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Review

Integrated Natural Resource Management and Sustainable Livelihoods: A Review of Ecosystem-Based Approaches for Sustainability and Community Resilience

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Abstract: This review explores the essential link between sustainable livelihoods and the natural resource management (NRM), stressing the importance of ecosystem health for ensuring long-term socio-economic and environmental stability. The research looks at significant strategies like the Sustainable Livelihoods Framework, community-based natural resource management (CBNRM), and ecosystem-based adaptation (EbA), which foster resilience, fairness, and participatory governance. It underscores that diverse livelihoods, traditional ecological knowledge, and inclusive decision-making enhance community resilience to climate change and resource-related vulnerabilities. Recent research developments highlight integrated planning approaches that take into account the connections among land, water, energy, and biodiversity, while addressing issues of climate resilience and social equity. Technological tools, market-oriented incentives, and innovative policies are acknowledged for their role in improving NRM effectiveness. Crucially, this review emphasizes the importance of collaboration among various stakeholders and the integration of indigenous knowledge to ensure relevance to specific contexts. The future of NRM is dependent on aligning ecological sustainability with human development objectives through adaptive, inclusive, and knowledge-driven approaches. Ultimately, the review calls for a transformative shift towards comprehensive, integrated, and community-focused frameworks for natural resource governance that can effectively tackle global environmental and livelihood issues.

Keywords: sustainable livelihoods; natural resource management; climate change; ecosystem-based management; ecosystem services; community resilience

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1. Introduction

Sustainable livelihoods are vital for building resilient communities worldwide through the responsible management of natural resources (Morse, 2025; Su et al., 2025). This ensures long-term economic, social, and environmental benefits. The health of the environment is closely linked to human well-being, especially for rural communities reliant on agriculture, fishing, and forestry. Unchecked exploitation of these resources can lead to environmental degradation and threaten livelihoods. Sustainable livelihood approaches promote practices that enhance resource productivity, strengthen resilience against shocks, empower local communities, and ensure fair benefit distribution (Chiang, 2024). Understanding the interactions between social, economic, and ecological systems is essential for developing effective, context-specific strategies to address resource management challenges (Natarajan et al., 2022).

Diversifying income sources is crucial for sustainable livelihoods. Communities should broaden their strategies beyond a single resource to manage risks and seize opportunities. For instance, a fishing community might supplement its income through eco-tourism, agroforestry, or small-scale handicrafts. This approach not only helps households withstand shocks like climate change but also reduces pressure on individual resources, promoting long-term sustainability (A. Kumar et al., 2023; Mazibuko, 2013; Natarajan et al., 2022). Combining traditional knowledge with modern technology is also vital. Indigenous communities possess valuable insights into sustainable resource management that can be integrated with contemporary practices (Galappaththi & Schlingmann, 2023). Technologies like remote sensing and mobile applications can enhance mon-

itoring and decision-making, leading to more effective resource management. It's important to ensure these tools are accessible and user-friendly to avoid digital divides and reliance on external expertise.

Inclusive governance and participatory decision-making are essential for sustainable livelihood initiatives. These efforts are most effective when local stakeholders, including marginalized groups like women, indigenous peoples, and youth, actively participate throughout all project stages (Bansal et al., 2024). This involvement fosters ownership and empowers communities, enhancing the legitimacy and effectiveness of interventions. Strong partnerships among government agencies, civil society, academia, and the private sector are crucial, built on transparency, accountability, and respect for customary rights and traditional governance systems. Additionally, addressing the root causes of vulnerability and promoting social justice are key to sustainable livelihoods. This means tackling structural inequalities and ensuring equitable distribution of benefits to reduce poverty and foster social stability. Policymakers should also integrate environmental sustainability into broader agendas, such as poverty reduction and climate resilience, to balance social, economic, and environmental goals.

Sustainable livelihoods can be achieved through effective natural resource management, fostering resilient and equitable communities in harmony with nature (A. Kumar et al., 2023; Arslan et al., 2022; Muchunguzi, 2023; Natarajan et al., 2022). By adopting principles of diversification, integration, participation, and equity, stakeholders can optimize local resources to enhance livelihoods, conserve biodiversity, and protect ecosystem services for future generations. This requires a collective effort guided by a commitment to sustainability and social justice. By working together, we can create an inclusive future for people and the planet. This study advocates for a shift in natural resource management that acknowledges ecosystem complexity and human diversity, promoting harmonious coexistence between communities and the natural world.

This research enhances the understanding of sustainable livelihoods by merging ecosystem-based management with participatory governance and adaptive capacity. It shows how localized resource strategies, when aligned with broader ecological and institutional frameworks, promote long-term sustainability. The study highlights recent advancements, such as integrating traditional ecological knowledge with digital tools, applying sustainable livelihood frameworks in climate planning, and supporting diversified livelihood portfolios for resilience. Unlike previous studies focused on either environmental or economic outcomes, this review identifies links between equity, resilience, and regeneration, providing a multi-faceted view for natural resource governance. This transdisciplinary approach lays the groundwork for community-driven resource models that are scalable and replicable.

This study examines the connection between natural resource management and sustainable livelihoods, emphasizing how resource practices can bolster community resilience and protect the environment. Despite existing research on sustainable resource use (Morse, 2025; Natarajan et al., 2022; Shah et al., 2021; Singh et al., 2024; Su et al., 2025), there is still a gap in identifying effective strategies that enhance livelihoods and adaptive capacity in the face of challenges like climate change. The literature also lacks comprehensive frameworks that combine community-based approaches, equitable governance, and income diversification for sustainable, long-term solutions.

To explore the links between sustainable livelihoods and the management of natural resources, this study utilizes a qualitative literature review approach that integrates various findings. We systematically gathered and examined scholarly articles, case studies, and policy documents published over the past two decades (2005–2025), using major academic databases such as Scopus, Web of Science, and Google Scholar. The focus was on selecting works that discuss ecosystem-based approaches, livelihood diversification, participatory governance, and climate resilience in various ecological and socio-economic settings. The thematic analysis is organized around principles derived from the Sustainable Livelihoods Framework and ecosystem-based management, facilitating a critical synthesis of strategies for implementation and their results. This methodology guarantees a thorough understanding of existing practices, challenges, and innovations in the governance of natural resources and community resilience. The main aims and objectives of this study are: (a) to explore the connection between sustainable livelihoods and NRM; (b) to examine the role of natural resources in supporting sustainable livelihoods; (c) to discuss approaches to sustainable livelihoods and NRM, including various frameworks and community-based strategies; and (d) to highlight the relationship between NRM, climate change adaptation, and ecosystem-based approaches that promote resilience.

The study is organized into the following segments to provide a comprehensive understanding of sustainable livelihoods and natural resource management:

- *Section 2* explores the interconnections between natural resources and sustainable livelihoods, highlighting their mutual dependence.
- *Section 3* examines various approaches to sustainable livelihoods and natural resource management, providing insights into practical frameworks and strategies.

- *Section 4* focuses on natural resource management in the context of climate change adaptation, emphasizing the importance of resilience and adaptive capacity.
- *Section 5* presents an ecosystem-based approach to sustainable livelihoods, underscoring a holistic strategy that aims to balance human well-being with the preservation of ecological integrity.
- *Section 6* discusses Integrated Resource Planning (IRP) for natural resource management—an inclusive and strategic approach to achieving sustainable development by managing interconnected natural systems holistically. IRP serves as a comprehensive framework that addresses the interdependencies and cumulative impacts of resource use on the environment, economy, and society.
- *Section 7* outlines future perspectives and emerging research trends in natural resource management, pointing toward more adaptive, inclusive, and sustainable practices.
- *Section 8* concludes the study by synthesizing key findings and reinforcing the importance of integrated, ecosystem-based, and community-driven approaches to ensure the sustainability of natural resources and the well-being of present and future generations.

2. Natural Resources and Sustainable Livelihood

Natural resources are fundamental to sustainable livelihoods, supplying the raw materials and ecosystem services essential for human societies. These resources, which include fertile soils, clean water, forests, fisheries, and minerals, are critical for sustenance, income, and overall well-being for millions globally (Ahmed et al., 2020; Arslan et al., 2022). However, the unsustainable exploitation and degradation of these resources threaten livelihood security, biodiversity, and ecosystem resilience, particularly in rural and marginalized communities, worsening poverty, inequality, and vulnerability (Ahmed et al., 2020). Sustainable livelihood approaches seek to address these challenges by encouraging responsible stewardship and equitable management of natural resources to ensure their long-term viability and fair distribution of benefits (Arslan et al., 2022; Shah et al., 2021; Singh et al., 2024; Mensah & Amoah, 2024). This involves holistic and participatory strategies that balance the needs of present and future generations while protecting the ecological integrity and cultural diversity of various landscapes and seascapes. These initiatives recognize the intrinsic value of nature and the interconnectedness between human well-being and environmental health, fostering a harmonious relationship between people and the planet based on equity, resilience, and intergenerational justice. Through collaborative action and shared stewardship, communities can harness natural resources' transformative power to build resilient, inclusive, and prosperous societies within planetary boundaries.

Natural resources play a crucial role in shaping community livelihoods and well-being worldwide (Figure 1). These resources encompass elements such as land, water, forests, minerals, fisheries, and biodiversity, forming the basis for various economic activities like agriculture, fishing, forestry, mining, and tourism (Lienert & Burger, 2015; Li et al., 2024; Sangha, 2020). They provide essential raw materials, food, energy, and other ecosystem services vital for human survival and development. Beyond their instrumental value for human welfare, these resources hold intrinsic value, contributing to cultural identity, spiritual significance, and aesthetic enjoyment. Unsustainable exploitation and degradation of natural resources pose significant threats to sustainable livelihoods and environmental sustainability. Overexploitation of fisheries, deforestation, soil erosion, water pollution, and habitat destruction are examples of harmful practices. These activities undermine ecosystem resilience and threaten the livelihoods of millions who depend directly on natural resources. The concept of sustainable livelihoods has emerged as a comprehensive approach to promoting human well-being while preserving ecosystem integrity.

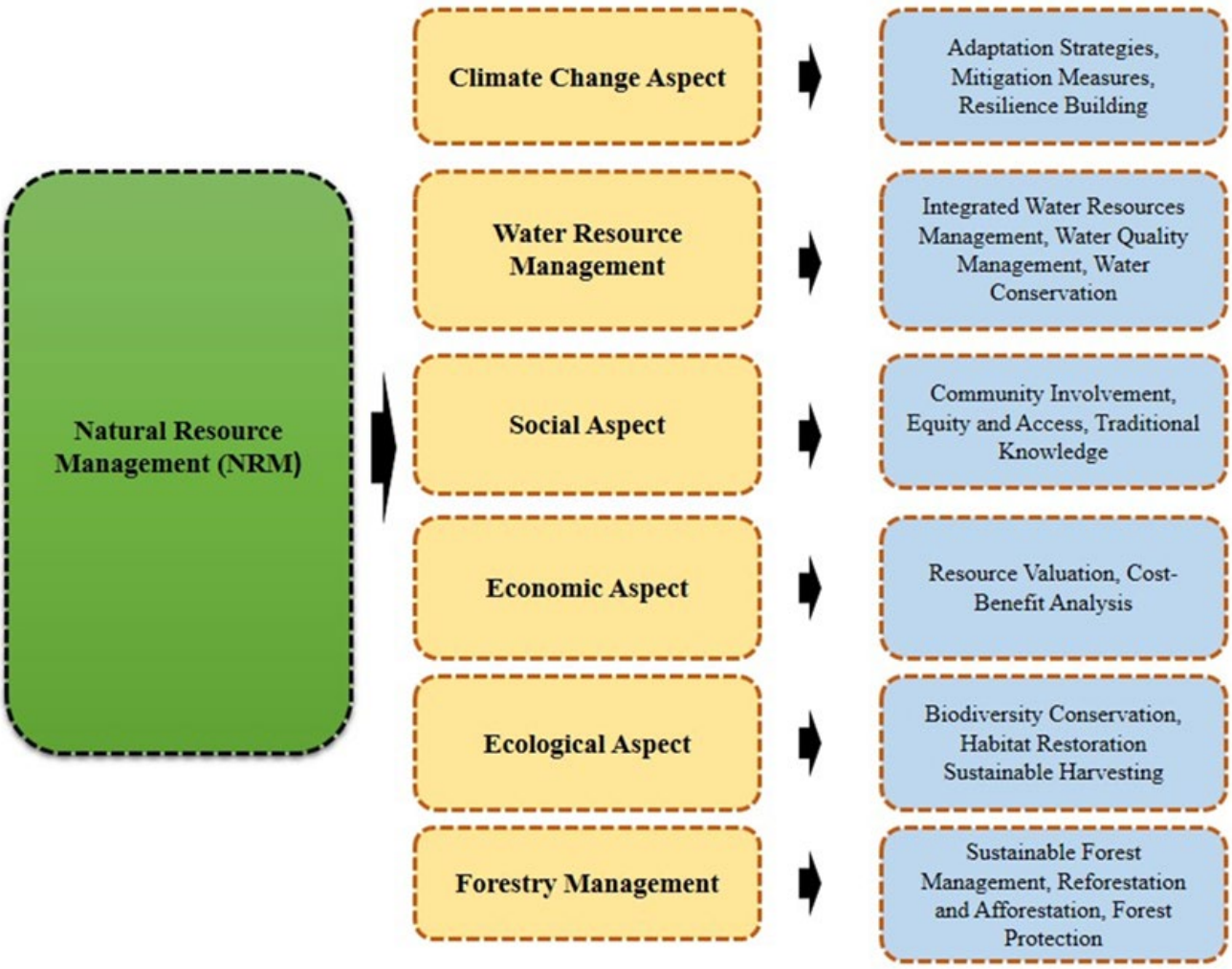

Figure 1. Different aspects of natural resource management.

Sustainable livelihoods recognize the interconnectedness of social, economic, and environmental systems (Nhamo et al., 2020; X. Ma et al., 2021). This approach emphasises integrated and participatory strategies that balance the needs of present and future generations, guided by the principle of sustainability (Natarajan et al., 2022). This involves meeting current needs without compromising future generations' ability to meet theirs. Central to this concept is resilience—the capacity of individuals, households, and communities to withstand and recover from shocks and stresses while maintaining well-being. Building resilience requires addressing the root causes and underlying vulnerabilities of poverty and environmental degradation. To enhance resilience, a multifaceted approach is essential, involving diversification of livelihood strategies, strengthening social networks, improving access to resources and services, and fostering adaptive capacity to cope with uncertainty and change. Sustainable livelihood interventions aim to break the cycle of poverty and promote inclusive and equitable development, ensuring that all community members can thrive (C. Wang et al., 2016; V. Kumar et al., 2015). The following are the key principles that support sustainable livelihoods (Alobo Loison, 2015; Davies, 1996):

- ***Participatory decision-making:*** It is important to involve local communities, especially marginalized groups such as women, indigenous peoples, and youth, in all stages of project planning, implementation, and evaluation to ensure that interventions are contextually relevant, socially acceptable, and sustainable in the long term.
- ***Integrated resource management:*** Sustainable livelihood approaches acknowledge the interconnectedness of social, economic, and environmental systems, and seek to integrate natural resource management with broader development objectives such as poverty reduction, food security, and climate resilience.
- ***Equity and social justice:*** For sustainable livelihood interventions to help reduce poverty, inequality, and exclusion, especially among vulnerable and marginalized populations, equitable access to resources, opportunities, and benefits must be promoted.

- ***Adaptive management:*** Approaches that embrace uncertainty and change, like adaptive management, emphasize learning-by-doing, experimentation, and flexibility to adjust strategies and actions based on new information, feedback, and evolving circumstances.
- ***Sustainable consumption and production:*** To promote sustainable lifestyles and livelihoods, it is necessary to minimize resource use, reduce waste and pollution, and adopt eco-friendly technologies and practices that enhance resource efficiency and environmental sustainability.

Natural resources play a crucial role in supporting sustainable livelihoods and human well-being (Morrison, 2015). However, their responsible management is critical to ensuring their long-term viability and equitable distribution of benefits. By embracing principles of sustainability, resilience, equity, and participation, communities can harness the transformative potential of natural resources to build a more prosperous, inclusive, and environmentally sustainable future for all. Natural resources and sustainable livelihoods are a complex and interconnected set of elements that are dependent on one another (Table 1).

Table 1. Elements of Natural Resources and Sustainable Livelihood.

Elements	Description	References
Ecosystem Services	Ecosystem services are the benefits that humans get from ecosystems, such as food, water, timber, climate regulation, flood control, recreation, spiritual values, and nutrient cycling. Sustainable livelihoods rely on the protection and sustainable use of these ecosystem services to support human well-being.	Li et al., 2024; J. Wang et al, 2024; Nungula et al., 2024; Roy et al., 2024;
Livelihood Strategies	Livelihood strategies include the different activities and resources that people use to support their livelihoods and meet their needs. These strategies may include agriculture, fishing, forestry, hunting, gathering, small-scale businesses, wage labor, remittances, and social safety nets. Sustainable livelihood approaches aim to diversify and strengthen these strategies to improve resilience and reduce vulnerability to shocks and stresses.	Habib et al., 2023; Liu et al., 2023
Natural Resource Management	Natural resource management involves the care and governance of natural resources to ensure their sustainable use and conservation. This includes sustainable agriculture, fisheries management, forest conservation, watershed management, soil conservation, biodiversity conservation, and integrated water resources management. Sustainable livelihood initiatives seek to promote participatory and integrated approaches to natural resource management that balance ecological, social, and economic objectives.	Baddianaah & Baaweh, 2021; Y. Xu & Zhao, 2023
Access to Resources and Assets	Access to resources and assets like land, water, forests, fisheries, credit, technology, education, and social capital is crucial to shaping livelihood opportunities and outcomes. Sustainable livelihood approaches aim to improve access to these resources and assets, especially for marginalized and vulnerable groups, to promote equitable and inclusive development.	Chuong, 2023; L. Ma et al., 2024; Z. Xu et al., 2023
Capacity Building and Empowerment	Capacity building and empowerment initiatives aim to improve the knowledge, skills, capabilities, and agency of individuals, households, and communities to participate effectively in decision-making processes, manage natural resources sustainably, and adapt to change. This may involve education, training, extension services, technology transfer, institution building, and strengthening of local governance structures.	Dushkova & Ivlieva, 2024
Market Access and Value Chains	Access to markets and participation in value chains are essential for converting natural resources into livelihood opportunities and income generation. Sustainable livelihood approaches seek to enhance market access, improve value addition, strengthen market linkages, and promote fair trade practices to ensure that producers receive a fair share of the value created along the supply chain.	Bagchi et al., 2021; Ruben, 2024; Tagwi & Chipfupa, 2023

Table 1. *Cont.*

Social Protection and Safety Nets	Social protection mechanisms such as social assistance, insurance, savings, and asset-building programs play a crucial role in reducing vulnerability and improving resilience to shocks and stresses. Sustainable livelihood approaches advocate for the design and implementation of social protection policies and programs that are sensitive to the needs and priorities of marginalized and vulnerable groups.	Fitrinitia & Matsuyuki, 2023; Kundo et al., 2023
Gender Equality and Social Inclusion	Gender equality and social inclusion are underlying principles of sustainable livelihoods that aim to ensure that all individuals, regardless of gender, age, ethnicity, or socio-economic status, have equal rights, opportunities, and voice in decision-making processes and access to resources and benefits. This involves addressing underlying power imbalances, discriminatory norms, and barriers to participation and inclusion.	Chikwe et al., 2024; Lwamba et al., 2022

The Sustainable Livelihoods Framework for the 21st century provides a holistic approach to improving the living conditions of vulnerable populations. It focuses on the interplay among people's assets, the institutional environment, and external factors (Natarajan et al., 2022). Central to this framework are five types of capital—human, natural, financial, physical, and social—that communities use in their livelihood strategies (Figure 2; Natarajan et al., 2022). These strategies are shaped by structures and processes, including government institutions and cultural norms, within a context of vulnerability marked by shocks and trends. The framework aims for sustainable outcomes, such as enhanced well-being, reduced vulnerability, and improved food security. In the 21st century, it has been adapted to address global challenges like climate change, gender disparities, urbanisation, and digital access, making it a vital tool for sustainable development planning.

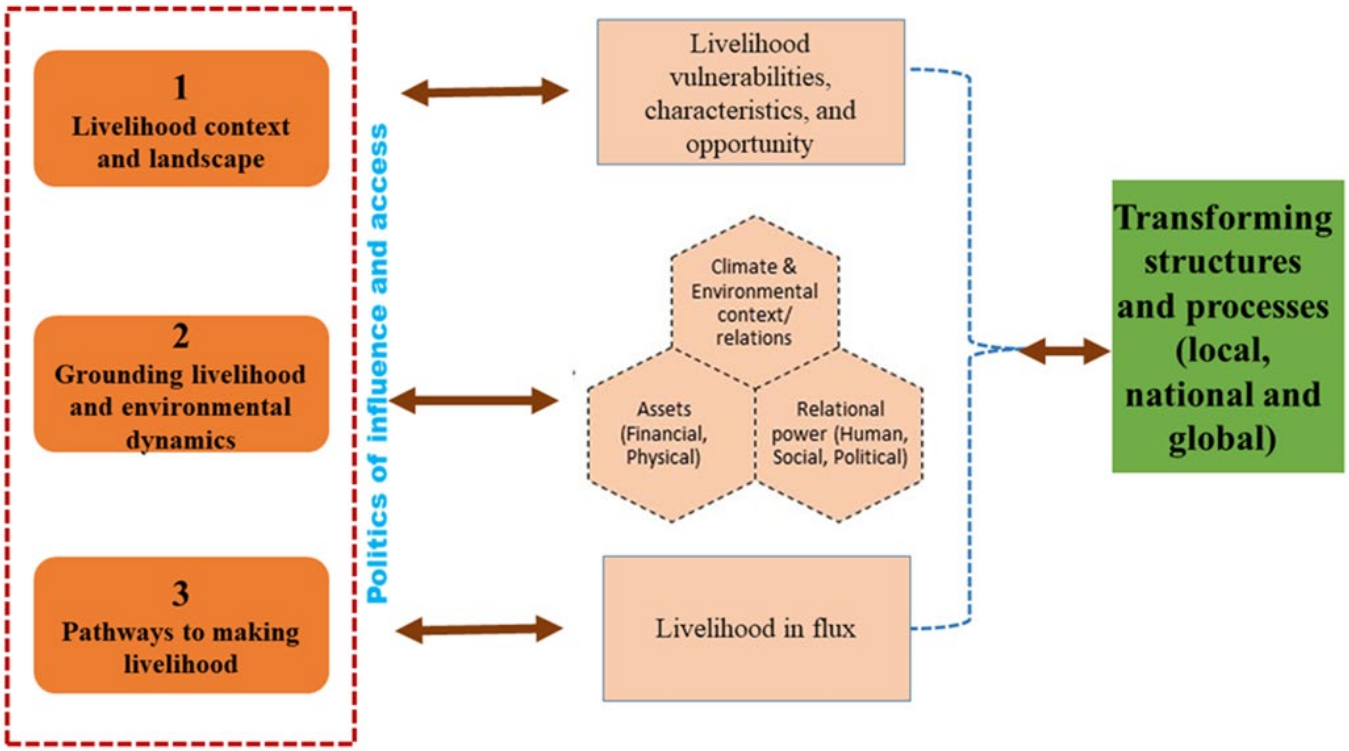

Figure 2. A sustainable livelihoods framework for the 21st century.

3. Approaches to Sustainable Livelihood and Natural Resource Management

The connection between sustainable livelihood approaches and natural resource management is vital for achieving long-term environmental and economic stability (C. Wang et al., 2016). These strategies aim to improve community well-being while ensuring the sustainable use and conservation of natural resources. One notable approach is the Sustainable Livelihoods Framework (SLF) developed by the Department for International Development, which emphasizes five core asset

categories: human, social, natural, physical, and financial capital. By developing these assets, the SLF seeks to enhance the resilience and adaptive capacity of communities (Tambe, 2022). Human capital involves skills, knowledge, and health; social capital includes networks and relationships; natural capital refers to resources such as land, water, and biodiversity; physical capital comprises infrastructure and tools; and financial capital covers savings, credit, and income.

Integrating natural resource management within sustainable livelihood strategies requires several key principles (Pani & Mishra, 2022). Firstly, community participation and local governance are essential. Involving local communities in decision-making ensures that resource management strategies are tailored to their specific needs and knowledge, fostering ownership and responsibility. Participatory approaches, such as CBNRM, empower communities to manage resources sustainably and equitably. Secondly, adopting an ecosystem-based approach is crucial. This holistic management of resources considers the interconnections between different ecosystem components and their services. For example, Integrated Water Resource Management (IWRM) addresses the entire water cycle and its interdependencies with land and other resources, promoting coordinated development and management to maximize economic and social welfare without compromising ecosystem sustainability. Incorporating traditional ecological knowledge (TEK) is also essential. Indigenous and local communities often have extensive environmental knowledge and sustainable practices developed over generations. Recognizing and integrating TEK into modern NRM strategies can enhance their effectiveness and cultural relevance.

Economic diversification is another key strategy. By diversifying income sources, communities can reduce dependency on a single natural resource, which is vulnerable to environmental changes or market fluctuations (Lashitew et al., 2021). Examples of diversified livelihood options include agroforestry, ecotourism, and sustainable fisheries, which can reduce pressure on natural resources while providing economic benefits. Considering the broader policy and institutional context is important for the success of sustainable livelihood and natural resource management approaches. This includes creating supportive policies, legal frameworks, and institutional arrangements that promote sustainable practices and ensure fair access to resources. For instance, strengthening property rights and tenure security can motivate individuals and communities to invest in sustainable resource management practices. In conclusion, sustainable livelihood approaches and natural resource management are closely linked. By focusing on diverse asset development, active community participation, ecosystem-based approaches, traditional knowledge integration, economic diversification, and supportive policies and institutions, these strategies can significantly contribute to creating more resilient and sustainable communities. This comprehensive and integrated approach is essential for addressing the complex challenges of sustainable development and environmental conservation in the face of global changes.

To implement the key strategies discussed, various methods and evaluation mechanisms for impact have been extensively utilised in the field. In CBNRM, methodologies commonly include Participatory Rural Appraisal (PRA), stakeholder mapping, the formation of resource user groups, and periodic community monitoring via scorecards or focus group discussions (Delgado-Serrano et al., 2018; Lara et al., 2018). Effectiveness is often assessed through ecological indicators (such as changes in forest cover and biodiversity metrics) and socio-economic measures (like household income diversification and governance participation scores; Pani & Mishra, 2022). In IWRM, tools like hydrological modelling (for example, SWAT), GIS-based watershed assessments, and scenario planning are used (Nath et al., 2024). Success is gauged using metrics such as water use efficiency, water quality indices, and outcomes related to multi-stakeholder conflict resolution. The SLF uses baseline livelihood evaluations, asset pentagon analyses, and longitudinal surveys to monitor changes in human, social, natural, physical, and financial capital over time (Tambe, 2022). TEK is collected via ethnographic approaches like oral histories, seasonal calendars, and participatory mapping, with validation carried out through comparative ecological studies and cultural acceptance surveys. These methodological tools not only facilitate the design of context-specific strategies but also enable thorough monitoring and adaptive management, which enhances the long-term sustainability and replicability of these approaches. In addition, the different key principles and strategies of sustainable livelihood and natural resource management are mentioned in Table 2.

Table 2. Principles and Strategies of Sustainable Livelihood and Natural Resource Management

Principle	Description	Example Strategies	References
Community Participation and Local Governance	Engaging local communities in decision-making to ensure relevant and effective management.	CBNRM, PRA	Aazami & Shanazi, 2020; Weiskopf et al., 2020
Ecosystem-Based Management	Holistic management that considers ecological interdependencies.	IWRM, Integrated Coastal Zone Management	Fortuna et al., 2024; Reis-Santos et al., 2023
Traditional Ecological Knowledge	Utilizing indigenous knowledge for sustainable practices.	Co-management of protected areas, Indigenous agricultural practices	Sinthumule, 2023
Economic Diversification	Reducing dependency on single resources by diversifying income sources.	Agroforestry, Ecotourism, Sustainable Fisheries	Jolo et al., 2022; Muhamad, 2023
Supportive Policy and Institutional Frameworks	Creating policies and institutions that support sustainable and equitable resource use.	Land tenure security, Environmental regulations	Ahmad et al., 2023

Furthermore, the concept of sustainable livelihood and natural resource management is closely interlinked, creating a mutually beneficial relationship that enhances both human well-being and environmental sustainability. The SLF underscores the importance of developing and utilizing various forms of capital (human, social, natural, physical, and financial) to boost the resilience and adaptability of communities (Karki, 2021; Su et al., 2021). Efficient NRM plays a pivotal role in this framework by ensuring the sustainable management of natural resources, which form the natural capital, to uphold long-term livelihoods.

- Natural resources like land, water, forests, and biodiversity are essential for many rural livelihoods. Sustainable management of these resources ensures their availability and productivity for future generations. Practices such as agroforestry, sustainable agriculture, and community-managed fisheries not only conserve natural resources but also improve the livelihoods of local communities by providing diverse and sustainable sources of income (Ismail et al., 2013).
- Community Participation and Governance involving local communities in NRM processes ensures that management strategies are aligned with their specific needs and knowledge, fostering a sense of ownership and responsibility. For instance, implementing CBNRM initiatives empowers communities to sustainably manage resources, resulting in improved conservation outcomes and enhanced livelihoods through activities such as ecotourism and sustainable harvesting (Jagers et al., 2018).
- Ecosystem-based approaches entail implementing management strategies to preserve the health of ecosystems, thereby ensuring the continuity of the essential services they provide, such as clean water, fertile soil, and a stable climate. These services play a critical role in sustaining agricultural productivity, reducing vulnerability to natural disasters, and facilitating diverse livelihood activities (Doughan, 2020).
- Indigenous and local communities possess extensive knowledge about sustainable resource management practices refined over generations. Integrating TEK with modern NRM strategies enhances their effectiveness and cultural relevance, ensuring that resource management practices are sustainable and locally appropriate (Fernández-Llamazares et al., 2021).
- Reducing dependency on a single natural resource through diversification strategies such as agroforestry, sustainable tourism, and non-timber forest products can help buffer communities against economic shocks and environmental changes. This diversification not only provides additional income streams but also reduces pressure on any one resource, contributing to its sustainability (Cheng et al., 2020).

- Supportive policies and institutional frameworks are essential for sustainable livelihoods and NRM. Policies that secure land tenure and access rights, enforce environmental regulations, and promote equitable resource distribution support sustainable resource use and help communities invest in sustainable livelihood strategies.

The reviewed literature highlights the multifaceted role of community-based tourism (CBT), natural resource management, and technological innovation in advancing sustainable development goals (SDGs). Homestays, a vital component of CBT—especially in rural areas—exhibit potential in contributing to SDG1 (No Poverty) and SDG11 (Sustainable Cities and Communities) by engaging local families and retaining decision-making at the community level. However, challenges remain in evaluating their broader impacts on livelihoods. In parallel, studies focused on environmental sustainability reveal the intricate relationship between economic growth, tourism, natural resource utilization, and ecological degradation. While urbanization and tourism contribute to CO_2 emissions, information and communication technology (ICT) demonstrates promise in mitigating these environmental impacts (Begum et al., 2025). Furthermore, research indicates that sustainable energy policy and socio-economic development significantly influence ecological footprints, particularly in rapidly developing countries like China (Zhu et al., 2024). Conversely, findings from resource-rich Asian economies present a more nuanced perspective, revealing that natural resource rents and energy security are negatively associated with ecological degradation, which challenges traditional assumptions of the environmental Kuznets curve (Zhang et al., 2024). Additionally, a district-level analysis in West Bengal utilizing the Sustainable Livelihood Security Index uncovers notable spatial disparities in ecological, economic, and social indicators, providing valuable insights for policy interventions aimed at enhancing regional resilience and equitable development (Roy et al., 2024). Collectively, these studies emphasize the critical importance of integrating livelihood, environmental, and technological dimensions to develop inclusive and sustainable development strategies.

4. Natural Resource Management and Climate Change Adaptation

Natural resource management and climate change adaptation are closely intertwined, with effective NRM playing a crucial role in enhancing the resilience of ecosystems and communities to the impacts of climate change (Weiskopf et al., 2020). Climate change poses significant threats to natural resources, including water scarcity, soil degradation, loss of biodiversity, and increased frequency of extreme weather events. These changes can undermine the livelihoods of communities that rely on these resources, making adaptation strategies essential for sustainable development (Ampaire et al., 2020; Maja & Ayano, 2021).

- ***Water Resource Management***: As climate change alters precipitation patterns and intensifies droughts and floods, sustainable water resource management becomes crucial. IWRM is an approach that promotes the coordinated development and management of water, land, and related resources. It aims to maximize economic and social welfare without compromising the sustainability of vital ecosystems. Techniques such as rainwater harvesting, efficient irrigation systems, and watershed management are essential to ensuring water availability for agriculture, drinking, and other uses (Xiang et al., 2021).
- ***Sustainable Agriculture and Soil Management***: Climate change affects agricultural productivity through changes in temperature, rainfall patterns, and increased incidence of pests and diseases. Sustainable agriculture practices, such as conservation tillage, crop rotation, organic farming, and agroforestry, can enhance soil health and fertility, reduce erosion, and improve water retention. These practices not only help in adapting to changing climatic conditions but also in sequestering carbon, thereby mitigating climate change (Fahad et al., 2021).
- ***Forest Management and Reforestation***: Forests act as carbon sinks, absorbing CO_2 from the atmosphere, and play a critical role in climate regulation. Sustainable forest management practices, including reforestation and afforestation, are vital for climate change adaptation and mitigation. Community-based forest management can empower local communities to protect and sustainably use forest resources, enhancing biodiversity and ecosystem services such as water regulation and soil stabilization (Hazarika et al., 2021).
- ***Coastal Zone Management***: Rising sea levels and increased storm surges due to climate change pose significant risks to coastal areas. Integrated Coastal Zone Management involves the sustainable management of coastal resources to protect against erosion, flooding, and habitat loss. Strategies include the restoration of mangroves and coral reefs, which act as natural barriers against storms and provide critical habitats for marine life. Additionally, sustainable fisheries management helps maintain fish stocks and the livelihoods of coastal communities (Gallina et al., 2020).
- ***Biodiversity Conservation***: Biodiversity enhances ecosystem resilience, enabling ecosystems to recover from disturbances and maintain functionality under changing climatic conditions.

Conservation strategies, such as the establishment of protected areas, habitat restoration, and the implementation of biodiversity corridors, are crucial for preserving genetic diversity and ecosystem services. Biodiversity conservation also supports the livelihoods of communities that depend on ecosystem services for food, medicine, and cultural values (Brown et al., 2022).

- ***Disaster Risk Reduction****:* NRM strategies that incorporate disaster risk reduction (DRR) can significantly reduce the vulnerability of communities to climate-related hazards. Measures such as the construction of flood defenses, sustainable land-use planning, and the restoration of wetlands and floodplains can mitigate the impacts of extreme weather events. Early warning systems and community-based disaster preparedness programs are also essential components of DRR (Weichselgartner & Pigeon, 2015).

By effectively linking NRM with climate change adaptation, we can enhance the resilience of both natural ecosystems and human communities. This integrated approach ensures that natural resources are managed sustainably, providing a buffer against the adverse impacts of climate change while supporting sustainable livelihoods and promoting overall well-being. Through collaborative efforts involving governments, communities, and various stakeholders, we can develop and implement strategies that address the complex challenges posed by climate change, securing a sustainable future for generations to come. Figure 3 illustrates the interconnected relationship between ecosystems, people, and climate change, emphasizing the dual roles of natural resource management in both climate change mitigation and adaptation. Climate change has both positive (indicated in purple) and predominantly negative (indicated in black) impacts on ecosystems and human communities, which influence each other in various ways. Ecosystem-based mitigation strategies, such as reforestation and river restoration, can play a crucial role in reducing greenhouse gas emissions and mitigating the effects of climate change (Morecroft et al., 2019). Concurrently, ecosystem-based adaptation strategies enhance the resilience of both ecosystems and human populations. These strategies include wetland restoration, protecting and expanding natural or semi-natural areas, increasing landscape connectivity, species translocation, and restoring natural fire regimes. These approaches not only help ecosystems adapt to changes in climate but also support biodiversity conservation and promote the livelihoods and well-being of local communities. However, it is important to note that the figure also highlights potential maladaptations—such as creating forests in ecologically unsuitable areas—which could result in unintended ecological consequences (Morecroft et al., 2019).

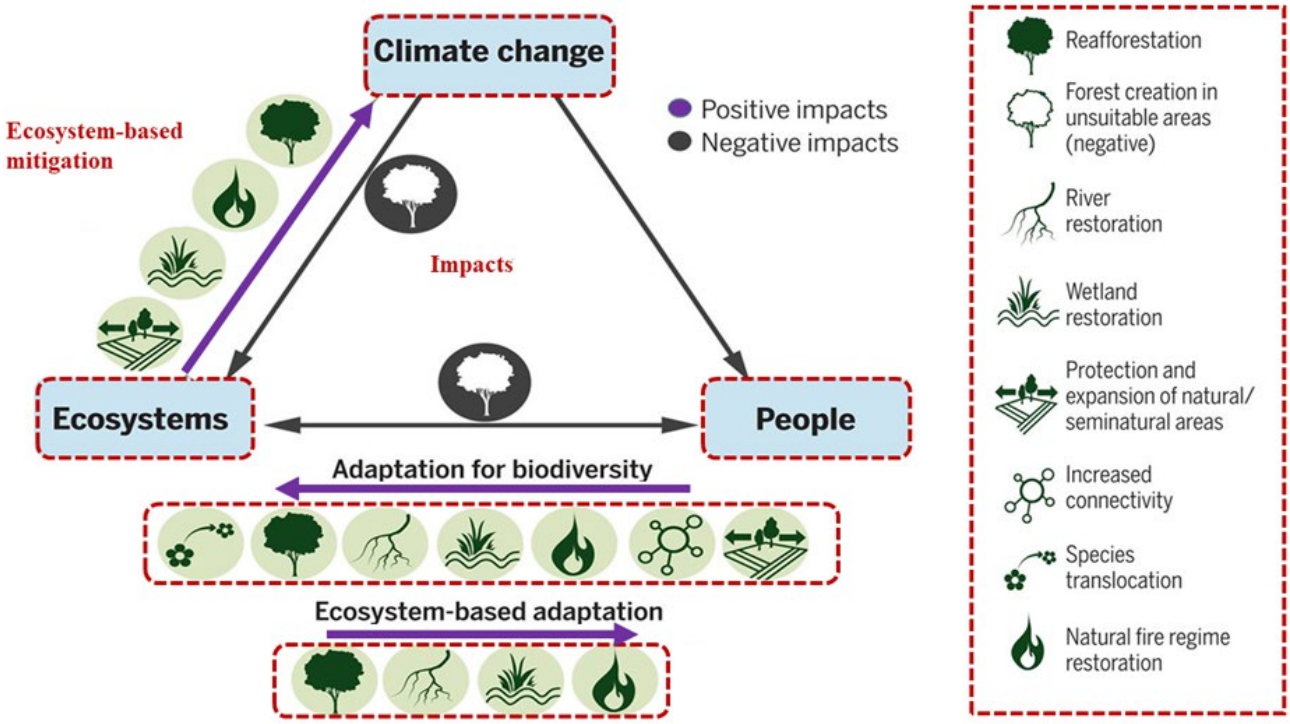

Figure 3. Ecosystem-Based Approaches for Climate Change Adaptation and Natural Resource Management (Redrawn from Morecroft et al., 2019)

5. Ecosystem-Based Approach for Sustainable Livelihood

An ecosystem-based approach to sustainable livelihoods through effective natural resource management is a comprehensive strategy that aims to balance human needs with the preservation of ecological integrity. This approach acknowledges that the well-being of communities and the sustainability of their livelihoods are intrinsically linked to healthy ecosystems. By managing natural resources in ways that support ecosystem services, such as clean water, fertile soil, and biodiversity, this approach ensures that these resources can sustain current and future generations (Kalogiannidis et al., 2023; Nalau et al., 2018). Furthermore, EbA offer innovative and sustainable solutions that integrate ecological health with human well-being, especially in vulnerable and resource-dependent communities (Table 3). By harnessing the services provided by natural ecosystems—such as water regulation, soil fertility, carbon sequestration, and biodiversity—these approaches support resilient livelihoods while preserving the environment. The following table outlines key ecosystem-based strategies that promote sustainable livelihoods through nature-based solutions, highlighting their ecosystem services, implementation levels, and co-benefits.

- One of the core principles of this approach involves integrating conservation and sustainable use. For instance, within agricultural systems, practices such as agroforestry, crop rotation, and organic farming have been shown to enhance soil health and biodiversity. As a result, crop yields are increased, and the crops become more resilient to pests and diseases. These practices not only contribute to food security but also provide economic benefits to farmers by reducing their dependency on chemical inputs and enhancing ecosystem services such as pollination and water retention (Kalogiannidis et al., 2023).
- In coastal areas, adopting an ecosystem-based approach entails the preservation and rejuvenation of crucial habitats such as mangroves, coral reefs, and seagrasses. These ecosystems function as natural defenses against storm surges and coastal erosion, shielding inland communities from severe weather events. Additionally, they play a vital role in supporting fisheries, which serve as a cornerstone for food security and livelihoods in many coastal regions. By safeguarding these habitats, we secure the sustainability of fisheries and bolster the resilience of coastal communities in the face of climate change (Santhanam & Kundu, 2022).
- Freshwater ecosystems, such as rivers, lakes, and wetlands, are a primary focus of ecosystem-based management and require protection from pollution, over-extraction, and habitat destruction to ensure optimal water quality and availability. Implementing sustainable watershed management practices, including reforestation and establishing riparian buffers, can effectively regulate water flow, minimize flooding, and replenish groundwater supplies. These practices have far-reaching benefits for agricultural activities, drinking water supplies, and biodiversity, ultimately contributing to the well-being of those who depend on these resources (Gray et al., 2020).
- Forestry management is a critical component of this approach. Sustainable forestry practices, including selective logging, reforestation, and the preservation of old-growth forests, help to maintain the ecological functions of forests. Forests act as carbon sinks, mitigate climate change, regulate water cycles, and provide habitat for a wide range of species. Additionally, forests offer numerous products such as timber, non-timber forest products, and ecotourism opportunities, which are vital sources of income for many communities (Banerjee et al., 2019).
- Furthermore, this approach advocates for policy integration and coherence across multiple levels. It fosters the alignment of local, national, and international policies to bolster sustainable resource management. Policies that promote sustainable land use, renewable energy, and conservation can work together synergistically to enhance the effectiveness of ecosystem-based management. For example, national policies that incentivize sustainable agricultural practices can complement local efforts to protect soil and water resources, ultimately contributing to overall sustainability.
- In urban areas, using an ecosystem-based approach can help create sustainable livelihoods by incorporating green infrastructure into city planning. Urban green spaces, such as parks, green roofs, and urban forests, offer a wide range of ecosystem services, including improving air quality, regulating temperature, and providing recreational opportunities. These green spaces can improve the quality of life for urban residents, promote mental and physical well-being, and bring economic benefits through increased property values and tourism (Brink et al., 2016).

Table 3. Ecosystem-Based Approach for Sustainable Livelihoods.

Strategy	Targeted Ecosystem Services	Level of Implementation	Livelihood & Ecological Co-Benefits	Examples / Case Studies	References
Agroforestry Systems	Provisioning (food, fuel), Regulating (carbon, water)	Community/Farm-level	Enhances food security, carbon sequestration, income diversification	Silvopasture in Karnataka, India	Chavan et al., 2024; Sahoo & Wani, 2019
Sustainable Wetland Management	Regulating (flood control, water purification), Cultural	Landscape/Watershed	Reduces disaster risk, improves fishery productivity, supports tourism	Loktak Lake, Manipur	Devi et al., 2024; Huidrom et al., 2024
Mangrove Restoration	Regulating (coastal protection), Provisioning (fisheries)	Coastal/Community	Builds climate resilience, protects from storms, supports fisheries	Sundarbans Biosphere Reserve	Kar & Basu, 2023
Community-Based Ecotourism	Cultural, Supporting (biodiversity)	Local/Regional	Generates income, incentivizes conservation, empowers local communities	Ecotourism in Periyar Tiger Reserve	Vinodan & Meera, 2024
Sustainable Pasture Management	Supporting (soil health), Regulating (carbon, erosion control)	Grassland/Tribal Lands	Enhances livestock productivity, restores degraded lands, stores carbon	Banni Grasslands, Gujarat	Dey et al., 2024
Participatory Watershed Management	Regulating (water availability, erosion), Provisioning	Micro-watershed/Village	Improves irrigation, crop productivity, water access for rural livelihoods	Sukhomajri Watershed, Haryana	Bhardwaj et al., 2021
Urban Green Infrastructure	Regulating (air quality, heat reduction), Cultural	Urban/Peri-Urban	Improves urban liveability, provides jobs (nurseries, landscaping), buffers climate	Delhi Ridge Forest, Green roofs in Chennai	Ahmad & Hassan, 2023
Organic Farming with Biodiversity Buffers	Provisioning, Supporting	Farm-level	Reduces chemical inputs, improves health, increases pollinator services	Sikkim Organic Mission	Manoharmayum et al., 2025
Integrated Rice-Fish Farming	Provisioning (food), Supporting (nutrient cycling)	Farm-level	Dual food system, reduces pest use, improves nutrition	Traditional systems in Eastern India	Sathoria & Roy, 2022

An ecosystem-based approach to sustainable livelihoods through effective natural resource management is crucial for achieving long-term ecological and socio-economic sustainability (Reid

et al., 2018). This approach recognizes the interdependence between human communities and natural ecosystems, fostering resilience, enhancing biodiversity, and ensuring that natural resources continue to support the well-being of all living beings. It is a comprehensive strategy that addresses the root causes of environmental degradation while promoting sustainable development and poverty alleviation. Collaborative efforts, policy integration, and the application of sustainable practices can help create a more resilient and equitable world for present and future generations. In addition, different national and international ecosystem-based approaches towards livelihoods is depicted in Table 4.

Table 4. The different national and international ecosystem-based approaches to sustainable livelihoods.

Countries	Eco-system based approach
United States	*Chesapeake Bay Program:* The Chesapeake Bay Program is a regional partnership that brings together states, federal agencies, local governments, NGOs, and academic institutions to restore and protect the Chesapeake Bay ecosystem. The program focuses on sustainable agriculture, wetland restoration, and pollution reduction. By improving water quality and restoring habitats, the program supports local fisheries, agriculture, and tourism, providing sustainable livelihoods for the communities in the watershed (Hood et al., 2021).
India	*Joint Forest Management (JFM):* India's Joint Forest Management program involves local communities in the management and restoration of forests. The JFM model empowers local communities to sustainably manage forest resources, ensuring their participation and benefit-sharing. This approach has led to improved forest cover, enhanced biodiversity, and increased livelihoods for rural populations through the collection of non-timber forest products and eco-tourism (Bisui et al., 2023).
Australia	*Great Barrier Reef Marine Park Authority (GBRMPA):* The GBRMPA manages the Great Barrier Reef Marine Park through a comprehensive ecosystem-based approach. This includes zoning plans that protect critical habitats, fisheries management, and initiatives to reduce land-based pollution. By preserving the health of the reef, the program supports sustainable tourism and fisheries, which are vital for the livelihoods of local communities (Kuhnert et al., 2015).
Kenya	*Community-Based Natural Resource Management:* In Kenya, CBNRM programs involve local communities in managing and conserving wildlife and natural habitats. One example is the conservancy model used in regions like the Maasai Mara, where communities manage conservation areas and benefit from eco-tourism. This approach not only conserves biodiversity but also provides income and employment opportunities, promoting sustainable livelihoods (Fabricius & Collins, 2007).
European Union	*Natura 2000 Network:* The Natura 2000 network is a European Union-wide initiative aimed at protecting biodiversity through the conservation of natural habitats and wild species. It involves the designation of protected areas and the implementation of management plans that integrate sustainable land use and community involvement. This network supports sustainable agriculture, forestry, and tourism, thereby promoting sustainable livelihoods across Europe (Evans, 2012).

Table 4. *Cont.*

Latin America	*The Amazon Sustainable Landscapes Program (ASL):* The ASL program, supported by the Global Environment Facility and implemented by the World Bank, aims to protect the Amazon biome through an ecosystem-based approach. It involves sustainable land management practices, reforestation, and the promotion of sustainable agriculture and fisheries. By maintaining the ecological integrity of the Amazon, the program supports the livelihoods of indigenous communities and smallholders (Global Environment Facility, 2021).
Africa	*The Great Green Wall Initiative:* The Great Green Wall is an African-led initiative aimed at combating desertification and land degradation in the Sahel region. It involves the restoration of degraded landscapes through reforestation, sustainable agricultural practices, and the creation of green jobs. This initiative enhances food security, water availability, and resilience to climate change, thereby supporting the livelihoods of millions of people in the region (Mirzabaev et al., 2022).
Global	*The Ecosystem-based Adaptation (EbA) Approach by UNEP:* The UNEP promotes the EbA approach, which uses biodiversity and ecosystem services to help people adapt to the adverse effects of climate change. This approach is implemented in various countries through projects that restore ecosystems, such as mangroves, forests, and wetlands, to protect communities from climate impacts while providing sustainable livelihoods through eco-tourism, sustainable agriculture, and fisheries (Donatti et al., 2020).

6. Integrated Resource Planning for Natural Resource Management

IRP for Natural Resource Management is a strategic approach aimed at achieving sustainable development by holistically managing natural resources. IRP is a comprehensive framework that considers the interdependencies and cumulative impacts of resource use on the environment, economy, and society. This approach goes beyond traditional, sector-specific planning methods by integrating various resource types—such as water, land, energy, and minerals—into a single cohesive strategy. The goal is to optimize resource utilization, minimize environmental degradation, and ensure long-term sustainability (Carvallo et al., 2021).

One of the core principles of IRP is stakeholder engagement. This involves actively involving all relevant parties, including government agencies, private sector entities, local communities, and non-governmental organizations, in the planning process (Gautam et al., 2024). The inclusive approach ensures that diverse perspectives and knowledge systems are incorporated, leading to more balanced and equitable resource management solutions. For example, in watershed management, IRP would coordinate water use for agriculture, industry, and domestic purposes while ensuring the protection of aquatic ecosystems and maintaining water quality standards. When making decisions in IRP, having data is crucial. Planners use advanced modeling tools and GIS to simulate different scenarios and assess the potential impacts of various management strategies. This helps identify the best solutions that balance resource availability, economic development, and environmental conservation (Gautam et al., 2024). For example, in forestry management, IRP could involve creating models to predict the effects of logging on biodiversity and carbon sequestration.

Climate change adaptation and mitigation are essential components of IRP, given the growing pressures on natural resources caused by changing climate conditions. IRP frameworks include measures to enhance climate resilience, such as promoting drought-resistant crop varieties in agriculture or designing water management systems capable of withstanding extreme weather events. By aligning resource management strategies with climate goals, IRP contributes to reducing vulnerability and enhancing the adaptive capacity of communities and ecosystems. Additionally, the IRP advocates for the utilization of renewable resources and the implementation of circular economy principles. This involves promoting the reuse and recycling of materials, minimizing waste, and transitioning to sustainable energy sources. The goal of the IRP is to lessen the environmental impact of resource utilization. For example, in energy planning, the integration of solar, wind, and biomass energy sources can reduce reliance on fossil fuels and help to mitigate greenhouse gas emissions. Economic efficiency in IRP involves optimizing resource allocation, reducing waste,

and employing economic instruments like subsidies and taxes to encourage sustainable resource use and fund conservation initiatives (Sadeghi et al., 2024).

Monitoring and evaluation are crucial elements of IRP to guarantee that the strategies being implemented are effective and adaptable. Continuous assessment permits the modification of plans based on real-time data and emerging challenges. Performance indicators associated with environmental health, resource productivity, and socio-economic outcomes assist in tracking progress and informing policy adjustments (Gautam et al., 2024). In essence, Integrated Resource Planning for Natural Resource Management is a proactive and all-encompassing strategy that advocates for sustainable development by integrating the use of natural resources with ecological and socio-economic objectives. Through active stakeholder engagement, informed decision-making based on data, climate resilience, incentivizing renewable resource utilization, maximizing economic efficiency, and continual monitoring, IRP establishes a robust framework for effectively addressing the multifaceted challenges of resource management in the 21st century. Table 5 mentions the different IRP for NRM across different countries.

Table 5. Integrated Resource Planning for Natural Resource Management across different countries.

Country	Approach to IRP/NRM	Key Features	References
United States	Comprehensive planning through EPA	Multi-sectoral collaboration, long-term forecasts	Donatti et al., 2020; Hood et al., 2021
Canada	Federally coordinated with provincial input	Emphasis on sustainable development, indigenous rights	Donatti et al., 2020; Gautam et al., 2024
Australia	State-led frameworks (e.g., NRM Regions)	Community engagement, adaptive management	Sadeghi et al., 2024
Germany	Integrated federal and state planning	Strong environmental standards, renewable energy focus	Sadeghi et al., 2024
Brazil	Mixed federal and state planning	Amazon protection, biodiversity conservation	Kuhnert et al., 2015
South Africa	National Development Plan and IRP	Inclusive growth, resource efficiency	Gautam et al., 2024
China	Centralized planning with regional autonomy	Renewable energy expansion, ecological restoration	Donatti et al., 2020
India	National Action Plans for Climate Change	Green growth strategies, biodiversity conservation	Sadeghi et al., 2024; Kuhnert et al., 2015

7. Natural Resource Management: Research Trend and Future Perspectives

Recent studies in NRM reveal an increasing alignment between ecological sustainability, social equity, and adaptive governance. A significant trend is the combination of ecosystem-based and community-based management strategies that comprehensively address environmental preservation alongside local livelihood requirements (Doughan, 2020; Fabricius & Collins, 2007; Muchunguzi, 2023). Researchers are increasingly highlighting the importance of participatory resource governance, as local engagement boosts the legitimacy and efficiency of conservation initiatives (Jagers et al., 2018; Pani & Mishra, 2022). At the same time, research points out how livelihood assets—including natural, social, human, financial, and physical capital—affect sustainable livelihood strategies (Liu et al., 2023; Su et al., 2025), especially among vulnerable rural communities. Tools such as the Sustainable Livelihood Framework (Karki, 2021; Morse, 2025) and socio-ecological modeling (C. Wang et al., 2016) are being utilized to assess resilience and adaptive capacity in the face of climatic and economic challenges (L. Ma et al., 2024; Li et al., 2024). Moreover, the significance of diversifying economies and enhancing resource use efficiency is emphasized to lessen reliance on extractive industries and boost resilience in resource-rich yet economically vulnerable areas (Jolo et al., 2022; Muhamad, 2023; Y. Xu & Zhao, 2023).

Research in integrated land and water resource planning also indicates a movement toward transdisciplinary approaches that connect ecosystem services, land use, and community well-being (Kalogiannidis et al., 2023; Xiang et al., 2021). Gender equality and social protection frameworks are increasingly recognized as vital policy priorities to secure inclusive, sustainable adaptation results (Kundo et al., 2023; Lwamba et al., 2022). Concurrently, acknowledgement of traditional ecological knowledge as a crucial asset in biodiversity preservation and climate adaptation broadens the epistemological foundation of NRM (Fernández-Llamazares et al., 2021; Sinthumule, 2023). Furthermore, with rising concerns about environmental degradation, research has focused on technological advancements like AI, remote sensing, and big data analytics to enhance the monitoring and management of resources (Xiang et al., 2021). Nature-based solutions, agroforestry systems, and circular bio-economy models are increasingly embraced to promote sustainability in both rural and urban settings (Manoharmayum et al., 2025; Nungula et al., 2024).

Natural resource management currently encounters several significant challenges and transformative possibilities. The future demands a clear transition towards sustainable practices that ensure equity for future generations, adopt renewable resources, and reduce ecological impacts. Addressing climate change in the management of natural resources is crucial, which involves reducing greenhouse gas emissions, adapting to altered climate patterns, and robustly safeguarding biodiversity. Advancements in technology—such as artificial intelligence, remote sensing, GIS, drones, and environmental modeling—are improving accuracy in resource assessment, extraction regulation, conservation planning, and ecosystem service valuation. These innovations should be integrated into community-based management frameworks for real-time monitoring and adaptive decision-making. Future research must prioritize implementation-oriented strategies, such as pilot projects, living labs, and multi-stakeholder platforms that test scalable, replicable solutions in diverse ecological and social contexts. Effective policy frameworks must align with these technological capabilities to balance economic development with environmental stewardship, while ensuring fair access and preventing unsustainable exploitation. Collaborative efforts among governments, communities, businesses, and NGOs are vital for confronting complex problems through integrated and multi-scalar strategies. Additionally, ensuring water and food security amidst climate fluctuations and population growth is a pressing issue. Urban growth requires thoughtful land use planning to preserve ecosystem services and protect biodiversity. Furthermore, raising public awareness and enhancing environmental education are critical to fostering a conservation mindset and encouraging behavioral change. In summary, the future of natural resource management hinges on sustainability, technological innovation, effective governance, collaboration, and public engagement. Addressing these aspects holistically through both policy and practice can help mitigate environmental degradation and ensure that natural resources are managed responsibly for future generations.

Building on the trends and insights previously mentioned, it is essential to propose creative strategies that can influence future management of natural resources. Firstly, co-innovation platforms that include local communities, scientists, and policymakers should be established to develop context-specific solutions through participatory learning and experimentation. Secondly, incorporating circular bioeconomy models and nature-based solutions into standard development planning can improve resource-use efficiency while minimizing waste and environmental harm. Thirdly, utilizing digital technologies such as AI, blockchain, and remote sensing can enhance monitoring, enforcement, and decision-making, particularly in decentralized governance contexts. Furthermore, TEK into adaptive management efforts can add cultural significance and sustainability to ecological restoration initiatives. Lastly, creating incentive-based mechanisms—like payments for ecosystem services, green microfinance, and certifications for climate-smart practices—can encourage sustainable behaviors among both producers and consumers. These inventive strategies present transformative opportunities to connect policy, science, and practice, ensuring equitable and efficient management of natural resources amid growing socio-ecological complexities.

8. Conclusion

In conclusion, the quest for sustainable livelihoods through proficient management of natural resources is a complex task that requires a comprehensive and integrated strategy. The issues brought about by population expansion, climate change, and depletion of resources necessitate a shift away from conventional resource-focused methods and the adoption of ecosystem-based approaches. This study highlights that sustainable livelihoods hinge on the amalgamation of ecological well-being with human development to cultivate resilient and flourishing communities. A core element of this strategy is the acknowledgement of how ecosystems are interconnected. Effective management of natural resources should encompass entire ecosystems in the decision-making processes, emphasizing conservation and sustainable utilization. Key measures to sustain the regenerative potential of natural resources for future generations include establishing protected areas, implementing sustainable harvesting practices, and safeguarding biodiversity. The involvement of communities is vital for ensuring that the governance of natural resources is inclusive and culturally

appropriate. Empowering local stakeholders in the decision-making process promotes a sense of ownership, aligns management with the needs of the community, and enhances the effectiveness and sustainability of initiatives. The diversification of livelihoods also emerges as an essential approach to lessen reliance on single resources and bolster resilience against environmental and economic disruptions. Through strategies such as eco-tourism, agroforestry, and value-added ventures, communities can enhance their capacity to adapt and alleviate pressure on natural ecosystems. Integrated resource planning is crucial for achieving sustainable development, necessitating the coordination of ecological, social, and economic objectives through aligned strategies. Regulatory frameworks, enforcement mechanisms, and supportive policies are fundamental in curbing overexploitation and fostering sustainable practices. Furthermore, market-based incentives—like eco-labeling, payments for ecosystem services, and sustainability certification—can motivate producers and consumers to make environmentally friendly choices. Adaptation strategies that tackle climate change—such as sustainable agriculture, water management, forest preservation, and disaster risk reduction—are essential for protecting livelihoods in vulnerable regions. Beyond the immediate findings, this study holds significant theoretical and practical implications. It adds to the increasing body of literature that advocates for integrated and participatory governance of natural resources. By connecting community-driven initiatives with ecosystem-based management and sustainable development, the research offers a conceptual and operational framework that can guide policy innovation, institutional changes, and grassroots actions. The outcomes support the advancement of global initiatives such as the SDGs, particularly those aimed at alleviating poverty (SDG 1), taking action on climate (SDG 13), promoting gender equality (SDG 5), and protecting ecosystems (SDG 15). In summary, this study advocates for a fundamental shift in the governance of natural resources and the securing of livelihoods. By embracing complexity, encouraging innovation, and ensuring participatory inclusiveness, sustainable livelihoods can be realized in ways that are environmentally responsible, socially equitable, and economically viable. This holistic approach benefits current generations while also preserving ecological foundations for future prosperity, thereby paving the way for long-term sustainability and resilience.

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Abbreviations

The following abbreviations are used in this manuscript:

NRM	Natural Resources Management
CBNRM	Community-Based Natural Resource Management
EbA	Ecosystem-based Adaptation
IRP	Integrated Resource Planning
SLF	Sustainable Livelihoods Framework
IWRM	Integrated Water Resource Management
TEK	Traditional Ecological Knowledge
CBT	Community-Based Tourism

SDGs	Sustainable Development Goals
DRR	Disaster Risk Reduction
JFM	Joint Forest Management
GBRMPA	Great Barrier Reef Marine Park Authority
ASL	The Amazon Sustainable Landscapes
UNEP	United Nations Environment Programme
EPA	Environmental Protection Agency
PRA	Participatory Rural Appraisal
GIS	Geographic Information Systems

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