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Sustainable Natural Resource and Environmental Management: A Review of Adaptive Governance, Benefit Distribution, and Implementation Challenges

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A R T I C L E I N F O

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A B S T R A C T

Management of natural resources (NR) and the environment often creates a gap between sustainability commitments and the benefits that stakeholders actually receive. This article aims to explain how ecological, economic, social, health, cultural, and educational benefits are formed, as well as to identify barriers and strategies for fair implementation. The study uses a qualitative literature review that is integrative and interpretative, analyzing reputable journal articles since 2020, with purposive-iterative searching, conceptual coding, cross-source comparison, and thematic-narrative synthesis. The findings show that sustainability benefits are formed through protecting natural capital, maintaining ecosystem services, reducing risks, strengthening local rights and capacities, and recognizing the plurality of values and knowledge. However, these benefits don't automatically spread evenly. Social-ecological complexity, institutional fragmentation, tenure conflicts, power imbalances, limited funding and data, weak enforcement, short-term market pressures, and symbolic participation often turn policies into mere administrative compliance without real improvements. This article proposes adaptive, polycentric, ecosystem-based, and equitable governance that integrates clear rights, benefit-sharing, cross-sector coordination, long-term funding, open data, participatory monitoring, and policy correction mechanisms. The main contribution of the article is a five-layer analytical framework connecting ecological boundaries, values and benefits, actors and power relations, institutions and instruments, as well as multidimensional outputs. This framework emphasizes that success isn't just measured by compliance or the scale of programs, but by the integrity of the ecosystem, the fairness of benefits, the legitimacy of processes, and long-term resilience

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INTRODUCTION

Natural resources and the environment not only provide raw materials for production activities but also form natural capital that supports health, food and water security, climate resilience, cultural identity, and social well-being. The natural capital perspective emphasizes that development decisions need to take into account resource stocks, ecosystem functions, flows of environmental services, opportunity costs, as well as the distribution of benefits and burdens among different community groups. At the same time, the value of nature cannot be reduced to just monetary terms because people understand nature through different instrumental, intrinsic, and relational values. Therefore, sustainable natural resource and environmental management should be seen as a decision-making process that maintains ecological integrity while guiding resource use to be efficient, fair, and supportive of long-term human well-being [1], [2].

The urgency of strengthening natural resource and environmental management is becoming more obvious because human pressures have exceeded the carrying capacity of many Earth systems. Updates to the planetary boundaries framework show that six out of nine planetary boundaries have been surpassed, including climate change, biosphere integrity, land system change, freshwater change, biogeochemical flows, and novel entities. This situation increases the risk of reinforcing changes between ecosystem damage, declining resource productivity, disasters, health disruptions, and economic instability. Biodiversity modeling studies also show that just conserving areas is not enough; Ecosystem restoration must be combined with transforming food systems, reducing waste, landscape planning, and controlling drivers of land-use change. Thus, sustainable management can't be carried out through separate sectoral interventions, but rather requires an integrated strategy that works on the relationship between ecology, economy, and social behavior [3], [4].

Conceptually, natural resource and environmental management takes place within complex, adaptive, and multi-level social-ecological systems. Changes in ecological conditions can alter economic incentives and political behavior, while institutional decisions can speed up or slow down environmental degradation. This complexity means that policy success isn't just about having the right technical tools, but also about the quality of institutions, cross-scale coordination, adaptive capacity, policy learning, and the ability to manage uncertainty. The leverage points approach adds that sustainable transformation often requires deeper changes than just tweaking parameters or targets—changes in rules, information flows, system goals, and the paradigms that shape public decisions. That's why sustainability should be seen as a systemic governance issue, not just a technical conservation problem.

In practice, there's a persistent gap between policy commitments and actual implementation results. Environmental regulations can lose their effectiveness when authority is fragmented, agency mandates overlap, implementing resources are limited, data is unavailable, law enforcement is weak, and economic interests hold disproportionate influence. Competition among interest groups can lead to deadlocks, delays, or policy weakening, but the right coalitions can also prevent resource collapse. Recent reviews of low- and

middle-income countries show that the implementation gap is linked to policy designs that don't fit the context, limited bureaucratic capacity, misaligned incentives, weak accountability, and lack of local actor involvement. This explains why having policies that are normatively sound doesn't automatically lead to the desired ecological and social changes [7], [8].

The dimension of justice becomes very important because the benefits and costs of natural resource management are not automatically or evenly distributed. Policies can increase overall economic value, but at the same time, they may limit local communities' access, shift environmental risks to vulnerable groups, or ignore cultural values and local knowledge. Fair management, therefore, needs to include distributive justice, which is the sharing of benefits and burdens; procedural justice, which is meaningful involvement in decision-making; and recognition justice, which is respecting diverse identities, rights, knowledge, and ways of life. Evidence shows that participation designed as an empowering process can strengthen conservation motivation, while symbolic participation that doesn't influence decisions tends to fail in building trust and legitimacy. Multiparty participation also has epistemic and institutional functions. Knowledge about social-ecological relationships is often spread across the government, academics, businesses, local communities, civil society organizations, and resource user groups. Combining knowledge from diverse stakeholders can lead to a better understanding of the system than approaches that rely on just one type of expertise. However, achieving these results requires participation design that considers who is present, who is not represented, how information is exchanged, and how collective decisions connect with broader policy arenas. Studies on resource governance show that civil society's contribution to transparency and accountability increases when participation spaces are real, protected, and linked to follow-up mechanisms [10], [11], [12].

The context in Indonesia clearly shows this urgency. Indonesia has tropical forests, peatlands, mineral resources, fisheries, coastal areas, and biodiversity that are very important for both the national economy and global sustainability. However, the use of these resources occurs within a complex governance setup, involving central-local authority relations, overlapping permits, tenure disputes, market pressures, and disparities in capacity between regions. Studies on landscape restoration in Indonesia show that multi-stakeholder partnerships can encourage collective action, but the results are often limited by conflicting institutional mandates and weak cross-sector integration. In the fisheries sector, failing to control exploitation can simultaneously harm ecosystems, weaken local economies, and increase the vulnerability of households that depend on these resources [13], [14].

Indonesia's experience also shows that expanding policies doesn't always mean benefits are spread equally. Take social forestry, for example—it can legally open up access for communities, but the process of formulation, granting rights, and implementation is still influenced by power relations, access to information, actor legitimacy, and organizational capacity. Networks of organizations outside the community, especially NGOs and government agencies, play a key role in connecting local groups with resources, permits, and technical support. In the

extractive sector, applying transparency standards has boosted civil society participation, but its impact on real transparency, accountability, and addressing social-environmental issues is still limited when national implementation isn't aligned with decentralized governance. These findings emphasize that achieving sustainability benefits depends on who has access, voice, knowledge, capacity, and power in the management process [15], [16], [17].

Although studies on conservation, restoration, social forestry, fisheries, mining, and community participation are continuously developing, the discussions often tend to be sectoral or focus only on one aspect of sustainability. There is still a need for a synthesis that integrally connects the conceptual foundations of natural resource and environmental management, the range of ecological-economic-social-cultural benefits, implementation challenges, distribution of benefits among stakeholders, and governance options to bridge the gap between policy and outcomes. This article addresses that need through a qualitative literature review that frames natural resource and environmental management as a socio-ecological, political, and institutional process, so success is measured not only by environmental indicators but also by the legitimacy of the process and the fairness of its outcomes [1], [2], [7].

Based on the background and gaps in the study, this article raises two research questions. First, how can the concepts and principles of sustainable natural resource and environmental management generate ecological, economic, social, cultural, and educational benefits for stakeholders? Second, what governance challenges hinder the fair realization and distribution of these benefits, and what approaches are needed to strengthen their implementation? These questions are aimed at connecting the normative aspects of sustainability with institutional conditions and power relations that shape management outcomes on the ground.

This article aims to: (1) explain the conceptual basis and main principles of sustainable natural resource and environmental management; (2) synthesize the benefits of sustainable management for ecosystems, the economy, society, and culture; (3) identify implementation challenges stemming from institutional fragmentation, power imbalances, limited capacity, conflicts of interest, and weak accountability; and (4) formulate directions for strengthening governance that is participatory, adaptive, transparent, knowledge-based, and fair. Academically, this article is expected to strengthen the integration between social-ecological systems literature, resource governance, environmental justice, and policy implementation. Practically, the synthesis is expected to serve as a framework for reflection for the government, businesses, civil society, academics, and local communities in ensuring that the benefits of sustainability do not stop at policy claims but are genuinely felt by all stakeholders.

LITERATURE RIVIEW

Conceptualization of Natural Resource and Environmental Management

Natural resources include stocks, flows, processes, and natural attributes that directly or indirectly support life and economic activities. This understanding goes beyond extractable raw materials because forests, soil, water, oceans, atmosphere, and biodiversity also provide regulatory, maintenance, informational functions, as well as cultural value. Within the framework of natural capital, ecosystems are understood as assets that produce services for humans, but these assets have thresholds, uncertainty, irreversibility, and non-market values that cannot always be replaced by man-made capital. Therefore, natural resource management should not only focus on increasing extraction yields but must also maintain the stock of natural capital, the quality of ecological functions, and the distribution of benefits over time [1], [18].

The environment is a system where biotic, abiotic, social, economic, technological, and institutional components interact. Humans are not external actors in this system, but part of the biosphere, whose collective actions can maintain, change, or weaken the capacity of ecosystems. Consequently, natural resource and environmental management can be defined as a planned and adaptive process to regulate access, utilization, protection, restoration, monitoring, and benefit-sharing of resources based on ecological limits, welfare goals, and principles of justice. This integrative definition connects the biophysical dimension with behavior, institutions, power, and knowledge that determine management outcomes [6], [18].

The objects of natural resource management can be divided into renewable resources, non-renewable resources, and ecosystem functions. Renewable resources like forests, fish, water, and soil fertility can recover if their use doesn't exceed their regeneration capacity and the ecosystem structure continues to function. Non-renewable resources like minerals and fossil fuels have limited stocks, so managing them requires efficiency, impact control, using rents for economic diversification, and transitioning to more sustainable alternatives. Meanwhile, ecosystem functions like climate regulation, pollination, flood control, and soil formation don't always have clear ownership boundaries, but they form the foundation for productivity and well-being across regions and generations [1], [4].

The Evolution of Sustainability Paradigms and Biophysical Limits

The way we manage natural resources has shifted from a focus on production and sectoral control to sustainability, which recognizes the link between the economy and the biosphere. Conventional approaches usually treat resources as production inputs and environmental damage as an externality that can be fixed after it happens. Modern sustainability approaches, on the other hand, require considering ecological risks, regenerative capacity, socio-cultural values, and distributional impacts right from the planning stage. This shift marks a change from reactive management to prevention, caution, restoration, and transforming production-consumption systems.

The concept of planetary boundaries provides a biophysical basis for sustainability by showing that human activities need to stay within a safe operating space for Earth's system stability. Recent updates indicate that many major processes, including climate change, biosphere integrity, land-system changes, freshwater cycles, nitrogen and phosphorus flows, as well as the release of new entities, have been under pressure beyond safe limits. Literature on new entities also points out that the production and release of chemicals and synthetic materials are growing faster than the world's ability to assess, monitor, and control their impacts. So, sustainability requires limiting absolute pressure, not just improving relative efficiency per unit of output.

The safe planetary boundaries framework was then expanded to include a safe and just boundary. This framework recognizes that biophysical thresholds and human protection are not always identical because damage can have a huge impact on vulnerable groups before the Earth system reaches global tipping points. Therefore, natural resource management needs to set a social floor, providing minimum access to water, food, energy, health, and livelihoods, while also establishing an ecological ceiling that limits pressure on the biosphere. Sustainability that only maintains ecological aggregates without considering who benefits and who bears the risks cannot be seen as true sustainability.

The difference between weak sustainability and strong sustainability is also relevant for management decisions. Weak sustainability assumes that some natural capital can be replaced by physical, financial, or technological capital as long as the total value of assets doesn't decrease. On the other hand, strong sustainability emphasizes the existence of critical natural capital whose functions, complexity, and irreversibility cannot be adequately substituted. In practice, both views can come together by identifying critical stocks that must be maintained, assessing ecosystem services to improve economic decisions, and applying a precautionary approach when scientific knowledge is still incomplete [1], [21].

Theoretical Foundations of Natural Resources and Environmental Management

The theory of natural capital and ecosystem services explains the relationship between ecosystem structure, ecological processes, services produced, benefits to humans, and the value that emerges in decisions. This framework helps uncover the hidden costs of degradation as well as protection benefits that are often not reflected in market prices. However, economic valuation is not the final goal and should not simplify nature into a purely monetary unit. Good decisions must consider instrumental, intrinsic, and relational values; recognize who is assessing, for what purpose, and by what methods; and prevent the dominance of easily monetized values over cultural, spiritual, identity, and intergenerational values of responsibility [1], [2], [22].

Socio-ecological systems theory views resource dynamics as the result of feedback between ecological conditions and human actions. Changes in fish stocks, forest cover, water discharge, or soil fertility change user incentives and strategies, while rules, technologies, markets, and social norms change the intensity of pressures on ecosystems. Such systems are complex and adaptive because cause-and-effect relationships are not always linear, outcomes can be

delayed, and interventions that are successful in one place may not necessarily be effective in another. This framework encourages analysis that connects the characteristics of resources, actors, governance systems, socio-economic contexts, interactions, and outcomes simultaneously [6], [12].

The concept of resilience deepens the analysis by assessing the system's ability to absorb disruptions, adapt, and transform without losing essential functions. Resilience is not the same as maintaining old conditions because an unfair or degraded system can also be very persistent. Therefore, management needs to distinguish between maintaining valuable capacity, making gradual adaptations, and driving transformation when existing development pathways are no longer compatible with ecological boundaries and social justice. Diversity of responses, functional redundancy, learning, and non-over-reliance can reduce the risk of simultaneous failure in the face of change [23], [24].

The theory of shared resource governance describes the challenge when many users have access to resources that are difficult to limit their utilization, while retrieval by one party reduces availability to the other. Management outcomes are not determined only by state or private ownership, but by the conformity of rules to local conditions, clarity of rights, monitoring, conflict resolution mechanisms, legitimacy, and the ability of users to build cooperation. Recent research shows that common goals can increase cooperation, but power dynamics and relationships between decision-making must still be analyzed so that collective institutions are not controlled by certain groups [25], [26].

The commoning approach adds a dimension of process and relationships to the theory of shared resources. Resources do not become commons just because of their biophysical character, but because there are social practices that build norms, identities, responsibilities, knowledge, and collective actions. This analysis is important because formal rules that look the same can produce different results due to variations in beliefs, historical experiences, power imbalances, and organizational skills. Thus, community strengthening is not just about handing over authority, but also creating the capacity to negotiate, access information, oversee implementation, and influence decisions across levels [15], [26].

Environmental justice theory complements efficiency and conservation analysis with three main dimensions. Distributive justice assesses the sharing of benefits, costs, risks, compensation, and access to resources. Procedural fairness assesses the quality of participation, information disclosure, the right to object, and tangible influence in decisions. Recognition fairness assesses whether the identities, customary rights, knowledge, values, and ways of life of different groups are respected. The three dimensions are interdependent; Seemingly equitable distribution can remain unfair if the process is coercive or does not recognize the rights of certain groups [20], [27], [28].

The literature on indigenous peoples and local communities shows that ecological effectiveness often has to do with tenure security, knowledge recognition, local leadership, and engagement from problem setting to evaluation. Local knowledge provides information about seasonal variations, species, sacred regions, risk patterns, and adaptation practices that are not always

captured by formal data. However, knowledge integration must be done through equal co-production, not just information extraction to legitimize external decisions. Recognition of rights and value systems is a prerequisite for participation to produce effective and equitable conservation [29], [30], [31].

Normative and Operational Principles of Sustainable Management

The principle of sustainability requires the integration of ecological, economic, social, and institutional dimensions in a single decision-making framework. Integration doesn't mean every goal can always be maximized simultaneously; Conflicts between production, conservation, revenue, and access rights remain possible. The task of management is to transparently identify synergies and trade-offs, set boundaries that should not be exceeded, and ensure that increased benefits in one group or period are not compensated for through permanent damage to another group or future generations. This approach rejects evidence-unsupported win-win claims and encourages cross-time and cross-scale judgments [1], [32].

Intra- and intergenerational justice is the main normative principle. Intragenerational justice demands that the people living today have decent access to resources and do not bear the burden of the environment disproportionately. Intergenerational justice demands the protection of ecosystem capacity and development options for future generations. These two principles can be contradictory if conservation policies limit the livelihoods of the poor without adequate alternatives or compensation. Therefore, restrictions on use need to be accompanied by transition mechanisms, social protection, benefit-sharing, and recognition of rights [21], [27].

The precautionary principle directs preventive action when there is a threat of serious or irreversible damage even if the causal evidence is not yet fully certain. This principle is relevant for persistent chemicals, land-use change, extraction in vulnerable ecosystems, and large-scale projects with cumulative impacts. Prudence does not mean banning all innovation, but shifting the burden of proof, setting safety thresholds, testing alternatives, building monitoring systems, and maintaining the ability to reverse decisions when risks increase. This approach is important when the pace of production and innovation exceeds the capacity of risk assessment [4], [19].

Resource efficiency needs to be placed below ecological limits. Increased productivity of materials, energy, water, and land can reduce the pressure per unit of output, but the benefits can be offset by an increase in total production and consumption. Therefore, efficiency strategies must be accompanied by absolute targets of pressure reduction, circular design, product life extension, reuse, material recovery, and demand control. For non-renewable resources, management also needs to ensure that rents are not only consumed, but converted into human capacity, low-carbon infrastructure, innovation, and ecosystem restoration [5], [18].

Participation, transparency, and accountability form procedural principles. Meaningful participation occurs when stakeholders obtain understandable information, have equal opportunities to convey knowledge and objections, and have influence on choices and follow-ups. Transparency needs to

include data on licensing, beneficial ownership, impact, payment, compliance, and monitoring results. Accountability requires clarity of accountability, audits, grievance mechanisms, proportionate sanctions, and access to remediation. Without these elements, multi-stakeholder forums risk becoming a symbol of legitimacy without changing the distribution of power [11], [17].

Ecosystem and landscape approaches require decisions to pay attention to relationships across sectors, spaces, and levels of government. Forest management affects water, agriculture, energy, health, and livelihoods; coastal management is influenced by upstream activities; While conservation in one location can shift pressure to another location. The landscape approach tries to bring together competing land use claims through spatial planning, negotiation, and joint monitoring. Its success depends on the ability to bridge sectoral silos, manage power relations, engage the private sector, and link local action with national policies [13], [33].

Adaptive management complements the ecosystem approach with a cycle of iterative learning: formulating goals and hypotheses, selecting actions, monitoring indicators, comparing results with expectations, and adjusting policies. Adaptation is necessary because changes in climate, markets, technology, and ecological conditions produce uncertainties that cannot be completely eliminated before decisions are made. However, adaptation should not be an excuse to delay action or opportunistically change goals. Consistent indicators, documentation of decisions, controlled experimental spaces, and mechanisms to stop interventions that have proven to be damaging are needed [34], [35].

Scope, Instruments, and Management Cycles

The scope of natural resources and environmental management includes protection, utilization, pollution control, conservation, rehabilitation, restoration, mitigation, adaptation, and benefit sharing. The instruments used can be regulative, economic, informational, voluntary, rights-based, or community-based. Regulations set standards and prohibitions; economic instruments change incentives through taxes, fees, subsidies, payments for environmental services, or recovery guarantees; information instruments strengthen openness and behavior change; Meanwhile, the rights-based and community-based approach regulates access, control, and responsibility. Effectiveness usually depends on a coherent combination of instruments, rather than on a single stand-alone instrument [7], [8].

The management cycle begins with a diagnosis that maps out biophysical conditions, drivers of change, actors, rights, dependencies, risks, values, and conflicts. The planning stage then establishes visions, limits, measurable goals, scenarios, choice of instruments, division of roles, sources of financing, and protection mechanisms for vulnerable groups. Implementation translates plans into budgeting, licensing, oversight, capacity building, incentives, and coordination. Monitoring and evaluation must test not only administrative outputs, but also changes in ecological conditions, welfare, benefit distribution, compliance, legitimacy, and adaptation capacity [6], [10].

Success indicators should be multidimensional. Ecological indicators can include habitat size and quality, resource stocks, connectivity, water and air quality, emissions, and resilience. Economic indicators include productivity, income diversification, livelihood stability, efficiency, and local added value. Social indicators include access, health, tenure security, conflict, organizational capacity, and perceptions of justice. Governance indicators include transparency, participation, coordination, enforcement, data quality, and complaint resolution. Indicator selection needs to involve users because technical indicators that are not considered relevant can fail to guide collective action [2], [12].

Nature-based solutions are one of the groups of interventions that link protection, recovery, and social problem solving. Mangrove restoration, watershed rehabilitation, agroforestry, peat protection, and green spaces can support mitigation, adaptation, biodiversity, and livelihoods. However, these benefits do not automatically appear. Effectiveness is influenced by ecological suitability, species diversity, scale, maintenance, land rights, participation, and protection against displacement. Nature-based solutions should not be used as a substitute for emission reductions or as a justification for damage at other sites [32], [36], [37], [38].

The latest literature confirms the need for integrity standards for nature-based solutions. Interventions must address clear social issues, generate net benefits for biodiversity, be designed to survive climate change, and be built through inclusive governance. Monoculture planting programs that focus solely on carbon can reduce biodiversity, disrupt water, and undermine people's rights. In contrast, the protection of intact ecosystems, the restoration of ecological processes, and co-management have more potential to yield compound benefits. Assessments should compare alternatives and recognize the limits of nature's ability to substitute for pressure reduction from the source [36], [39].

Multilevel Governance and Implementation Challenges

Natural resource governance architecture is typically multi-level and polycentric because authority is spread among the central government, local governments, sectoral institutions, communities, companies, civil society organizations, and international institutions. Decentralization can bring decisions closer to local conditions, but it can also result in variations in capacity, jurisdictional competition, and cross-border impact shifting. On the contrary, centralization can strengthen standards and redistribution, but risks ignoring local knowledge. The main challenge is to design a division of authority, coordination, information, and correction mechanisms that are appropriate to the ecological scale of the problem [6], [40].

Polycentric governance is not synonymous with fragmentation. Productive polycentricity has a relatively autonomous but connected decision-making center through rules, learning, supervision, and conflict resolution mechanisms. Institutional redundancy can increase innovation and resilience when the division of roles is clear; Conversely, overlapping without coordination can create forum shopping, throwing responsibility at each other, and weak enforcement. Therefore, inter-agency connectivity needs to be designed for data exchange, target alignment, and response to cross-regional impacts [34], [40].

Implementation gaps arise when good policies are normatively not translated into changes in behavior and environmental conditions. The causes can come from vague objectives, inconsistent instruments, overlapping mandates, limited human resources and budgets, weak data, selective enforcement, and inadequate involvement of nongovernmental actors. Political and economic interests can also influence agendas, exclusion designs, oversight, and sanctions. Implementation analysis, therefore, must assess the relationship between policy content, institutional capacity, incentives, power relations, and political context, not just the existence of regulations [7], [8].

Multistakeholder participation can help address knowledge fragmentation and build legitimacy, but its effectiveness is determined by design. Forums dominated by actors with greater resources, technical language, or political access can reproduce inequality. Participatory management requires independent facilitation, support for underrepresented groups, conflict of interest rules, disclosure of evidence, and clarity on how recommendations affect decisions. When these conditions are met, diversity of knowledge can improve the quality of understanding of systems and strengthen commitment to joint action [9], [10].

In the Indonesian context, the complexity of governance can be seen in the management of forests, landscapes, mining, coasts, and fisheries. Expanding legal access through social forestry can increase community opportunities, but the outcome is influenced by access to capital, markets, mentoring, and position in the policy network. Landscape restoration faces the challenges of sectoral mandates and land-use interests, while extractive sector transparency has not automatically resolved the socio-environmental impacts of decentralized systems. The literature shows that formal reform must be accompanied by capacity building, recognition of rights, cross-sectoral coordination, and accountability mechanisms that work at the implementation level [13], [16], [17].

Conceptual Synthesis and Article Analysis Framework

Based on the literature, sustainable natural resource and environmental management can be analyzed through five interconnected layers. The first layer is ecological conditions and boundaries, including stocks, flows, functions, thresholds, and resilience. The second layer is value and benefits, including ecosystem services, income, health, identity, and intrinsic value. The third layer is actors as well as the distribution of rights, capacity, knowledge, risk, and power. The fourth layer is institutions, instruments, coordination, and accountability mechanisms. The fifth layer is the results in the form of ecological sustainability, economic efficiency, welfare, justice, legitimacy, and adaptability. Changes to one layer result in feedback against another layer [1], [2], [6].

The framework explains that the benefits of management are not only determined by the amount of benefits generated, but also by the sustainability of the source of the benefit, its distribution, its formation process, and the ability of stakeholders to sustain it. Ecological benefits can fail to become social benefits if access is unfairly restricted; income can increase while resource stocks decrease; and participation can take place without substantive influence. Therefore, the

evaluation must link ecological outcomes with economic, social, cultural, educational, and governance outcomes simultaneously [20], [27].

Literature Review This is the basis for the Results and Discussion section to answer two research questions. The first question is analyzed through the relationship between management principles, service and value formation mechanisms, and multidimensional benefits for stakeholders. The second question is analyzed through implementation gaps, institutional fragmentation, power inequality, conflicts of interest, limited capacity, and governance strengthening options. With this framework, the article does not stop at the normative description of sustainability, but assesses the conditions that allow benefits to be truly realized and distributed equitably [5], [7], [8].

METHODOLOGY

This article uses the qualitative literature review (QLR) method with an integrative and interpretive orientation, not systematic literature review (SLR). This approach was chosen because the purpose of the study was not to calculate the magnitude of the effects, to rank the evidence, or to inventory all publications in an exhaustive manner, but to connect concepts, theories, empirical findings, and policy debates regarding natural resource management (SDA) and the sustainable environment. QLR allows authors to examine assumptions, compare perspectives, identify relationships between concepts, and construct a synthesis that explains how sustainability benefits are formed, distributed, and constrained by socio-ecological conditions and governance. Although it is non-SLR, the study process still requires transparent selection arguments, coherence between the research questions and the literature used, and synthesis that goes beyond descriptive summaries [41], [42], [43].

Literature search is carried out purposively and iteratively by prioritizing reputable journal articles published since 2020 and can be searched through publisher metadata, internet access address, and DOI if available. The keywords in Indonesian and English are combined flexibly, including sustainable natural resource management, environmental governance, social-ecological systems, natural capital, ecosystem services, environmental justice, common-pool resources, adaptive governance, stakeholder participation, implementation gap, social forestry, natural resource governance, and environmental justice. The literature was selected based on its direct relevance to the research question, conceptual or empirical strength, relevance to the context of developing countries and Indonesia, and its ability to explain benefits, conflicts of interest, risk distribution, institutional capacity, and implementation challenges. Publications that are duplicative, unverifiable, non-scientific opinion, or only tangentially related are excluded. Unlike SLR, this study does not use the PRISMA protocol, the target number of studies, nor the claim of extortive coverage; The adequacy of literature is determined by the conceptual depth and ability of the selected sources to explain the relevant themes and relationships [41], [42].

Analysis is carried out through repeated reading, conceptual coding, thematic grouping, comparison between sources, and the preparation of narrative synthesis. The findings of the literature are first mapped into the theme of ecological conditions and boundaries; the value and benefits of natural

resources; actors, rights, capacity, knowledge, risks, and power relations; institutions, instruments, participation, coordination, and accountability; as well as ecological, economic, social, cultural, and institutional outputs. Furthermore, convergence patterns, differences, contextual conditions, causal mechanisms, and opposing findings are analyzed to answer both research questions and avoid context-insensitive generalizations. The credibility of the synthesis is strengthened through triangulation of cross-disciplinary and regional sources, examination of citation consistency with reference lists, verification of DOIs and publisher pages, and reflexivity in distinguishing empirical evidence, author interpretation, and policy implications. Thematic analysis is treated as an interpretive process that requires a corresponding correspondence between conceptual positions, ways of coding, theme formation, and resulting claims [43], [44], [45].

RESULT AND DISCUSSION

Multidimensional Benefits and Mechanisms of Their Formation

The results of the synthesis show that the benefits of natural resource management (SDA) and the sustainable environment are formed through a series of interdependent mechanisms, rather than through a single intervention. Protection of natural capital stocks maintains ecological functions; these functions produce ecosystem services; ecosystem services then affect productivity, health, food and water security, disaster risk reduction, and quality of life. However, new benefits turn into welfare when there are clear access rights, capacity to take advantage of opportunities, supporting infrastructure, reasonable markets, and institutions that prevent the control of benefits by certain groups. Thus, the relationship between management and benefit is conditional: conservation or restoration can create great social value, but the magnitude of the value, who enjoys it, and how long the benefits last are determined by ecological conditions, policy design, and local socio-economic structure [1], [46], [47].

These findings expand the understanding of sustainability from simply a balance between the three economic, social, and environmental dimensions to the analysis of cause-and-effect relationships and the distribution of outcomes. Ecologically sound management is not necessarily fair if access restrictions are primarily borne by local communities, while financial or reputational benefits flow to stronger actors. In contrast, income-maximizing programs that ignore ecosystem regenerative boundaries can produce transient benefits at the long-term cost of decreased productivity, conflict, and disaster vulnerability. Therefore, the evaluation of success ;p erlu assesses ecosystem conditions, benefit streams, risk reduction, quality of participation, recognition of rights, livelihood resilience, and the ability of institutions to learn. The approach is consistent with the idea of secure and fair earth boundaries and the plurality of natural values, which reject sustainability assessments based solely on economic aggregates or single biophysical indicators [2], [20], [21].

Ecological Benefits: Integrity, Resilience, and Stability of Natural Systems

The most fundamental ecological benefit is the maintenance of the ecosystem's structure, function, and regenerative capacity. Integrated management of forests, coasts, watersheds, peatlands, agricultural land, and marine areas can maintain habitats, landscape connectivity, water cycles, soil fertility, pollination, erosion control, and carbon storage. Biodiversity also provides a diversity of responses to disturbances, so that the system is not entirely dependent on one species or one function. When some components are disrupted, other components can retain the necessary functions; This mechanism increases resilience to drought, fire, flooding, pest attacks, and climate change. The literature confirms that diversity of responses is a sustainability strategy because it reduces the likelihood of simultaneous failures in complex systems [18], [23].

Ecosystem restoration can restore some of the lost function, but the evidence synthesis warns that restoration should not be treated as an equivalent substitute for natural ecosystems. Meta-analyses of mangroves show that restored areas generally function better than expanses without vegetation, but often do not match natural mangroves; Results also depend on the age of restoration, species selection, engineering, hydrology, and comparative conditions. A similar pattern supports the principle of a mitigation hierarchy: avoiding damage should be prioritized, followed by impact reduction, rehabilitation, and only then compensation for the rest of the impact. Therefore, the target of planting area alone is not enough; Ecological quality, species composition, connectivity, hydrological processes, as well as sustainability of maintenance should be part of the measure of success [32], [36], [48].

Ecological benefits also emerge through the synergy of biodiversity protection, climate mitigation, and adaptation. Marine area planning, for example, can be designed to improve species protection, maintain food production, and simultaneously secure carbon stocks. On land, landscape approaches that combine protected areas, ecological corridors, agroforestry, degraded land restoration, and sustainable production can reduce fragmentation and reduce impact shifts from one site to another. However, not all locations produce the same synergy; Conflicts between the goals of conservation, production, and ecosystem services are still possible. Planning needs to explicitly identify trade-offs and avoid claiming win-win solutions without contextual evidence [33], [38], [49], [50].

Economic Benefits: Productivity, Risk Reduction, and Livelihood Diversification

From an economic perspective, sustainable management maintains productive assets that are often not recorded in conventional balance sheets. Healthy soils, clean water, fish stocks, forests, mangroves, and pollinators are production inputs as well as natural infrastructure that reduces costs. Conservation and restoration can reduce losses from flooding, erosion, storms, fires, and degraded water quality, while carbon storage and biodiversity protection create public benefits across regions and generations. Comparisons of different sites show that the social value of conservation or restoration, especially if climate management and disaster protection services are considered, often

outweigh the private benefits of more intensive land conversion. This reinforces the economic rationale for including natural capital, externalities, and long-term risks in investment and policy analysis [1], [46], [51].

Restoration can also generate economic returns when the design is in accordance with the character of the ecosystem and the needs of users. Mangrove evidence shows a positive benefit-cost ratio, while land restoration from extractive activities can generate benefits through carbon sequestration and productivity restoration. However, the benefits do not appear immediately and are often spread to the public, whereas costs must be incurred early by the government, company, or society. Time differences, beneficiaries, and cost insurers create financing gaps. Therefore, policies need to combine public funding, recovery obligations by business actors, performance-based payments, maintenance guarantees, and instruments that recognize ecosystem services without converting the entire value of nature into a single commodity [48], [52], [53].

At the household and regional levels, sustainable management can diversify livelihoods through agroforestry, non-timber forest products, sustainable fisheries, ecotourism, renewable energy, ecosystem restoration, and local processing efforts. Diversification reduces dependence on a single commodity and improves the ability to cope with price fluctuations or climate disruptions. However, green economic opportunities are not automatically inclusive. Capital requirements, certifications, technology, land certainty, and market access can exclude small producers. In Indonesian peatlands, for example, agroforestry and paludiculture models have the potential to align hydrological recovery with income, but require value chains, financing, counseling, and market certainty so that communities do not return to destructive land use but generate income faster [38], [54], [55], [56].

Social, Health, Cultural, and Educational Benefits

Social benefits arise when management strengthens livelihood security, access to basic resources, social cohesion, and the collective ability to manage risk. A healthy ecosystem supports water quality, food, protection from hazards, and decent living spaces. Interventions that combine conservation and health objectives can yield shared benefits, but they must be designed based on proven ecological relationships so as not to shift risks or incur unintended consequences. Community-based programs can also build local organizations, consultative experience, and monitoring capacity. In the case of mangrove and fisheries conservation in West Kalimantan, participatory assessments identified benefits in the form of income, health, education, and the formation of local management systems, suggesting that social and ecological outcomes can be mutually reinforcing when communities have a substantive role [57], [58].

The cultural dimension is part of the socio-ecological function, not a separate addition. Local and indigenous knowledge contains classifications, seasonal indicators, utilization techniques, access rules, and maintenance practices formed through long-term interactions with specific places. Recognition of such knowledge can improve the diagnosis of problems, improve the appropriateness of actions, and maintain identity and relational relationships

with nature. However, knowledge integration must not stop at information extraction without recognition of rights, intellectual property, and decision-making authority. Conservation that ignores local value systems can undermine management practices that previously protected biodiversity and fuel unfair recognition [29], [30], [59].

Educational benefits operate through improved ecological literacy, the ability to read environmental changes, and the formation of behavioral norms. Effective environmental education is not enough to provide information; He needs to connect knowledge with direct experience, identity, efficacy, opportunities for action, and institutional support. Meta-analysis shows that connection to nature is associated with pro-environmental behavior, while environmental attention is related to both public and private behavior. In natural resource governance, education needs to be extended from individual campaigns to social learning between stakeholders, including technical training, legal knowledge, data literacy, negotiation, and evaluation. Thus, education becomes a capacity infrastructure that allows meaningful participation, not just an instrument for changing consumer behavior [60], [61].

Benefit Distribution, Trade-offs, and Stakeholder Positions

The answer to the first question is incomplete without assessing the distribution of benefits. The government can obtain public revenue, disaster cost reduction, and target achievement; companies can obtain raw material certainty, risk reduction, market access, and legitimacy; local communities can obtain rights, income, protection of livelihoods, and ecosystem services; Meanwhile, the wider community benefits from climate, biodiversity, water, and health. However, each benefit has a different scale and time. Protection costs are often localized to restricted users, while climate or biodiversity benefits are widespread. These inconsistencies raise issues of fairness and incentives, so compensation mechanisms, benefit-sharing, and transition support need to be built from the planning stage [2], [27].

Trade-offs also arise within groups that are often considered homogeneous. Local communities are made up of households with different land ownership, gender, age, occupation, migration status, political networks, and resource dependencies. Programs that benefit village elites or landholders do not necessarily help women, fishermen without assets, seasonal workers, or indigenous groups whose rights have not been recognized. Therefore, participation needs to be accompanied by social mapping, analysis of rights and dependencies, complaint mechanisms, and monitoring of benefits at the group level. The emphasis on distributive justice alone is also inadequate if the community has no influence on decisions or its cultural values are not recognized [27], [31], [62].

The benefit-sharing mechanism should avoid the assumption that financial incentives are always the solution. Payments can encourage compliance, but their effectiveness is influenced by trust, certainty of payment, perception of fairness, and a relationship with intrinsic motivation. When compensation is stopped or uncertain, conservation behavior can weaken; On the contrary, participatory policies that strengthen autonomy and a sense of

belonging can maintain motivation. Therefore, the combination of secure rights, equitable material benefits, public services, cultural recognition, and participation opportunities is stronger than short-term transactions. The design also reduces the risk that conservation is perceived as an external restriction that only shifts costs to the community [9], [52], [63].

Implementation Challenges: Ecological Complexity and Uncertainty

The first challenge stems from the nature of the socio-ecological system that is non-linear, dynamic, and contains thresholds. The relationship between interventions and outcomes can experience time lags, feedback, and sudden changes. Successful restoration at a single location cannot always be replicated due to differences in hydrology, soil, market pressure, tenure, and community capacity. This uncertainty is often at odds with a planning system that demands simple targets and annual budget disbursement. As a result, the program pursues output indicators such as the number of seeds, the area of permits, or socialization activities, but pays less attention to changes in ecosystem and institutional functions. Adaptive governance is necessary to treat policies as hypotheses that are tested, monitored, and adjusted based on results [6], [23], [34].

Uncertainty also opens up space for selective selection of evidence. Actors can highlight certain benefits and ignore other impacts, especially when indicators, baselines, and measurement methods are not agreed upon. The concept of nature-based solutions, for example, has the potential to integrate adaptation, mitigation, biodiversity, and well-being, but can turn into an overly broad label if it is not accompanied by ecosystem integrity protection, additional benefits, long-term resilience, and maladaptation prevention. The evaluation, therefore, needs to compare interventions with conditions without a project, consider impact leakage, assess sustainability, and record groups that gain or lose benefits [36], [37], [39].

Institutional Fragmentation and Policy Inconsistency

The second challenge is the fragmentation of authority between sectors, levels of government, and administrative boundaries. Water, forests, agriculture, mining, energy, infrastructure, coastal, and spatial planning are often managed by agencies with different mandates, data, budgets, and indicators. One institution can encourage restoration, while another provides incentives for conversion or development that increases pressure. Policies that are integrated on paper can also be unraveled when translated to the regional level due to differences in capacity and priorities. Analysis of policy networks shows that the dominance of central actors and limited cross-sectoral or cross-level linkages can reduce local support and hinder implementation [40], [64], [65].

In the Indonesian context, fragmentation is seen in social forestry and landscape restoration. The expansion of access permits can be held back by competition for bureaucratic mandates, administrative processes, and weak post-permit support. At the same time, restoration requires coordination across concession boundaries, villages, districts, and hydrological areas. If coordination is only project-based, the sustainability of the action weakens after funding ends. The experience shows that institutional design needs to establish who leads, how

mandate conflicts are resolved, how data is shared, and how cross-agency accountability is implemented. Without such an architecture, collaboration can become a forum for the exchange of information without the authority to change sectoral decisions [13], [16], [66].

Power Inequality, Tenure Conflicts, and the Risk of Elite Capture

The third challenge relates to power inequality. Actors with greater capital, information, political access, and legal capabilities can influence the determination of territories, permits, standards, and the distribution of compensation. Formal participation does not necessarily correct these inequities if the agenda, technical language, time, and evidence are controlled by a particular party. In fact, a collaborative process can legitimize predetermined decisions. Commoning and resource governance analysis shows that power needs to be treated as a core element, not an external variable. Facilitation interventions, organizational strengthening, access to information, and independent support are needed so that groups with low bargaining positions are able to articulate their interests [26], [67].

Tenure conflicts magnify the problem because the clarity of rights reduces long-term investment incentives and increases the risk of benefit takeover. Legal recognition that is only administrative is also not enough if it is not accompanied by the ability to access land, capital, technology, and markets. In Indonesia's social forestry, policy outcomes are influenced by access and exclusion processes and organizational networks that connect communities with governments and donors. These findings suggest that the granting of permits must be followed by boundary resolution, mentoring, conflict mechanisms, and business strengthening. Community-based management does not mean that the government withdraws, but rather changes its role from a sole controller to a guarantor of rights, facilitators, and overseers of justice [15], [16].

Capacity Limitations, Financing, Data, and Enforcement

The fourth challenge is the implementation capacity gap. Policies can be more numerous, but their impact remains low when the implementing organization lacks staff, competencies, operational budgets, laboratories, monitoring tools, or enforcement authority. A high reporting burden can also drive administrative compliance without substantive improvements. The literature on rule growth shows that the addition of regulations only produces an impact when implementation capacity grows in line; Without it, there will be empty rule growth. This challenge is especially relevant for areas with large areas and limited monitoring resources [8], [68].

Digitalization, remote sensing, data platforms, and early warning systems can strengthen detection and transparency, but technology is not a substitute for institutions. Data should have standards, updates, interoperability, and follow-up mechanisms. Public access also needs to be accompanied by the ability to understand information and complaint channels. Evidence shows that digitalization can increase capacity through data and indicators, knowledge transfer, satellite imagery, risk-based inspections, and community oversight. However, inequality in connectivity, data quality, and technological mastery can create new forms of exclusion. Therefore, digital investment needs to go hand in

hand with strengthening human resources, field verification protocols, data protection, and response accountability [69], [70].

Financing also faces the issue of duration and additional benefits. Many conservation programs rely on short project cycles, while ecosystem restoration and institutional strengthening take a long time. Output-only funding can drive actions that are easily calculated but less meaningful. In contrast, outcome-based payments must be careful not to penalize regions with poor baseline, high risk, or low capacity. Financing portfolios should incorporate core funds for capacity, long-term funding for maintenance, performance incentives, private sector liabilities, and transition support for affected groups. The assessment should also include non-market benefits and risk of failure, not just direct cash flow [46], [71].

Market Pressures, Short-Term Orientation, and Externalities

The fifth challenge stems from an economic incentive structure that rewards short-term extraction, while the cost of degradation is passed on to society, government, or future generations. Commodity prices often do not reflect biodiversity loss, emissions, pollution, land degradation, or conflict. Companies and local governments can face revenue pressures that drive production expansion, while conservation benefits are scattered and difficult to capture by local actors. The correction requires a combination of regulation, the elimination of destructive subsidies, the internalization of externalities, sustainable procurement, traceability, and incentives for practices that generate public benefits. However, market instruments must be accompanied by social protection so that compliance costs do not push small producers out of the value chain [1], [22].

Carbon mechanisms and certifications can help direct capital, but they also risk simplifying the ecosystem into a single metric. Forest carbon projects in Southeast Asia show potential additional benefits for biodiversity and ecosystem services, but the magnitude of the benefits depends on location and design. If the priority is only on the cheapest tons of carbon, the project can ignore areas of high biodiversity value, community rights, or ecosystem resilience. Therefore, standards must require social protection, additionality, permanence, leak handling, and measurement of non-carbon benefits. Contract transparency and revenue sharing are also important so that environmental value is not concentrated on intermediaries or capital owners [2], [72].

Quality of Participation, Trust, and Knowledge Integration

The sixth challenge is the difference between procedural participation and participation that actually influences decisions. Meeting invitations, one-time consultations, or signing agreements do not guarantee that the group understands the options, has time to negotiate, and can refuse without consequences. Meaningful participation requires comprehensible initial information, inclusive representation, independent facilitation, documentation of reasons for the decision, and objection mechanisms. Participatory interventions tend to be effective when they fit the configuration of actors and contexts, rather than being implemented as a uniform package. Trust is built through consistency of action, fulfillment of promises, and experience that input produces real change [10], [12].

In Indonesia, public perceptions of peat restoration show that support is influenced by the impact on livelihoods, understanding of the goals, experience with the government, and the availability of viable alternatives. The concept of social license to restore emphasizes that legitimacy cannot be obtained only from legal authority; It depends on the reception that continues to build. Programs that change water systems or land-use patterns without addressing revenue needs can face rejection or non-compliance. Integrating scientific and local knowledge needs to be done through joint design, field experiments, and participatory monitoring so that the community becomes a knowledge producer, not just a source of data [56], [73].

Direction of Strengthening Implementation: Adaptive, Polycentric, and Equitable Governance

The synthesis shows that strengthening implementation needs to begin with an ecosystem and landscape approach that places sectoral decisions in a single socio-ecological unit. Ecological, production, infrastructure, and livelihood goals should be analyzed together to identify synergies, trade-offs, and impact shifts. This approach does not mean forming a single super organization, but building coordination rules, shared data, conflict resolution forums, and the sharing of responsibilities that follow the scale of the problem. On cross-border issues, polycentric governance allows multiple decision centers to work with limited but coordinated autonomy, so that local knowledge can be used without losing national support [33], [40].

Adaptive governance then requires cycles of planning, action, monitoring, evaluation, learning, and adjustment. Targets should include ecological and social indicators, a clear baseline, and thresholds that trigger corrections. Failures need to be treated as information, not hidden to fulfill the report. Institutional learning can be a shared evaluation, an open data repository, a community of practice, and a budget that allows for design changes. Diversity of strategies is also important so that the system does not depend on a single technology, commodity, or institution. This approach strengthens the ability to respond to surprises while maintaining a normative direction towards ecological justice and integrity [23], [24], [34].

Strengthening Rights, Sharing Benefits, and Protection of Vulnerable Groups

Equitable implementation must place the recognition of tenure rights and security as the foundation. Participatory mapping, recognition of customary territories, access to legal assistance, and conflict resolution mechanisms are required before economic incentives are provided. Benefit-sharing needs to be designed around dependencies, contributions, vulnerabilities, and opportunity costs, not just formal ownership. Analysis disaggregated by gender and social group helps detect hidden impacts. In addition to financial transfers, benefits can be in the form of basic services, business support, restoration work, education, technology, and management authority. The rights-based principle prevents conservation from becoming a form of green takeover at the expense of the groups that depend most on nature [20], [30], [62].

Local organizations need long-term support to manage finances, internal rules, conflicts, marketing, and monitoring. Evidence suggests that stronger local governance is associated with positive outcomes from long-term community conservation, but that capacity grows through experience and networking, rather than just short training. Governments and companion organizations need to provide tiered support and prevent dependency. Cross-level networking can connect communities with technical, market, financing, and decision-maker knowledge, while maintaining accountability to members. This design recognizes that community-based management requires an institutional ecosystem outside the community [15], [74].

Integration of Incentives, Financing, Data, and Accountability

The policy package needs to align regulatory, fiscal, market, and information. Enforcement of ecological boundaries should be the foundation, while incentives are used to encourage action beyond minimum compliance. Subsidies that accelerate degradation need to be diverted towards recovery, resource efficiency, and livelihood transition. Public financing can bear the general benefits and initial risks, while business actors must bear the prevention, recovery, and compensation for the impact. Government procurement and financial institutions may require traceability and environmental-social due diligence. Consistency between instruments is more important than many because conflicting policy signals will defeat conservation programs on a smaller scale [5], [8].

Data systems and accountability must enable a traceability from commitment to results. Information on permits, environmental conditions, compliance, acceptance, benefit-sharing, and complaint follow-up needs to be available in a usable format. Community monitoring can expand reach and increase legitimacy, but it requires protocols, whistleblower protection, and official responses. Independent verification and social auditing help reduce conflicts of interest. The EITI experience shows that transparency standards can open up space for participation, but the substantive impact depends on the relationship with decentralization, enforcement, and the ability of civil society to use information. Transparency, therefore, is a means to accountability, not an end goal [11], [17].

Education, Social Learning, and Paradigm Transformation

Capacity building needs to be directed at cross-actor social learning. Apparatus requires competencies in policy integration, system analysis, conflict mediation, evaluation, and risk communication; companies require due diligence and supply chain management capabilities; the community needs access to law, data, technology, and business development; Meanwhile, academics need to strengthen the production of common knowledge. Learning forums should be connected to budget and licensing decisions so that knowledge doesn't stop at reports. Epistemic diversity helps to test assumptions, uncover overlooked impacts, and come up with solutions that are more contextually appropriate [2], [29].

At a deeper level, transformation requires a paradigm shift from natural resources as a commodity supply to nature as a life support system and space for social relations. These changes affect the goals, indicators, and success criteria. Production growth cannot be the only measure if it is accompanied by a reduction in natural capital, inequality, and risks. The leverage points approach shows that changes in rules, information flows, goals, and perspectives have greater potential than technical adjustments that do not change the structure. Paradigm transformation needs to be realized in budgets, investment assessments, curriculum, organizational mandates, and accountability mechanisms so that it does not stop as rhetoric [5], [18].

Synthesis and Answers to Research Questions

To answer the first research question, the concepts and principles of sustainable natural resource and environmental management generate benefits through five main pathways. First, protection and restoration maintain ecological functions and resilience. Second, ecosystem services support production and reduce risks and costs. Third, safer rights and access strengthen livelihoods, health, and collective capacity. Fourth, the recognition of local knowledge and values maintains cultural identity and increases the appropriateness of action. Fifth, education and social learning build the ability to manage change. The pathways reinforce each other, but only when ecological integrity, efficiency, justice, participation, transparency, and adaptation are applied as a whole, not as stand-alone principles [1], [2], [47].

Benefits to stakeholders differ by position and scale. The government gains risk reduction and legitimacy; the business world gains certainty, efficiency, and supply security; local communities obtain livelihoods, ecosystem services, and authority; Wider communities benefit from climate, biodiversity, health, and intergenerational heritage. However, these benefits are not automatically equivalent. When rights are unclear, capacity is uneven, or benefit-sharing is weak, management can create winners and burdens. Therefore, success must be assessed on the basis of additional ecological benefits as well as distributive, procedural, and recognition justice [20], [27].

To answer the second question, the main obstacles consist of complexity and ecological uncertainty; institutional fragmentation; power imbalances and tenure conflicts; limitations on capacity, financing, data, and enforcement; short-term market pressure; and superficial participation and integration of knowledge. These barriers interact. Data limitations can increase information inequality; fragmentation weakens enforcement; the unclear right to lower incentives; and economic pressures can shift costs to vulnerable groups. Therefore, partial resolution risks moving the problem, not addressing it [6], [7], [8].

The approach needed is ecosystem-based adaptive and polycentric governance, with rights protection, benefit-sharing, cross-sector coordination, long-term financing, open data, participatory monitoring, and correction mechanisms. In the Indonesian context, the priorities include synchronization of spatial planning and licensing, tenure settlement, post-permit support for social forestry, business models compatible with peat and coastal restoration,

strengthening local governments, and accountability of the extractive sector. The approach should be seen as a long-term institutional investment. Sustainability becomes real when rules, incentives, capabilities, and power relations allow all stakeholders to maintain ecosystems while reaping decent and fair benefits [13], [17], [54].

CONCLUSIONS AND RECOMMENDATIONS

This article concludes that sustainable natural resource and environmental management is a process of socio-ecological system governance, not just a technical activity of conservation or pollution control. The goal is to maintain natural capital and ecosystem function, direct utilization within regenerative limits, and ensure benefits and burdens are distributed equitablely. The synthesis of literature shows that the ecological, economic, social, cultural, educational, and institutional dimensions are interdependent. Policies that pursue only one dimension risk resulting in hidden trade-offs, reducing resilience, or shifting costs to vulnerable communities and future generations.

Ecological benefits are realized through the protection of biodiversity, hydrological function, soil fertility, carbon storage, and diversity of responses to disturbances. These benefits support productivity, reduce disaster and health risks, and create opportunities for economic diversification. At the same time, management that recognizes local rights and knowledge can strengthen organization, cultural identity, learning, and policy legitimacy. However, restoration does not always equate to natural ecosystems and economic benefits do not automatically reach the group that bears the cost. Damage prevention, ecological quality, durability, and distribution of results should therefore be central to evaluation.

Implementation barriers are structural and mutually reinforcing. Fragmentation of authority, mandate conflicts, tenure ambiguity, inequality of information and power, limited implementing capacity, short-term funding, unintegrated data, weak enforcement, and market pressures can turn good policies into administrative compliance. Symbolic participation also fails to build trust. This situation explains why an increase in the number of rules, social permits, or restoration targets is not necessarily followed by improvements in ecological conditions and welfare.

Strengthening implementation requires adaptive, polycentric, and equitable governance. This approach must integrate ecosystem scale with clear division of authority; linking regulations, financing, markets, and information; guarantee the right and grievance mechanism; and building ecological-social monitoring that can trigger policy corrections. In the Indonesian context, post-permit support, tenure conflict resolution, regional and community capacity building, business models compatible with ecological functions, transparency of licensing and admission, and cross-sector coordination are priorities. Success must be measured through changing conditions and the distribution of benefits, not just program outputs.

Future research needs to develop longitudinal and comparative studies that track the relationship between governance design, changes in ecosystem

conditions, benefit distribution, and livelihood resilience at different scales. Research also needs to examine equity indicators that can be applied in routine monitoring, the effectiveness of a combination of regulatory instruments and incentives, the impact of digitalization on accountability, and mechanisms for integrating scientific and local knowledge without extraction or marginalization. In Indonesia, special attention is needed on the long-term outcomes of social forestry, peat and mangrove restoration, mining governance, small-scale fisheries, and the impact of green transition policies on vulnerable groups. Community involvement as design and research partners will increase the relevance, legitimacy, and ability of findings to improve policy.

FURTHER STUDY

This research still has its limitations, so further studies on the topic of Spatial Planning Regulation and Sustainable Development: A Review of Governance, Spatial Justice, and SDG Implementation are needed to improve this research and add insights for both the author and the readers

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