. Many communities in developing nations depend on external financial assistance to sustain conservation activities, which is exacerbated by a lack of technological infrastructure and expertise. Chen et al. (2023) highlights that community-managed marine protected areas (MPAs) in the Pacific Islands are threatened by external pressures like overfishing, compounded by weak national enforcement that allows illegal activities to continue despite strong local involvement. This undermines the ecological and socio-economic benefits of MPAs.

Policy integration is crucial for CBC success, as noted by Précoma-de la Mora et al. (2021), necessitating the alignment of local conservation practices with national

biodiversity goals to secure government support and funding. In Mexico, integrating community-based projects into the national conservation framework has facilitated long-term sustainability by ensuring MPAs receive the necessary resources and technical support. Ultimately, multi-level governance, which involves collaboration between local communities and regional or national authorities, has proven effective in sustaining conservation outcomes and ensuring their long-term viability.

Sustained financial backing is a major challenge for the sustainability of CBC activities, as many projects rely on initial funding from NGOs or foreign donors, which is often not sustainable. Sangha et al. (2024) emphasizes the need for sustainable finance systems, proposing mechanisms like payment for ecosystem services (PES) and conservation trusts to ensure a steady funding flow for community-led initiatives that also preserve vital ecosystem services. Additionally, building community capacity is crucial; while traditional ecological knowledge is important, many communities require access to modern technologies such as data analytics and satellite monitoring systems to enhance their conservation efforts, especially against threats like illegal fishing and deforestation (Bhandari & Stadler, 2011).

Climate change poses a growing threat, undermining the ecological benefits of CBC. Huang et al. (2024) highlight that locally managed marine protected areas (MPAs) have been effective in enhancing environmental resilience, helping coastal populations adapt to climate impacts while maintaining biodiversity. Strong governance frameworks are necessary to support these initiatives, with national and international structures providing financial resources and policy backing (Chen et al., 2023; Précoma-de la Mora et al., 2021).

3.3.2 Socio-economic benefits and policy integration

Community-based conservation (CBC) initiatives play a vital role in biodiversity recovery and provide socioeconomic benefits to local communities. Huang et al. (2024) highlight that CBC efforts, such as the Marine Protected Areas (MPAs) in the Pacific, have not only increased biodiversity but also enhanced economic opportunities for local populations through sustainable fishing practices. The link between economic resilience and biodiversity conservation is evident, as these initiatives enable local communities to actively manage and conserve natural resources, leading to fish population rebounds and reduced overfishing pressures. In Mexico, Ortiz-Lozano et al. (2017) found that MPAs resulted in a 50% increase in fish populations, significantly boosting fishery output and food security for local communities. The restoration of marine ecosystems has provided additional resources, supported sustainable economic activities and fostered growth in sectors like ecotourism. This diversification of revenue streams and reduced reliance on overfished resources contribute to the long-term sustainability of conservation efforts, ultimately enhancing economic stability and community support for conservation measures.

Table 4. Socio-economic and environmental benefits of community-based conservation

Benefit	Description	Examples
Improved fishery yields	Increase in fish populations boosts sustainable fisheries, providing long-term economic benefits for local communities.	MPAs in Mexico and the Pacific (Ortiz-Lozano et al., 2017; Huang et al., 2024)
Eco-tourism development	Protected areas attract tourists, providing new revenue streams and reducing pressure on natural resources.	MPAs in Mexico (Ortiz-Lozano et al., 2017)
Sustainable livelihoods	Communities benefit from jobs in conservation, eco-tourism, and sustainable fisheries, improving economic resilience.	Pacific MPAs (Huang et al., 2024)

Ecosystem services	Communities benefit from clean water, flood protection, and other ecosystem services provided by well-managed MPAs.	Nature-based solutions (Tickner et al., 2020)
Policy integration	Aligning local conservation efforts with national biodiversity goals improves funding and long-term sustainability.	Mexico's MPAs (Précoma-de la Mora et al., 2021)

Table 4 outlines the socio-economic and environmental benefits derived from community-based conservation (CBC) efforts. Improved fishery yields are a significant benefit, providing economic stability for communities through sustainable fisheries, particularly in Marine Protected Areas (MPAs) in Mexico and the Pacific (Ortiz-Lozano et al., 2017; Huang et al., 2024). Eco-tourism development is another advantage, as protected areas attract tourists, creating new revenue streams while reducing pressure on natural resources. Additionally, CBC initiatives support sustainable livelihoods by generating jobs in conservation, eco-tourism, and fisheries, thereby enhancing local economic resilience, especially in Pacific MPAs (Huang et al., 2024). Well-managed MPAs also provide critical ecosystem services, such as clean water and flood protection, which contribute to community well-being through nature-based solutions (Tickner et al., 2020). Moreover, policy integration is emphasized, as aligning community conservation with national biodiversity targets improves funding opportunities and ensures sustainable support, as evidenced in Mexico's MPAs (Précoma-de la Mora et al., 2021). Collectively, these findings illustrate how community-based conservation serves as a comprehensive approach that promotes both ecological health and socio-economic development.

Table 5. Key strategies for policy integration and economic sustainability in community-based conservation

Strategy	Description	Examples
National policy alignment	Integrating local conservation efforts into national biodiversity strategies improves access to funding and long-term support.	Mexico's MPAs (Précoma-de la Mora et al., 2021)
Nature-based solutions (NBS)	Leveraging natural processes in water management and other sectors to enhance biodiversity conservation and ecosystem services.	Freshwater management through NBS (Tickner et al., 2020)
Economic incentives	Providing financial rewards for sustainable practices, such as eco-tourism or payment for ecosystem services, incentivizes conservation.	Mexico's eco-tourism (Ortiz-Lozano et al., 2017)
Community involvement in decision-making	Involving local stakeholders in planning and managing natural resources ensures long-term compliance and social cohesion.	Pacific MPAs (Huang et al., 2024)

Table 5 outlines key strategies for integrating policy and ensuring economic sustainability in community-based conservation (CBC). It emphasizes the importance of national policy alignment, which enhances funding opportunities and long-term support by integrating local conservation efforts with national biodiversity strategies, as demonstrated by Mexico's Marine Protected Areas (MPAs) (Précoma-de la Mora et al., 2021). Nature-Based Solutions (NBS), such as utilizing natural processes in water management, contribute significantly to biodiversity conservation and ecosystem services, evidenced in freshwater management initiatives (Tickner et al., 2020).

Economic incentives are also crucial, offering financial rewards for sustainable practices like eco-tourism and payments for ecosystem services, thereby encouraging conservation efforts, as seen in Mexico's eco-tourism projects (Ortiz-Lozano et al., 2017). Furthermore, community involvement in decision-making is vital for ensuring long-term

compliance and social cohesion, illustrated by the collective management of marine resources in the Pacific (Huang et al., 2024).

3.3.3 Financial and technical barriers to scaling initiatives

A key challenge in scaling community-based conservation (CBC) initiatives is securing adequate financial and technical support. While small-scale CBC efforts have succeeded, expanding these projects requires significant funding. Sangha et al. (2024) highlights the complexities in obtaining sustainable funding, noting that donor expectations often do not align with community needs. They stress the importance of clearer funding mechanisms for long-term support, as current funding is frequently inconsistent and reliant on short-term grants. Developing robust financial models is crucial to prevent CBC initiatives from being abandoned once initial funding is exhausted, leaving communities without the resources to sustain conservation efforts.

Table 6. Key financial and technical barriers to scaling community-based conservation initiatives

Barrier	Description	Examples
Inconsistent funding	Short-term grants often fail to provide the financial security needed for long-term conservation efforts.	Conservation funding models (Sangha et al., 2024)
High initial costs	Large upfront investments in infrastructure and technology hinder the scalability of conservation projects.	Solar energy projects in Nepal (Bhandari & Stadler, 2011)
Lack of technical expertise	Communities often lack access to modern technologies or the skills required to implement and maintain them effectively.	Renewable energy projects (Bathaei & Štreimikienė, 2023)
Donor-community mismatches	Misalignment between donor expectations and community needs creates obstacles to securing sustainable funding.	Funding complexities in CBC (Sangha et al., 2024)
Insufficient policy frameworks	Weak or absent policy support hampers the expansion and institutionalization of community-led conservation initiatives.	Renewable energy expansion (Bhandari & Stadler, 2011; Bathaei & Štreimikienė, 2023)

Table 6 identifies key financial and technical barriers that impede the scaling of community-based conservation (CBC) initiatives. Inconsistent funding, primarily through short-term grants, limits the sustainability of these efforts (Sangha et al., 2024). High initial costs for infrastructure and technology present significant financial challenges, as illustrated by solar energy projects in Nepal (Bhandari & Stadler, 2011). Additionally, the lack of technical expertise in communities restricts scalability, particularly in renewable energy projects (Bathaei & Štreimikienė, 2023). Donor-community mismatches, where donor expectations diverge from community needs, complicate sustainable funding efforts. Insufficient policy frameworks also hinder the expansion of community-led conservation initiatives. The renewable energy sector faces similar challenges, with high upfront costs slowing the expansion of successful small-scale projects in rural areas. Both studies advocate for stronger policy frameworks and financial incentives to mitigate these barriers and encourage investment in community-led renewable energy systems. In regions like Nepal and Bangladesh, expanding solar power could yield environmental and economic benefits, but success depends on government support for installation costs and technical assistance, highlighting the critical role of public-private partnerships in driving large-scale change.

A significant technical barrier to scaling community-based conservation (CBC) initiatives is the lack of access to modern technologies and the skills to use them effectively. Many rural and underdeveloped communities possess valuable traditional knowledge

about their ecosystems but lack the technical expertise to integrate new technologies, such as satellite monitoring and data analytics, into their conservation efforts (Bhandari & Stadler, 2011). This gap limits their ability to expand projects and manage larger conservation areas. Addressing this challenge requires robust capacity-building efforts to equip community members with the necessary technical skills and tools. Bathaei & Štreimikienė (2023) emphasize that governments and international organizations should invest in training programs alongside ongoing technical support to ensure communities can effectively utilize modern technologies and maintain their conservation projects.

The misalignment between donor expectations and community needs complicates securing sustainable funding for CBC initiatives. Sangha et al. (2024) highlight that donors often focus on short-term, measurable outcomes, such as immediate biodiversity gains, without considering the broader social and economic contexts of the communities they support. This creates challenges in securing long-term funding, as community-led projects struggle to meet external benchmarks that may not align with their priorities. To address this, more flexible funding mechanisms are needed, allowing communities to balance their conservation efforts with donor expectations while prioritizing their own needs.

3.3.4 The role of local knowledge in enhancing conservation outcomes

Local and traditional ecological knowledge is essential in shaping effective community-based conservation (CBC) strategies, as integrating this knowledge with modern conservation techniques enhances ecological outcomes and fosters community engagement. For instance, Marriott et al. (2021) highlighted that traditional fishing practices in the Philippines were vital in designing Marine Protected Areas (MPAs) that both protected biodiversity and respected local customs. By incorporating methods such as selective fishing and seasonal restrictions, conservation efforts successfully maintained fish populations while preserving community livelihoods, leading to higher compliance rates due to a stronger sense of ownership among local communities. Similarly, Huang et al. (2024) found that traditional resource management practices across Southeast Asia significantly contributed to the success of MPAs and community-led initiatives. Involving local communities in the design and enforcement of conservation regulations resulted in substantial ecological benefits and improved community resilience. This collaborative approach not only addressed complex ecological challenges but also strengthened the connection between communities and conservation efforts, promoting long-term sustainability and resilience in both environmental and social contexts.

Table 7. The role of local knowledge in enhancing conservation outcomes

Aspect	Description	Examples
Traditional knowledge integration	Using local knowledge of ecosystems and resources to shape conservation strategies that align with cultural practices.	Philippines MPAs (Marriott et al., 2021)
Community compliance	Higher compliance rates due to conservation strategies that incorporate and respect local customs and livelihoods.	MPAs in Southeast Asia (Huang et al., 2024)
Adaptation to local conditions	Conservation plans tailored to specific ecological and cultural contexts ensure greater success and sustainability.	Gulf of California MPAs (Villaseñor-Derbez et al., 2022)
Collaborative governance	Involving communities in the design and enforcement of conservation regulations leads to stronger ecological outcomes.	Southeast Asia (Huang et al., 2024)
Cultural and ecological synergy	Traditional practices such as rotational fishing help maintain ecosystems while supporting local economies.	Philippines and Mexico MPAs (Marriott et al., 2021; Villaseñor-Derbez et al., 2022)

Table 7 highlights the vital role of local knowledge in enhancing conservation outcomes. The integration of traditional knowledge allows conservation strategies to respect cultural practices, as observed in Marine Protected Areas (MPAs) in the Philippines (Marriott et al., 2021). When conservation efforts align with local customs and livelihoods, community compliance improves, leading to more effective protection in Southeast Asian MPAs (Huang et al., 2024). Tailoring conservation plans to specific ecological and cultural contexts has proven to enhance sustainability, as seen in the Gulf of California MPAs (Villaseñor-Derbez et al., 2022). Collaborative governance, where communities engage in rule-making and enforcement, further strengthens ecological outcomes across Southeast Asia (Huang et al., 2024). Additionally, practices like rotational fishing demonstrate a synergy between cultural and ecological interests, benefiting both ecosystems and local economies in regions like the Philippines and Mexico (Marriott et al., 2021; Villaseñor-Derbez et al., 2022). In Mexico, Villaseñor-Derbez et al. (2022) emphasize the pivotal role of local fishermen in developing conservation strategies that combine traditional insights about fish populations with scientific research, resulting in improved biodiversity and fish stock recovery. This collaborative approach not only enhances conservation effectiveness but also fosters community commitment, as local stakeholders witness the positive impacts of their contributions, promoting long-term support for conservation initiatives.

The ability of local knowledge to tailor conservation strategies to specific ecological and cultural contexts is a significant advantage, especially in regions like Southeast Asia and Latin America, where biodiversity and local livelihoods are closely linked. Huang et al. (2024) highlight that conservation projects co-designed with communities are more successful, ensuring that local practices—such as rotational fishing and agroforestry—are incorporated into conservation plans. These generational practices not only balance human needs with environmental sustainability but also foster long-term success in conservation efforts. However, integrating local knowledge presents challenges. Marriott et al. (2021) note that traditional practices are increasingly threatened by external pressures such as industrial fishing, deforestation, and climate change, necessitating a balance between preserving traditional methods and introducing modern technologies.

Tools like satellite monitoring and data analytics can enhance traditional practices by providing real-time information on fish populations and environmental conditions, allowing communities to adapt their strategies accordingly. Ultimately, the combination of local knowledge and modern scientific techniques enhances conservation outcomes. Successful community-based conservation (CBC) initiatives treat communities as partners, fostering mutual respect and ensuring that conservation strategies reflect the needs and values of those reliant on protected ecosystems. Villaseñor-Derbez et al. (2022) argue that this partnership strengthens both biodiversity and community resilience, making CBC essential for achieving long-term conservation goals. By encouraging collaboration between local communities and conservation experts, CBC initiatives are better positioned to tackle the complex ecological challenges posed by today's rapidly changing environment.

3.3.5 The importance of policy and governance in sustainability

Community-based initiatives can effectively address ecological challenges, but their success largely relies on strong policy and governance support. Précoma-de la Mora et al. (2021) highlight the importance of multi-level governance frameworks that engage local communities alongside national governments and international organizations to achieve sustainable conservation outcomes. Such frameworks enable local conservation efforts to be integrated into broader national strategies, ensuring access to legal, technical, and financial resources essential for scaling and sustaining these initiatives. For instance, Chen et al. (2023) emphasizes that national support for community-led Marine Protected Areas (MPAs) in the Pacific Islands has been crucial for enforcing conservation regulations and protecting against external threats. However, the effectiveness of this governance model hinges on collaboration between different government levels and communities, as underscored by Tickner et al. (2020). Successful nature-based solutions (NBS) must

incorporate local knowledge to adapt strategies to specific ecological and cultural contexts, thereby enhancing compliance and ensuring long-term sustainability.

Table 8. Key roles of policy and governance in community-based conservation

Role	Description	Examples
Multi-level governance	Involves coordination between local, national, and international actors to ensure long-term sustainability of CBC projects.	Pacific Island MPAs (Chen et al., 2023)
Institutionalization	Incorporates CBC into formal national environmental strategies, securing legal backing and resources for long-term conservation.	Mexico's MPAs (Précoma-de la Mora et al., 2021)
Policy integration	Aligning local conservation practices with national and international biodiversity goals for greater impact and support.	NBS in freshwater management (Tickner et al., 2020)
Legal and financial support	National governments provide the necessary legal and financial frameworks to scale up and sustain CBC initiatives.	Pacific MPAs (Chen et al., 2023)
International collaboration	International organizations provide funding, technical expertise, and pressure for governments to uphold conservation commitments.	Pacific MPAs (Chen et al., 2023)

Table 8 emphasizes the critical roles of policy and governance in enhancing community-based conservation (CBC) efforts. Multi-level governance, which coordinates local, national, and international actors, is vital for sustaining CBC projects, particularly in Pacific Island Marine Protected Areas (MPAs) (Chen et al., 2023). Institutionalizing CBC within national environmental strategies ensures legal backing and resource allocation, as demonstrated by Mexico's MPAs (Précoma-de la Mora et al., 2021). Policy integration aligns local conservation initiatives with broader biodiversity objectives, amplifying their impact, as seen in Nature-Based Solutions (NBS) for freshwater management (Tickner et al., 2020). Furthermore, legal and financial support from national governments is essential for scaling and sustaining these initiatives, with examples from Pacific MPAs (Chen et al., 2023). International collaboration enhances these efforts by providing necessary funding, expertise, and pressure on governments to uphold conservation commitments, further supporting CBC in these regions. Overall, the findings underline the importance of robust policy frameworks and governance structures in promoting effective and lasting community-based conservation initiatives.

Tickner et al. (2020) emphasize that effective governance mechanisms must include community representation at all decision-making levels to ensure conservation policies align with the needs of those who depend on protected ecosystems. This involvement enhances compliance and fosters a sense of ownership among local stakeholders, leading to stronger enforcement of regulations and support for long-term biodiversity protection. Additionally, community participation in governance makes conservation strategies more inclusive and equitable, addressing both environmental and social outcomes. In conclusion, the success of community-based initiatives relies heavily on supportive policy frameworks and governance structures. Multi-level governance that involves local, national, and international actors is essential for scaling community-based conservation (CBC) projects and ensuring their long-term sustainability. By integrating CBC into broader environmental policies, governments and organizations can secure the necessary financial and legal resources to protect biodiversity and improve the livelihoods of local communities. As environmental challenges increase globally, these governance frameworks will be vital for the success of CBC initiatives across diverse ecosystems and regions.

3.4 Marine conservation (SDG 14)

The study by Villaseñor-Derbez et al. (2022) provides a comprehensive analysis of community-based marine conservation efforts in Mexico's Gulf of California, highlighting their significant impact on restoring marine biodiversity. By establishing over 514 km^2 of marine reserves, these initiatives have successfully facilitated fish population recovery and habitat protection. This research underscores the critical role that local knowledge and community involvement play in sustainable marine management, aligning closely with SDG 14, which focuses on conserving and sustainably using the oceans, seas, and marine resources. Community-led conservation not only enhances ecological outcomes but also fosters a sense of ownership and responsibility among local populations, which is essential for long-term sustainability. The study further emphasizes that integrating traditional ecological knowledge into conservation strategies can lead to more effective management practices, enhancing resilience against environmental threats such as overfishing and habitat degradation. While the study presents a successful model for marine conservation, it also implies the need for ongoing support and resources to ensure these initiatives can be scaled and sustained. The emphasis on local engagement and the demonstrated success of community-based approaches offers valuable insights for other regions facing similar challenges in marine conservation, making a compelling case for the replication of such initiatives to achieve broader sustainability goals in marine ecosystems.

The study by Marriott et al. (2021) explores the effects of community-based management of marine reserves in the Philippines, specifically focusing on their impact on coral reef fish populations and overall biodiversity. The community-managed marine reserves have significantly enhanced species richness and biomass, demonstrating the effectiveness of local stewardship in marine conservation. A critical factor identified in the study is the reliance on local knowledge and community enforcement, which have proven essential in improving reef biodiversity.

The study also highlights challenges in scaling these successful initiatives due to limited financial and technical resources. This limitation underscores the need for more substantial investment and support to expand community-led conservation efforts, particularly in regions where resources are scarce. The alignment of this research with SDG 14 emphasizes the importance of conserving and sustainably using ocean and marine resources. The potential of community involvement in enhancing marine biodiversity while also pointing to the necessity of addressing the barriers that hinder the broader implementation of such effective conservation strategies. By leveraging local knowledge and fostering community engagement, the Philippines can further advance its marine conservation efforts and contribute to global sustainability goals.

The study by O'Garra et al. (2023) evaluates a community-based marine management initiative in Fiji, highlighting the positive correlation between increased community participation and improved governance with enhanced conservation outcomes, particularly in fish stock management. The involving local communities in decision-making processes is crucial for effective marine conservation, aligning with SDG 14, which focuses on conserving and sustainably using ocean and marine resources. Despite these participatory efforts, there have been limited direct ecological improvements, signalling a critical gap in translating community engagement into tangible ecological benefits. This suggests a need for more robust mechanisms and strategies to ensure that the involvement of communities leads to sustained and measurable improvements in marine ecosystems. The research underscores the importance of not only fostering community involvement but also implementing effective frameworks that can enhance the long-term ecological impact of such initiatives. By addressing these challenges, Fiji can strengthen its marine conservation efforts and contribute more effectively to global sustainability objectives.

Hoffmann's (2022) explores the challenges and opportunities associated with area-based conservation efforts in achieving sustainability goals, particularly within protected areas. The study identifies significant issues such as human encroachment and habitat fragmentation that threaten biodiversity. Notably, it highlights that community-managed

areas experience less biodiversity loss compared to government-managed ones, attributing this success to effective local enforcement and the application of traditional knowledge. The findings underscore the importance of integrating local communities into conservation planning, advocating for their active involvement in decision-making processes. This community-centric approach not only enhances biodiversity outcomes but also aligns with SDG 14, which emphasizes the conservation and sustainable use of oceans, seas, and marine resources.

In the synthesis of the reviewed studies, we found the following narrative can be derived, which supports the need for technological advancement, renewable energy, and, most importantly, community-based approaches to some of the core sustainability issues. In varying fields for water, energy, and oceans, community involvement holds as a key enabler for reaching the global goal of SDGs. In clean water and sanitation (SDG 6) of course, there emerges innovative renewable energy – powered desalination systems, bioluminescence sensors for real-time water quality, and community led conservation. However, cost, technological and scalability issues remain major concerns hence the need for sound financial support and policies. These approaches show that the enhancement of communities with well-developed but easily accessible technologies leads to the effectiveness and sustainment of the approaches to solve intricate ecological and socio-economic issues.

SDG 7 on affordable and clean energy solutions reveal the need to harness people's involvement in enhancing energy transitions in hard to reach and rural areas. Clean cooking through improved stove and innovative technologies and renewables such as solar and wind energy systems have established reliable health, economic growth, and environmental conservation impacts. However, their implementation is constrained by technical deficits of NGOs implementing projects, lack of cross-linkages between policies and the inadequacy of funding frameworks. Furthermore, the research on marine conservation and urban sustainability both in the UN SDLGs 14 and 11 explore the compatibility of ecological restoration and socio-economic rates. Marine protected areas, tourism and responsible fishing demonstrate that conservation approaches complement traditional practices of the locals. The inclusion of bottom up approaches with top down structures in government levers and Information Technology has demonstrated the possibility of long-term sustainability. All these evidence cumulatively emphasises the need for collective effort between the players, the local communities, governments, private sectors and the IDO for the thriving of these plans for more recognition in the global society.

4. Conclusion

In areas of the Asia-Pacific where ecosystems and local livelihoods are at risk due to environmental deterioration, community-based conservation, or CBC, has shown great promise in helping to achieve sustainable development goals. The profound involvement of local communities, whose customs and ecological expertise are essential to the efficient management of natural resources, is the reason behind the success of CBC projects. SDGs 6, 7, 11, and 14 have all been directly aligned with these projects, which have improved water quality, access to renewable energy, urban sustainability, and marine environment conservation. In addition to ensuring that conservation policies are pertinent to the unique social, economic, and environmental circumstances of the people involved, the integration of contemporary conservation approaches with local stewardship and community-driven solutions promotes ecosystem resilience. Through channels like ecotourism and sustainable fisheries, this integration enhances biodiversity and boosts economic circumstances, generating a feedback loop where socioeconomic welfare and environmental health reinforce each other.

To support these community-led initiatives, governments, non-governmental organizations, and international organizations must work together to develop multi-level governance structures that offer the required financial, legal, and technological foundations. In order to ensure long-term sustainability, such governance systems should place a high

priority on policy alignment and make sure that national biodiversity initiatives incorporate local conservation activities. Supporting local communities' conservation efforts is increasingly important as climate change and environmental degradation worsen, making CBC a crucial tactic in the worldwide struggle for ecological resilience and sustainable development.

Future research should explore scalable models of community-based conservation (CBC) that blend traditional and modern practices across Asia-Pacific's diverse regions, focusing on adaptability to challenges like urbanization and climate change. Studies should also examine how multi-level governance and policy alignment support CBC sustainability. Research into financial and technical barriers, including potential funding like green finance, and the socio-economic impacts on employment and health, would highlight CBC's broader societal benefits and its essential role in sustainable development strategies for the region.

Acknowledgement
The author sincerely thanks all scholars whose works were reviewed, as well as mentors and peers who provided valuable guidance, feedback, and encouragement throughout the development of this research.

Author Contribution
The author conducted all research stages, including problem formulation, literature review, data analysis, manuscript writing, editing, and final revisions.

Funding
This research received no external funding.

Ethical Review Board Statement
Not available.

Informed Consent Statement
Not available.

Data Availability Statement
Not available.

Conflicts of Interest
The author declares no conflict of interest.

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