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Citation for published version:

Garcia Ferrari, S, Bain, AA & Crane De Narváez, S 2021, 'Drivers, opportunities, and challenges for integrated resource co-management and sustainable development in Galapagos', *Frontiers in Sustainable Cities*, vol. 3, 666559. <https://doi.org/10.3389/frsc.2021.666559>

Digital Object Identifier (DOI):

[10.3389/frsc.2021.666559](https://doi.org/10.3389/frsc.2021.666559)

Link:

[Link to publication record in Edinburgh Research Explorer](#)

Document Version:

Publisher's PDF, also known as Version of record

Published In:

Frontiers in Sustainable Cities

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Drivers, Opportunities, and Challenges for Integrated Resource Co-management and Sustainable Development in Galapagos

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OPEN ACCESS

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Specialty section:

This article was submitted to
Governance and Cities,
a section of the journal
Frontiers in Sustainable Cities

Received: 10 February 2021

Accepted: 26 April 2021

Published: 26 May 2021

Citation:

Garcia Ferrari S, Bain AA and Crane
De Narváez S (2021) Drivers,
Opportunities, and Challenges for
Integrated Resource Co-management
and Sustainable Development in
Galapagos.
Front. Sustain. Cities 3:666559.
doi: 10.3389/frsc.2021.666559

The Galapagos archipelago represents an insular system with finite natural resources, a growing population, and an economy heavily weighted on tourism that leaves it vulnerable to shocks, such as the Covid-19 crisis. This work proposes an alternative scenario developed through creating intersections between water-energy-food (WEF) nexus and adaptive co-management (ACM) approaches to resource management. This framework allows the identification of novel synergies that are applied to the analysis of Galapagos as case study. Within this approach, qualitative analysis is applied to data collected via a set of interviews with local stakeholders (including community, business, third sector, and government actors) to evaluate (i) how a deeper understanding of community perceptions and needs can help to identify pathways toward more sustainable development in line with conservation goals, (ii) what governance frameworks should be implemented to promote community-based resource management and resilience, and (iii) what role education and capacitation can play in supporting alternative forms of economic activity. The research suggests that the implementation of an integrated WEF-ACM framework for resource management in Galapagos could promote resilience by opening a space for deliberation and conflict resolution between legitimate stakeholders, thus supporting more effective and balanced participative governance. The current Covid-19 crisis has led to the emergence of alternative forms of community collaboration that demonstrate the potential for a more economically diverse and more sustainable future. By placing different sources of knowledge on a level platform in such a framework, greater community ownership of resource management and conservation goals could be achieved. The incorporation of an ACM approach within the management of WEF resources would also allow Galapagueños to determine their own vision of a future sustainable socio-ecosystem, based on optimising system outcomes by co-identifying the trade-offs and synergies between the interrelated resource sectors, but requires a transformation in institutional culture.

Keywords: WEF nexus, adaptive co-management, sustainable development, conservation, participation, Galapagos

INTRODUCTION

The Galapagos archipelago is widely recognised as a model of biodiversity and natural environment conservation. This Ecuadorian province has been administered as a Special Regime since 1959, with the primary aim of fulfilling national and international conservation commitments. Since that date, the unique terrestrial and marine ecosystems of the islands have been shielded through a range of legal frameworks that have controlled the impact of human activities in the protected areas (i.e., through the creation of the Galapagos National Park, covering 97% of the land area, and the Marine Reserve, which extends 40 nautical miles beyond the coastline of the archipelago). However, there has been increasing recognition that the most severe threats to the protected natural environment originate from pressures arising due to rapid population growth and economic activity in the remaining 3% of the territory (e.g., Andrade and Ferri, 2019; Batty et al., 2019), with attendant issues concerning the introduction of foreign species, resource management and waste disposal. Conversely, political debates have arisen from the loss of rights (e.g., restrictions on livelihoods and migration) of the ca. 25,000 local citizens (Instituto Nacional de Estadísticas y Censos, 2013, as cited in Espin et al., 2019) emerging from the prioritisation of conservation goals, compared to citizens of mainland Ecuador, and the various attempts to compensate for this in the province's governance mechanisms, laws, and subsequent reforms. As a result of these tensions, current views, and policies around sustainable development in Galapagos advocate for the need to consider the province no longer as simply a natural system to be protected, from which humans are excluded, but as a socio-ecosystem in which resolving social issues will lead to achieving “*buen vivir*” (a term incorporating physical and spiritual well-being) for local communities, as well as helping to address conservation challenges (Tapia et al., 2009; Consejo de Gobierno del Régimen Especial de Galapagos, 2016; Rousseaud et al., 2017; Espin et al., 2019). This paradigm shift acknowledges that opportunities for social improvement and sustainable development may have been missed by approaching governance in the archipelago through an overly puristic conservation lens and a lack of coordinated action between conservation agencies, communities, and government institutions.

Overall, there has been a dearth of social and economic studies in Galapagos (Andrade and Ferri, 2019) compared to research focusing on the natural ecosystem and conservation policies, resulting in knowledge gaps around the needs of local communities, their perceptions of conservation measures and the impact these have on their well-being and prosperity. The 2008 National Constitution (Asamblea Constituyente, 2008) and subsequent provincial policies highlight that local citizens are expected to play an important role in governance; however, questions remain as to the best way to involve communities in these participative processes so that they may achieve ownership over issues of sustainable development and conservation.

Of particular relevance for sustainable development is the recognition of the increasing challenges faced by small island territories within the territorial boundaries of continental states,

such as the Galapagos archipelago. These challenges relate to the insular geography and the fragility of their environmental and ecological characteristics, which are increasingly exposed to the impacts of climate change, in the form of natural hazards and sea-level rise, as well as the international drive toward globalisation and economic growth (Douglas, 2006). Achieving the United Nations (UN) Sustainable Development Goals (SDGs) and conservation targets in such contexts hinges on understanding the embedded trade-offs between conserving the islands' insularity and safeguarding the economic well-being of their inhabitants (Kerr, 2005; Pazmiño et al., 2018). Moreover, as conservation is often seen as being at odds with economic development, a lack of institutional trust may present a challenge for inclusive governance and the effectiveness of participatory processes aimed toward sustainable development (Agrawal and Gibson, 1999). To address these issues, Pazmiño et al. (2018) highlight three dimensions through which the challenges facing island settings can be viewed. From one point of view, it is argued that sustainable socio-ecological systems require the island's insularity to be protected, both from a biological perspective (i.e., to avoid and control invasive foreign species), and within cultural processes (i.e., protecting local cultural identities and lifestyles) (Baldacchino, 2004; Pazmiño et al., 2018). Conversely, socio-economic welfare depends on access to external resources (technical, financial, goods, services) that require interaction with foreign ecosystems, cultures and markets; however, these can pose a threat to the integrity of the islands' ecological and cultural processes (Kerr, 2005; Pazmiño et al., 2018). Further, while the sustainable use of small islands' biodiversity toward tourism-compatible conservation has been called for to support livelihoods, it is critical to strengthen the technical and organisational capacities of local communities to effectively manage resources, tourism, socio-economic growth, and environmental conservation in a way that accommodates their own priorities and visions for the future (Rietbergen et al., 2008; Pazmiño et al., 2018).

The current economic model of Galapagos is heavily weighted on tourism, with over 200,000 visitors per year, and widely viewed as unsustainable (e.g., González et al., 2008; Rousseaud et al., 2017), with profits historically largely benefitting external companies rather than local people (Walsh et al., 2019). Due to the immovable boundaries of the National Park, the challenge of reformulating the Galapagos economy to encompass more diverse livelihoods and more equitable growth must be accomplished without expanding the urban footprint (Kvan and Karakiewicz, 2019). To minimise the ingress of foreign species and make progress in sustainability and food security, the reliance on products shipped from the mainland must also decrease (Espin et al., 2019; Quiroga, 2019).

González et al. (2008) suggested that traditional practises in relation to tourism and urban development in the province must be modified to achieve a model based on adaptive-resilience and co-management, with a more comprehensive approach to territorial planning, more participative processes and stronger institutional networks. de Haan et al. (2019) proposed that the potential for local Galapagos people themselves to influence a transition to sustainable development, which intimately

represents their way of life, might be encouraged through community self-organisation and transition management, lasting beyond political cycles, bringing together representatives of communities, conservationists, and government. To achieve a more participative governance model, the agency of the local population, in balance with conservation and sustainable tourism, will be key for the future of the islands, as well as achieving more equitable development facilitating local access to education, medical and cultural services, amongst others.

Furthermore, understanding the relationships and dynamics behind human-environment systems requires a complex systems approach (Batty et al., 2019), in which a careful consideration of social and ecological domains can help shape natural resource management to incorporate pluralistic, deliberative processes, and partnerships. We argue that a holistic understanding of the socio-ecosystem in Galapagos could be attained by employing both a resource nexus approach—to gain a deeper understanding of the realities and complexities of this particular human-environment system and resource use in relation to sustainable development processes, resilience, and climate change adaptation—along with alternative forms of resource co-management that could strengthen the role of communities. We view the case of Galapagos as especially relevant to such a debate because it is currently intersected by discourses of conservation, natural resource management, sustainable development, community participation, and empowerment, as well as by the global call for developing resilience and capacities for climate change adaptation.

This paper focuses on the Galapagos case as an opportunity to discuss the emergence of alternative sustainable development models that address local human-environment dynamics and provide a clearer understanding of the knowledge gaps in theory and practise for further research. The research builds on existing literature around the resource nexus framework by integrating perspectives of local organisations and community members to work toward a rooted approach that contributes to defining the principles of a bottom-up, more inclusive and more sustainable development model.

The research addresses the following questions, as initial reflection points in understanding the nexus between natural resource demand and the need for sustainable resource management and conservation:

1. Addressing the complexities between conservation and development, can a more profound understanding of community perceptions around economic development, environmental conservation, and resource management help to identify pathways toward sustainable development?
2. How can community-based resource management help to increase resilience? What governance frameworks should be in place to effectively support resource co-management with local communities and stakeholders having a more active role in co-designing and co-managing strategies? Moreover, can policy be framed to engender a sense of ownership in local citizens that might support conservation efforts?
3. What role can training, education, capacity strengthening, and social learning play in the shift toward alternative forms

of economic activity arising from sustainable development initiatives, toward building skills, trust, and resilience?

Addressing these questions, this research is structured around the following objectives: (1) to understand the evolution of participatory mechanisms in the context of conservation, resource management and community livelihoods in the case of Galapagos; (2) to identify the obstacles, challenges and elements of success that participatory governance and resource management have had in the past, and (3) to explore how future processes, toward promoting inclusive and sustainable economic development and resilience, could be enhanced in light of both community-based resource management frameworks and a resource nexus approach, to highlight possible opportunities for more effective participatory environmental governance in policy and practise, and define key areas for further research.

METHODOLOGY

This research is part of a broader project focused on understanding the role of energy, environment, and communities for sustainable development in Galapagos, with the aim of outlining pathways toward the goal of zero fossil fuel use in the archipelago by 2040¹.

The paper first reviews key literature on the Water-Energy-Food (WEF) resource nexus approach, community-based and adaptive co-management, and social learning and collaboration (section Theoretical Framework). The cornerstones of these approaches are then identified and intersected to serve as a theoretical framework encompassing both the critical importance of resources in the insular setting of Galapagos and progressive participative mechanisms that could strengthen the role of communities in resource governance. A detailed case study analysis of the Galapagos context is then provided (section Galapagos Case Study), drawing on the economic and livelihoods setting, governance, and participative processes, with the goal of assessing how participatory mechanisms have been framed and have evolved.

A qualitative analysis of the data collected from a set of semi-structured interviews with key local actors in Galapagos is then performed (section Analysis: Drivers, Opportunities, and Challenges for Integrated Resource Co-Management and Sustainable Development). In the time period from June to July 2020, nine local actors were interviewed from a range of institutions, community organisations, third sector organisations, and local businesses. All of the people approached for interviews agreed to participate, and an assurance of anonymity was given by the research team to ensure that interviewees could express their views freely, irrespective of

¹The Galapagos 2040 Vision was presented by the Minister of the Galapagos region during COP25 in Madrid (December 2019), leading to an initial research and knowledge exchange programme on the theme of 'Sustainable Energy, Environment and Communities' in Galapagos, in the context of Ecuador's goal of achieving a net-zero carbon footprint in Galapagos by 2040. This collaboration includes local and international organisations (the Government of Galapagos, the University of Edinburgh, the British-Ecuadorian Chamber of Commerce and the Charles Darwin Foundation).

their affiliation. The institutions and groups that interviewees belonged to include: the Governing Council of Galapagos, the devolved government of the Galapagos province of Ecuador; the Charles Darwin Foundation, a scientific research and environmental education agency operating in the islands since 1959; the Island Front of the Galapagos Marine Reserve (Frente Insular de la Reserva Marina de Galapagos), a grassroots citizen group active on environmental and social issues; Fundar Galapagos, a local environmental NGO (non-governmental organisation); and two small businesses (in hospitality and eco-farming, respectively). Interviews typically lasted 1–1.5 h and interviewees were asked a series of open-answer questions (see **Appendix**) designed to elicit their experiences, views, and local examples in relation to the following themes: (i) governance and participation; (ii) community agency and resources co-management; (iii) conservation and economic development. These interviews therefore provided local perspectives from community, academic and institutional representatives around the degree of community participation and inclusion in decision-making processes in relation to resource governance, conservation, and sustainable development in Galapagos. In addition, several of the interviewees have held multiple roles in the provincial government, third sector organisations and/or local businesses, and were able to share valuable holistic viewpoints.

The results of this qualitative analysis then feed a discussion around the relationship between conservation, development, participation and sustainability, aimed at identifying the principles of alternative development patterns. The conclusions from this research (section Conclusions) provide practical insights in relation to the role of the community within these complex dynamics and reflect on the need to transform institutional culture to support novel approaches to sustainable resource use, conservation, and development in Galapagos.

THEORETICAL FRAMEWORK

The Resource Nexus Framework: An Alternative Approach for Achieving Sustainable Development in Galapagos

A water-energy-food (WEF) nexus framework (e.g., Smajgl et al., 2016) is increasingly invoked as a suitable and contemporary approach for “understanding the realities and complexities between human-environment systems and related environment-development goals” (Bleischwitz et al., 2018). Although it is still an evolving concept, this approach generally encompasses the study of the water, energy, and food resource sectors and how they are managed, along with their interconnections, including synergies, conflicts and trade-offs (Simpson and Jewitt, 2019). The definition necessarily includes the bio-physical characteristics of the chosen domain, but is also fundamentally based around people and their basic human rights (Salam et al., 2017), and incorporates the human dimensions of security and governance (Bleischwitz et al., 2018). As the WEF nexus approach is multi-centric, with each sector treated equally (Smajgl et al., 2016), it may be accepted by a broader range of stakeholders than

other approaches that prioritise one of these spheres (Cai et al., 2018).

Bleischwitz et al. (2018) argue that, if a WEF nexus framework can be applied in a flexible manner at different scales and in different contexts, this approach could help to deliver the UN SDGs in unprecedented integration, with benefits including reducing trade-offs between SDGs and reducing silo-thinking. Although the need for interdisciplinarity and the concept of not considering sectors in isolation are not new, the holistic integration of the different policy sectors is innovative (Benson et al., 2015). Conversely, Wichelns (2017) cautions that livelihoods are often omitted from the nexus approach, potentially resulting in negative impacts for the poorest in society, and Biggs et al. (2015) argue that the nexus approach must consider resource security for all, as achieving food security on the scale of the household, city, provincial, or country level may be more complex than at the macro-scale (Grafton et al., 2016). Although most nexus approaches have not explicitly integrated livelihoods into their framework, a growing body of research (e.g., Bouapao, 2012; Granit et al., 2012; Rasul, 2014) argues for livelihoods to be a central component of WEF nexus approaches, as these represent a means of linking socioeconomic and environmental concerns (Brocklesby and Fisher, 2003), as well as an effective way to evaluate the effects of development on livelihoods (Biggs et al., 2015).

One criticism of the nexus approach has been that it fails to adequately consider the irreplaceable foundation of environment (De Grenade et al., 2016). However, Simpson and Jewitt (2019) note that in order to achieve equitable resource security through a WEF nexus framework, the resource base and the integrity of ecosystem services must be maintained. The ultimate challenge is therefore cross-sectoral policy development that promotes resource sustainability, maximising synergies to promote the best system outcomes (Albrecht et al., 2018), as well as access to these resources for all levels of society, therefore requiring that both the protection of the environment (Simpson and Jewitt, 2019) and the needs of the poorest (Leese and Meisch, 2015) be prioritised. Bleischwitz et al. (2018) also note that the integrated nexus approach is useful when one resource is managed for multiple purposes that may be conflicting, for example for biodiversity conservation as well as food supply and community livelihoods, as is the case for the Galapagos Marine Reserve.

In terms of the practical implementation of a nexus framework, Dawoud (2017) states that the main challenge is ensuring the risks, challenges and opportunities are identified and considered by all relevant stakeholders. Wicaksono et al. (2017) conducted a review of the implementation of nexus models and concluded that stakeholder involvement, policy integration and the development of a simulation model are all necessary for the successful implementation of a nexus framework. The nexus may also serve as a tool to evaluate the consequences of policies, technologies and practises (Howarth and Monasterolo, 2017) and for monitoring and assessment of these over time (Smajgl et al., 2016).

We therefore define the cornerstones of a WEF nexus framework to approach resource governance as follows, based on the key principles identified above:

1. A **complex systems view** is required in research and practise to achieve interconnected SDGs, necessitating an understanding of the synergies, conflicts and trade-offs within the WEF resource nexus, as well as the integration of multiple stakeholders and organisation types in the management of resources (e.g., Bleischwitz et al., 2018; Simpson and Jewitt, 2019).
2. A focus on sustainable **livelihoods** within the WEF resources nexus is vital to better understand the relationship between socioeconomic development and environmental concerns, which directly impact resource security on multiple scales (Biggs et al., 2015), particularly in terms of food security for the poorest in society (Wichelns, 2017).
3. The **environmental integrity** of ecosystems and their associated resource base is fundamental for sustainable development, requiring policy frameworks that ensure the sustainability of WEF resources while facilitating equitable access to resources for all (e.g., Leese and Meisch, 2015; Simpson and Jewitt, 2019).
4. Strengthening stakeholder involvement in **deliberative scenario planning** is needed to shape policy integration and the development of simulation models to successfully implement sustainable WEF nexus governance, which would in turn allow evaluation and monitoring processes to take place (e.g., Howarth and Monasterolo, 2017; Wicaksono et al., 2017).

A compelling case for establishing such a WEF nexus framework to assist in participative decision-making in the Galapagos is supported by a range of local characteristics such as: the insular nature and small-scale of the Galapagos socio-ecosystem; the existing strong legal framework protecting the environment, and the current issues surrounding pressures on natural resources. The latter include a heavy reliance on an unsustainable tourism model and the aspiration of achieving a transition to a more diverse, sustainable, self-reliant economic model with more satisfying livelihoods for local communities. In line with Smajgl et al. (2016), this research is based on the argument that applying a dynamic nexus framework approach in this insular system would improve sectoral coordination and ensure that policies and investments improve the overall system outcomes, thus promoting sustainability and resilience. Moreover, as the WEF nexus approach places sectors on a level platform, this approach could serve to reduce conflict between stakeholders, by providing a deliberative space for co-assessment of the Galapagos resource system where scientific and other knowledge types are brought into dialogue on a horizontal platform. The research therefore explores how a model of community resource management might be integrated with a resource nexus framework to achieve progress on the SDGs in a province that aspires to become a pioneering UN SDG territory (Consejo de Gobierno del Régimen Especial de Galapagos, 2018), achieving its national and international

conservation goals and *buen vivir* for its inhabitants in the process.

Collaborative and Adaptive Frameworks for Resource Management

It can be argued that the role of community in resource management is a critical aspect for sustainable development. In the context of a complex socio-ecological system such as Galapagos, achieving sustainable development relies on the existence of effective governance mechanisms as well as collaborative, inclusive, and sustainable natural resource management that must also respond to the socio-economic needs of local citizens. As suggested by Upreti (1994), a development paradigm that is rooted in the principles of cooperation, social synergism, equity and understanding of ecological and social sustainability of resource use, allocation and management is required to effectively implement environmental conservation. Understanding resource management as a complex systems problem between social and ecological domains can shape natural resource management processes, by moving away from simple blueprint solutions while incorporating pluralistic, deliberative processes and partnerships (Berkes, 2007).

In this regard, community-based natural resource management (CBNRM) is a response to the limitations of resource management approaches that affirm centralised views of technical expertise and top-down bureaucratic governance (Armitage, 2005), as well as a shift from the predominantly preservationist and state-driven approaches to natural resource management (Wasonga et al., 2010). As such, CBNRM (1) concentrates on the collective management of ecosystems to improve human well-being; (2) aims to empower and devolve ecosystem management to local communities through the full participation of resource users in decision-making processes; and (3) requires the incorporation of local institutions, established practises, and multi-level knowledge systems in processes of management and enforcement (Armitage, 2005; Fabricius and Collins, 2007). However, CBNRM has been criticised for failing to deliver benefits to communities. High rates of disintegration of CBNRM initiatives have resulted from conflict, financial and natural resources mismanagement, a high turnover of leaders and other key players, political and economic change at higher levels, and changes in markets and top-down developments (Fabricius and Collins, 2007). CBNRM can be affected by certain obstacles such as (1) the slow pace of development, (2) weak participation by local, national and provincial government, (3) poor coordination, (4) weak local and municipal governance structures, (5) conflict, and (6) historical legacies of unequal development and an overdependence on top-down governance frameworks and strategies. Thus, Fabricius and Collins (2007) propose a dialogue form of cooperative governance, where communities, scientists and government can collaborate to develop innovative solutions, and offer a set of parameters that recognise the role of governance in “buffering” against the negative effects of unexpected change and conflict, which include:

1. Knowledge networks
2. Formalised decision-making structures

3. Clearly defined and legitimised conflict-resolution procedures
4. Legitimacy and acceptance of the governance structure by community members
5. Formal commitment to well-defined roles and responsibilities
6. Tangible incentives for key individuals to meet their commitments
7. Professional facilitation to promote communication

With regards to the role of community in CBNRM, Agrawal and Gibson (1999) argue that greater attention must “be focused on three critical aspects of communities: the multiple actors with multiple interests that make up communities, the processes through which these actors interrelate, and, especially, the institutional arrangements that structure their interactions.” Furthermore, they suggest that three critical domains need to be considered to effectively manage resources at a local level: (1) define sets of rules for the use and management of local resources; (2) implement and uphold these rules; and, (3) resolve disputes that arise in the process. In this sense, a focus on institutions, conceptualised here as sets of rules describing and prescribing human actions within these domains, leads to locally oriented conservation policies instead of top-down policies that adhere to simplistic understandings of “community.” This emphasises the ability of communities to create and to enforce rules (Agrawal and Gibson, 1999).

However, as argued by Armitage et al. (2007), community-based approaches to resource management have evolved into the field of adaptive co-management (ACM) as a result of multi-scalar and dynamic conceptualisations of human communities and natural resources alike (Hill et al., 2010), although some consider ACM to be an integral component of successful CBNRM processes (Gruber, 2010). ACM is an interdisciplinary approach to ecosystem management that focuses on building trust through collaboration, institutional development and social learning, aiming to address multi-scale socio-ecological systems and their challenges (Armitage et al., 2009). ACM is a step forward from adaptive management (AM) and co-management (CM) (Carlsson and Berkes, 2005; Armitage et al., 2008; Plummer et al., 2012; Hasselman, 2017). AM focuses on integrating environmental, social and economic dimensions in policy design and implementation (Holling, 1978), and CM is aimed toward power-sharing between state and community with varying levels of collaboration (Carlsson and Berkes, 2005). A review of these approaches identified challenges in terms of legitimacy and stakeholder inclusion (Hasselman, 2017) as well as limited application in cross-scale interactions (e.g., vertical and horizontal relationships) (Berkes, 2004). ACM was thus suggested to merge the vertical linkages of CM and the dynamic learning aspects of AM (Berkes, 2004). We therefore argue that ACM presents an appropriate framework for resource management in the particular context of Galapagos.

In particular, ACM seeks to empower local stakeholders through processes of experimentation, monitoring, deliberation and responsive resource management, in conjunction with multi-level organisations, such as governmental agencies, educational institutions and NGOs (Hasselman, 2017). Furthermore, ACM harnesses accumulated socio-ecological

knowledge and experience, while relying on the participation of diverse and multi-scale interest groups, ranging from local communities, municipalities, regional and national institutions and international-level organisations (Folke et al., 2002). Fabricius and Currie (2015) offer four cornerstones of ACM processes that outline a range of critical factors for their success:

1. Institutional arrangements, leadership, policies, and legislation that promote an **enabling environment** (e.g., incentives) (Armitage et al., 2009; Berkes, 2009);
2. A focus on “**learning by doing**” through experimentation, monitoring and evaluation in a specific setting (Armitage et al., 2008, 2009; Berkes, 2009; Cundill and Fabricius, 2009), which requires appropriate participation and capacity building processes;
3. **Collaborative dynamics** between different types of stakeholders that share resources, rights and responsibilities at multiple levels and scales (Ruitenbeek and Cartier, 2001; Armitage et al., 2009; Berkes, 2009);
4. Continuity through **cyclical and iterative assessment processes** (Plummer, 2009).

It is important to note, however, that ACM requires a balance between ecological resilience and human empowerment, in order to effectively harmonise stakeholder engagement and facilitate social learning within resource management processes (Bown et al., 2013). In addition, finding effective forms of governance is key for safeguarding ACM processes from a lack of financial resources for systemic monitoring, as well as to maximise stakeholder commitment, which could be eroded due to lengthy processes that may not present positive results in the short term (Bown et al., 2013).

Despite these relative limitations, of particular relevance to this research is the capacity of ACM to promote consensus, allowing stakeholders to perceive the system as integrated, complex and adaptive, where interactions between resource users, ecosystems, governance, and public infrastructure are facilitated (Anderies et al., 2004; Fabricius and Currie, 2015). Furthermore, we highlight the capacity of ACM to promote participatory processes through social learning and learning through experimentation by assessing and understanding both context-specific interactions and interactions across scales (Fabricius and Currie, 2015). In sum, the principal concepts that underpin ACM, which include adaptation through social learning, and trust-building through collaboration and institutional development (Armitage et al., 2009), can serve as benchmark indicators to facilitate participative governance mechanisms in complex socio-ecological contexts.

Intersecting Frameworks

In light of the possible benefits that a WEF resource nexus framework can offer in the context of complex human-environment systems, we suggest that this approach could be enhanced through an intersection with ACM applied in a systemic and systematic manner, and this may represent a potentially powerful approach for resource management in

		WEF NEXUS CORNERSTONES			
		Complex systems view	Livelihoods	Environmental Integrity	Deliberative scenario testing
ADAPTIVE CO-MANAGEMENT (ACM) CORNERSTONES	Institutional arrangements, leadership, policies and legislation that promote an enabling environment	Policies that promote sectoral integration, bringing all legitimate stakeholders to the table	Cross-sector policies acknowledging tradeoffs and synergies to support diversified and enhanced livelihoods	Integrated policies considering sustainable development and environmental conservation as indivisible	Framework in place to implement co-produced policy decisions
	A focus on 'learning by doing' through experimentation, monitoring and evaluation	Adaptive policy making with a complex systems view	Inclusive forms of engagement through social learning processes that incorporate and legitimise multiple stakeholders	Capacity to test and monitor strategies that are aimed towards conservation and sustainable development	Stakeholder deliberation to reach optimal system outcomes
	Collaborative dynamics between stakeholders that share resources	Collaborative dynamics allow resource systems to be managed sustainably	Win-win synergies between different sectors support sustainable livelihoods and reduce negative impacts related to one sector thriving at the expense of others	Resource users and conservationists brought into dialogue	Different types of knowledge placed on a level platform, builds trust and provides a space for conflict resolution
	Continuity through cyclical and iterative assessment processes	Develop appropriate indicators reflecting both sectoral and system evolution	Develop indicators to assess livelihood diversification	Develop indicators to assess environmental integrity	Comparison of predicted versus actual outcomes and adaptive policy making

FIGURE 1 | WEF-ACM Matrix: WEF nexus cornerstones intersected by adaptive co-management (ACM) cornerstones. Source: The authors.

Galapagos. **Figure 1** provides a matrix that illustrates how these frameworks may be integrated to provide practical tools for effective governance within complex ecological, economic, and socio-political contexts. By mapping the WEF nexus cornerstones proposed in section The Resource Nexus Framework: An Alternative Approach for Achieving Sustainable Development in Galapagos on a horizontal axis, and the cornerstones of ACM (Fabricius and Currie, 2015) reviewed in section Collaborative and Adaptive Frameworks for Resource Management on a vertical axis, novel synergies arise from integrated resource co-management, environmental conservation, and economic development, which could contribute to achieving multiple SDGs in the short, medium, and long terms. To our knowledge, a WEF nexus framework has not been previously interlinked with adaptive resource co-management. In this work we propose this intersection as a way

to connect ideas from both frameworks to create an integrated and participatory approach to resource co-management and sustainable development.

We offer this framework (**Figure 1**) as a first step in the integration of the WEF and ACM approaches and explore its application to the case study of Galapagos (section Analysis: Drivers, Opportunities, and Challenges for Integrated Resource Co-Management and Sustainable Development), however the proposed framework is flexible and adaptable to other contexts. The research suggests that this could be tested in the form of a pilot project to comprehensively develop a fully integrated framework and identify the challenges and weaknesses of the proposed approach. In this process, broad stakeholder engagement (including government institutions, the private sector, and community organisations, among others) will be required to participatively and deliberatively

develop the context-specific integration of WEF and ACM cornerstones. The aim of such a locally-validated integrated framework should be to guide resource co-management, environmental conservation and economic development toward achieving interconnected SDGs and responding to the particular complexities of insular territories, as previously discussed, or other contexts. This approach brings the opportunity to rebalance the management of the resource system, by placing WEF sectors on a level platform, as well as opening deliberative spaces for the community to participate in decision-making processes. In addition, it allows for community knowledge to be brought into dialogue with more traditional top-down policy-making, as well as with the knowledge of conservation NGOs that are idiosyncratic in the archipelago. Finally, this approach promotes the co-creation of appropriate context-specific indicators assessing both livelihood diversification and environmental integrity, and supplies a deliberative environment in which the trajectories of these indicators may be forecast and monitored, enabling adaptive governance.

The newly-defined WEF-ACM matrix is used in section Analysis: Drivers, Opportunities, and Challenges for Integrated Resource Co-Management and Sustainable Development, as a lens through which to analyse a set of interviews with key local stakeholders in Galapagos, identifying and exploring their perceptions and experiences around sustainable development, conservation, governance and community participation. Testing these perceptions in relation to the WEF-ACM matrix will guide future approaches to sustainable development in Galapagos.

In the following section, we perform an in-depth case study analysis of the Galapagos context in relation to economic development, governance and policy frameworks, and the evolution of participatory mechanisms.

GALAPAGOS CASE STUDY

Economic and Livelihoods Context

The economy of the Galapagos islands began around agriculture, shifting to fishing in the 1950s (de Haan et al., 2019). Tourism began to grow as an economic sector in the 1960s and the crash in the sea cucumber market in the 1990s meant that tourism became the dominant economic activity. The progressively more rapid increase in tourism has driven urbanisation and population growth in the islands (de Haan et al., 2019). The population of the archipelago has grown at an average annual rate of 4.83% over the last two decades, whilst that of Ecuador has grown at a rate of 2.03% (Espin et al., 2019). This rapid growth has been attributed to migration from mainland Ecuador of workers seeking employment in the tourism industry (Espin et al., 2019). The employment rate in the province has consistently been measured as higher than that of mainland Ecuador, and average salaries are also higher (average monthly salaries of USD 772 in Galapagos compared to USD 252 in the mainland in 2010), which offsets the higher living costs (Espin et al., 2019). Migration has also been driven by subsidies available for Galapagos residents, including for energy, airfares and shipping, which has aided in raising the standard of living above that of

the mainland (Espin et al., 2019). Although the poverty rates are lower in Galapagos than the average across Ecuador, 11% of the population is estimated to be living in extreme poverty (defined as lacking two or more basic needs) and a further 40% are estimated to be living in poverty (lacking one basic need), as measured using the Unsatisfied Basic Needs Index (Karakiewicz, 2019).

Prior to the Covid-19 crisis, the Galapagos economy was heavily dependent on the booming tourism industry, which provided 66% of the Galapagos Gross Domestic Product (GDP) in 2010 (MINTUR, 2010). This dominance is partially a result of incentives for those engaged in more traditional work, such as fishing and farming, to participate in the tourism industry, as these activities were perceived to be at odds with conservation goals. Invasive species may also be responsible for transforming the landscape of the islands and reducing land productivity, leading to the abandonment of fields and farming for preferred jobs in the tourism industry (Walsh et al., 2019). However, tourist activities and the population growth driven by the associated employment opportunities (Walsh et al., 2019), although now limited by strong population control measures, are putting pressure on local ecosystems as well as on the limited basic services (de Haan et al., 2019) and resources (e.g., water, food, and energy; Batty et al., 2019). Espin et al. (2019) called for a change in strategy from high-volume/low-value tourism, to more limited numbers of tourists with offerings that are designed to maximise the economic value with a lower environmental impact, accompanied by stronger technical and administrative capacities to enact these changes.

The provincial sustainable development plan highlights the political will toward promoting eco-tourism and nature-based tourism, incorporating more participative processes (Consejo de Gobierno del Régimen Especial de Galapagos, 2016). Walsh et al. (2019) suggested that if local communities are able to take control of the business opportunities that the tourism boom represents, this could provide an impetus for a transition to more satisfying livelihoods for a greater proportion of residents, with lower environmental impacts. Karakiewicz (2019) argues that local residents could reduce their dependence on imports and build a path toward self-sufficiency if they can identify opportunities that are specific to the local context and create their own specific knowledge around potential solutions. In this sense, economic development and conservation goals might be brought into a better balance through a transition to nature-based, local knowledge- and skills-based, tourism.

Institutional, Legal, and Policy Framework

The changes in the institutional and legal framework of the Galapagos document an evolution in the approach to managing and planning in the province, from the urgent prioritisation of conservation to the realisation that sustainable development requires a more balanced approach addressing the root causes of social pressures on the Islands' ecosystems (González et al., 2008). Following rapid population growth, intense fishing activity, and the need to apply conservation measures to reduce the impact on biodiversity, the 1959 law of the Galapagos decreed that the province would be administered as a special regime and created the Galapagos National Park (GNP) (González et al.,

2008). The islands were declared a UNESCO World Heritage Site in 1978, and the “National Institute for Galapagos” (INGALA) was created in 1980 as the planning and policy-making body for the province, encompassing social, economic, cultural and environmental sectors with the goal of achieving sustainable development and environmental conservation (López Jijón, 2016).

The ‘Law of the Special Regime of the Galapagos Province’ came into force in March 1998, regulating, among other things, the economic activities of residents, migration, tourism, and the remuneration of the public and private sectors (Consejo Nacional de la República del Ecuador, 1998). INGALA was mandated by this law to conduct research relating to the environmental and social problematics of the islands, in collaboration with civil, academic, scientific, and independent institutions as well as sectoral government bodies. The “Special Law,” as it is known in Ecuador, put a strong emphasis on conservation measures, creating for example a new category of protected area, the Galapagos Marine Reserve. However, the need for an integrated approach incorporating the social and economic aspects of life in the province also featured as an element in this law, seeking to promote sustainable development in a form that was compatible with national and international conservation commitments. The concept of sustainable tourism emerged with the Special Law, which incorporated a precautionary principle in the execution of works and activities that could threaten the environment or island ecosystems. Under the law, tourism activities would be based around nature tourism. An entry fee for the national park was also put into place and the revenue from this was allocated to local institutions and projects. The Special Law also stated that the revenues from tourism and artisanal fishing should benefit the local communities. Local permanent residents were granted the operational rights for tourism permits. Only artisanal fishing was permitted in the Marine Reserve and permits were reserved for permanent residents affiliated with one of the artisanal fishing cooperatives.

The 2008 national constitution reform (Asamblea Constituyente, 2008) incorporated the rights of nature and the importance of participatory processes into the national legislation, and created a new planning and management authority for the Galapagos special regime (the “Government Council of the Special Regime of Galapagos,” or CGREG—Consejo de Gobierno del Régimen Especial de Galapagos), requiring a reform of the 1998 Special Law. The reformed law (the “Organic Law of the Special Regime of the Galapagos” or LOREG, the acronym for its name in Spanish) is based on the concept that the populated and protected areas should be managed in a more integrated manner (Asamblea Nacional de la República del Ecuador, 2015). The CGREG therefore acquired constitutional powers to plan and manage the natural resources and activities that are carried out within the territory, including migration and permanent residency. The CGREG is also responsible for formulating provincial policies relating to the use of alternative energies, research and innovation, as well as technology development and transfer, to support the province’s sustainable development. In line with the new constitution, citizen participation is stated as a key element in the new law,

with citizens expected to, individually or collectively, become “protagonists in decision-making,” and the overall planning and management of the special regime (Asamblea Nacional de la República del Ecuador, 2015).

The “Galapagos Special Regime Sustainable Development Plan 2015–2020” (or “Plan Galapagos”) drawn up by the CGREG, in line with international commitments and the national sustainable development plan, is the current planning and development instrument for all public sector and private entities operating in Galapagos. The 2015–2020 “Plan Galapagos” was organised around five strategic objectives: (i) Consolidate a comprehensive model of sustainable development for the Galapagos socio-ecosystem; (ii) Promote the *buen vivir* of Galapagos residents, within the context of island life; (iii) Promote a knowledge society and diversification of the production matrix; (iv) Reduce energy dependence on the continent, optimising the generation of renewable electricity, transport, and connectivity; and, (v) Strengthen the governance model of the Special Regime of Galapagos (Consejo de Gobierno del Régimen Especial de Galapagos, 2016). Within these objectives, the plan included a set of metrics and targets relating to sustainable development and citizen participation. The most important of these targets in relation to WEF resources included:

- *Water sector*: increase access to drinking water within homes to 100% by 2018; increase the perception of drinking water quality on the islands to 81% by 2018; increase to 100% the coverage of the public sewer network on the populated islands by 2018; increase to 90% the proportion of homes connected to a wastewater treatment system by 2020.
- *Energy sector*: reduce the per capita fossil fuel consumption by 10% in the province by 2020; reduce the annual growth rate of fossil fuel consumption for electricity generation to 3% by 2020; increase electricity generation from renewable energy sources to 40% by 2020.
- *Food sector*: reduce by 20% the per capita consumption of perishable basic goods that enter the islands by 2020; increase the per capita production of agricultural crops by 30% by 2020; increase to at least three the number of sustainable fishery certifications by 2020.

In terms of citizen participation, the plan stated the goal of increasing to 20% the percentage of the population that attends a citizen participation event organised by the institutions of the province by 2018 (Consejo de Gobierno del Régimen Especial de Galapagos, 2016). At the time of writing, the Sustainable and Urban Development Plan for 2030 is in the late stages of development by the CGREG, its preparation having been delayed by the Covid-19 crisis.

The Evolution of Formal Participative Processes in Galapagos

Prior to the establishment of the Special Law, violent conflicts between stakeholders and a high level of non-compliance with respect to the existing management plan for the Marine Reserve (classified as a Biosphere Reserve at the time) led to the development of a novel form of participatory management,

in which decision-making was shared between community representatives and government institutions (Heylings and Cruz, 1998). The conflicts around the management plan were related to a feeling of alienation of community stakeholders with respect to decision-making around the shared resources of the reserve (Heylings and Cruz, 1998). Establishing the framework for the co-management of the reserve involved a participatory process that forced the conflicting stakeholders to discuss and negotiate around their needs (Quiroga, 2019). In addition, the prospect of establishing a legal framework in the drafting of the Special Law for the co-management of the reserve solidified the movement and gave legitimacy to a multi-stakeholder planning group, named the “Grupo Núcleo,” comprising representatives from artisanal fisheries, tourism and conservation, to the exclusion of the industrial fishing sector (Heylings and Cruz, 1998). The definition of the management plan involved 74 meetings of the Grupo Núcleo, as well as two fisheries summits and three community workshops (Lockwood et al., 2012). These meetings were facilitated by third party consultants contracted by the Charles Darwin Foundation (an international non-profit organisation dedicated to scientific research in Galapagos), who operated on the basis of community-based conservation and participative research and planning, as well as a conflict resolution expert, to regulate interactions between participants and maintain a focus on problem-solving (Heylings and Cruz, 1998). This approach was successful in implementing a level platform for discussion and decision-making, ensuring transparency as to each of the parties’ agendas and allowing stakeholders to form an understanding of the implications for all, and consensus to be reached (Heylings and Cruz, 1998).

A communications specialist was also provided to design educational materials distributed to the local and national media, to build awareness of the process and the issues involved (Heylings and Cruz, 1998). However, despite the positive results in conflict-resolution and consensus-making, issues remained around the selection of representatives in the Grupo Núcleo, i.e., whether these were truly representative and/or suitable choices for the role, and whether follow-up discussions and revisions were taking place as intended within each sector and each island following the group meetings (Heylings and Cruz, 1998).

The outcome of this participatory process was the creation of the Marine Reserve in the Special Law, as a new category of protected area. The Marine Reserve was to be co-managed by the Galapagos National Park (GNP) service at the local level, incorporating a Participatory Management Board (PMB—Junta de Manejo Participativo), and the Inter-Institutional Management Authority (IMA—Autoridad Inter-Institucional de Manejo) at the national level, tasked with approving the management plan and certain decisions of the PMB. The PMB, modelled after the Grupo Núcleo, was composed of primary local stakeholders, and operated through members making specific management proposals (e.g., regarding fishing or tourism), which were analysed, negotiated and finally agreed upon by consensus (Lockwood et al., 2012). These proposals were then passed for approval to the IMA, which comprised representatives of ministers and local stakeholders, and then on to the GNP

for implementation and control (Lockwood et al., 2012). If consensus could not be reached in the PMB, the different stakeholder positions were communicated to the IMA, where decisions were then made. Most consensus-based proposals from the PMB were approved without modification by the IMA, demonstrating the effectiveness of the co-management approach, which resulted from strong incentives among local stakeholders to agree upon viable proposals (Lockwood et al., 2012). However, with the exception of representatives from the fishing sector, the IMA was made up of ministers and government authorities far removed from the daily reality of the islands (López Jijón, 2016). In addition, the powers of the IMA related to formulating conservation policies, approving the fishing calendar and generating scientific research, while the GNP was in charge of the administration and management of the Marine Reserve, which resulted in what was seen as an unsustainable “two-headed” administration (López Jijón, 2016).

The 2015 reform of the Special Law marked a shift in power, with the dissolution of INGALA and the new CGREG gaining in authority over existing institutions, such as the GNP (López Jijón, 2016). The CGREG plenary is currently made up of representatives of the President of the Republic, the ministries of the Environment, Tourism, Agriculture, the national planning authority, and the local municipalities and parishes, but contains no local representatives of the fisheries and tourism sectors. The reformed law dismantled the PMB and a Participatory Management Advisory Council (Consejo Consultivo de Manejo Participativo), a participatory citizen group providing non-binding advice for the management of the Marine Reserve, was created in place of the PMB. This was viewed by certain actors as a regression in terms of citizen participation (López Jijón, 2016) and is described in the Galapagos development plan as a transition from cooperative to consultative management (Consejo de Gobierno del Régimen Especial de Galapagos, 2016).

In accordance with the 2008 national constitution and the 2010 Law of Citizen Participation, Article 3 of the LOREG guarantees citizen participation in decision-making, planning and management in the province, as well as transparency and accountability. In Galapagos, this is intended to be implemented through citizen assemblies at every level of government (provincial, municipal, parroquial), however there are reports that this has not been effectively enacted in practise (López Jijón, 2016). The 2015–2020 Galapagos development plan reports that some of these assemblies had not yet been implemented as of 2015 (e.g., on Floreana and Isabela islands and at the cantonal level on Santa Cruz; Consejo de Gobierno del Régimen Especial de Galapagos, 2016). In addition, although the Charles Darwin Foundation appeared in the 1998 law as an independent, non-voting voice participating in the INGALA council, able to affect decisions taken by the GNP and the provincial government, this organisation does not appear in the reformed law.

Challenges and Opportunities Associated With the Covid-19 Crisis

The advent of the Covid-19 crisis led to an almost complete disappearance of the province’s main economic activity virtually

overnight in March 2020, as the tourism industry collapsed. Coupled with the sanitary crisis, the economic crisis highlighted the extreme vulnerability of Galapagos to shocks, and economic diversification emerged as a renewed priority. To offset the economic losses brought by the crisis, Galapagueños working in the tourism industry demanded more direct international flights (which are generally viewed as a biosecurity hazard) facilitating the arrivals to the archipelago, and those working in the fisheries sector demanded permission to use long-lines in the Marine Reserve (threatening protected species). In this sense, the Covid-19 crisis, by threatening the livelihoods of Galapagos residents, threatens to reverse progress on conservation goals, demonstrating the clear link between development and conservation in the archipelago. Conversely, the crisis has led to greater visibility and government support for local producers, in particular through the provision of government-subsidised food parcels aimed at injecting liquidity into the collapsed economy, as well as supporting food security for families whose livelihoods disappeared. The crisis has also led to an upsurge in community-led associativity and new actions and forms of communication to support food security, particularly in the fisheries sector, demonstrating the importance of an engaged community capitalising on locally-held knowledge to support sustainable development and resource management.

As local communities revert to forms of economic activity that were previously more dominant, such as agriculture and fishing, we speculate that the changes brought by the crisis could herald a possible future that is more economically diverse and more sustainable, with strengthened local food security. The principal planning instrument guiding development over the next decades and supporting recovery from the crisis, the Sustainable and Urban Development Plan for 2030, will be structured around strategic objectives in relation to governance, community, environmental resilience and sustainability, habitat and economy (Consejo de Gobierno del Regimen Especial de Galapagos, 2021, unpublished draught shared with the authors, formally launched on 4 May 2021 during the production of this article). It poses a set of ambitious goals based on better governance structures, improved monitoring of targets, strengthened citizen participation and support for local enterprises capacitation and innovation. This new plan recognises a range of challenges in Galapagos and sets the political strategic context to confront these. However, progress will hinge on defining the instruments and tools that will allow the achievement of the broad objectives, particularly around knowledge development, citizen participation, and alternative sustainable economic patterns.

ANALYSIS: DRIVERS, OPPORTUNITIES AND CHALLENGES FOR INTEGRATED RESOURCE CO-MANAGEMENT AND SUSTAINABLE DEVELOPMENT

As detailed in section Methodology, a series of semi-structured interviews (see **Appendix**) were carried out with representatives from government, business and third sector organisations, toward identifying challenges and opportunities in relation

to resource co-management and sustainable development in Galapagos. The research team conducted a qualitative analysis by identifying themes emerging from the responses of interviewees and grouping them into related categories, such as: perceptions of the tourism industry, conservation policies, participative processes and the Covid-19 crisis; identified development challenges, bottom-up processes and pathways forward for Galapagos. The views of the participants were found to be complementary, together providing a detailed and multi-faceted picture of the challenges and opportunities with respect to sustainable development. The following discussion addresses the research questions posed in the introduction through exploring the perspectives of these local actors, and builds understanding of the context-specific relationships between conservation, sustainable development and economic growth in the archipelago. We approach this analysis through the lens of the WEF-ACM matrix (**Figure 1**) from section Intersecting Frameworks, highlighting the opportunities that these synergies can bring toward defining more integrated and co-produced forms of resource management compatible with sustainable development and conservation.

Community Perceptions of Sustainable Development

Interviewees expressed critical perspectives relating to the complex dynamics between economic development, conservation and livelihoods. A shared understanding of the importance of the integrity of ecological systems for the community's current and future livelihoods was widely voiced. For example, a synergy between tourism and conservation was highlighted, as the lack of effective conservation policies will necessarily impact the tourism sector, which largely depends on the archipelago's pristine natural ecosystems to attract visitors. However, an over-dependence on tourism is perceived to have increased socio-economic vulnerability to shocks, such as the Covid-19 crisis. In addition, there is a perception that conservation policies have traditionally favoured the development of conservation NGOs and the tourism sector for political reasons, whereas communities continue to lack access to suitable education, health, and other social services. Conservation policies are therefore understood to have helped guarantee economic opportunities for Galapagueños over the long term, but are viewed as lacking a consideration of the impact of environmental conservation processes on human development.

A key challenge is therefore to facilitate participatory mechanisms that allow communities to assume an active role in decision-making within conservation and development. As highlighted in section Theoretical Framework, conservation ideologies, policies and regulations geared toward the control and management of natural resources may alter socio-ecological dynamics, as certain stakeholders can acquire more or less power than others in decision-making. Historically, effective collaboration within and between stakeholder groups in Galapagos has been hindered by a lack of organisation, internal conflicts, hidden agendas, and conflicting interests, which

have effectively limited the capacity of citizens to influence public policy and actively pursue their priorities. As outlined in **Figure 1**, working toward more comprehensive, inclusive and integrated forms of conservation governance, resource management and sustainable development requires a complex-systems view that incorporates pluralistic and deliberative processes and partnerships. Participatory frameworks allowing citizens to take part in decision-making processes and resource management that impact their livelihoods should therefore incorporate spaces for deliberation and conflict resolution.

In addition, effective conservation policy frameworks will require economic incentives and clear communication strategies as to how these initiatives will not only protect environmental assets, but also provide positive socio-economic benefits. These should provide pathways forward for sustainable development within different interconnected and interdependent productive sectors that rely on natural resources, as facilitated through the WEF-ACM matrix defined in section Theoretical Framework. Policy frameworks should strengthen cross-sectoral and multi-level collaborative networks and linkages, while facilitating a systems perspective that promotes incentives, participation, capacity building, and stakeholder commitment.

More broadly, Galapagos legislation showcases pioneering public policy structures aimed at balancing environmental conservation, sustainable human development, and economic growth. This evidences a paradigm shift from a traditional focus on natural systems to a more inclusive approach that integrates human dimensions in relation to the challenges that underpin conservation and sustainability. In this new vision, producers, fishers, farmers, and ranchers who are aware of their role in promoting sustainable production and development emerge as the best allies of conservation. In line with this perspective, a range of institutional and grassroots efforts have recently materialised, focusing on climate change, waste management, and environmental restoration. Examples of bottom-up community-based conservation efforts, although limited in scale and scope, illustrate the capacity of citizens to mobilise around environmental agendas, further evidencing the importance of community actions in conservation and sustainable development². However, a commonly expressed view among interviewees was that there exists a lack of, and a need for a clear, shared vision of the form that the future Galapagos socio-ecosystem will take, in order to guide policy-making. This lack of vision was cited as connected to many perceived issues in the islands, from inconsistent decision-making to a lack of progress on sustainable development and disengaged communities. This absence of long-term direction is therefore viewed as impacting progress on conservation goals, as well as skills development and economic diversification.

As a whole, these diverse challenges and complex dynamics between social and economic development, conservation and governance reflect the need for more comprehensive and integral

approaches aimed toward strengthening the role of communities. We argue these processes could be enhanced by employing key components of ACM approaches within sustainable development and conservation policies and strategies, aimed to create enabling institutional arrangements that facilitate social learning, collaborative dynamics, and continuous monitoring across various overlapping and interdependent domains.

Building Resilience Through Balanced Participative Governance Frameworks

Historical top-down governance policies encouraged workers out of the agricultural and fisheries sectors and into tourism. This resulted in a significant loss of local knowledge and skill in these resource sectors, as well as decreased resilience through impacting food security. The disenfranchisement of the community resulting from such top-down governance has led, paradoxically, to a community culture of demanding top-down solutions to local problems. This situation is perceived to be related to the chronic lack of investment in the human component of the Galapagos socio-ecosystem and the sense of disempowerment in the local community. In addition, poor coordination between government institutions is perceived to have hindered progressive programmes aimed at improving access to key services for residents in Galapagos³. In this light, the Galapagos example advocates for a system where top-down power is balanced with community autonomy and empowerment through clear and effective participative mechanisms for co-developing policies that promote sustainable development and resilience. Establishing common aims and objectives within multi-level governance is also essential to ensure the viability and continuity of governance mechanisms.

There is a local perception that any policy strengthening sustainable development must be viewed as a sound conservation policy, as policies promoting unsustainable versions of development will necessarily negatively impact conservation goals. Conversely, policies promoting *buen vivir* for the residents of the archipelago will bolster more holistic progress toward sustainable development and lower environmental impacts. In particular, policies that help to reconnect residents with the natural environment, such as providing preferential rates for locals to enjoy the natural riches of the Galapagos, are viewed as sorely needed to re-engage communities in a shared vision of a sustainable socio-ecosystem.

There is a perception among interviewees that participatory processes have not been effectively implemented in Galapagos, despite being enshrined in the new national constitution as well as the LOREG and the 2015–2020 Galapagos Development Plan. A lack of continuity of participatory processes due to policy shifts related with government change or discontinuous funding is perceived to have led to community disengagement and an

²One of the most emblematic grassroots movements in Galapagos is the fight against plastic waste, which is perceived as a significant threat to local ecosystems. Locals regularly gather to clean beaches and have lobbied for the introduction of a plastic bag charge.

³For instance, in 2016 the CGREG developed the Dinamiza Program, in conjunction with the Ministry of Education, seeking to dynamise the education sector in Galapagos. However, the project faced a conflict of differing political agendas with SENPLADES (Secretaría de Planificación y Desarrollo de Ecuador), which exercises regional decision-making. This was perceived as evidence of a lack of holistic perspective within the Galapagos special regime.

erosion of trust. Current formal participative processes are also perceived as a “box-ticking” exercise, in which local government currently engages out of necessity, without valuing the process, leading to a lack of progress and engagement. A clearer, more transparent framework for participative processes, as well as processes that are sustainable over time, where the population participates in the full cycle of a project from inception to monitoring and reporting, irrespective of political cycles, were called for to rebuild trust and ensure progress. The participation of the community in decision-making processes was cited as vital to avoid incoherent or negatively-viewed projects from taking place, and keeping the government on track through as a mechanism of co-governance. These processes must also ensure to include vulnerable and under-represented groups and aim to put scientific as well as other forms of knowledge on a level platform.

The PMB of the Marine Reserve was commonly cited as a past example of functioning participation, with the acknowledgement that the process was not perfect, with many good and bad decisions being taken, but also as a source of learning for the different stakeholders around processes of participation. This successful and valued example of participative management was dismantled to make way for the new generation of participative processes brought in with the 2008 constitutional and 2015 LOREG reforms, and survives only in “consultative” form. The new Participatory Management Advisory Council was also confirmed to be presently inoperative and lacking a defined framework.

Interviewees noted the existence of grassroots community movements aimed at improving the quality of local products and developing local skills. For example, there is currently a movement in the agricultural sector lobbying for support to enhance the genetic diversity of livestock in order to improve the quality of dairy products. Galapagos branded coffee was also cited as a recent success, with local growers successfully lobbying for a brand identifying locally-grown products over products generated from imported coffee beans. Interviewees voiced a need to enhance the visibility of these bottom-up enterprises, as a key component for fomenting skills development and innovation on the islands, through examples of best practise.

To summarise, (pre-Covid-19) participatory processes in Galapagos are currently implemented in a top-down manner that is widely perceived as inefficient and lacking a clear framework. Successful examples of grassroots lobbying efforts exist and are increasing in visibility, but there remains a severe disconnection between communities and government, with communities tending to be disengaged in decision-making, resulting in being the passive recipients of top-down actions. We suggest that the implementation of an adaptive co-management framework for WEF resources, based on the past format of the PMB for the Marine Reserve but with an explicit focus on the WEF and ACM synergies identified in this paper, could represent a valuable solution to achieve greater community ownership of sustainable development policies and strategies and increase resilience.

Knowledge Development and Knowledge Sharing

The historical conflict between conservation goals and the needs of the local population partly arose as a result of a lack of local capacitation through access to training and education, and a dearth of specialised organisations working with communities to resolve issues that lie beyond the scope of conservation institutions. Although some funding for local training has come from NGOs, trained personnel has traditionally been brought from outside the islands, via contracting to temporary residents arriving from the mainland to fill local posts. This deficiency has led to a perception that conservation projects should incorporate aspects of human sustainable development in a way that they have not previously engaged in. For example, promoting assertive communication skills as a means to increase associative capacities in citizens, as well as interdisciplinary training to encourage mediation between stakeholders, can contribute to building trust and increasing resilience. In recognition of these issues, upon signing in 2016 its third agreement with the Government of Ecuador giving it a remit to conduct research in the archipelago until 2041, the Charles Darwin Foundation has diversified its work to include social sciences and interdisciplinary projects in addition to its traditional work in the natural sciences and conservation.

Moreover, education and capacity building are viewed by interviewees as important components that must be strengthened and promoted on multiple levels. Knowledge sharing is seen as a channel to foment notions of environmental conservation and ownership, which should be delivered through formal education and extracurricular youth programmes. Encouraging the formation of community-based solidarity or knowledge exchange groups was also cited as a valuable action to support skills diversification where government policies and incentives are currently lacking.

The research also identified a view that education goes hand in hand with economic models for the future, thus the need to create specialised programmes in biodiversity conservation, protected areas management, etc. For example, a clear vision of a specialist offering in Galapagos would enable investment in research and higher education centres, but this must be supported by a clear vision of what the future economic model will be, as training people without demand for their skills would be pointless. Continuous training programmes providing knowledge targeted for the different sectors (hotels, tourist boats, and different types of business) should be integrated into the institutional structures from inception to completion. For example, progress toward a higher-value/lower-impact form of tourism requires language and hospitality sector training to boost the quality of the offerings and the revenue for local people. In addition, there has been a lack of community capacity building enabling innovation through the use of technology, which will be necessary for a transition to more diverse forms of economic activity and may aid in solving conservation problems. Finally, a system where Galapagueños are empowered and their local knowledge is harnessed for change must include educational programs for young people, women

and other vulnerable groups, so that they are engaged and act as future leaders.

Building on the above findings, the novel synergies outlined in section Intersecting Frameworks, arising from the intersection of ACM and WEF nexus approaches to resource management, may have the capacity to support skills diversification and sustainable livelihoods in Galapagos. This may be achieved through placing the different sources of knowledge existing in the islands on a level platform, and providing an explicit space for deliberation and scenario testing, allowing Galapagueños themselves to determine their future trajectory (Karakiewicz, 2019).

CONCLUSIONS

Through the specific case study of the Galapagos Islands, this paper has assessed how community perceptions of conservation, resource management and economic development issues can be harnessed to identify pathways toward sustainable development. An important finding of this research is the widespread view that a holistic vision for the sustainable development of Galapagos, to guide economic diversification and the associated need for targeted education and capacity-building, is needed and still lacking. Conversely, grassroots organisations lobbying for capacity-building and sustainable development exist in the productive sector and would benefit from the support of integrative policies that treat achieving conservation goals as inextricable from human development. Increasing the visibility of these movements could promote economic diversification by fomenting innovative and sustainable livelihoods showcasing novel resource management approaches that support conservation.

Historically, the co-management of the Galapagos Marine Reserve, a resource of shared interest for conservationists, fishers, and tourism operators, represents an important example of conflict-resolution, consensus-building, and dynamic learning. In this process, the legitimacy of stakeholders was recognised and their different types of knowledge were put on a level platform within an inclusive and collaborative decision-making structure enshrined in legislation. Our analysis of data collected through interviews with institutional, community, and third sector actors revealed that this experience, although viewed as imperfect, is still perceived as a positive process. Moreover, the elimination of this governance framework in the reformed 2015 law is considered a regression in terms of participatory resource management, toward more top-down decision-making. The participative governance structures in place since 2015 are viewed as inefficient and inoperative and there is an overall sense of erosion of community trust due to the discontinuous nature of inclusion.

On one hand, our analysis indicates that clearer, more effective participatory processes are needed, with community involvement in the full cycle of decision-making from project planning to execution, monitoring, and accountability, with an approach by government authorities recognising the importance of these processes rather than fulfilling a box-ticking exercise. Dedicated funding is required to perpetuate participative

processes beyond political cycles to rebuild trust. On the other hand, the example of the Marine Reserve represents a strong precedent (and a world-leading example) of participative co-management in Galapagos. Overall, the Galapagos example advocates for a system where top-down power is balanced with community autonomy and empowerment through clear and effective participative mechanisms for co-developing policies, and implementing and testing actions, that promote sustainable development and resilience. Such a system requires a shift in institutional culture and a rebalancing of power in the province, echoing, and supported by the paradigm shift that has recently taken place within the conservation agencies that have traditionally focussed on the natural environment to the exclusion of human development in the archipelago.

Finally, we suggest that the implementation of an adaptive co-management framework in the Water-Energy-Food resource sectors, that builds on the historical experience of co-management in the Marine Reserve and involves all legitimate stakeholders, would be highly valuable to achieve progress on sustainable development and conservation goals in Galapagos. To this aim, we have outlined an initial set of synergies arising from the intersection of ACM and WEF nexus approaches that illustrate the opportunities that such a framework presents. In view of the challenges that multi-stakeholder groups face in building consensus on the complex issues around conservation and sustainable development, we recommend that the proposed flexible framework be validated prior to application in Galapagos or other contexts through a range of pilot projects across sectors. As noted in section Institutional, Legal, and Policy Framework, the current planning framework proposes metrics and targets in relation to the water, energy, and food sectors, with less emphasis on the concrete actions to be carried out to achieve these. Testing the framework proposed in this paper through a series of co-created and co-managed pilot activities where the suggested approach and the identified synergies are debated and collaboratively adjusted for the local context by uniting representatives of all legitimate local and provincial (or similar scale) actors, would therefore contribute to further understanding its benefits and potential future impact.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors upon request.

AUTHOR CONTRIBUTIONS

AB and SC performed the literature review, organized, and conducted the interviews and prepared the initial coding of the data. All authors contributed to the data analysis and reflections presented in this paper.

FUNDING

This work was supported by a GCRF Theme Development Fund award from the Scottish Funding Council to the University of Edinburgh.

REFERENCES

- Agrawal, A., and Gibson, C. C. (1999). Enchantment and disenchantment: the role of community in natural resource conservation. *World Dev.* 27, 629–649. doi: 10.1016/S0305-750X(98)00161-2
- Albrecht, T. R., Crotoof, A., and Scott, C. A. (2018). The Water-Energy-Food Nexus: a systematic review of methods for nexus assessment. *Environ. Res. Lett.* 13:043002. doi: 10.1088/1748-9326/aaa9c6
- Anderies, J. M., Janssen, M. A., and Ostrom, E. (2004). A framework to analyze the robustness of social-ecological systems from an institutional perspective. *Ecol. Soc.* 9. doi: 10.5751/ES-00610-090118
- Andrade, J. E. L., and Ferri, D. Q. (2019). “The Galapagos urban context,” in *Urban Galapagos: Transition to Sustainability in Complex Adaptive Systems*, eds T. Kvan and J. Karakiewicz (Cham: Springer), 9–22. doi: 10.1007/978-3-319-99534-2_2
- Armitage, D. (2005). Adaptive capacity and community-based natural resource management. *Environ. Manage.* 35, 703–715. doi: 10.1007/s00267-004-0076-z
- Armitage, D., Berkes, F., and Doubleday, N. (2007). “Introduction: moving beyond co-management,” in *Adaptive Co-management: Collaboration, Learning, and Multi-level Governance*, eds D. Armitage, F. Berkes, and N. Doubleday (Vancouver, BC: UBC Press), 1–18.
- Armitage, D., Marschke, M., and Plummer, R. (2008). Adaptive co-management and the paradox of learning. *Global Environ. Change* 18, 86–98. doi: 10.1016/j.gloenvcha.2007.07.002
- Armitage, D. R., Plummer, R., Berkes, F., Arthur, R. I., Charles, A. T., Davidson-Hunt, I. J., et al. (2009). Adaptive co-management for social-ecological complexity. *Front. Ecol. Environ.* 7, 95–102. doi: 10.1890/070089
- Asamblea Constituyente (2008). *Constitución de la República del Ecuador*. Available online at: https://www.oas.org/juridico/pdfs/mesicic4_ecu_const.pdf (accessed April 2, 2021).
- Asamblea Nacional de la República del Ecuador. (2015). *Ley Orgánica de Régimen Especial de la provincia de Galápagos*. Available online at: <https://www.turismo.gob.ec/wp-content/uploads/2016/04/LOREG-11-06-2015.pdf> (accessed April 2, 2021).
- Baldacchino, G. (2004). Sustainable use practices, including tourism, in/for small Islands. *Int. J. Island Affairs* 13, 15–20.
- Batty, M., Bettencourt, L. M., and Kirley, M. (2019). “Understanding coupled urban-natural dynamics as the key to sustainability: the example of the galapagos,” in *Urban Galapagos: Transition to Sustainability in Complex Adaptive Systems*, eds T. Kvan and J. Karakiewicz (Cham: Springer), 23–41. doi: 10.1007/978-3-319-99534-2_3
- Benson, D., Gain, A. K., and Rouillard, J. J. (2015). Water governance in a comparative perspective: from IWRM to a ‘nexus’ approach? *Water Alternat.* 8, 756–773. Available online at: <https://www.water-alternatives.org/index.php/alldoc/articles/vol8/v8issue1/275-a8-1-8/file>
- Berkes, F. (2004). Rethinking community-based conservation. *Conserv. Biol.* 18, 621–630. doi: 10.1111/j.1523-1739.2004.00077.x
- Berkes, F. (2007). Community-based conservation in a globalized world. *Proc. Natl. Acad. Sci. U.S.A.* 104, 15188–15193. doi: 10.1073/pnas.0702098104
- Berkes, F. (2009). Evolution of co-management: role of knowledge generation, bridging organizations and social learning. *J. Environ. Manage.* 90, 1692–1702. doi: 10.1016/j.jenvman.2008.12.001
- Biggs, E. M., Bruce, E., Boruff, B., Duncan, J. M., Horsley, J., Pauli, N., et al. (2015). Sustainable development and the water-energy-food nexus: a perspective on livelihoods. *Environ. Sci. Policy* 54, 389–397. doi: 10.1016/j.envsci.2015.08.002
- Bleischwitz, R., Spataru, C., VanDeveer, S. D., Obersteiner, M., van der Voet, E., Johnson, C., et al. (2018). Resource nexus perspectives towards the United Nations sustainable development goals. *Nat. Sustain.* 1, 737–743. doi: 10.1038/s41893-018-0173-2
- Bouapao, L. (2012). “Livelihoods and migration” in *The Water-Food-Energy Nexus in the Mekong Region*, eds A. Smajgl, and J. Ward (New York, NY: Springer), 143–178. doi: 10.1007/978-1-4614-6120-3_5
- Bown, N. K., Gray, T. S., and Stead, S. M. (2013). Co-management and adaptive co-management: two modes of governance in a Honduran marine protected area. *Marine Policy*. 39, 128–134. doi: 10.1016/j.marpol.2012.09.005
- Brocklesby, M. A., and Fisher, E. (2003). Community development in sustainable livelihoods approaches—an introduction. *Commun. Dev. J.* 38, 185–198. doi: 10.1093/cdj/38.3.185
- Cai, X., Wallington, K., Shafiee-Jood, M., and Marston, L. (2018). Understanding and managing the food-energy-water nexus—opportunities for water resources research. *Adv. Water Resour.* 111, 259–273. doi: 10.1016/j.advwatres.2017.11.014
- Carlsson, L., and Berkes, F. (2005). Co-management: concepts and methodological implications. *J. Environ. Manage.* 75, 65–76. doi: 10.1016/j.jenvman.2004.11.008
- Consejo de Gobierno del Regimen Especial de Galapagos (2021). *Plan de Desarrollo Sustentable y Ordenamiento Territorial del Regimen Especial de Galápagos, Plan Galápagos 2030*. Puerto Baquerizo Moreno: CGREG. Available online at: <https://owncloud.gobiernogalapagos.gob.ec/owncloud/index.php/s/c9oQ43hafbTlthH#pdfviewer>
- Consejo de Gobierno del Régimen Especial de Galapagos. (2016). *Plan de Desarrollo Sustentable y Ordenamiento Territorial del Régimen Especial de Galápagos – Plan Galápagos*. Available online at: https://www.gobiernogalapagos.gob.ec/wp-content/uploads/downloads/2017/04/Plan-Galapagos-2015-2020_12.pdf (accessed April 2, 2021).
- Consejo de Gobierno del Régimen Especial de Galapagos. (2018). *Resolution No. 24- CGREG-XI-V-2018*. Available online at: https://www.gobiernogalapagos.gob.ec/wp-content/uploads/downloads/2019/01/RESOLUCION_Nro_24-CGREG-XI-V-2018.pdf (accessed April 2, 2021).
- Consejo Nacional de la República del Ecuador. (1998). *Ley Especial para la Provincia de Galápagos*. Available online at: <https://www.gobiernogalapagos.gob.ec/wp-content/uploads/downloads/2014/05/LOREG.pdf> (accessed April 2, 2021).
- Cundill, G., and Fabricius, C. (2009). Monitoring in adaptive co-management: toward a learning based approach. *J. Environ. Manage.* 90, 3205–3211. doi: 10.1016/j.jenvman.2009.05.012
- Dawoud, M. A. H. (2017). “Water, energy, and food security nexus in the west Asian region,” in *Water-Energy-Food Nexus: Principles and Practices*, eds P. Abdul Salam, S. Shrestha, V. Prasad Pandey, and A. K. Anal (Washington, DC: John Wiley and Sons, Inc.), 163–180. doi: 10.1002/9781119243175.ch15
- De Grenade, R., House-Peters, L., Scott, C. A., Thapa, B., Mills-Novoa, M., Gerlak, A., et al. (2016). The nexus: reconsidering environmental security and adaptive capacity. *Curr. Opinion Environ. Sustain.* 21, 15–21. doi: 10.1016/j.cosust.2016.10.009
- de Haan, F. J., Ferri, D. Q., Walsh, S. J., and Bettencourt, L. M. (2019). “Scales 1668 and transformative change: transitions in the Galapagos,” in *Urban Galapagos: Transition to Sustainability in Complex Adaptive Systems*, eds T. Kvan and J. Karakiewicz (Cham: Springer), 43–58. doi: 10.1007/978-3-319-99534-2_4
- Douglas, C. H. (2006). Small Island states and territories: Islands in a changing world. *Sustain. Dev.* 14, 75–80. doi: 10.1002/sd.297
- Espin, P. A., Mena, C. F., and Pizzitutti, F. (2019). “A model-based approach 1672 to study the tourism sustainability in an island environment: the case 1673 of Galapagos Islands,” in *Urban Galapagos: Transition to Sustainability in Complex Adaptive Systems*, eds T. Kvan and J. Karakiewicz (Cham: Springer), 97–113. doi: 10.1007/978-3-319-99534-2_7
- Fabricius, C., and Collins, S. (2007). Community-based natural resource management: governing the commons. *Water Policy*. 9, 83–97. doi: 10.2166/wp.2007.132
- Fabricius, C., and Currie, B. (2015). “Adaptive co-management,” in *Adaptive Management of Social-Ecological Systems* (Dordrecht: Springer), 147–179. doi: 10.1007/978-94-017-9682-8_9
- Folke, C., Carpenter, S., Elmqvist, T., Gunderson, L., Holling, C. S., and Walker, B. (2002). Resilience and sustainable development: building adaptive capacity in a world of transformations. *AMBIO* 31, 437–440. doi: 10.1579/0044-7447-31.5.437
- González, J. A., Montes, C., Rodríguez, J., and Tapia, W. (2008). Rethinking the Galapagos Islands as a complex social-ecological system: implications for conservation and management. *Ecol. Soc.* 13. doi: 10.5751/ES-02557-130213
- Grafton, R. Q., McLindin, M., Hussey, K., Wyrwoll, P., Wichelns, D., Ringler, C., et al. (2016). Responding to global challenges in food, energy, environment and water: risks and options assessment for decision-making. *Asia Pacific Policy Stud.* 3, 275–299. doi: 10.1002/app5.128

- Granit, J., Jägerskog, A., Lindström, A., Björklund, G., Bullock, A., Löfgren, R., et al. (2012). Regional options for addressing the water, energy and food nexus in Central Asia and the Aral Sea Basin. *Int. J. Water Resour. Dev.* 28, 419–432. doi: 10.1080/07900627.2012.684307
- Gruber, J. S. (2010). Key principles of community-based natural resource management: a synthesis and interpretation of identified effective approaches for managing the commons. *Environ. Manage.* 45, 52–66. doi: 10.1007/s00267-008-9235-y
- Hasselman, L. (2017). Adaptive management; adaptive co-management; adaptive governance: what's the difference?. *Austr. J. Environ. Manage.* 24, 31–46. doi: 10.1080/14486563.2016.1251857
- Heylings, P., and Cruz, F. (1998). "Common property, conflict and participatory management in the Galapagos Islands," in *Proceedings of the International Association for the Study of Common Property (IASCP) Conference 1998*. Available online at: <http://hdl.handle.net/10535/1670> (accessed April 2, 2021).
- Hill, R., Williams, K. J., Pert, P. L., Robinson, C. J., Dale, A. P., Westcott, D. A., et al. (2010). Adaptive community-based biodiversity conservation in Australia's tropical rainforests. *Environ. Conserv.* 37, 73–82. doi: 10.1017/S0376892910000330
- Holling, C. S. (1978). *Adaptive Environmental Assessment and Management*. Chichester: John Wiley & Sons.
- Howarth, C., and Monasterolo, I. (2017). Opportunities for knowledge co-production across the energy-food-water nexus: making interdisciplinary approaches work for better climate decision making. *Environ. Sci. Policy* 75, 103–110. doi: 10.1016/j.envsci.2017.05.019
- Instituto Nacional de Estadísticas y Censos (2013). *Principales características demográficas de Galápagos. Resultados del Censo 2010*. Puerto Baquerizo Moreno: Talleres gráficos del CGREG. Available online at: <https://www.slideshare.net/radioencantada/principales-caracteristicas-demograficas-de-galapagos>
- Karakiewicz, J. (2019). "Toward Urban Self-Sufficiency in the Galapagos Islands," in *Urban Galapagos* (Cham: Springer), 115–136. doi: 10.1007/978-3-319-99534-2_8
- Kerr, S. A. (2005). What is small island sustainable development about?. *Ocean Coastal Manage.* 48, 503–524. doi: 10.1016/j.ocecoaman.2005.03.010
- Kvan, T., and Karakiewicz, J. (eds.). (2019). *Urban Galapagos: Transition to Sustainability in Complex Adaptive Systems*. Cham: Springer.
- Leese, M., and Meisch, S. (2015). Securitising sustainability? Questioning the water, energy and food-security nexus'. *Water Alternat.* 8, 695–709. Available online at: <https://www.water-alternatives.org/index.php/alldoc/articles/vol8/v8issue1/272-a8-1-5/file>
- Lockwood, M., Worboys, G., and Kothari, A., (eds.). (2012). *Managing Protected Areas: A Global Guide*. London: Routledge. doi: 10.4324/9781849771900
- López Jijón, A. M. (2016). *Análisis y contextualización de la Ley Orgánica de Régimen Especial de la provincia de Galápagos, 2015*. Dissertation, Universidad San Francisco de Quito, Ecuador, Quito.
- MINTUR (2010). *Cuenta satélite de Galápagos*. Available online at: <https://servicios.turismo.gob.ec/index.php/18-turismo-en-cifras/analisis-economico/97-cuenta-satelite-de-turismo> (accessed April 2, 2021).
- Pazmiño, A., Serrao-Neumann, S., and Low Choy, D. (2018). Towards comprehensive policy integration for the sustainability of small islands: a landscape-scale planning approach for the Galapagos Islands. *Sustainability* 10:1228. doi: 10.3390/su10041228
- Plummer, R. (2009). The adaptive co-management process: an initial synthesis of representative models and influential variables. *Ecol. Society* 14:24. doi: 10.5751/ES-03130-140224
- Plummer, R., Crona, B., Armitage, D. R., Olsson, P., Tengö, M., and Yudina, O. (2012). Adaptive comanagement: a systematic review and analysis. *Ecol. Soc.* 17:11. doi: 10.5751/ES-04952-170311
- Quiroga, D. (2019). "Socioecological systems and the management of the natural resources in the Galapagos," in *Urban Galapagos* (Cham: Springer), 85–93. doi: 10.1007/978-3-319-99534-2_6
- Rasul, G. (2014). Food, water, and energy security in South Asia: A nexus perspective from the Hindu Kush Himalayan region. *Environ. Sci. Policy* 39, 35–48. doi: 10.1016/j.envsci.2014.01.010
- Rietbergen, S., Hammond, T., Sayegh, C., Mooney, K., and Hesselink, F. (2008). *Island Voices-island Choices: Developing Strategies for Living With Rapid Ecosystem Change in Small Islands* (No. 6). Gland: IUCN.
- Rousseaud, A., Cruz, E., Naula, E., Ramos, A., Granda, M., Calvopifita, M., et al. (2017). "Plan Galapagos: An instrument for the holistic sustainable development of the province," in *Galapagos Report 2015-2016* (Puerto Ayora: GNPD; GCREG; CDF; GC), 13–19.
- Ruitenbeek, J., and Cartier, C. M. (2001). *The Invisible Wand: Adaptive Co-Management as an Emergent Strategy in Complex Bio-Economic Systems*. Vol. 34 (Bogor: CIFOR), 51.
- Salam, P. A., Shrestha, S., Pandey, V. P., and Anal, A. K., (eds.). (2017). *Water-Energy-Food Nexus: Principles and Practices*, Vol. 229. Hoboken, NJ: John Wiley and Sons. doi: 10.1002/9781119243175
- Simpson, G. B., and Jewitt, G. P. (2019). The development of the water-energy-food nexus as a framework for achieving resource security: a review. *Front. Environ. Sci.* 7:8. doi: 10.3389/fenvs.2019.00008
- Smajgl, A., Ward, J., and Pluschke, L. (2016). The water-food-energy Nexus-Realising a new paradigm. *J. Hydrol.* 533, 533–540. doi: 10.1016/j.jhydrol.2015.12.033
- Tapia, W., Ospina, P., Quiroga, D., Reck, G., Gonzales, J. A., Montes, C., et al. (2009). "Toward a shared vision of Galapagos: the archipelago as a socioecological system," in *Galapagos Report 2007-2008* (Puerto Ayora: GNPS; GCREG; CDF; GC), 11–15.
- Upreti, G. (1994). Environmental conservation and sustainable development require a new development approach. *Environ. Conserv.* 21, 18–29. doi: 10.1017/S0376892900024036
- Walsh, S. J., Engie, K., Page, P. H., and Frizzelle, B. G. (2019). "Demographics 1778 of change: modeling the transition of fishers to tourism in the 1779 Galapagos Islands," in *Urban Galapagos: Transition to Sustainability in Complex Adaptive Systems*, eds T. Kvan and J. Karakiewicz (Cham: Springer), 61–83. doi: 10.1007/978-3-319-99534-2_5
- Wasonga, V. O., Kambewa, D., and Bekal, I. (2010). "Community-based natural resource management," in *Managing Natural Resources for Development in Africa: A Resource Book*, eds O. Washington, Sanginga, P., and Bekalo I (Kenya, University of Nairobi Press), 165–210.
- Wicaksono, A., Jeong, G., and Kang, D. (2017). Water, energy, and food nexus: review of global implementation and simulation model development. *Water Policy* 19, 440–462. doi: 10.2166/wp.2017.214
- Wichelns, D. (2017). The water-energy-food nexus: is the increasing attention warranted, from either a research or policy perspective?. *Environ. Sci. Policy* 69, 113–123. doi: 10.1016/j.envsci.2016.12.018

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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APPENDIX

For this article, interviewees in Galapagos were asked to comment on the following open-ended questions relating to the themes of: (i) Governance and Participation; (ii) Community Agency and Resource Co-Management; (iii) Conservation and Economic Development.

Themes and Questions

Governance and Participation

1. How can conservation policies be designed to encompass the needs of both nature and community?
2. How is participation framed within development policy in Galapagos?
3. Do you have examples of how previous participatory processes have shaped or altered recent governance mechanisms (in the last 10 years or so)?
4. How can policy be framed in the future to engender a sense of ownership in locals that might help conservation efforts?

Community Agency and Resource Co-management

1. Have there been experiences with community-based management of resources, such as water, or food production, energy production? If so,
 - a. Who were the main beneficiaries and how did they benefit?
 - b. Did power relations at the local level derive from differences of class, ethnicity, and gender?
2. What role can education, capacity strengthening and social learning play in the shift toward alternative forms of economic activity?
3. How can collaboration and trust within community management of resources be achieved? What key obstacles need to be addressed in this regard?
4. How can local and traditional knowledge be harnessed as mechanisms for co-management and empowerment?

Conservation and Economic Development

1. Have conservation programmes helped or hindered the livelihood needs of local people?
2. How can the current focus on a transition to a more sustainable energy system in Galapagos benefit communities and support a wider range of economic activities and forms of livelihood in the islands?